SGT University, Chandu-Budhera, Gurugram

Faculty of Engineering & Technology

Department of Computer Science &Engineering

B. Tech. Computer Science & Engineering

(B.Tech in CSE with Specialization in AI/ML, Full Stack Web Development and Cloud Computing, Cyber Security & Block Chain, iOS and Mobile Application Development, Gaming & Augmented Reality (Immersive Experience))

Scheme & Syllabus (2021-22 Onwards)

Vision of SGT University

"Driven by Research & Innovation, we aspire to be amongst the top ten Universities in the Country by 2022"

B-Tech Computer Science & Engineering

S. No.	Subject Code	Subject Name	Semester	L	T	P	C	Category A (Core/ ID/ VAC	Category B (Compulsory/ DE/ BSC/ EAS/ OE/ MC/ II/ MOOC)	Internal	External	Theory/ Practical
1		Applied Physics	1st	3	0	0	3	ID	BSC	40	60	Theory
2		Design Thinking	1st	3	0	0	3	ID	EAS	40	60	Theory
3		Computer Fundamental	1st	3	0	0	3	Core	Compulsory	40	60	Theory
4		Communication Skills-I	1st	2	0	0	2	ID	EAS	40	60	Theory
5		Object Oriented Programming	1st	3	0	0	3	Core	Compulsory	40	60	Theory
6		Value Addition Course-I	1st	2	0	0	2	VAC	VAC	40	60	Theory
7		Computer Fundamental Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
8		Object Oriented Programming Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
9		Communication Skills-I Lab	1st	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement Mandatery Course 1	1st	2	0	0	2	ID	MC	40	60	Theory
		Total	**1st**	**18**	**0**	**6**	**21**					
1		Applied Mathematics	2nd	3	0	0	3	ID	BSC	40	60	Theory
2		Java Programming	2nd	2	0	0	2	Core	Compulsory	40	60	Theory
3		Basics of Data Structure	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
4		Web Development	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
5		Computer Architecture	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
6		Java Programming Lab	2nd	0	0	4	2	Core	Compulsory	60	40	Practical
7		Basics of Data Structure Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Web Development Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
9		Engineering Graphics and Design Lab	2nd	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement Mandatery Course II	2nd	2	0	0	2	ID	MC	40	60	Theory
		Total	**2nd**	**16**	**0**	**10**	**21**					
1		Operating System	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
2		Database Management Systems	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-I	3rd	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-II	3rd	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-I	3rd	4	0	0	4	ID	OE	40	60	Theory
6		Operating System Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
7		Database Management Systems Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-I	3rd	0	0	2	1	Core	DE	60	40	Practical
9		Industrial Internship	3rd	0	0	4w	2	Core	II	60	40	Practical
10		Value Addition Course-II	3rd	2	0	0	2	VAC	VAC	60	40	Theory
11		Ability Enhancement Mandatery Course III	3rd	2	0	0	2	ID	MC	40	60	Theory
		Total	**3rd**	**20**	**0**	**6**	**25**					

1		Design and Analysis of Algorithm	4th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Software Engineering	4th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-III	4th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-IV	4th	3	0	0	3	Core	DE	40	60	Theory
5		Medical imaging techniques	4th	3	0	0	3	ID	EAS	40	60	Theory
6		Open Elective-II	4th	4	0	0	4	ID	OE	40	60	Theory
7		Design and Analysis of Algorithm Lab	4th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-III	4th	0	0	2	1	Core	DE	60	40	Practical
9		Research Methodology	4th	3	0	0	3	ID	EAS	60	40	Theory
		Total	**4th**	**22**	**0**	**4**	**24**					
1		Theory of Computation	5th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Data Communication & Networking	5th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-V	5th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-VI	5th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-III	5th	4	0	0	4	ID	OE	40	60	Theory
6		Medical informatics	5th	3	0	0	3	ID	EAS	40	60	Theory
7		Data Communication & Networking Lab	5th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-VI	5th	0	0	2	1	Core	DE	60	40	Practical
9		Ability Enhancement Mandatery Course IV	5th	2	0	0	2	ID	MC	40	60	Theory
10		Industrial Training-I	5th	0	0	4w	2	Core	II	60	40	Practical
		Total	**5th**	**21**	**0**	**4**	**25**					
1		Compiler Design	6th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Artificial Intelligence	6th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-VII	6th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-VIII	6th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-IV	6th	4	0	0	4	ID	OE	40	60	Theory
6		Compiler Design Lab	6th	0	0	2	1	Core	Compulsory	60	40	Practical
7		Artificial Intelligence Lab	6th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Value Addition Course-III	6th	2	0	0	2	VAC	VAC	60	40	Theory
		Total	**6th**	**18**	**0**	**4**	**20**					

1		Department Electives-IX	7th	3	0	0	3	Core	DE	40	60	Theory
2		Embedded system and its Biomedical applications	7th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-X	7th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives Lab-IX	7th	0	0	2	1	Core	DE	60	40	Practical
5		Capstone Project	7th	0	0	4	2	Core	Compulsory	60	40	Practical
6		Industrial Training-II	7th	0	0	6w	3	Core	II	60	40	Practical
7		Value Addition Course-IV	7th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**7th**	**11**	**0**	**6**	**17**					
1		Industrial Internship with Project (Industrial oriented/Research oriented)	8th	-	-	20W	**10**	Core	II	100	100	Practical
		Total	8th				**10**					
		Overall Total	**1st to 8th**				**163**					

Note:

1. Mooc Course: Student will be offered various available SWAYAM MOOC Courses in leiu of various regular core (Compulsary and Department Electives) courses. A student can opt maximum of 2 MOOC courses in a semester for credit transfer with prior permissin and out of the list published by the department prior to start of the semester.

2. Student can opt for Honours degree by earning 18 - 20 additional credits through SWAYAM MOOC courses but with prior permission of the department and limit to the courses related to the Discipline.

3. A student can have Honours degree WITH SPECIALIZATION in the particular of his/her branch by earning 18-20 additional credits in particular specialization through MOOC or Departmental Elective bucket with Permission of the Department

4. Courses Highlighted in green need to be fixed according to the group (ME+CE in one group and CSE+ECE other group. Value added, RM and Mandatory courses also need to be fixed in numbers but department can put in any semester as per requirement (In order to balance the courses and credits in a semester. Internship credits need to be fixed as shown above.

Abbrevation Used:	
ID	Interdisciplinary
VAC	Value Addition Course
DE	Department Electives
BSC	Basic Science Courses
EAS	Engineering Applied Science
II	Industrial Internship
MC	Mandatory Courses (Non- Credit

Credit Distribution	**Core Credits**	**Other Credits**	**Interdisciplinary Credits**

Core	109
Other (Interdisciplinary + VAC)	54
Total	**163**

Compulsory	58
Department Electives	34
Industrial Internship	17
Total	**109**

Interdisciplinary	**46**
VAC	**8**
Total	**54**

Basic Science Courses			6
Engineering Applied Science			16
Open Elective			16
Mandatory Courses - 4 Courses (Non-Credit))			8
Total			**46**

B-Tech Computer Science & Engineering (Reasearch)

S. No.	Subject Code	Subject Name	Semester	L	T	P	C	Category A (Core/ ID/ VAC	Category B (Compulsory/ DE/ BSC/ EAS/ OE/ MC/ II/	Internal	External	Theory/ Practical
1		Applied Physics	1st	3	0	0	3	ID	BSC	40	60	Theory
2		Design Thinking	1st	3	0	0	3	ID	EAS	40	60	Theory
3		Computer Fundamental	1st	3	0	0	3	Core	Compulsory	40	60	Theory
4		Communication Skills-I	1st	2	0	0	2	ID	EAS	40	60	Theory
5		Object Oriented Programming	1st	3	0	0	3	Core	Compulsory	40	60	Theory
6		Value Addition Course-I	1st	2	0	0	2	VAC	VAC	40	60	Theory
7		Computer Fundamental Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
8		Object Oriented Programming Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
9		Communication Skills-I Lab	1st	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement Mandatory Course 1	1st	2	0	0	2	ID	MC	40	60	Theory
		Total	**1st**	**18**	**0**	**6**	**21**					
1		Applied Mathematics	2nd	3	0	0	3	ID	BSC	40	60	Theory
2		Java Programming	2nd	2	0	0	2	Core	Compulsory	40	60	Theory
3		Basics of Data Structure	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
4		Web Development	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
5		Computer Architecture	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
6		Java Programming Lab	2nd	0	0	4	2	Core	Compulsory	60	40	Practical
7		Basics of Data Structure Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Web Development Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
9		Engineering Graphics and Design Lab	2nd	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement mandatory Course II	2nd	2	0	0	2	ID	MC	40	60	Theory
		Total	**2nd**	**16**	**0**	**10**	**21**					
1		Operating System	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
2		Database Management Systems	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-I	3rd	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-II	3rd	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-I	3rd	4	0	0	4	ID	OE	40	60	Theory
6		Operating System Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
7		Database Management Systems Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-I	3rd	0	0	2	1	Core	DE	60	40	Practical
9		Industrial Internship	3rd	0	0	4w	2	Core	II	60	40	Practical
10		Value Addition Course-II	3rd	2	0	0	2	VAC	VAC	60	40	Theory
11		Ability Enhancement mandatory Course III	3rd	2	0	0	2	ID	MC	40	60	Theory
		Total	**3rd**	**20**	**0**	**6**	**25**					

1		Design and Analysis of Algorithm	4th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Software Engineering	4th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-III	4th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-IV	4th	3	0	0	3	Core	DE	40	60	Theory
5		Medical imaging techniques	4th	3	0	0	3	ID	EAS	40	60	Theory
6		Open Elective-II	4th	4	0	0	4	ID	OE	40	60	Theory
7		Design and Analysis of Algorithm Lab	4th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-III	4th	0	0	2	1	Core	DE	60	40	Practical
9		Research Methodology	4th	3	0	0	3	ID	EAS	60	40	Theory
		Total	**4th**	**22**	**0**	**4**	**24**					
1		Theory of Computation	5th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Data Communication & Networking	5th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-V	5th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-VI	5th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-III	5th	4	0	0	4	ID	OE	40	60	Theory
6		Medical informatics	5th	3	0	0	3	ID	EAS	40	60	Theory
7		Data Communication & Networking Lab	5th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-VI	5th	0	0	2	1	Core	DE	60	40	Practical
9		Ability Enhancement mandatory Course IV	5th	2	0	0	2	ID	MC	40	60	Theory
10		Industrial Training-I	5th	0	0	4w	2	Core	II	60	40	Practical
		Total	**5th**	**21**	**0**	**4**	**25**					
1		Compiler Design	6th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Artificial Intelligence	6th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-VII	6th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-VIII	6th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-IV	6th	4	0	0	4	ID	OE	40	60	Theory
6		Compiler Design Lab	6th	0	0	2	1	Core	Compulsory	60	40	Practical
7		Artificial Intelligence Lab	6th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Value Addition Course-III	6th	2	0	0	2	VAC	VAC	60	40	Theory
		Total	**6th**	**18**	**0**	**4**	**20**					

1		Department Electives-IX	7th	3	0	0	3	Core	DE	40	60	Theory
2		Embedded system and its Biomedical Applications	7th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-X	7th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives Lab-IX	7th	0	0	2	1	Core	DE	40	60	Practical
5		Research Phase-1	7th	-	-	-	10	Core	Research Track	60	40	Practical
6		Industrial Training-II	7th	0	0	6w	3	Core	II	60	40	Practical
7		Value Addition Course-IV	7th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**7th**	**11**	**0**	**2**	**25**					
1		Department Electives-XI	8th	3	0	0	3	Core	DE	40	60	Theory
2		Department Electives-XII	8th	3	0	0	3	Core	DE	40	60	Theory
3		IPR and Patenting	8th	3	0	0	3	Core	EAS	60	40	Practical
4		Research Phase-II	8th	-	-	-	10	Core	Research Track	60	40	Practical
		Total	**8th**	**9**	**0**	**0**	**19**					
		Overall Total	**1st to 8th**				**180**					

Note:

1. Mooc Course: Student will be offered various available SWAYAM MOOC Courses in leiu of various regular core (Compulsary and Department
2. Student can opt for Honours degree by earning 18 - 20 additional credits through SWAYAM MOOC courses but with prior permission of the
3. A student can have Honours degree WITH SPECIALIZATION in the particular of his/her branch by earning 18-20 additional credits in particular
4. Courses Highlighted in green need to be fixed according to the group (ME+CE in one group and CSE+ECE other group. Value added, RM and

Abbrevation Used:

ID	Interdisciplinary
VAC	Value Addition Course
DE	Department Electives
BSC	Basic Science Courses
EAS	Engineering Applied Science
II	Industrial Internship
MC	Mandatory Courses (Non- Credit)

Credit	
Core	123
Other (Inter discip linary	57
Total	**180**

Core Credits	
Compulso ry	56
Departme nt Electives	40
Industrial Internship	7
Research Track	20
Total	**123**

Other Credits	
Interdisci plinary	**49**
VAC	**8**
Total	**57**

Interdisciplinary Credits	
Basic Science Courses	6
Engineering Applied Science	19
Open Elective	16
Mandatory Courses - 4 Courses (Non-	8
Total	**49**

B-Tech Computer Science & Engineering (Integrated)

S. No.	Subject Code	Subject Name	Semester	L	T	P	C	Category A (Core/ ID/ VAC	Category B (Compulsory/ DE/ BSC/ EAS/ OE/ MC/ II/ MOOC)	Internal	External	Theory/ Practical
1		Applied Physics	1st	3	0	0	3	ID	BSC	40	60	Theory
2		Design Thinking	1st	3	0	0	3	ID	EAS	40	60	Theory
3		Computer Fundamental	1st	3	0	0	3	Core	Compulsory	40	60	Theory
4		Communication Skills-I	1st	2	0	0	2	ID	EAS	40	60	Theory
5		Object Oriented Programming	1st	3	0	0	3	Core	Compulsory	40	60	Theory
6		Value Addition Course-I	1st	2	0	0	2	VAC	VAC	40	60	Theory
7		Computer Fundamental Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
8		Object Oriented Programming Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
9		Communication Skills-I Lab	1st	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement Mandatery Course 1	1st	2	0	0	2	ID	MC	40	60	Theory
		Total	**1st**	**18**	**0**	**6**	**21**					
1		Applied Mathematics	2nd	3	0	0	3	ID	BSC	40	60	Theory
2		Java Programming	2nd	2	0	0	2	Core	Compulsory	40	60	Theory
3		Basics of Data Structure	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
4		Web Development	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
5		Computer Architecture	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
6		Java Programming Lab	2nd	0	0	4	2	Core	Compulsory	60	40	Practical
7		Basics of Data Structure Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Web Development Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
9		Engineering Graphics and Design Lab	2nd	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement Mandatery Course II	2nd	2	0	0	2	ID	MC	40	60	Theory
		Total	**2nd**	**16**	**0**	**10**	**21**					
1		Operating System	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
2		Database Management Systems	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-I	3rd	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-II	3rd	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-I	3rd	4	0	0	4	ID	OE	40	60	Theory
6		Operating System Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
7		Database Management Systems Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-I	3rd	0	0	2	1	Core	DE	60	40	Practical
9		Industrial Internship	3rd	0	0	4w	2	Core	II	60	40	Practical
10		Value Addition Course-II	3rd	2	0	0	2	VAC	VAC	60	40	Theory
11		Ability Enhancement Mandatery Course III	3rd	2	0	0	2	ID	MC	40	60	Theory

		Total	**3rd**	**20**	**0**	**6**	**25**					
1		Design and Analysis of Algorithm	4th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Software Engineering	4th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-III	4th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-IV	4th	3	0	0	3	Core	DE	40	60	Theory
5		Medical imaging techniques	4th	3	0	0	3	ID	EAS	40	60	Theory
6		Open Elective-II	4th	4	0	0	4	ID	OE	40	60	Theory
7		Design and Analysis of Algorithm Lab	4th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-III	4th	0	0	2	1	Core	DE	60	40	Practical
9		Research Methodology	4th	3	0	0	3	ID	EAS	60	40	Theory
		Total	**4th**	**22**	**0**	**4**	**24**					
1		Theory of Computation	5th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Data Communication & Networking	5th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-V	5th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-VI	5th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-III	5th	4	0	0	4	ID	OE	40	60	Theory
6		Medical informatics	5th	3	0	0	3	ID	EAS	40	60	Theory
7		Data Communication & Networking Lab	5th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-VI	5th	0	0	2	1	Core	DE	60	40	Practical
9		Ability Enhancement Mandatery Course IV	5th	2	0	0	2	ID	MC	40	60	Theory
10		Industrial Training-I	5th	0	0	4w	2	Core	II	60	40	Practical
		Total	**5th**	**21**	**0**	**4**	**25**					

1		Compiler Design	6th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Artificial Intelligence	6th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-VII	6th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-VIII	6th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-IV	6th	4	0	0	4	ID	OE	40	60	Theory
6		Compiler Design Lab	6th	0	0	2	1	Core	Compulsory	60	40	Practical
7		Artificial Intelligence Lab	6th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Value Addition Course-III	6th	2	0	0	2	VAC	VAC	60	40	Theory
		Total	**6th**	**18**	**0**	**4**	**20**					
1		Department Electives-IX	7th	3	0	0	3	Core	DE	40	60	Theory
2		Embedded system and its Biomedical Applications	7th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-X	7th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives Lab-IX	7th	0	0	2	1	Core	DE	40	60	Practical
5		Research Phase-1	7th	-	-	-	10	Core	Research Track	60	40	Practical
6		Industrial Training-II	7th	0	0	6w	3	Core	II	60	40	Practical
7		Value Addition Course-IV	7th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**7th**	**11**	**0**	**2**	**25**					
1		Department Electives-XI	8th	3	0	0	3	Core	DE	40	60	Theory
2		Department Electives-XII	8th	3	0	0	3	Core	DE	40	60	Theory
3		IPR and Patenting	8th	3	0	0	3	Core	EAS	60	40	Practical
4		Research Phase-II	8th	-	-	-	10	Core	Research Track	60	40	Practical
		Total	**8th**	**9**	**0**	**0**	**19**					
		Overall Total	**1st to 8th**				**180**					

Note:
1. Mooc Course: Student will be offered various available SWAYAM MOOC Courses in leiu of various regular core (Compulsary and Department Electives) courses. A student can opt
2. Student can opt for Honours degree by earning 18 - 20 additional credits through SWAYAM MOOC courses but with prior permission of the department and limit to the courses related
3. A student can have Honours degree WITH SPECIALIZATION in the particular of his/her branch by earning 18-20 additional credits in particular specialization through MOOC or
4. Courses Highlighted in green need to be fixed according to the group (ME+CE in one group and CSE+ECE other group. Value added, RM and Mandatory courses also need to be fixed in

Abbrevation Used:

ID	Interdisciplinary
VAC	Value Addition Course
DE	Department Electives
BSC	Basic Science Courses
EAS	Engineering Applied Science
II	Industrial Internship
MC	Mandatory Courses (Non- Credit)

Credit Distribution	
Core	123
Other (Interdisciplinary + VAC)	57
Total	**180**

Core Credits	
Compulsory	56
Department Electives	40
Industrial Internship	7
Research Track	20
Total	**123**

Other Credits	
Interdisciplinary	**49**
VAC	**8**
Total	**57**

Interdisciplinary Credits	
Basic Science Courses	6
Engineering Applied Science	19
Open Elective	16
Mandatory Courses - 4 Courses (Non-Credit))	8
Total	**49**

For Five Year Integrated M. Tech. and For Candidates having B. Tech. with research track (Atleast 180 credits)

1.		Distributed Computing	9th	3	0	0	3	Core	Compulsory	40	60	Theory
2.		AI & Soft Computing	9th	3	0	0	3	Core	Compulsory	40	60	Theory
3.		Department Electives-XIII	9th	3	0	0	3	Core	DE	40	60	Theory
4.		Department Electives-XIV	9th	3	0	0	3	Core	DE	40	60	Theory
5.		Department Electives-XV	9th	3	0	0	3	Core	DE	40	60	Theory
6.		AI & Soft Computing Lab	9th	0	0	4	2	Core	Compulsory	60	40	Practical
7.		Department Electives Lab-XIII	9th	0	0	2	1	Core	DE	60	40	Practical
8.		Department Electives Lab-XV	9th	0	0	2	1	Core	DE	60	40	Practical
9.		Distributed Computing Lab	9th	0	0	2	1	Core	Compulsory	60	40	Practical
10.		Value Added Courses-V	9th	2	0	0	2	VAC	VAC	40	60	Theory
		Total		**17**	**0**	**10**	**22**					
1.		Dissertation	10th	-	-	**20 W**	**20**	Core	Research Track	100	100	Practical
							42					

	Overall Total Credits = I to X = 222

Note:

1. Mooc Course: Student will be offered various available SWAYAM MOOC Courses in leiu of various regular core (Compulsary and Department Electives) courses. A
2. Student can opt for Honours degree by earning 18 - 20 additional credits through SWAYAM MOOC courses but with prior permission of the department and limit to the
3. A student can have Honours degree WITH SPECIALIZATION in the particular of his/her branch by earning 18-20 additional credits in particular specialization through
4. Courses Highlighted in green need to be fixed according to the group (ME+CE in one group and CSE+ECE other group. Value added, RM and Mandatory courses also

Credit Distribution	
Core	163
Other (Interdisciplinary + VAC)	59
Total	**222**

Core Credits	
Compulsory	64
Department Electives	52
Industrial Internship	7
Research Track	40
Total	**163**

Other Credits	
Interdisciplinary	49
VAC	10
Total	**59**

Interdisciplinary Credits	
Basic Science Courses	6
Engineering Applied Science	19
Open Elective	16
Mandatory Courses - 4 Courses (Non-Credit))	8
Total	**49**

B-Tech in Computer Science with Specialization in iOS & Mobile Application Development

S. No.	Subject Code	Subject Name	Semester	L	T	P	C	Category A (Core/ ID/ VAC	Category B (Compulsory/ DE/ BSC/ EAS/ OE/ MC/ II/ MOOC)			Theory/ Practical
1		Applied Physics	1st	3	0	0	3	ID	BSC	40	60	Theory
2		Design Thinking	1st	3	0	0	3	ID	EAS	40	60	Theory
3		iOS Frameworks / User Interface	1st	2	0	0	2	Core	SE	40	60	Theory
4		Fundamentals of Mac OS and iOS Interface guidelines	1st	2	0	0	2	Core	SE	40	60	Theory
5		Communication Skills-I	1st	2	0	0	2	ID	EAS	40	60	Theory
6		Object Oriented Programming	1st	3	0	0	3	Core	Compulsory	40	60	Theory
7		Value Addition Course-I	1st	2	0	0	2	VAC	VAC	40	60	Theory
8		iOS Frameworks / User Interface Lab	1st	0	0	2	1	Core	SE	60	40	Practical
9		Object Oriented Programming Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
10		Fundamentals of Mac OS and iOS Interface guidelines Lab	1st	0	0	2	1	Core	SE	60	40	Practical
11		Communication Skills-I Lab	1st	0	0	2	1	ID	EAS	60	40	Practical
12		Ability Enhancement Mandatery Course I	1st	2	0	0	2	ID	MC	40	60	Theory
		Total	**1st**	**19**	**0**	**8**	**23**					
1		Applied Mathematics	2nd	3	0	0	3	ID	BSC	40	60	Theory
2		DevOps	2nd	2	0	0	2	Core	SE	40	60	Theory
3		Basics of Data Structure	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
4		Full Stack Web Development	2nd	2	0	0	2	Core	SE	40	60	Theory
5		Computer Architecture	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
6		DevOps Lab	2nd	0	0	2	1	Core	SE	60	40	Practical
7		Basics of Data Structure Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Full Stack Web Development Lab	2nd	0	0	2	1	Core	SE	60	40	Practical
9		Engineering Graphics and Design Lab	2nd	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement Mandatery Course II	2nd	2	0	0	2	ID	MC	40	60	Theory
		Total	**2nd**	**15**	**0**	**8**	**19**					

1		Operating System	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
2		Database Management Systems	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
3		User Interface Advanced Techniques	3rd	2	0	0	2	Core	SE	40	60	Theory
4		Objective Oriented Programming Language with Objective C	3rd	2	0	0	2	Core	SE	40	60	Theory
5		Open Elective-I	3rd	4	0	0	4	ID	OE	40	60	Theory
6		Operating System Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
7		Database Management Systems Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
8		User Interface Advanced Techniques Lab	3rd	0	0	2	1	Core	SE	60	40	Practical
9		Objective Oriented Programming Language with Objective C Lab	3rd	0	0	2	1	Core	SE	60	40	Practical
10		Industrial Internship	3rd	0	0	4w	2	Core	II	60	40	Practical
11		Value Addition Course-II	3rd	2	0	0	2	VAC	VAC	40	60	Theory
12		Ability Enhancement Mandatery Course III	3rd	2	0	0	2	ID	MC	40	60	Theory
		Total	**3rd**	**18**	**0**	**8**	**24**					
1		Design and Analysis of Algorithm	4th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Software Engineering	4th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-III	4th	3	0	0	3	Core	DE	40	60	Theory
4		Swift Programming language	4th	2	0	0	2	Core	SE	40	60	Theory
5		iCloud and Cloud tools and Techniques for Back end development	4th	2	0	0	2	Core	SE	40	60	Theory
6		Open Elective-II	4th	4	0	0	4	ID	OE	40	60	Theory
7		Design and Analysis of Algorithm Lab	4th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-III	4th	0	0	2	1	Core	DE	60	40	Practical
9		Swift Programming language Lab		0	0	2	1	Core	SE	60	40	Practical
10		iCloud and Cloud tools and Techniques for Back end development Lab	4th	0	0	2	1	Core	SE	60	40	Practical
11		Research Methodology	4th	3	0	0	3	ID	EAS	40	60	Theory
		Total	**4th**	**20**	**0**	**8**	**24**					
1		Theory of Computation	5th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Data Communication & Networking	5th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Mobile Application Development/ iPhone Operating System Basic	5th	2	0	0	2	Core	SE	40	60	Theory
4		Department Electives-VI	5th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-III	5th	4	0	0	4	ID	OE	40	60	Theory
6		Mobile device Management (Security and Forensics)	5th	2	0	0	2	Core	SE	40	60	Theory
7		Mobile device Management (Security and Forensics) Lab	5th	0	0	2	1	Core	SE	60	40	Practical
8		Mobile Application Development/ iPhone Operating System Basic lab	5th	0	0	2	1	Core	SE	60	40	Practical
9		Data Communication & Networking Lab	5th	0	0	2	1	Core	Compulsory	60	40	Practical
10		Department Electives Lab-VI	5th	0	0	2	1	Core	DE	60	40	Practical
11		Ability Enhancement Mandatery Course IV	5th	2	0	0	2	ID	MC	40	60	Theory
12		Industrial Training-I	5th	0	0	4w	2	Core	II	60	40	Practical
		Total	**5th**	**19**	**0**	**8**	**25**					

1		Compiler Design	6th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Cyber Forensics and Investigations (New)	6th	2	0	0	2	Core	SE	40	60	Theory
3		iCloud Security +iOS Development		2	0	0	2	Core	SE	40	60	Theory
4		Department Electives-VII	6th	3	0	0	3	Core	DE	40	60	Theory
5		Department Electives-VIII	6th	3	0	0	3	Core	DE	40	60	Theory
6		Open Elective-IV	6th	4	0	0	4	ID	OE	40	60	Theory
7		Compiler Design Lab	6th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Cyber Forensics and Investigations (New) Lab	6th	0	0	2	1	Core	SE	60	40	Practical
9		iCloud Security +iOS Development Lab		0	0	2	1	Core	SE	60	40	Practical
10		Value Addition Course-III	6th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**6th**	**19**	**0**	**6**	**22**					
1		Department Electives-IX	7th	3	0	0	3	Core	DE	40	60	Theory
2		Embedded system and its biomedical applications	7th	3	0	0	3	Core	Compulsory	40	60	Theory
3		iPhone Operating System Practical Implementation Techniques	7th	2	0	0	2	Core	SE	40	60	Theory
4		Department Electives Lab-IX	7th	0	0	2	1	Core	DE	60	40	Practical
5		Department Electives-X	7th	3	0	0	3	Core	DE	40	60	Theory
6		iPhone Operating System Practical Implementation Techniques Lab	8th	0	0	2	1	Core	SE	60	40	Practical
7		Capstone Project	7th	0	0	4	2	Core	Compulsory	60	40	Practical
8		Industrial Training-II	7th	0	0	6w	3	Core	II	60	40	Practical
9		Value Addition Course-IV	7th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**7th**	**13**	**0**	**8**	**20**					
1		Internships and Placements	8th	-	-	20W	**20**	Core	II	100	100	Practical
	Total Credits	Total	8th				**20**					
		Overall Total	**1st to 8th**				**177**					

Note:

1. Mooc Course: Student will be offered various available SWAYAM MOOC Courses in leiu of various regular core (Compulsary and Department Electives) courses. A student can opt maximum of 2 MOOC courses
2. Student can opt for Honours degree by earning 18 - 20 additional credits through SWAYAM MOOC courses but with prior permission of the department and limit to the courses related to the Discipline.
3. A student can have Honours degree WITH SPECIALIZATION in the particular of his/her branch by earning 18-20 additional credits in particular specialization through MOOC or Departmental Elective bucket with Permission of the Department
4. Courses Highlighted in green need to be fixed according to the group (ME+CE in one group and CSE+ECE other group. Value added, RM and Mandatory courses also need to be fixed in numbers but department can put in any semester as per requirement (In order to balance the courses and credits in a semester. Internship credits need to be fixed as shown above.

Abbrevation Used:	
ID	Interdisciplinary
VAC	Value Addition Course
DE	Department Electives
BSC	Basic Science Courses
EAS	Engineering Applied Science
II	Industrial Internship
MC	Mandatory Courses (Non- Credit
SE	Specialization Electives

Credit Distribution	
Core	129
Other (Interdisciplinary + VAC)	48
Total	**177**

Core Credits	
Compulsory	42
Department Electives	21
Industrial Internship	27
Specialization Electives	39
Total	**129**

Other Credits	
Interdisciplinary	**40**
VAC	**8**
Total	**48**

Interdisciplinary Credits			
Basic Science Courses			6
Engineering Applied Science			10
Open Elective			16
Mandatory Courses - 4 Courses (Non-Credit))			8
Total			**40**

B-Tech in Computer Science with Specialization in AI/ML

S. No.	Subject Code	Subject Name	Semester	L	T	P	C	Category A (Core/ ID/ VAC	Category B (Compulsory/ DE/ BSC/ EAS/ OE/ MC/ II/ MOOC)	Internal	External	Theory/ Practical
1		Applied Physics	1st	3	0	0	3	ID	BSC	40	60	Theory
2		Design Thinking	1st	3	0	0	3	ID	EAS	40	60	Theory
3		Computer Fundamental	1st	3	0	0	3	Core	Compulsory	40	60	Theory
4		Introduction to AI, Data Science, Ethics and Foundation of Data Analysis	1st	2	0	0	2	Core	SE	40	60	Theory
5		Communication Skills-I	1st	2	0	0	2	ID	EAS	40	60	Theory
6		Object Oriented Programming	1st	3	0	0	3	Core	Compulsory	40	60	Theory
7		Value Addition Course-I	1st	2	0	0	2	VAC	VAC	40	60	Theory
8		Computer Fundamental Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
9		Object Oriented Programming Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
10		Introduction to AI, Data Science, Ethics and	1st	0	0	2	1	Core	SE	60	40	Practical
11		Communication Skills-I Lab	1st	0	0	2	1	ID	EAS	60	40	Practical
12		Ability Enhancement Mandatery Course I	1st	2	0	0	2	ID	MC	40	60	Theory
		Total	**1st**	**20**	**0**	**8**	**24**					
1		Applied Mathematics	2nd	3	0	0	3	ID	BSC	40	60	Theory
2		Data Analysis using Python, Numpy, Pandas, Matplotlib, and Seaborn	2nd	2	0	0	2	Core	SE	40	60	Theory
3		Basics of Data Structure	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
4		Web Development	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
5		Computer Architecture	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
6		Data Analysis using Python, Numpy, Pandas, Matplotlib, and Seaborn Lab	2nd	0	0	2	1	Core	SE	60	40	Practical
7		Basics of Data Structure Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Web Development Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
9		Engineering Graphics and Design Lab	2nd	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement Mandatery Course II	2nd	2	0	0	2	ID	MC	40	60	Theory
		Total	**2nd**	**16**	**0**	**8**	**20**					
1		Operating System	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
2		Database Management Systems	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
3		Probabilistics Modeling and Reasoning with Python	3rd	2	0	0	2	Core	SE	40	60	Theory

4		R Programming for Data Science and Data Analysis	3rd	2	0	0	2	Core	SE	40	60	Theory
5		Open Elective-I	3rd	4	0	0	4	ID	OE	40	60	Theory
6		Operating System Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
7		Database Management Systems Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Probabilistics Modeling and Reasoning with Python Lab	3rd	0	0	2	1	Core	SE	60	40	Practical
9		R Programming for Data Science and Data Analysis Lab	3rd	0	0	2	1	Core	SE	60	40	Practical
10		Industrial Internship	3rd	0	0	4w	2	Core	II	60	40	Practical
11		Value Addition Course-II	3rd	2	0	0	2	VAC	VAC	40	60	Theory
12		Ability Enhancement Mandatery Course III	3rd	2	0	0	2	ID	MC	40	60	Theory
		Total	**3rd**	**18**	**0**	**8**	**24**					
1		Design and Analysis of Algorithm	4th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Software Engineering	4th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-III	4th	3	0	0	3	Core	DE	40	60	Theory
4		Machine Learning Practical with Python , Scikit-learn, matplotlib, TensorFlow	4th	1	0	0	1	Core	SE	40	60	Theory
5		Machine Learning and Pattern Recognition	4th	2	0	0	2	Core	SE	40	60	Theory
6		Open Elective-II	4th	4	0	0	4	ID	OE	40	60	Theory
7		Design and Analysis of Algorithm Lab	4th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-III	4th	0	0	2	1	Core	DE	60	40	Practical
9		Machine Learning Practical with Python , Scikit-learn, matplotlib, TensorFlow Lab		0	0	2	1	Core	SE	60	40	Practical
10		Machine Learning and Pattern Recognition Lab	4th	0	0	2	1	Core	SE	60	40	Practical
11		Research Methodology	4th	3	0	0	3	ID	EAS	40	60	Theory
		Total	**4th**	**19**	**0**	**8**	**23**					

1		Theory of Computation	5th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Data Communication & Networking	5th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Deep Learning Practical with Python, TensorFlow and Keras	5th	1	0	0	1	Core	SE	40	60	Theory
4		Department Electives-VI	5th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-III	5th	4	0	0	4	ID	OE	40	60	Theory
6		Neural Network and deep learning (Vision and NLP)	5th	2	0	0	2	Core	SE	40	60	Theory
7		Neural Network and deep learning (Vision and NLP) Lab		0	0	2	1	Core	SE	60	40	Practical
8		Deep Learning Practical with Python, TensorFlow and Keras		0	0	2	1	Core	SE	60	40	Practical
9		Data Communication & Networking Lab	5th	0	0	2	1	Core	Compulsory	60	40	Practical
10		Department Electives Lab-VI	5th	0	0	2	1	Core	DE	60	40	Practical
11		Ability Enhancement Mandatery Course IV	5th	2	0	0	2	ID	MC	40	60	Theory
12		Industrial Training-I	5th	0	0	4w	2	Core	II	60	40	Practical
		Total	**5th**	**18**	**0**	**8**	**24**					
1		Compiler Design	6th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Data Science-Tools and Techniques	6th	2	0	0	2	Core	SE	40	60	Theory
3		Natural Language Processing		2	0	0	2	Core	SE	40	60	Theory
4		Department Electives-VII	6th	3	0	0	3	Core	DE	40	60	Theory
5		Department Electives-VIII	6th	3	0	0	3	Core	DE	40	60	Theory
6		Open Elective-IV	6th	4	0	0	4	ID	OE	40	60	Theory
7		Compiler Design Lab	6th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Data Science-Tools and Techniques Lab	6th	0	0	2	1	Core	SE	60	40	Practical
9		Natural Language Processing Lab		0	0	2	1	Core	SE	60	40	Practical
10		Value Addition Course-III	6th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**6th**	**19**	**0**	**6**	**22**					
1		Department Electives-IX	7th	3	0	0	3	Core	DE	40	60	Theory
2		Data Visualization	7th	2	0	0	2	Core	SE	40	60	Theory
3		DevOps for Web Development	7th	2	0	0	2	Core	SE	40	60	Theory
4		Department Electives Lab-IX	7th	0	0	2	1	Core	DE	60	40	Practical
5		Department Electives-X	7th	3	0	0	3	Core	DE	40	60	Theory
6		Data Visualization Lab		0	0	2	1	Core	SE	60	40	Practical
7		DevOps for Web Development Lab		0	0	2	1	Core	SE	60	40	Practical
8		Capstone Project	7th	0	0	4	2	Core	Compulsory	60	40	Practical
9		Industrial Training-II	7th	0	0	6w	3	Core	II	60	40	Practical
10		Value Addition Course-IV	7th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**7th**	**12**	**0**	**10**	**20**					

1		Industrial Internship with	8th	-	-	20W	**20**	Core	II	100	100	Practical
		Total	8th				**20**					
		Overall Total	**1st to 8th**				177					

Note:

1. Mooc Course: Student will be offered various available SWAYAM MOOC Courses in leiu of various regular core (Compulsary and Department Electives) courses. A student can opt maximum of 2 MOOC courses in a semester for credit transfer with prior permissin and out of the list published by the department prior to start of the semester.

2. Student can opt for Honours degree by earning 18 - 20 additional credits through SWAYAM MOOC courses but with prior permission of the department and limit to the courses related to the Discipline.

3. A student can have Honours degree WITH SPECIALIZATION in the particular of his/her branch by earning 18-20 additional credits in particular specialization through MOOC or Departmental Elective bucket with Permission of the Department

4. Courses Highlighted in green need to be fixed according to the group (ME+CE in one group and CSE+ECE other group. Value added, RM and Mandatory courses also need to be fixed in numbers but department can put in any semester as per requirement (In order to balance the courses and credits in a semester. Internship credits need to be fixed as shown above.

Abbrevation Used:	
ID	Interdisciplinary
VAC	Value Addition Course
DE	Department Electives
BSC	Basic Science Courses
EAS	Engineering Applied Science
II	Industrial Internship
MC	Mandatory Courses (Non- Credit
SE	Specialization Electives

Credit Distribution	
Core	129
Other (Interdiscipl plinary +	48
Total	**177**

Core Credits	
Compulsory	47
Department Electives	21
Industrial Internship	27
Specialization Electives	34
Total	**129**

Other Credits	
Interdisciplinary	**40**
VAC	**8**
Total	**48**

Interdisciplinary Credits			
Basic Science Courses			6
Engineering Applied Science			10
Open Elective			16
Mandatory Courses - 4 Courses (Non-Credit))			8
Total			**40**

B-Tech in Computer Science with Specialization in Full Stack Web Development & Cloud Computing

S. No.	Subject Code	Subject Name	Semester	L	T	P	C	Category A (Core/ ID/ VAC	Category B (Compulsory/ DE/ BSC/ EAS/ OE/ MC/ II/ MOOC)	Internal	External	Theory/ Practical
1		Applied Physics	1st	3	0	0	3	ID	BSC	40	60	Theory
2		Design Thinking	1st	3	0	0	3	ID	EAS	40	60	Theory
3		Python +Clean Coding	1st	2	0	0	2	Core	SE	40	60	Theory
4		Computer Fundamental	1st	3	0	0	3	Core	Compulsory	40	60	Theory
5		Communication Skills-I	1st	2	0	0	2	ID	EAS	40	60	Theory
6		Object Oriented Programming	1st	3	0	0	3	Core	Compulsory	40	60	Theory
7		Value Addition Course-I	1st	2	0	0	2	VAC	VAC	40	60	Theory
8		Python +Clean Coding Lab	1st	0	0	2	1	Core	SE	60	40	Practical
9		Object Oriented Programming Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
10		Computer Fundamental Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
11		Communication Skills-I Lab	1st	0	0	2	1	ID	EAS	60	40	Practical
12		Ability Enhancement Mandatery Course 1	1st	2	0	0	2	ID	MC	40	60	Theory
		Total	**1st**	**20**	**0**	**8**	**24**					
1		Applied Mathematics	2nd	3	0	0	3	ID	BSC	40	60	Theory
2		DevOps	2nd	2	0	0	2	Core	SE	40	60	Theory
3		Basics of Data Structure	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
4		HTML + Javascript	2nd	2	0	0	2	Core	SE	40	60	Theory
5		Computer Architecture	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
6		DevOps Lab	2nd	0	0	2	1	Core	SE	60	40	Practical
7		Basics of Data Structure Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
8		HTML + Javascript Lab	2nd	0	0	2	1	Core	SE	60	40	Practical
9		Engineering Graphics and Design Lab	2nd	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement Mandatery Course II	2nd	2	0	0	2	ID	MC	40	60	Theory
		Total	**2nd**	**15**	**0**	**8**	**19**					

1		Operating System	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
2		Database Management Systems	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
3		Microservices (Dockers and Kubernetes)	3rd	2	0	0	2	Core	SE	40	60	Theory
4		Rest API & Node JS	3rd	2	0	0	2	Core	SE	40	60	Theory
5		Open Elective-I	3rd	4	0	0	4	ID	OE	40	60	Theory
6		Operating System Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
7		Database Management Systems Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Microservices (Dockers and Kubernetes) Lab	3rd	0	0	2	1	Core	SE	60	40	Practical
9		Rest API & Node JS Lab	3rd	0	0	2	1	Core	SE	60	40	Practical
10		Industrial Internship	3rd	0	0	4w	2	Core	II	60	40	Practical
11		Value Addition Course-II	3rd	2	0	0	2	VAC	VAC	40	60	Theory
12		Ability Enhancement Mandatery Course III	3rd	2	0	0	2	ID	MC	40	60	Theory
		Total	**3rd**	**18**	**0**	**8**	**24**					
1		Design and Analysis of Algorithm	4th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Software Engineering	4th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-III	4th	3	0	0	3	Core	DE	40	60	Theory
4		Java	4th	2	0	0	2	Core	SE	40	60	Theory
5		Cloud Computing	4th	2	0	0	2	Core	SE	40	60	Theory
6		Open Elective-II	4th	4	0	0	4	ID	OE	40	60	Theory
7		Design and Analysis of Algorithm Lab	4th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-III	4th	0	0	2	1	Core	DE	60	40	Practical
9		Java Lab		0	0	2	1	Core	SE	60	40	Practical
10		Cloud Computing Lab	4th	0	0	2	1	Core	SE	60	40	Practical
11		Research Methodology	4th	3	0	0	3	ID	EAS	40	60	Theory
		Total	**4th**	**20**	**0**	**8**	**24**					
1		Theory of Computation	5th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Data Communication & Networking	5th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Virtualization	5th	2	0	0	2	Core	SE	40	60	Theory
4		Department Electives-VI	5th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-III	5th	4	0	0	4	ID	OE	40	60	Theory
6		No SQL Data Base	5th	2	0	0	2	Core	SE	40	60	Theory
7		Virtualization Lab		0	0	2	1	Core	SE	60	40	Practical
8		No SQL Data Base lab		0	0	2	1	Core	SE	60	40	Practical
9		Data Communication & Networking Lab	5th	0	0	2	1	Core	Compulsory	60	40	Practical
10		Department Electives Lab-VI	5th	0	0	2	1	Core	DE	60	40	Practical
11		Ability Enhancement Mandatery Course 1V	5th	2	0	0	2	ID	MC	40	60	Theory
12		Industrial Training-I	5th	0	0	4w	2	Core	II	60	40	Practical
		Total	**5th**	**19**	**0**	**8**	**25**					

1		Compiler Design	6th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Big Data Analytics	6th	2	0	0	2	Core	SE	40	60	Theory
3		Web Services		2	0	0	2	Core	SE	40	60	Theory
4		Department Electives-VII	6th	3	0	0	3	Core	DE	40	60	Theory
5		Department Electives-VIII	6th	3	0	0	3	Core	DE	40	60	Theory
6		Open Elective-IV	6th	4	0	0	4	ID	OE	40	60	Theory
7		Compiler Design Lab	6th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Big Data Analytics Lab	6th	0	0	2	1	Core	SE	60	40	Practical
9		Web Services Lab	6th	0	0	2	1	Core	SE	60	40	Practical
10		Value Addition Course-III	6th	2	0	0	2	VAC	VAC	60	40	Theory
		Total	**6th**	**19**	**0**	**6**	**22**					
1		Department Electives-IX	7th	3	0	0	3	Core	DE	40	60	Theory
2		Project Development	7th	0	0	4	2	Core	SE	60	40	Theory
3		Department Electives Lab-IX	7th	0	0	2	1	Core	DE	60	40	Practical
4		Department Electives-X	7th	3	0	0	3	Core	DE	40	60	Theory
5		Cloud Native		2	0	0	2	Core	SE	40	60	Theory
6		Cloud Native Lab		0	0	2	1	Core	SE	60	40	Practical
7		Cloud Security	7th	2	0	0	2	Core	SE	40	60	Theory
8		Cloud security Lab		0	0	2	1	Core	SE	60	40	Practical
9		Industrial Training-II	7th	0	0	6w	3	Core	II	60	40	Practical
10		Value Addition Course-IV	7th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**7th**	**12**	**0**	**10**	**20**					
1		Industrial Internship with Project (Industrial oriented/Research oriented)	8th	-	-	20W	**20**	Core	II	100	100	Practical
	Total Credits	Total	8th				**20**					
		Overall Total	**1st to 8th**				**178**					

Note:
1. Mooc Course: Student will be offered various available SWAYAM MOOC Courses in leiu of various regular core (Compulsary and Department Electives) courses. A student can opt maximum of 2 MOOC courses in a semester for credit transfer with prior permissin and out of the list published by the department prior to start of the semester.
2. Student can opt for Honours degree by earning 18 - 20 additional credits through SWAYAM MOOC courses but with prior permission of the department and limit to the courses related to the Discipline.
3. A student can have Honours degree WITH SPECIALIZATION in the particular of his/her branch by earning 18-20 additional credits in particular specialization through MOOC or Departmental Elective bucket
4. Courses Highlighted in green need to be fixed according to the group (ME+CE in one group and CSE+ECE other group. Value added, RM and Mandatory courses also need to be fixed in numbers but department can put in any semester as per requirement (In order to balance the courses and credits in a semester. Internship credits need to be fixed as shown above.

Abbrevation Used:	
ID	Interdisciplinary
VAC	Value Addition Course
DE	Department Electives
BSC	Basic Science Courses
EAS	Engineering Applied Science
II	Industrial Internship
MC	Mandatory Courses (Non- Credit
SE	Specialization Electives

Credit Distribution	
Core	130
Other (Interdisciplinary + VAC)	48
Total	**178**

Core Credits	
Compulsory	43
Department Electives	21
Industrial Internship	27
Specialization Electives	39
Total	**130**

Other Credits	
Interdisciplinary	**40**
VAC	**8**
Total	**48**

Interdisciplinary Credits			
Basic Science Courses			6
Engineering Applied Science			10
Open Elective			16
Mandatory Courses - 4 Courses (Non-Credit))			8
Total			**40**

B-Tech in Computer Science with Specialization in Cyber Security & Block Chain

S. No.	Subject Code	Subject Name	Semester	L	T	P	C	Category A (Core/ ID/ VAC	Category B (Compulsory/ DE/ BSC/ EAS/ OE/ MC/ II/ MOOC)	Internal	External	Theory/ Practical
1		Applied Physics	1st	3	0	0	3	ID	BSC	40	60	Theory
2		Design Thinking	1st	3	0	0	3	ID	EAS	40	60	Theory
3		Python +Clean Coding	1st	2	0	0	2	Core	SE	40	60	Theory
4		Computer Fundamental	1st	3	0	0	3	Core	Compulsory	40	60	Theory
5		Communication Skills-I	1st	2	0	0	2	ID	EAS	40	60	Theory
6		Object Oriented Programming	1st	3	0	0	3	Core	Compulsory	40	60	Theory
7		Value Addition Course-I	1st	2	0	0	2	VAC	VAC	40	60	Theory
8		Python +Clean Coding Lab	1st	0	0	2	1	Core	SE	60	40	Practical
9		Object Oriented Programming Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
10		Computer Fundamental Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
11		Communication Skills-I Lab	1st	0	0	2	1	ID	EAS	60	40	Practical
12		Ability Enhancement Mandatery Course 1	1st	2	0	0	2	ID	MC	60	40	Theory
		Total	**1st**	**20**	**0**	**8**	**24**					
1		Applied Mathematics	2nd	3	0	0	3	ID	BSC	40	60	Theory
2		Fundamental of Cloud	2nd	2	0	0	2	Core	SE	40	60	Theory
3		Basics of Data Structure	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
4		Web Development	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
5		Computer Architecture	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
6		Fundamental of Cloud Lab	2nd	0	0	2	1	Core	SE	60	40	Practical
7		Basics of Data Structure Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Web Development Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
9		Engineering Graphics and Design Lab	2nd	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement Mandatery Course II	2nd	2	0	0	2	ID	MC	40	60	Theory
		Total	**1st**	**16**	**0**	**8**	**20**					

1		Operating System	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
2		Database Management Systems	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
3		Cloud Security	3rd	2	0	0	2	Core	SE	40	60	Theory
4		Open Elective-I	3rd	4	0	0	4	ID	OE	40	60	Theory
5		Operating System Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
6		Database Management Systems Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
7		Cloud Security Lab	3rd	0	0	2	1	Core	SE	60	40	Practical
8		Industrial Internship	3rd	0	0	4w	2	Core	II	60	40	Practical
9		Value Addition Course-II	3rd	2	0	0	2	VAC	VAC	40	60	Theory
10		Ability Enhancement Mandatery Course III	3rd	2	0	0	2	ID	MC	40	60	Theory
		Total	**3rd**	**16**	**0**	**6**	**21**					
1		Design and Analysis of Algorithm	4th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Software Engineering	4th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-III	4th	3	0	0	3	Core	DE	40	60	Theory
4		Big Data Fundamental	4th	2	0	0	2	Core	SE	40	60	Theory
5		Department Electives-IV	4th	3	0	0	3	Core	DE	40	60	Theory
6		Open Elective-II	4th	4	0	0	4	ID	OE	40	60	Theory
7		Design and Analysis of Algorithm Lab	4th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Department Electives Lab-III	4th	0	0	2	1	Core	DE	60	40	Practical
9		Big Data Fundamental Lab		0	0	2	1	Core	SE	60	40	Practical
10		Research Methodology	4th	3	0	0	3	ID	EAS	40	60	Theory
		Total	**4th**	**21**	**0**	**6**	**24**					
1		Theory of Computation	5th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Data Communication & Networking	5th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Big Data Security	5th	2	0	0	2	Core	SE	40	60	Theory
4		Department Electives-VI	5th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-III	5th	4	0	0	4	ID	OE	40	60	Theory
6		Identity Access Management	5th	2	0	0	2	Core	SE	40	60	Theory
7		Big Data Security Lab	5th	0	0	2	1	Core	SE	60	40	Practical
8		Identity Access Management lab	5th	0	0	2	1	Core	SE	60	40	Practical
9		Data Communication & Networking Lab	5th	0	0	2	1	Core	Compulsory	60	40	Practical
10		Department Electives Lab-VI	5th	0	0	2	1	Core	DE	60	40	Practical
11		Ability Enhancement Mandatery Course IV	5th	2	0	0	2	ID	MC	40	60	Theory
12		Industrial Training-I	5th	0	0	4w	2	Core	II	60	40	Practical
		Total	**5th**	**19**	**0**	**8**	**25**					

1		Compiler Design	6th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Security Intelligence	6th	2	0	0	2	Core	SE	40	60	Theory
3		Artificial Intelligence	6th	3	0	0	3	Core	Compulsory	40	60	Theory
4		Department Electives-VII	6th	3	0	0	3	Core	DE	40	60	Theory
5		Department Electives-VIII	6th	3	0	0	3	Core	DE	40	60	Theory
6		Open Elective-IV	6th	4	0	0	4	ID	OE	40	60	Theory
7		Compiler Design Lab	6th	0	0	2	1	Core	Compulsory	60	40	Practical
8		Security Intelligence Lab	6th	0	0	2	1	Core	SE	60	40	Practical
9		Artificial Intelligence Lab	6th	0	0	4	2	Core	Compulsory	60	40	Practical
10		Value Addition Course-III	6th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**6th**	**20**	**0**	**8**	**24**					
1		Department Electives-IX	7th	3	0	0	3	Core	DE	40	60	Theory
2		Project Development	7th	0	0	4	2	Core	SE	60	40	Practical
4		Department Electives Lab-IX	7th	0	0	2	1	Core	DE	60	40	Practical
5		Department Electives-X	7th	3	0	0	3	Core	DE	40	60	Theory
6		Security and Data Privacy Laws and Standard	7th	2	0	0	2	Core	SE	40	60	Theory
7		Security and Data Privacy	7th	0	0	2	1	Core	SE	60	40	Practical
8		Blockchain	7th	2	0	0	2	Core	SE	40	60	Theory
9		Blockchain Lab	7th	0	0	2	1	Core	SE	60	40	Practical
10		Industrial Training-II	7th	0	0	6w	3	Core	II	60	40	Practical
11		Value Addition Course-IV	7th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**7th**	**12**	**0**	**10**	**20**					
1		Industrial Internship with Project (Industrial	8th	-	-	20W	**20**	Core	II	100	100	Practical
	Total Credits	Total	8th				**20**					
		Overall Total	**1st to 8th**				**178**					

Note:
1. Mooc Course: Student will be offered various available SWAYAM MOOC Courses in leiu of various regular core (Compulsary and Department Electives) courses. A student can opt maximum of 2 MOOC
2. Student can opt for Honours degree by earning 18 - 20 additional credits through SWAYAM MOOC courses but with prior permission of the department and limit to the courses related to the Discipline.
3. A student can have Honours degree WITH SPECIALIZATION in the particular of his/her branch by earning 18-20 additional credits in particular specialization through MOOC or Departmental Elective bucket with Permission of the Department

4. Courses Highlighted in green need to be fixed according to the group (ME+CE in one group and CSE+ECE other group. Value added, RM and Mandatory courses also need to be fixed in numbers but department can put in any semester as per requirement (In order to balance the courses and credits in a semester. Internship credits need to be fixed as shown above.

Abbrevation Used:	
ID	Interdisciplinary
VAC	Value Addition Course
DE	Department Electives
BSC	Basic Science Courses
EAS	Engineering Applied Science
II	Industrial Internship
MC	Mandatory Courses (Non- Credit
SE	Specialization Electives

Credit Distribution	
Core	127
Other (Interdisciplinary + VAC)	48
Total	**175**

Core Credits	
Compulsory	50
Department Electives	24
Industrial Internship	27
Specialization Electives	29
Total	**130**

Other Credits	
Interdisciplinary	**40**
VAC	**8**
Total	**48**

Interdisciplinary Credits			
Basic Science Courses			6
Engineering Applied Science			10
Open Elective			16
Mandatory Courses - 4 Courses (Non-Credit))			8
Total			**40**

B-Tech in Computer Science with Specialization in Gaming & Augmented Reality (Immersive Experience)

S. No.	Subject Code	Subject Name	Semester	L	T	P	C	Category A (Core/ ID/ VAC	Category B (Compulsory/ DE/ BSC/ EAS/ OE/ MC/ II/ MOOC)	Internal	External	Theory/ Practical
1		Applied Physics	1st	3	0	0	3	ID	BSC	40	60	Theory
2		Design Thinking	1st	3	0	0	3	ID	EAS	40	60	Theory
3		Computer Fundamental	1st	3	0	0	3	Core	Compulsory	40	60	Theory
4		Communication Skills-I	1st	2	0	0	2	ID	EAS	40	60	Theory
5		Object Oriented Programming	1st	3	0	0	3	Core	Compulsory	40	60	Theory
6		Value Addition Course-I	1st	2	0	0	2	VAC	VAC	40	60	Theory
7		Computer Fundamental Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
8		Object Oriented Programming Lab	1st	0	0	2	1	Core	Compulsory	60	40	Practical
9		Communication Skills-I Lab	1st	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement Mandatary Course 1	1st	2	0	0	2	ID	MC	40	60	Theory
		Total	**1st**	**21**	**0**	**8**	**23**					
1		Applied Mathematics	2nd	3	0	0	3	ID	BSC	40	60	Theory
2		Usability Design of Software Applications	2nd	3	2	0	4	Core	SE	40	60	Theory
3		Basics of Data Structure	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
4		Web Development	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
5		Computer Architecture	2nd	3	0	0	3	Core	Compulsory	40	60	Theory
6		Usability Design of Software Applications Programming Lab	2nd	0	0	2	1	Core	SE	60	40	Practical
7		Basics of Data Structure Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Web Development Lab	2nd	0	0	2	1	Core	Compulsory	60	40	Practical
9		Engineering Graphics and Design Lab	2nd	0	0	2	1	ID	EAS	60	40	Practical
10		Ability Enhancement Mandatery Course II	2nd	2	0	0	2	ID	MC	40	60	Theory
		Total	**2nd**	**17**	**2**	**10**	**22**					
1		Operating System	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
2		Database Management Systems	3rd	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-I	3rd	3	0	0	3	Core	DE	40	60	Theory
4		Intelligent Game Design and its Applications	3rd	3	2	0	4	Core	SE	40	60	Theory
5		Open Elective-I	3rd	4	0	0	4	ID	OE	40	60	Theory
6		Intelligent Game Design and its Applications Lab		0	0	2	1	Core	SE	60	40	Practical
7		Operating System Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
8		Database Management Systems Lab	3rd	0	0	2	1	Core	Compulsory	60	40	Practical
9		Department Electives Lab-I	3rd	0	0	2	1	Core	DE	60	40	Practical
10		Industrial Internship	3rd	0	0	4w	2	Core	II	60	40	Practical
11		Value Addition Course-II	3rd	2	0	0	2	VAC	VAC	40	60	Theory
12		Ability Enhancement Mandatery Course III	3rd	2	0	0	2	ID	MC	40	60	Theory
		Total	**3rd**	**18**	**2**	**10**	**27**					
1		Design and Analysis of Algorithm	4th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Software Engineering	4th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Department Electives-III	4th	3	0	0	3	Core	DE	40	60	Theory
4		Innovation & Entrepreneurship	4th	3	2	0	4	Core	SE	40	60	Theory
5		Medical imaging techniques	4th	3	0	0	3	ID	EAS	40	60	Theory
6		Open Elective-II	4th	4	0	0	4	ID	OE	40	60	Theory
7		Innovation & Entrepreneurship Lab	4th	0	0	2	1	Core	SE	60	40	Practical
8		Design and Analysis of Algorithm Lab	4th	0	0	2	1	Core	Compulsory	60	40	Practical
9		Department Electives Lab-III	4th	0	0	2	1	Core	DE	60	40	Practical
10		Research Methodology	4th	3	0	0	3	ID	EAS	40	60	Theory
		Total	**4th**	**20**	**2**	**10**	**26**					

1		Theory of Computation	5th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Data Communication & Networking	5th	3	0	0	3	Core	Compulsory	40	60	Theory
3		Augmented Reality and its Applications	5th	3	2	0	4	Core	SE	40	60	Theory
4		Department Electives-VI	5th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-III	5th	4	0	0	4	ID	OE	40	60	Theory
6		Medical informatics	5th	3	0	0	3	ID	EAS	40	60	Theory
7		Augmented Reality and its Applications lab	5th	0	0	2	1	Core	SE	60	40	Practical
8		Data Communication & Networking Lab	5th	0	0	2	1	Core	Compulsory	60	40	Practical
9		Department Electives Lab-VI	5th	0	0	2	1	Core	DE	60	40	Practical
10		Ability Enhancement Mandatery Course IV	5th	2	0	0	2	ID	MC	40	60	Theory
11		Industrial Training-I	5th	0	0	4w	2	Core	II	60	40	Practical
		Total	**5th**	**19**	**2**	**8**	**27**					
1		Compiler Design	6th	3	0	0	3	Core	Compulsory	40	60	Theory
2		Vision Intelligence and Machine Learning*	6th	3	2	0	4	Core	SE	40	60	Theory
3		Department Electives-VII	6th	3	0	0	3	Core	DE	40	60	Theory
4		Department Electives-VIII	6th	3	0	0	3	Core	DE	40	60	Theory
5		Open Elective-IV	6th	4	0	0	4	ID	OE	40	60	Theory
6		Compiler Design Lab	6th	0	0	2	1	Core	Compulsory	60	40	Practical
7		Vision Intelligence and Machine Learning*	6th	0	0	2	1	Core	SE	60	40	Practical
8		Value Addition Course-III	6th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**6th**	**16**	**2**	**6**	**20**					
1		Department Electives-IX	7th	3	0	0	3	Core	DE	40	60	Theory
2		Virtual Reality and its Applications	7th	3	2	0	4	Core	SE	40	60	Theory
3		Department Electives-X	7th	3	0	0	3	Core	DE	40	60	Theory
4		Virtual Reality and its Applications Lab	7th	0	0	2	1	Core	SE	60	40	Practical
5		Department Electives Lab-IX	7th	0	0	2	1	Core	DE	60	40	Practical
6		Capstone Project	7th	0	0	4	2	Core	Compulsory	60	40	Practical
7		Industrial Training-II	7th	0	0	4w	2	Core	II	60	40	Practical
8		Value Addition Course-IV	7th	2	0	0	2	VAC	VAC	40	60	Theory
		Total	**7th**	**11**	**0**	**8**	**18**					
1		Industrial Internship with Project (Industrial oriented/Research oriented)	8th	-	-	20W	**20**	Core	II	100	100	Practical
	Total Credits	Total	8th				**20**					
		Overall Total	**1st to 8th**				**182**					

Note:
1. Mooc Course: Student will be offered various available SWAYAM MOOC Courses in leiu of various regular core (Compulsary and Department Electives) courses. A student can opt maximum of 2 MOOC courses in a semester for credit transfer with prior permissin and out of the list published by the department prior to start of the semester.
2. Student can opt for Honours degree by earning 18 - 20 additional credits through SWAYAM MOOC courses but with prior permission of the department and limit to the courses related to the Discipline.
3. A student can have Honours degree WITH SPECIALIZATION in the particular of his/her branch by earning 18-20 additional credits in particular specialization through MOOC or Departmental Elective bucket with Permission of the Department
4. Courses Highlighted in green need to be fixed according to the group (ME+CE in one group and CSE+ECE other group. Value added, RM and Mandatory courses also need to be fixed in numbers but department can put in any semester as per requirement (In order to balance the courses and credits in a semester. Internship credits need to be fixed as shown above.

Abbrevation Used:	
ID	Interdisciplinary
VAC	Value Addition Course
DE	Department Electives
BSC	Basic Science Courses
EAS	Engineering Applied Science
II	Industrial Internship
MC	Mandatory Courses (Non- Credit
SE	Specialization Elective

Credit Distribution	
Core	128
Other (Interdisciplinary + VAC)	54
Total	**182**

Core Credits	
Compulsory	47
Department Electives	25
Industrial Internship	26
SE	30
Total	**128**

Other Credits	
Interdisciplinary	**46**
VAC	**8**
Total	**54**

Interdisciplinary Credits			
Basic Science Courses			6
Engineering Applied Science			16
Open Elective			16
Mandatory Courses - 4 Courses (Non-Credit))			8
Total			**46**

B-Tech in Computer Science with Specialization in Gaming & Augmented Reality (Immersive Experience)									
Semester 1st									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Applied Physics	3	0	0	3	40	60	100
2		Design Thinking	3	0	0	3	40	60	100
3		Computer Fundamental	3	0	0	3	40	60	100
4		Communication Skills-I	2	0	0	2	40	60	100
5		Object Oriented Programming	3	0	0	3	40	60	100
6		Value Addition Course-I	2	0	0	2	40	60	100
7		Computer Fundamental Lab	0	0	2	1	60	40	100
8		Object Oriented Programming Lab	0	0	2	1	60	40	100
9		Communication Skills-I Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatory Course 1	2	0	0	2	40	60	Grade*
		Total	**18**	**0**	**6**	**21**	**460**	**540**	**900**

B-Tech in Computer Science with Specialization in Gaming & Augmented Reality (Immersive Experience)									
Semester 2nd									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Applied Mathematics	3	0	0	3	40	60	100
2		Usability Design of Software Applications	3	2	0	4	40	60	100
3		Basics of Data Structure	3	0	0	3	40	60	100
4		Web Development	3	0	0	3	40	60	100
5		Computer Architecture	3	0	0	3	40	60	100
6		Usability Design of Software Applications Programming Lab	0	0	2	1	60	40	100
7		Basics of Data Structure Lab	0	0	2	1	60	40	100
8		Web Development Lab	0	0	2	1	60	40	100
9		Engineering Graphics and Design Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatory Course II	2	0	0	2	40	60	Grade*
		Total	**17**	**2**	**8**	**22**	**480**	**520**	**900**

B-Tech in Computer Science with Specialization in Gaming & Augmented Reality (Immersive Experience)									
Semester 3rd									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Operating System	3	0	0	3	40	60	100
2		Database Management Systems	3	0	0	3	40	60	100
3		Department Electives-I	3	0	0	3	40	60	100
4		Intelligent Game Design and its Applications	3	2	0	4	40	60	100
5		Open Elective-I	4	0	0	4	40	60	100
6		Intelligent Game Design and its Applications Lab	0	0	2	1	60	40	100
7		Operating System Lab	0	0	2	1	60	40	100
8		Database Management Systems Lab	0	0	2	1	60	40	100
9		Department Electives Lab-I	0	0	2	1	60	40	100
10		Industrial Internship	0	0	4w	2	60	40	100
11		Value Addition Course-II	2	0	0	2	40	60	100
12		Ability Enhancement Mandatory Course III	2	0	0	2	40	60	Grade*
		Total	**20**	**2**	**8**	**27**	**580**	**620**	**1100**

B-Tech in Computer Science with Specialization in Gaming & Augmented Reality (Immersive Experience)									
Semester 4th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Design and Analysis of Algorithm	3	0	0	3	40	60	100
2		Software Engineering	3	0	0	3	40	60	100
3		Department Electives-III	3	0	0	3	40	60	100
4		Innovation & Entrepreneurship	3	2	0	4	40	60	100
5		Medical imaging techniques	3	0	0	3	40	60	100
6		Open Elective-II	4	0	0	4	40	60	100
7		Innovation & Entrepreneurship Lab	0	0	2	1	60	40	100
8		Design and Analysis of Algorithm Lab	0	0	2	1	60	40	100
9		Department Electives Lab-III	0	0	2	1	60	40	100
10		Research Methodology	3	0	0	3	40	60	100
		Total	**22**	**2**	**6**	**26**	**460**	**540**	**1000**

B-Tech in Computer Science with Specialization in Gaming & Augmented Reality (Immersive Experience)									
Semester 5th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Theory of Computation	3	0	0	3	40	60	100
2		Data Communication & Networking	3	0	0	3	40	60	100
3		Augmented Reality and its Applications	3	2	0	4	40	60	100
4		Department Electives-VI	3	0	0	3	40	60	100
5		Open Elective-III	4	0	0	4	40	60	100
6		Medical informatics	3	0	0	3	40	60	100
7		Augmented Reality and its Applications lab	0	0	2	1	60	40	100
8		Data Communication & Networking Lab	0	0	2	1	60	40	100
9		Department Electives Lab-VI	0	0	2	1	60	40	100
10		Ability Enhancement Mandatory Course IV	2	0	0	2	40	60	Grade*
11		Industrial Training-I	0	0	4w	2	60	40	100
		Total	**21**	**2**	**6**	**27**	**520**	**580**	**1000**

B-Tech in Computer Science with Specialization in Gaming & Augmented Reality (Immersive Experience)

Semester 6th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Compiler Design	3	0	0	3	40	60	100
2		Vision Intelligence and Machine Learning*	3	2	0	4	40	60	100
3		Department Electives-VII	3	0	0	3	40	60	100
4		Department Electives-VIII	3	0	0	3	40	60	100
5		Open Elective-IV	4	0	0	4	40	60	100
6		Compiler Design Lab	0	0	2	1	60	40	100
7		Vision Intelligence and Machine Learning*	0	0	2	1	60	40	100
8		Value Addition Course-III	2	0	0	2	40	60	100
		Total	**18**	**2**	**4**	**21**	**360**	**440**	**800**

B-Tech in Computer Science with Specialization in Gaming & Augmented Reality (Immersive Experience)									
Semester 7th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Department Electives-IX	3	0	0	3	40	60	100
2		Virtual Reality and its Applications	3	2	0	4	40	60	100
3		Department Electives-X	3	0	0	3	40	60	100
4		Virtual Reality and its Applications Lab	0	0	2	1	60	40	100
5		Department Electives Lab-IX	0	0	2	1	60	40	100
6		Capstone Project	0	0	4	2	60	40	100
7		Industrial Training-II	0	0	4w	2	60	40	100
8		Value Addition Course-IV	2	0	0	2	40	60	100
		Total	**11**	**2**	**8**	**18**	**400**	**400**	**800**

B-Tech in Computer Science with Specialization in Gaming & Augmented Reality (Immersive Experience)

Semester 8th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Industrial Internship with Project (Industrial oriented/Research oriented)	-	-	20W	**20**	100	100	200
		Total				**20**			

B-Tech in Computer Science with Specialization in Cyber Security & Block Chain

Semester 1st

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Applied Physics	3	0	0	3	40	60	100
2		Design Thinking	3	0	0	3	40	60	100
3		Python +Clean Coding	2	0	0	2	40	60	100
4		Computer Fundamental	3	0	0	3	40	60	100
5		Communication Skills-I	2	0	0	2	40	60	100
6		Object Oriented Programming	3	0	0	3	40	60	100
7		Value Addition Course-I	2	0	0	2	40	60	100
8		Python +Clean Coding Lab	0	0	2	1	60	40	100
9		Object Oriented Programming Lab	0	0	2	1	60	40	100
10		Computer Fundamental Lab	0	0	2	1	60	40	100
11		Communication Skills-I Lab	0	0	2	1	60	40	100
12		Ability Enhancement Mandatory Course 1	2	0	0	2	60	40	Grade*
		Total	**20**	**0**	**8**	**24**	**580**	**620**	**1100**

B-Tech in Computer Science with Specialization in Cyber Security & Block Chain									
Semester 2nd									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Applied Mathematics	3	0	0	3	40	60	100
2		Fundamental of Cloud	2	0	0	2	40	60	100
3		Basics of Data Structure	3	0	0	3	40	60	100
4		Web Development	3	0	0	3	40	60	100
5		Computer Architecture	3	0	0	3	40	60	100
6		Fundamental of Cloud Lab	0	0	2	1	60	40	100
7		Basics of Data Structure Lab	0	0	2	1	60	40	100
8		Web Development Lab	0	0	2	1	60	40	100
9		Engineering Graphics and Design Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatory Course II	2	0	0	2	40	60	Grade*
		Total	**16**	**0**	**8**	**20**	**480**	**520**	**900**

B-Tech in Computer Science with Specialization in Cyber Security & Block Chain

Semester 3rd

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Operating System	3	0	0	3	40	60	100
2		Database Management Systems	3	0	0	3	40	60	100
3		Cloud Security	2	0	0	2	40	60	100
4		Open Elective-I	4	0	0	4	40	60	100
5		Operating System Lab	0	0	2	1	60	40	100
6		Database Management Systems Lab	0	0	2	1	60	40	100
7		Cloud Security Lab	0	0	2	1	60	40	100
8		Industrial Internship	0	0	4w	2	60	40	100
9		Value Addition Course-II	2	0	0	2	40	60	100
10		Ability Enhancement Mandatory Course III	2	0	0	2	40	60	Grade*
		Total	**16**	**0**	**6**	**21**	**480**	**520**	**900**

B-Tech in Computer Science with Specialization in Cyber Security & Block Chain

Semester 4th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Design and Analysis of Algorithm	3	0	0	3	40	60	100
2		Software Engineering	3	0	0	3	40	60	100
3		Department Electives-III	3	0	0	3	40	60	100
4		Big Data Fundamental	2	0	0	2	40	60	100
5		Department Electives-IV	3	0	0	3	40	60	100
6		Open Elective-II	4	0	0	4	40	60	100
7		Design and Analysis of Algorithm Lab	0	0	2	1	60	40	100
8		Department Electives Lab-III	0	0	2	1	60	40	100
9		Big Data Fundamental Lab	0	0	2	1	60	40	100
10		Research Methodology	3	0	0	3	40	60	100
		Total	**21**	**0**	**6**	**24**	**460**	**540**	**1000**

B-Tech in Computer Science with Specialization in Cyber Security & Block Chain									
Semester 5th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Theory of Computation	3	0	0	3	40	60	100
2		Data Communication & Networking	3	0	0	3	40	60	100
3		Big Data Security	2	0	0	2	40	60	100
4		Department Electives-VI	3	0	0	3	40	60	100
5		Open Elective-III	4	0	0	4	40	60	100
6		Identity Access Management	2	0	0	2	40	60	100
7		Big Data Security Lab	0	0	2	1	60	40	100
8		Identity Access Management lab	0	0	2	1	60	40	100
9		Data Communication & Networking Lab	0	0	2	1	60	40	100
10		Department Electives Lab-VI	0	0	2	1	60	40	100
11		Ability Enhancement Mandatory Course IV	2	0	0	2	40	60	Grade*
12		Industrial Training-I	0	0	4w	2	60	40	100
		Total	**19**	**0**	**8**	**25**	**580**	**620**	**1100**

B-Tech in Computer Science with Specialization in Cyber Security & Block Chain									
Semester 6th									
S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Compiler Design	3	0	0	3	40	60	100
2		Security Intelligence	2	0	0	2	40	60	100
3		Artificial Intelligence	3	0	0	3	40	60	100
4		Department Electives-VII	3	0	0	3	40	60	100
5		Department Electives-VIII	3	0	0	3	40	60	100
6		Open Elective-IV	4	0	0	4	40	60	100
7		Compiler Design Lab	0	0	2	1	60	40	100
8		Security Intelligence Lab	0	0	2	1	60	40	100
9		Artificial Intelligence Lab	0	0	4	2	60	40	100
10		Value Addition Course-III	2	0	0	2	40	60	100
		Total	**20**	**0**	**8**	**24**	**460**	**540**	**1000**

B-Tech in Computer Science with Specialization in Cyber Security & Block Chain

Semester 7th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Department Electives-IX	3	0	0	3	40	60	100
2		Project Development	0	0	4	2	60	40	100
4		Department Electives Lab-IX	0	0	2	1	60	40	100
5		Department Electives-X	3	0	0	3	40	60	100
6		Security and Data Privacy Laws and	2	0	0	2	40	60	100
7		Security and Data Privacy Laws and	0	0	2	1	60	40	100
8		Blockchain	2	0	0	2	40	60	100
9		Blockchain Lab	0	0	2	1	60	40	100
10		Industrial Training-II	0	0	6w	3	60	40	100
11		Value Addition Course-IV	2	0	0	2	40	60	100
		Total	**12**	**0**	**10**	**20**	**500**	**500**	**1000**

B-Tech in Computer Science with Specialization in Cyber Security & Block Chain

Semester 8th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Industrial Internship with Project (Industrial oriented/Research oriented)	-	-	20W	**20**	100	100	200
		Total				**20**			

B-Tech in Computer Science with Specialization in Full Stack Web Development & Cloud Computing

Semester 1st									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Applied Physics	3	0	0	3	40	60	100
2		Design Thinking	3	0	0	3	40	60	100
3		Python +Clean Coding	2	0	0	2	40	60	100
4		Computer Fundamental	3	0	0	3	40	60	100
5		Communication Skills-I	2	0	0	2	40	60	100
6		Object Oriented Programming	3	0	0	3	40	60	100
7		Value Addition Course-I	2	0	0	2	40	60	100
8		Python +Clean Coding Lab	0	0	2	1	60	40	100
9		Object Oriented Programming Lab	0	0	2	1	60	40	100
10		Computer Fundamental Lab	0	0	2	1	60	40	100
11		Communication Skills-I Lab	0	0	2	1	60	40	100
12		Ability Enhancement Mandatory Course 1	2	0	0	2	40	60	Grade*
		Total	**20**	**0**	**8**	**24**	**560**	**640**	**1100**

B-Tech in Computer Science with Specialization in Full Stack Web Development & Cloud Computing

Semester 2nd									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Applied Mathematics	3	0	0	3	40	60	100
2		DevOps	2	0	0	2	40	60	100
3		Basics of Data Structure	3	0	0	3	40	60	100
4		HTML + Javascript	2	0	0	2	40	60	100
5		Computer Architecture	3	0	0	3	40	60	100
6		DevOps Lab	0	0	2	1	60	40	100
7		Basics of Data Structure Lab	0	0	2	1	60	40	100
8		HTML + Javascript Lab	0	0	2	1	60	40	100
9		Engineering Graphics and Design Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatory Course II	2	0	0	2	40	60	Grade*
		Total	**15**	**0**	**8**	**19**	**480**	**520**	**900**

B-Tech in Computer Science with Specialization in Full Stack Web Development & Cloud Computing

Semester 3rd									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Operating System	3	0	0	3	40	60	100
2		Database Management Systems	3	0	0	3	40	60	100
3		Microservices (Dockers and	2	0	0	2	40	60	100
4		Rest API & Node	2	0	0	2	40	60	100
5		Open Elective-I	4	0	0	4	40	60	100
6		Operating System Lab	0	0	2	1	60	40	100
7		Database Management Systems Lab	0	0	2	1	60	40	100
8		Microservices (Dockers and	0	0	2	1	60	40	100
9		Rest API & Node	0	0	2	1	60	40	100
10		Industrial Internship	0	0	4w	2	60	40	100
11		Value Addition Course-II	2	0	0	2	40	60	100
12		Ability Enhancement Mandatory Course III	2	0	0	2	40	60	Grade*
		Total	**18**	**0**	**8**	**24**	**580**	**620**	**1100**

B-Tech in Computer Science with Specialization in Full Stack Web Development & Cloud Computing

Semester 4th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Design and Analysis of Algorithm	3	0	0	3	40	60	100
2		Software Engineering	3	0	0	3	40	60	100
3		Department Electives-III	3	0	0	3	40	60	100
4		Java	2	0	0	2	40	60	100
5		Cloud Computing	2	0	0	2	40	60	100
6		Open Elective-II	4	0	0	4	40	60	100
7		Design and Analysis of Algorithm Lab	0	0	2	1	60	40	100
8		Department Electives Lab-III	0	0	2	1	60	40	100
9		Java Lab	0	0	2	1	60	40	100
10		Cloud Computing Lab	0	0	2	1	60	40	100
11		Research Methodology	3	0	0	3	40	60	100
		Total	**20**	**0**	**8**	**24**	**520**	**580**	**1100**

B-Tech in Computer Science with Specialization in Full Stack Web Development & Cloud Computing

Semester 5th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Theory of Computation	3	0	0	3	40	60	100
2		Data Communication & Networking	3	0	0	3	40	60	100
3		Virtualization	2	0	0	2	40	60	100
4		Department Electives-VI	3	0	0	3	40	60	100
5		Open Elective-III	4	0	0	4	40	60	100
6		No SQL Data Base	2	0	0	2	40	60	100
7		Virtualization Lab	0	0	2	1	60	40	100
8		No SQL Data Base lab	0	0	2	1	60	40	100
9		Data Communication & Networking Lab	0	0	2	1	60	40	100
10		Department Electives Lab-VI	0	0	2	1	60	40	100
11		Ability Enhancement Mandatory Course 1V	2	0	0	2	40	60	Grade*
12		Industrial Training-I	0	0	4w	2	60	40	100
		Total	**19**	**0**	**8**	**25**	**580**	**620**	**1100**

B-Tech in Computer Science with Specialization in Full Stack Web Development & Cloud Computing

Semester 6th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Compiler Design	3	0	0	3	40	60	100
2		Big Data Analytics	2	0	0	2	40	60	100
3		Web Services	2	0	0	2	40	60	100
4		Department Electives-VII	3	0	0	3	40	60	100
5		Department Electives-VIII	3	0	0	3	40	60	100
6		Open Elective-IV	4	0	0	4	40	60	100
7		Compiler Design Lab	0	0	2	1	60	40	100
8		Big Data Analytics Lab	0	0	2	1	60	40	100
9		Web Services Lab	0	0	2	1	60	40	100
10		Value Addition Course-III	2	0	0	2	60	40	100
		Total	**19**	**0**	**6**	**22**	**480**	**520**	**1000**

B-Tech in Computer Science with Specialization in Full Stack Web Development & Cloud Computing

Semester 7th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Department Electives-IX	3	0	0	3	40	60	100
2		Project Development	0	0	4	2	60	40	100
3		Department Electives Lab-IX	0	0	2	1	60	40	100
4		Department Electives-X	3	0	0	3	40	60	100
5		Cloud Native	2	0	0	2	40	60	100
6		Cloud Native Lab	0	0	2	1	60	40	100
7		Cloud Security	2	0	0	2	40	60	100
8		Cloud security Lab	0	0	2	1	60	40	100
9		Industrial Training-II	0	0	6w	3	60	40	100
10		Value Addition Course-IV	2	0	0	2	40	60	100
		Total	**12**	**0**	**10**	**20**	**500**	**500**	**1000**

B-Tech in Computer Science with Specialization in Full Stack Web Development & Cloud Computing

Semester 8th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Industrial Internship with Project (Industrial	-	-	20W	**20**	100	100	200
	Total Credits	Total				**20**			

B-Tech in Computer Science with Specialization in iOS & Mobile Application Development

Semester 1st

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Applied Physics	3	0	0	3	40	60	100
2		Design Thinking	3	0	0	3	40	60	100
3		iOS Frameworks / User Interface	2	0	0	2	40	60	100
4		Fundamentals of Mac OS and iOS Interface guidelines	2	0	0	2	40	60	100
5		Communication Skills-I	2	0	0	2	40	60	100
6		Object Oriented Programming	3	0	0	3	40	60	100
7		Value Addition Course-I	2	0	0	2	40	60	100
8		iOS Frameworks / User Interface Lab	0	0	2	1	60	40	100
9		Object Oriented Programming Lab	0	0	2	1	60	40	100
10		Fundamentals of Mac OS and iOS Interface guidelines Lab	0	0	2	1	60	40	100
11		Communication Skills-I Lab	0	0	2	1	60	40	100
12		Ability Enhancement Mandatery Course I	2	0	0	2	40	60	Grade*
		Total	**19**	**0**	**8**	**23**	**560**	**640**	**1100**

B-Tech in Computer Science with Specialization in iOS & Mobile Application Development

Semester 2nd

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Applied Mathematics	3	0	0	3	40	60	100
2		DevOps	2	0	0	2	40	60	100
3		Basics of Data Structure	3	0	0	3	40	60	100
4		Full Stack Web Development	2	0	0	2	40	60	100
5		Computer Architecture	3	0	0	3	40	60	100
6		DevOps Lab	0	0	2	1	60	40	100
7		Basics of Data Structure Lab	0	0	2	1	60	40	100
8		Full Stack Web Development Lab	0	0	2	1	60	40	100
9		Engineering Graphics and Design Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatery Course II	2	0	0	2	40	60	Grade*
		Total	**15**	**0**	**8**	**19**	**480**	**520**	**900**

B-Tech in Computer Science with Specialization in iOS & Mobile Application Development

Semester 3rd

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Operating System	3	0	0	3	40	60	100
2		Database Management Systems	3	0	0	3	40	60	100
3		User Interface Advanced Techniques	2	0	0	2	40	60	100
4		Objective Oriented Programming Language with Objective C	2	0	0	2	40	60	100
5		Open Elective-I	4	0	0	4	40	60	100
6		Operating System Lab	0	0	2	1	60	40	100
7		Database Management Systems Lab	0	0	2	1	60	40	100
8		User Interface Advanced Techniques Lab	0	0	2	1	60	40	100
9		Objective Oriented Programming Language with Objective C Lab	0	0	2	1	60	40	100
10		Industrial Internship	0	0	4w	2	60	40	100
11		Value Addition Course-II	2	0	0	2	40	60	100
12		Ability Enhancement Mandatery Course III	2	0	0	2	40	60	Grade*
		Total	**18**	**0**	**8**	**24**	**580**	**620**	**1100**

B-Tech in Computer Science with Specialization in iOS & Mobile Application Development

Semester 4th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Design and Analysis of Algorithm	3	0	0	3	40	60	100
2		Software Engineering	3	0	0	3	40	60	100
3		Department Electives-III	3	0	0	3	40	60	100
4		Swift Programming language	2	0	0	2	40	60	100
5		iCloud and Cloud tools and Techniques for Back end development	2	0	0	2	40	60	100
6		Open Elective-II	4	0	0	4	40	60	100
7		Design and Analysis of Algorithm Lab	0	0	2	1	60	40	100
8		Department Electives Lab-III	0	0	2	1	60	40	100
9		Swift Programming language Lab	0	0	2	1	60	40	100
10		iCloud and Cloud tools and Techniques for Back end	0	0	2	1	60	40	100
11		Research Methodology	3	0	0	3	40	60	100
		Total	**20**	**0**	**8**	**24**	**520**	**580**	**1100**

B-Tech in Computer Science with Specialization in iOS & Mobile Application Development

Semester 5th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Theory of Computation	3	0	0	3	40	60	100
2		Data Communication & Networking	3	0	0	3	40	60	100
3		Mobile Application Development/ iPhone Operating System Basic	2	0	0	2	40	60	100
4		Department Electives-VI	3	0	0	3	40	60	100
5		Open Elective-III	4	0	0	4	40	60	100
6		Mobile device Management (Security and Forensics)	2	0	0	2	40	60	100
7		Mobile device Management (Security and Forensics) Lab	0	0	2	1	60	40	100
8		Mobile Application Development/ iPhone Operating System Basic lab	0	0	2	1	60	40	100
9		Data Communication & Networking Lab	0	0	2	1	60	40	100
10		Department Electives Lab-VI	0	0	2	1	60	40	100
11		Ability Enhancement Mandatery Course IV	2	0	0	2	40	60	Grade*
12		Industrial Training-I	0	0	4w	2	60	40	100
		Total	**19**	**0**	**8**	**25**	**580**	**620**	**1100**

B-Tech in Computer Science with Specialization in iOS & Mobile Application Development

Semester 6th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Compiler Design	3	0	0	3	40	60	100
2		Cyber Forensics and Investigations (New)	2	0	0	2	40	60	100
3		iCloud Security +iOS Development	2	0	0	2	40	60	100
4		Department Electives-VII	3	0	0	3	40	60	100
5		Department Electives-VIII	3	0	0	3	40	60	100
6		Open Elective-IV	4	0	0	4	40	60	100
7		Compiler Design Lab	0	0	2	1	60	40	100
8		Cyber Forensics and Investigations (New) Lab	0	0	2	1	60	40	100
9		iCloud Security +iOS Development Lab	0	0	2	1	60	40	100
10		Value Addition Course-III	2	0	0	2	40	60	100
		Total	**19**	**0**	**6**	**22**	**460**	**540**	**1000**

B-Tech in Computer Science with Specialization in iOS & Mobile Application Development

Semester 7th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Department Electives-IX	3	0	0	3	40	60	100
2		Embedded system and its biomedical applications	3	0	0	3	40	60	100
3		iPhone Operating System Practical Implementation Techniques	2	0	0	2	40	60	100
4		Department Electives Lab-IX	0	0	2	1	60	40	100
5		Department Electives-X	3	0	0	3	40	60	100
6		iPhone Operating System Practical Implementation Techniques Lab	0	0	2	1	60	40	100
7		Capstone Project	0	0	4	2	60	40	100
8		Industrial Training-II	0	0	6w	3	60	40	100
9		Value Addition Course-IV	2	0	0	2	40	60	100
		Total	**13**	**0**	**8**	**20**	**440**	**460**	**900**

B-Tech in Computer Science with Specialization in iOS & Mobile Application Development

Semester 8th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Internships and Placements	-	-	20W	**20**	100	100	200
		Total				**20**	100	100	200

B-Tech in Computer Science with Specialization in AI/ML

Semester 1st

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Applied Physics	3	0	0	3	40	60	100
2		Design Thinking	3	0	0	3	40	60	100
3		Computer Fundamental	3	0	0	3	40	60	100
4		Introduction to AI, Data Science, Ethics and Foundation of Data Analysis	2	0	0	2	40	60	100
5		Communication Skills-I	2	0	0	2	40	60	100
6		Object Oriented Programming	3	0	0	3	40	60	100
7		Value Addition Course-I	2	0	0	2	40	60	100
8		Computer Fundamental Lab	0	0	2	1	60	40	100
9		Object Oriented Programming Lab	0	0	2	1	60	40	100
10		Introduction to AI, Data Science, Ethics and Foundation of Data Analysis	0	0	2	1	60	40	100
11		Communication Skills-I Lab	0	0	2	1	60	40	100
12		Ability Enhancement Mandatory Course I	2	0	0	2	40	60	Grade*
		Total	**20**	**0**	**8**	**24**	**560**	**640**	**1100**

B-Tech in Computer Science with Specialization in AI/ML

Semester 2nd

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Applied Mathematics	3	0	0	3	40	60	100
2		Data Analysis using Python, Numpy, Pandas, Matplotlib, and Seaborn	2	0	0	2	40	60	100
3		Basics of Data Structure	3	0	0	3	40	60	100
4		Web Development	3	0	0	3	40	60	100
5		Computer Architecture	3	0	0	3	40	60	100
6		Data Analysis using Python, Numpy, Pandas, Matplotlib, and Seaborn Lab	0	0	2	1	60	40	100
7		Basics of Data Structure Lab	0	0	2	1	60	40	100
8		Web Development Lab	0	0	2	1	60	40	100
9		Engineering Graphics and Design Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatory Course II	2	0	0	2	40	60	Grade*
		Total	**16**	**0**	**8**	**20**	**480**	**520**	**900**

B-Tech in Computer Science with Specialization in AI/ML

Semester 3rd

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Operating System	3	0	0	3	40	60	100
2		Database Management Systems	3	0	0	3	40	60	100
3		Probabilistics Modeling and Reasoning with Python	2	0	0	2	40	60	100
4		R Programming for Data Science and Data Analysis	2	0	0	2	40	60	100
5		Open Elective-I	4	0	0	4	40	60	100
6		Operating System Lab	0	0	2	1	60	40	100
7		Database Management Systems Lab	0	0	2	1	60	40	100
8		Probabilistics Modeling and Reasoning with Python Lab	0	0	2	1	60	40	100
9		R Programming for Data Science and Data Analysis Lab	0	0	2	1	60	40	100
10		Industrial Internship	0	0	4w	2	60	40	100
11		Value Addition Course-II	2	0	0	2	40	60	100
12		Ability Enhancement Mandatory Course III	2	0	0	2	40	60	Grade*
		Total	**18**	**0**	**8**	**24**	**580**	**620**	**1100**

B-Tech in Computer Science with Specialization in AI/ML									
Semester 4th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	Total
1		Design and Analysis of Algorithm	3	0	0	3	40	60	100
2		Software Engineering	3	0	0	3	40	60	100
3		Department Electives-III	3	0	0	3	40	60	100
4		Machine Learning Practical with Python , Scikit-learn, matplotlib, TensorFlow	1	0	0	1	40	60	100
5		Machine Learning and Pattern Recognition	2	0	0	2	40	60	100
6		Open Elective-II	4	0	0	4	40	60	100
7		Design and Analysis of Algorithm Lab	0	0	2	1	60	40	100
8		Department Electives Lab-III	0	0	2	1	60	40	100
9		Machine Learning Practical with Python , Scikit-learn, matplotlib, TensorFlow Lab	0	0	2	1	60	40	100
10		Machine Learning and Pattern Recognition Lab	0	0	2	1	60	40	100
11		Research Methodology	3	0	0	3	40	60	100
		Total	**19**	**0**	**8**	**23**	**520**	**580**	**1100**

B-Tech in Computer Science with Specialization in AI/ML									
Semester 5th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	Total
1		Theory of Computation	3	0	0	3	40	60	100
2		Data Communication & Networking	3	0	0	3	40	60	100
3		Deep Learning Practical with Python, TensorFlow and Keras	1	0	0	1	40	60	100
4		Department Electives-VI	3	0	0	3	40	60	100
5		Open Elective-III	4	0	0	4	40	60	100
6		Neural Network and deep learning (Vision and NLP)	2	0	0	2	40	60	100
7		Neural Network and deep learning (Vision and NLP)	0	0	2	1	60	40	100
8		Deep Learning Practical with Python, TensorFlow and Keras lab	0	0	2	1	60	40	100
9		Data Communication & Networking Lab	0	0	2	1	60	40	100
10		Department Electives Lab-VI	0	0	2	1	60	40	100
11		Ability Enhancement Mandatory Course IV	2	0	0	2	40	60	Grade*
12		Industrial Training-I	0	0	4w	2	60	40	100
		Total	**18**	**0**	**8**	**24**	**580**	**620**	**1100**

B-Tech in Computer Science with Specialization in AI/ML

Semester 6th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Compiler Design	3	0	0	3	40	60	100
2		Data Science-Tools and Techniques	2	0	0	2	40	60	100
3		Natural Language Processing	2	0	0	2	40	60	100
4		Department Electives-VII	3	0	0	3	40	60	100
5		Department Electives-VIII	3	0	0	3	40	60	100
6		Open Elective-IV	4	0	0	4	40	60	100
7		Compiler Design Lab	0	0	2	1	60	40	100
8		Data Science-Tools and Techniques Lab	0	0	2	1	60	40	100
9		Natural Language Processing Lab	0	0	2	1	60	40	100
10		Value Addition Course-III	2	0	0	2	40	60	100
		Total	**19**	**0**	**6**	**22**	**460**	**540**	**1000**

B-Tech in Computer Science with Specialization in AI/ML

Semester 7th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Department Electives-IX	3	0	0	3	40	60	100
2		Data Visualization	2	0	0	2	40	60	100
3		DevOps for Web Development	2	0	0	2	40	60	100
4		Department Electives Lab-IX	0	0	2	1	60	40	100
5		Department Electives-X	3	0	0	3	40	60	100
6		Data Visualization Lab	0	0	2	1	60	40	100
7		DevOps for Web Development Lab	0	0	2	1	60	40	100
8		Capstone Project	0	0	4	2	60	40	100
9		Industrial Training-II	0	0	6w	3	60	40	100
10		Value Addition Course-IV	2	0	0	2	40	60	100
		Total	**12**	**0**	**10**	**20**	**500**	**500**	**1000**

B-Tech in Computer Science with Specialization in AI/ML

Semester 8th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Industrial Internship with	-	-	20W	**20**	100	100	200
		Total				**20**			

B-Tech Computer Science & Engineering									
Semester 1st									
S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Applied Physics	3	0	0	3	40	60	100
2		Design Thinking	3	0	0	3	40	60	100
3		Computer Fundamental	3	0	0	3	40	60	100
4		Communication Skills-I	2	0	0	2	40	60	100
5		Object Oriented Programming	3	0	0	3	40	60	100
6		Value Addition Course-I	2	0	0	2	40	60	100
7		Computer Fundamental Lab	0	0	2	1	60	40	100
8		Object Oriented Programming Lab	0	0	2	1	60	40	100
9		Communication Skills-I Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatery Course 1	2	0	0	2	40	60	Grade*
		Total	**18**	**0**	**6**	**21**	460	540	900

Score
90 marks and above
80 marks and above but less than 90 marks
70 marks and above but less than 80 marks
60 marks and above but less than 70 marks
50 marks to 60 marks
Below Minimum Pass marks

B-Tech Computer Science & Engineering									
Semester 2nd									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Applied Mathematics	3	0	0	3	40	60	100
2		Java Programming	2	0	0	2	40	60	100
3		Basics of Data Structure	3	0	0	3	40	60	100
4		Web Development	3	0	0	3	40	60	100
5		Computer Architecture	3	0	0	3	40	60	100
6		Java Programming Lab	0	0	4	2	60	40	100
7		Basics of Data Structure Lab	0	0	2	1	60	40	100
8		Web Development Lab	0	0	2	1	60	40	100
9		Engineering Graphics and Design Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatery Course II	2	0	0	2	40	60	Grade*
		Total	**16**	**0**	**10**	**21**	480	520	900

Score
90 marks and above
80 marks and above but less than 90 marks
70 marks and above but less than 80 marks
60 marks and above but less than 70 marks
50 marks to 60 marks
Below Minimum Pass marks

Note:-

1.4weeks mandatory Industrial Internship of 2 credits after completetion of 1st year.

2.One MOOC Course of atleat 8 weeks (4 credits) must be completed during First Year. The list of MOOC courses will be provided by the Departement to the students before commencement of the semester.

Exit Point

Certificate Course in Basics of Computer Science and Engineering.

Entry Point

Three years Diploma or One year Certificate Course in Basics of Computer Science and and in lieu of Industrial Internship of 4 weeks student has to complete MOOC Course of 4 weeks (2 Credits) in 3rd semester.

B-Tech Computer Science & Engineering									
Semester 3rd									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Operating System	3	0	0	3	40	60	100
2		Database Management Systems	3	0	0	3	40	60	100
3		Department Electives-I	3	0	0	3	40	60	100
4		Department Electives-II	3	0	0	3	40	60	100
5		Open Elective-I	4	0	0	4	40	60	100
6		Operating System Lab	0	0	2	1	60	40	100
7		Database Management Systems Lab	0	0	2	1	60	40	100
8		Department Electives Lab-I	0	0	2	1	60	40	100
9		Industrial Internship	0	0	4w	2	60	40	100
10		Value Addition Course-II	2	0	0	2	60	40	100
11		Ability Enhancement Mandatery Course III	2	0	0	2	40	60	Grade*
		Total	**20**	**0**	**6**	**25**	540	560	1000

B-Tech Computer Science & Engineering									
Semester 4th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Design and Analysis of Algorithm	3	0	0	3	40	60	100
2		Software Engineering	3	0	0	3	40	60	100
3		Department Electives-III	3	0	0	3	40	60	100
4		Department Electives-IV	3	0	0	3	40	60	100
5		Medical imaging techniques	3	0	0	3	40	60	100
6		Open Elective-II	4	0	0	4	40	60	100
7		Design and Analysis of Algorithm Lab	0	0	2	1	60	40	100
8		Department Electives Lab-III	0	0	2	1	60	40	100
9		Research Methodology	3	0	0	3	60	40	100
		Total	**22**	**0**	**4**	**24**	420	480	900

Note: -

1.6weeks mandatory Industrial Training-I of 3 credits after completetion of 2nd year.

2.One MOOC Course of atleat 8 weeks (4 credits) must be completed during Second Year. The list of MOOC courses will be provided by the Departement to the students before commencement of the semester.

3.Student can opt for any of the Open Elective subject outside from the Parent Institute leading to Holistic development of student. It may include Yoga, Dance, Fashion, Agriculture, Medicine, etc.

4.Hours for open elective may vary as per course but not credits.

5.The Department has liberty to vary Credits of Core CoursesLab but not for Department Electives Lab. The Department Elective Labs are significant. So, there hours not to be reduced.

6.Department Electives must be selected such that they should not have any year-wise dependency.

*2nd Year Core Courses along with 4 Department Elective Courses should make a capsule program with some specialization.

** Students entring directly in 2nd and 3rd year with Certifciate Course and Advanced Certification Course will be given Undergradute Diploma considering their credits of previous courses after successfully completion of 3rd year but the student need to submit his original previous certificate.

Exit Point

Advanced CertificationCourse in Computer Science and with minor specialization in_____________.

Entry Point

Advanced CertificationCourse in Computer Science and and in lieu of Industrial Training-I of 6 weeks student has to complete MOOC Course of atleast 6 weeks (3 Credits) in 5thsemester.

B-Tech Computer Science & Engineering									
Semester 5th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Theory of Computation	3	0	0	3	40	60	100
2		Data Communication & Networking	3	0	0	3	40	60	100
3		Department Electives-V	3	0	0	3	40	60	100
4		Department Electives-VI	3	0	0	3	40	60	100
5		Open Elective-III	4	0	0	4	40	60	100
6		Medical informatics	3	0	0	3	40	60	100
7		Data Communication & Networking Lab	0	0	2	1	60	40	100
8		Department Electives Lab-VI	0	0	2	1	60	40	100
9		Ability Enhancement Mandatery Course IV	2	0	0	2	40	60	Grade*
10		Industrial Training-I	0	0	4w	2	60	40	100
		Total	**21**	**0**	**4**	**25**	460	540	900

B-Tech Computer Science & Engineering									
Semester 6th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Compiler Design	3	0	0	3	40	60	100
2		Artificial Intelligence	3	0	0	3	40	60	100
3		Department Electives-VII	3	0	0	3	40	60	100
4		Department Electives-VIII	3	0	0	3	40	60	100
5		Open Elective-IV	4	0	0	4	40	60	100
6		Compiler Design Lab	0	0	2	1	60	40	100
7		Artificial Intelligence Lab	0	0	2	1	60	40	100
8		Value Addition Course-III	2	0	0	2	60	40	100
		Total	**18**	**0**	**4**	**20**	380	420	800

Note:-

1.6weeks mandatory Industrial Training-II of 3 credits after completetion of 1st year.

2.One MOOC Course of atleat 8 weeks (4 credits) must be completed during Third Year. The list of MOOC courses will be provided by the Departement to the students before commencement of the semester.

3.Student can opt for any of the Open Elective subject outside from the Parent Institute leading to Holistic Development of student. It may include Yoga, Dance, Fashion, Agriculture, Medicine, etc.

4.Hours for open elective may vary as per course but not credits.

5.The Department has liberty to vary Credits of Core CoursesLab but not for Department Electives Lab. The Department Elective Labs are significant. So, there hours not to be reduced.

6.Department Electives must be selected such that they should not have any year-wise dependency.

***3rd Year Core Courses along with 4 Department Elective Courses should make a capsule program with some specialization.**

Exit Point

Undergraduate Diploma in Computer Science and Engineering with specialization in_____________.

Entry Point

Undergraduate Diploma in Computer Science and and in lieu of Industrial Training of 6 weeks student has to complete MOOC Course of atleast6 weeks (3 Credits) in 7thsemester.

B-Tech Computer Science & Engineering									
Semester 7th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Department Electives-IX	3	0	0	3	40	60	100
2		Embedded system and its Biomedical applications	3	0	0	3	40	60	100
3		Department Electives-X	3	0	0	3	40	60	100
4		Department Electives Lab-IX	0	0	2	1	60	40	100
5		Capstone Project	0	0	4	2	60	40	100
6		Industrial Training-II	0	0	6w	3	60	40	100
7		Value Addition Course-IV	2	0	0	2	40	60	100
		Total	**11**	**0**	**6**	**17**	340	360	700

B-Tech Computer Science & Engineering									
Semester 8th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Industrial Internship with Project (Industrial oriented/Research oriented)	-	-	20W	**10**	100	100	200
		Total				**10**			

B-Tech M-Tech Computer Science & Engineering (Integrated)

Semester 1st

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Applied Physics	3	0	0	3	40	60	100
2		Design Thinking	3	0	0	3	40	60	100
3		Computer Fundamental	3	0	0	3	40	60	100
4		Communication Skills-I	2	0	0	2	40	60	100
5		Object Oriented Programming	3	0	0	3	40	60	100
6		Value Addition Course-I	2	0	0	2	40	60	100
7		Computer Fundamental Lab	0	0	2	1	60	40	100
8		Object Oriented Programming Lab	0	0	2	1	60	40	100
9		Communication Skills-I Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatory Course-I	2	0	0	2	40	60	Grade*
		Total	**18**	**0**	**6**	**21**	460	540	900

Score
90 marks and above
80 marks and above but less than 90 marks
70 marks and above but less than 80 marks
60 marks and above but less than 70 marks
50 marks to 60 marks
Below Minimum Pass marks

B-Tech M-Tech Computer Science & Engineering (Integrated)

Semester 2nd

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Applied Mathematics	3	0	0	3	40	60	100
2		Java Programming	2	0	0	2	40	60	100
3		Basics of Data Structure	3	0	0	3	40	60	100
4		Web Development	3	0	0	3	40	60	100
5		Computer Architecture	3	0	0	3	40	60	100
6		Java Programming Lab	0	0	4	2	60	40	100
7		Basics of Data Structure Lab	0	0	2	1	60	40	100
8		Web Development Lab	0	0	2	1	60	40	100
9		Engineering Graphics and Design Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatory Course II	2	0	0	2	40	60	Grade*
		Total	**16**	**0**	**10**	**21**	480	520	900

Score
90 marks and above
80 marks and above but less than 90 marks
70 marks and above but less than 80 marks
60 marks and above but less than 70 marks
50 marks to 60 marks
Below Minimum Pass marks

Note:-
1.4weeks mandatory Industrial Internship of 2 credits after completetion of 1st year.
2.One MOOC Course of atleat 8 weeks (4 credits) must be completed during First Year. The list of MOOC courses will be provided by the Departement to the students before commencement of the semester.

Exit Point
Certificate Course in Basics of Computer Science and Engineering.

Entry Point
Three years Diploma or One year Certificate Course in Basics of Computer Science and and in lieu of Industrial Internship of 4 weeks student has to complete MOOC Course of 4 weeks (2 Credits) in 3rd semester.

B-Tech M-Tech Computer Science & Engineering (Integrated)

Semester 3rd

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Operating System	3	0	0	3	40	60	100
2		Database Management Systems	3	0	0	3	40	60	100
3		Department Electives-I	3	0	0	3	40	60	100
4		Department Electives-II	3	0	0	3	40	60	100
5		Open Elective-I	4	0	0	4	40	60	100
6		Operating System Lab	0	0	2	1	60	40	100
7		Database Management Systems Lab	0	0	2	1	60	40	100
8		Department Electives Lab-I	0	0	2	1	60	40	100
9		Industrial Internship	0	0	4w	2	60	40	100
10		Value Addition Course-II	2	0	0	2	60	40	100
11		Ability Enhancement Mandatory Course III	2	0	0	2	40	60	Grade*
		Total	**20**	**0**	**6**	**25**	540	560	1000

Open Elective will be chosen from Multidisciplinary Generic Elective

B-Tech M-Tech Computer Science & Engineering (Integrated)

Semester 4th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Design and Analysis of Algorithm	3	0	0	3	40	60	100
2		Software Engineering	3	0	0	3	40	60	100
3		Department Electives-III	3	0	0	3	40	60	100
4		Department Electives-IV	3	0	0	3	40	60	100
5		Medical imaging techniques	3	0	0	3	40	60	100
6		Open Elective-II	4	0	0	4	40	60	100
7		Design and Analysis of Algorithm Lab	0	0	2	1	60	40	100
8		Department Electives Lab-III	0	0	2	1	60	40	100
9		Research Methodology	3	0	0	3	60	40	100
		Total	**22**	**0**	**4**	**24**	420	480	900

Note: -

1.6weeks mandatory Industrial Training-I of 3 credits after completetion of 2nd year.

2.One MOOC Course of atleat 8 weeks (4 credits) must be completed during Second Year. The list of MOOC courses will be provided by the Departement to the students before commencement of the semester.

3.Student can opt for any of the Open Elective subject outside from the Parent Institute leading to Holistic development of student. It may include Yoga, Dance, Fashion, Agriculture, Medicine, etc.

4.Hours for open elective may vary as per course but not credits.

5.The Department has liberty to vary Credits of Core CoursesLab but not for Department Electives Lab. The Department Elective Labs are significant. So, there hours not to be reduced.

6.Department Electives must be selected such that they should not have any year-wise dependency.

*2nd Year Core Courses along with 4 Department Elective Courses should make a capsule program with some specialization.

** Students entring directly in 2nd and 3rd year with Certifciate Course and Advanced Certification Course will be given Undergradute Diploma considering their credits of previous courses after successfully completion of 3rd year but the student need to submit his original previous certificate.

Exit Point

Advanced CertificationCourse in Computer Science and with minor specialization in_____________.

Entry Point

Advanced CertificationCourse in Computer Science and and in lieu of Industrial Training-I of 6 weeks student has to complete MOOC Course of atleast 6 weeks (3 Credits) in 5thsemester.

B-Tech M-Tech Computer Science & Engineering (Integrated)

Semester 5th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Theory of Computation	3	0	0	3	40	60	100
2		Data Communication & Networking	3	0	0	3	40	60	100
3		Department Electives-V	3	0	0	3	40	60	100
4		Department Electives-VI	3	0	0	3	40	60	100
5		Open Elective-III	4	0	0	4	40	60	100
6		Medical informatics	3	0	0	3	40	60	100
7		Data Communication & Networking Lab	0	0	2	1	60	40	100
8		Department Electives Lab-VI	0	0	2	1	60	40	100
9		Ability Enhancement Mandatory Course IV	2	0	0	2	40	60	Grade*
10		Industrial Training-I	0	0	4w	2	60	40	100
		Total	**21**	**0**	**4**	**25**	460	540	900

B-Tech M-Tech Computer Science & Engineering (Integrated)

Semester 6th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Compiler Design	3	0	0	3	40	60	100
2		Artificial Intelligence	3	0	0	3	40	60	100
3		Department Electives-VII	3	0	0	3	40	60	100
4		Department Electives-VIII	3	0	0	3	40	60	100
5		Open Elective-IV	4	0	0	4	40	60	100
6		Compiler Design Lab	0	0	2	1	60	40	100
7		Artificial Intelligence Lab	0	0	2	1	60	40	100
8		Value Addition Course-III	2	0	0	2	60	40	100
		Total	**18**	**0**	**4**	**20**	380	420	800

Note:-

1.6weeks mandatory Industrial Training-II of 3 credits after completetion of 1st year.

2.One MOOC Course of atleat 8 weeks (4 credits) must be completed during Third Year. The list of MOOC courses will be provided by the Departement to the students before commencement of the semester.

3.Student can opt for any of the Open Elective subject outside from the Parent Institute leading to Holistic Development of student. It may include Yoga, Dance, Fashion, Agriculture, Medicine, etc.

4.Hours for open elective may vary as per course but not credits.

5.The Department has liberty to vary Credits of Core CoursesLab but not for Department Electives Lab. The Department Elective Labs are significant. So, there hours not to be reduced.

6.Department Electives must be selected such that they should not have any year-wise dependency.

***3rd Year Core Courses along with 4 Department Elective Courses should make a capsule program with some specialization.**

Exit Point

Undergraduate Diploma in Computer Science and Engineering with specialization in_____________.

Entry Point

Undergraduate Diploma in Computer Science and and in lieu of Industrial Training of 6 weeks student has to complete MOOC Course of atleast6 weeks (3 Credits) in 7thsemester.

B-Tech M-Tech Computer Science & Engineering (Integrated)

Semester 7th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Department Electives-IX	3	0	0	3	40	60	100
2		Embedded system and its Biomedical Applications	3	0	0	3	40	60	100
3		Department Electives-X	3	0	0	3	40	60	100
4		Department Electives Lab-IX	0	0	2	1	40	60	100
5		Research Phase-1	-	-	-	10	60	40	100
6		Industrial Training-II	0	0	6w	3	60	40	100
7		Value Addition Course-IV	2	0	0	2	40	60	100
		Total	**11**	**0**	**2**	**25**	**320**	**380**	**700**

B-Tech M-Tech Computer Science & Engineering (Integrated)									
Semester 8th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Department Electives-XI	3	0	0	3	40	60	100
2		Department Electives-XII	3	0	0	3	40	60	100
3		IPR and Patenting	3	0	0	3	40	60	100
4		Research Phase-II	-	-	-	10	60	40	100
		Total	**9**	**0**	**0**	**19**	180	220	400

B-Tech M-Tech Computer Science & Engineering (Integrated)									
Semester 9th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1.		Distributed Computing	3	0	0	3	40	60	100
2.		AI & Soft Computing	3	0	0	3	40	60	100
3.		Department Electives-XIII	3	0	0	3	40	60	100
4.		Department Electives-XIV	3	0	0	3	40	60	100
5.		Department Electives-XV	3	0	0	3	40	60	100
6.		AI & Soft Computing Lab	0	0	4	2	60	40	100
7.		Department Electives Lab-XIII	0	0	2	1	60	40	100
8.		Department Electives Lab-XV	0	0	2	1	60	40	100
9.		Distributed Computing Lab	0	0	2	1	60	40	100
10.		Value Added Courses-V	2	0	0	2	40	60	100
		Total	**17**	**0**	**10**	**22**	**480**	**520**	**1000**

B-Tech M-Tech Computer Science & Engineering (Integrated)									
Semester 10th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1.		Dissertation	-	-	**20 W**	**20**	100	100	200

B-Tech Computer Science & Engineering (Research)									
Semester 1st									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Applied Physics	3	0	0	3	40	60	100
2		Design Thinking	3	0	0	3	40	60	100
3		Computer Fundamental	3	0	0	3	40	60	100
4		Communication Skills-I	2	0	0	2	40	60	100
5		Object Oriented Programming	3	0	0	3	40	60	100
6		Value Addition Course-I	2	0	0	2	40	60	100
7		Computer Fundamental Lab	0	0	2	1	60	40	100
8		Object Oriented Programming Lab	0	0	2	1	60	40	100
9		Communication Skills-I Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatory Course-I	2	0	0	2	40	60	Grade*
		Total	**18**	**0**	**6**	**21**	460	540	900

Score
90 marks and above
80 marks and above but less than 90 marks
70 marks and above but less than 80 marks
60 marks and above but less than 70 marks
50 marks to 60 marks
Below Minimum Pass marks

B-Tech Computer Science & Engineering (Research)

Semester 2nd

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Applied Mathematics	3	0	0	3	40	60	100
2		Java Programming	2	0	0	2	40	60	100
3		Basics of Data Structure	3	0	0	3	40	60	100
4		Web Development	3	0	0	3	40	60	100
5		Computer Architecture	3	0	0	3	40	60	100
6		Java Programming Lab	0	0	4	2	60	40	100
7		Basics of Data Structure Lab	0	0	2	1	60	40	100
8		Web Development Lab	0	0	2	1	60	40	100
9		Engineering Graphics and Design Lab	0	0	2	1	60	40	100
10		Ability Enhancement Mandatory Course II	2	0	0	2	40	60	Grade*
		Total	**16**	**0**	**10**	**21**	480	520	900

Score
90 marks and above
80 marks and above but less than 90 marks
70 marks and above but less than 80 marks
60 marks and above but less than 70 marks
50 marks to 60 marks
Below Minimum Pass marks

Note:-
1.4weeks mandatory Industrial Internship of 2 credits after completetion of 1st year.
2.One MOOC Course of atleat 8 weeks (4 credits) must be completed during First Year. The list of MOOC courses will be provided by the Departement to the students before commencement of the semester.

Exit Point
Certificate Course in Basics of Computer Science and Engineering.

Entry Point
Three years Diploma or One year Certificate Course in Basics of Computer Science and and in lieu of Industrial Internship of 4 weeks student has to complete MOOC Course of 4 weeks (2 Credits) in 3rd semester.

B-Tech Computer Science & Engineering (Research)									
Semester 3rd									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Operating System	3	0	0	3	40	60	100
2		Database Management Systems	3	0	0	3	40	60	100
3		Department Electives-I	3	0	0	3	40	60	100
4		Department Electives-II	3	0	0	3	40	60	100
5		Open Elective-I	4	0	0	4	40	60	100
6		Operating System Lab	0	0	2	1	60	40	100
7		Database Management Systems Lab	0	0	2	1	60	40	100
8		Department Electives Lab-I	0	0	2	1	60	40	100
9		Industrial Internship	0	0	4w	2	60	40	100
10		Value Addition Course-II	2	0	0	2	60	40	100
11		Ability Enhancement Mandatory Course III	2	0	0	2	40	60	Grade*
		Total	**20**	**0**	**6**	**25**	540	560	1000

Open Elective will be chosen from Multidisciplinary Generic Elective

B-Tech Computer Science & Engineering (Research)

Semester 4th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Design and Analysis of Algorithm	3	0	0	3	40	60	100
2		Software Engineering	3	0	0	3	40	60	100
3		Department Electives-III	3	0	0	3	40	60	100
4		Department Electives-IV	3	0	0	3	40	60	100
5		Medical imaging techniques	3	0	0	3	40	60	100
6		Open Elective-II	4	0	0	4	40	60	100
7		Design and Analysis of Algorithm Lab	0	0	2	1	60	40	100
8		Department Electives Lab-III	0	0	2	1	60	40	100
9		Research Methodology	3	0	0	3	60	40	100
		Total	**22**	**0**	**4**	**24**	420	480	900

Note: -

1.6weeks mandatory Industrial Training-I of 3 credits after completetion of 2nd year.

2.One MOOC Course of atleat 8 weeks (4 credits) must be completed during Second Year. The list of MOOC courses will be provided by the Departement to the students before commencement of the semester.

3.Student can opt for any of the Open Elective subject outside from the Parent Institute leading to Holistic development of student. It may include Yoga, Dance, Fashion, Agriculture, Medicine, etc.

4.Hours for open elective may vary as per course but not credits.

5.The Department has liberty to vary Credits of Core CoursesLab but not for Department Electives Lab. The Department Elective Labs are significant. So, there hours not to be reduced.

6.Department Electives must be selected such that they should not have any year-wise dependency.

*2nd Year Core Courses along with 4 Department Elective Courses should make a capsule program with some specialization.

** Students entring directly in 2nd and 3rd year with Certifciate Course and Advanced Certification Course will be given Undergradute Diploma considering their credits of previous courses after successfully completion of 3rd year but the student need to submit his original previous certificate.

Exit Point

Advanced CertificationCourse in Computer Science and with minor specialization in_____________.

Entry Point

Advanced CertificationCourse in Computer Science and and in lieu of Industrial Training-I of 6 weeks student has to complete MOOC Course of atleast 6 weeks (3 Credits) in 5thsemester.

B-Tech Computer Science & Engineering (Research)

Semester 5th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Theory of Computation	3	0	0	3	40	60	100
2		Data Communication & Networking	3	0	0	3	40	60	100
3		Department Electives-V	3	0	0	3	40	60	100
4		Department Electives-VI	3	0	0	3	40	60	100
5		Open Elective-III	4	0	0	4	40	60	100
6		Medical informatics	3	0	0	3	40	60	100
7		Data Communication & Networking Lab	0	0	2	1	60	40	100
8		Department Electives Lab-VI	0	0	2	1	60	40	100
9		Ability Enhancement Mandatory Course IV	2	0	0	2	40	60	Grade*
10		Industrial Training-I	0	0	4w	2	60	40	100
		Total	**21**	**0**	**4**	**25**	460	540	900

B-Tech Computer Science & Engineering (Research)

Semester 6th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Compiler Design	3	0	0	3	40	60	100
2		Artificial Intelligence	3	0	0	3	40	60	100
3		Department Electives-VII	3	0	0	3	40	60	100
4		Department Electives-VIII	3	0	0	3	40	60	100
5		Open Elective-IV	4	0	0	4	40	60	100
6		Compiler Design Lab	0	0	2	1	60	40	100
7		Artificial Intelligence Lab	0	0	2	1	60	40	100
8		Value Addition Course-III	2	0	0	2	60	40	100
		Total	**18**	**0**	**4**	**20**	380	420	800

Note:-

1.6weeks mandatory Industrial Training-II of 3 credits after completetion of 1st year.

2.One MOOC Course of atleat 8 weeks (4 credits) must be completed during Third Year. The list of MOOC courses will be provided by the Departement to the students before commencement of the semester.

3.Student can opt for any of the Open Elective subject outside from the Parent Institute leading to Holistic Development of student. It may include Yoga, Dance, Fashion, Agriculture, Medicine, etc.

4.Hours for open elective may vary as per course but not credits.

5.The Department has liberty to vary Credits of Core CoursesLab but not for Department Electives Lab. The Department Elective Labs are significant. So, there hours not to be reduced.

6.Department Electives must be selected such that they should not have any year-wise dependency.

***3rd Year Core Courses along with 4 Department Elective Courses should make a capsule program with some specialization.**

Exit Point

Undergraduate Diploma in Computer Science and Engineering with specialization in_____________.

Entry Point

Undergraduate Diploma in Computer Science and and in lieu of Industrial Training of 6 weeks student has to complete MOOC Course of atleast6 weeks (3 Credits) in 7thsemester.

B-Tech Computer Science & Engineering (Research)

Semester 7th

S. No.	Subject Code	Subject Name	L	T	P	C	Internal	External	Total
1		Department Electives-IX	3	0	0	3	40	60	100
2		Embedded system and its Biomedical Applications	3	0	0	3	40	60	100
3		Department Electives-X	3	0	0	3	40	60	100
4		Department Electives Lab-IX	0	0	2	1	40	60	100
5		Research Phase-1	-	-	-	10	60	40	100
6		Industrial Training-II	0	0	6w	3	60	40	100
7		Value Addition Course-IV	2	0	0	2	40	60	100
		Total	**11**	**0**	**2**	**25**	**320**	**380**	**700**

B-Tech Computer Science & Engineering (Research)									
Semester 8th									
S. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**	**Internal**	**External**	**Total**
1		Department Electives-XI	3	0	0	3	40	60	100
2		Department Electives-XII	3	0	0	3	40	60	100
3		IPR and Patenting	3	0	0	3	40	60	100
4		Research Phase-II	-	-	-	10	60	40	100
		Total	**9**	**0**	**0**	**19**	180	220	400

UNIVERSITY UMBRELLA (MULTIDISCIPLINARY GENERIC ELECTIVES)/ Open Elective

BATCH : 2021-22

										Theory		Theory (Internal)					Practical				Practical (Internal)							
Sr. No.	Faculty	Semester	Subject Code	Nomenclature	Theory/ Practical	L	T	P	Credits	Max	Pass	Midterm	Assignment	Professional Activities	Max	Pass	Demonstration/Presentation	Viva-voce	Max	Pass	Attendance	Project/Laboratory Work	Midterm	Conduct/Demonstration	Max	Pass	Overall Pass Marks	Scheme of Examinations (Theory+Internal +Practical+Oral/ Theory+Internal +Practical/ Theory+Practical
					ASSIGNED MARKS																							
1	Behavioural	Odd	MGEC01001	Basic Psychological Processes	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
2	Behavioural	Odd	MGEC01002	Personality and Behaviour	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
3	Behavioural	Odd	MGEC01003	Media Psychology	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
4	Behavioural	Odd	MGEC01004	Inclusive Education	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
5	Behavioural	Odd	MGEC01005	Childhood Communication Disorders	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
6	Education	Odd	MGEC01006	Understanding the Teaching-Learning Process	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
7	Fashion	Odd	MGEC01007	Fibre to Fabric	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
8	Fashion	Odd	MGEC01008	Cultural Studies & Traditional Embroidery	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
9	Engineering	Odd	MGEC01009	Automobile Engineering	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
10	Engineering	Odd	MGEC01010	Industrial Engineering	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
11	Engineering	Odd	MGEC01011	Total Quality Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
12	Engineering	Odd	MGEC01012	Water Trewatment & Supply System	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
13	Engineering	Odd	MGEC01013	Solid Waste Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
14	Engineering	Odd	MGEC01014	Environment Impact Assessment	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
15	Engineering	Odd	MGEC01015	Computer Fundamental	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
16	Engineering	Odd	MGEC01016	Cloud Computing	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
17	Engineering	Odd	MGEC01017	Software Engineering	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
18	Science	Odd	MGEC01018	Digital and Analog Electronic Circuit and Instrumentation	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
19	Science	Odd	MGEC01019	Analytical Methods in Chemistry	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
20	Science	Odd	MGEC01020	Molecules of Life	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
21	Science	Odd	MGEC01021	Operations Research	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
22	Science	Odd	MGEC01022	Economic Offences	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
23	Nursing	Odd	MGEC01023	A Basic Introduction to the Disaster Managemwent & Response	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
24	Nursing	Odd	MGEC01024	Ethics in Research	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
25	Nursing	Odd	MGEC01025	Paediatric First Aid Skills	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
26	Nursing	Odd	MGEC01026	Add for Effective Teaching	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
27	Nursing	Odd	MGEC01027	Fundamental of Home-Based Care	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
28	Hotel Management	Odd	MGEC01028	Food Production Foundation	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
29	Hotel Management	Odd	MGEC01029	Food and Beverage Service Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
30	Hotel Management	Odd	MGEC01030	Basic Bakery & Patisserie	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
31	Hotel Management	Odd	MGEC01031	Bar Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
32	Hotel Management	Odd	MGEC01032	Culinary Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
33	Management	Odd	MGEC01033	Customer Relationship Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
34	Management	Odd	MGEC01034	Management Concepts	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
35	Management	Odd	MGEC01035	Business Ethics	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
36	Management	Odd	MGEC01036	Sales and Distribution Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
37	Management	Odd	MGEC01037	Tax Law and Planning	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
38	Management	Odd	MGEC01038	Basics of Enterpreneurship Skills	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
39	Management	Odd	MGEC01039	Medical Terminology and Medical Record Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
40	Management	Odd	MGEC01040	Health Economics	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
41	Management	Odd	MGEC01041	Business Law	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal

42	Agricultural	Odd	MGEC01042	Agriculture Finance and Cooperation	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
43	Agricultural	Odd	MGEC01043	Geoinformatics, Nanotechnology and Precision Farming	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
44	Agricultural	Odd	MGEC01044	Production Technology for Vegetables and Spices	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
45	Law	Odd	MGEC01045	Juriprudence	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
46	Law	Odd	MGEC01046	Law of Crimes	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
47	Law	Odd	MGEC01047	Law of Torts	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
48	Law	Odd	MGEC01048	Salient Feature of Constitution	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
49	Law	Odd	MGEC01049	Law of Contracts	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
50	Mass Communication	Odd	MGEC01050	Contemporary Issues and Current Affairs	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
51	Mass Communication	Odd	MGEC01051	Digital Media	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
52	Mass Communication	Odd	MGEC01052	Content Writing &Scripting	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
53	Mass Communication	Odd	MGEC01053	Soft Skills	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
54	Pharmacy	Odd	MGEC01054	Pharmaceutical Microbiology	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
55	Pharmacy	Odd	MGEC01055	Pharmaceutical Juriprudence	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
56	Pharmacy	Odd	MGEC01056	Instrumental Methods of Analysis	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
57	Pharmacy	Odd	MGEC01057	Pharmaceutical (Prescription and Dosage Form)	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
58	Pharmacy	Odd	MGEC01058	Industrial Pharmacy	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
59	Naturopathy	Odd	MGEC01059	Yoga	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
60	Physiotherapy	Odd	MGEC01060	Physical Fitness	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
61	Physiotherapy	Odd	MGEC01061	Introduction to Rehabilitation	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
62	Ayurveda	Odd	MGEC01062	Concept of Rasayana Vajikarana (Rejuvenation Therapy)	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
63	Ayurveda	Odd	MGEC01063	Sootika Paricharya (Immediate Post-Natal Care in Ayurveda Way)	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
64	Allied	Odd	MGEC01064	Healthy Lifestyles and Nutrition	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
65	Allied	Odd	MGEC01065	Food Laws & Food Safety	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
66	Dental	Odd	MGEC01066	Dental Material Engineering	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
67	Behavioural	Even	MGEC02001	Anxiety & Stress Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
68	Behavioural	Even	MGEC02002	Happiness & Wellbeing	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
69	Behavioural	Even	MGEC02003	Technology & Disability	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
70	Behavioural	Even	MGEC02004	Paediatric Audiology	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal

71	Education	Even	MGEC02005	Professional Development of Teachers	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
72	Fashion	Even	MGEC02006	Introduction to Fashion Industry	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
73	Fashion	Even	MGEC02007	Fashion Marketing & Merchandising	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
74	Fashion	Even	MGEC02008	Socio-Psychological Aspect of Clothing	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
75	Engineering	Even	MGEC02009	Plant Layout and Material Handling	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
76	Engineering	Even	MGEC02010	Nanomaterials	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
77	Engineering	Even	MGEC02011	Biomaterials	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
78	Engineering	Even	MGEC02012	Air and Noise Pollution	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
79	Engineering	Even	MGEC02013	Natural Disaster Mitigation and Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
80	Engineering	Even	MGEC02014	Urban Water Resources Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
81	Engineering	Even	MGEC02015	Artificial Intelligence	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
82	Engineering	Even	MGEC02016	Software Project Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
83	Engineering	Even	MGEC02017	Information Security Fundamental	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
84	Science	Even	MGEC02018	Elements of Modern Physics	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
85	Science	Even	MGEC02019	Polymer Chemistry	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
86	Science	Even	MGEC02020	Numerical Methods	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
87	Science	Even	MGEC02021	Introduction to Biometry	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
88	Science	Even	MGEC02022	Forensic Psychology	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
89	Nursing	Even	MGEC02023	First Aid for Common Ailments	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
90	Nursing	Even	MGEC02024	Infection Control : Basics	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
91	Nursing	Even	MGEC02025	Child Development	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
92	Nursing	Even	MGEC02026	Substance Use : An Urgent Issue to Address	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
93	Nursing	Even	MGEC02027	Gender Based Violence : Global and Indian Scenario	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
94	Hotel Management	Even	MGEC02028	Front Office and Accommodation Operations	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
95	Hotel Management	Even	MGEC02029	Accounting Skills for Hospitality Industry	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
96	Hotel Management	Even	MGEC02030	French for Hotels	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
97	Hotel Management	Even	MGEC02031	Researching for Hospitality & Tourism Management with Project Work	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
98	Hotel Management	Even	MGEC02032	Retail Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
99	Management	Even	MGEC02033	Business Research Methods	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
100	Management	Even	MGEC02034	Export and Import Documentation	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
101	Management	Even	MGEC02035	Operations Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
102	Management	Even	MGEC02036	Human Resource Management and Marketing Management	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
103	Management	Even	MGEC02037	Health Economics	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
104	Agricultural	Even	MGEC02038	Soil and Water Conservation Engineering	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
105	Agricultural	Even	MGEC02039	Agricultural Microbiology	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
106	Agricultural	Even	MGEC02040	Production Technology for Ornamental Crops, MAP and Landscaping	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
107	Law	Even	MGEC02041	Competition Law	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
108	Law	Even	MGEC02042	Copyright Law	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
109	Law	Even	MGEC02043	Socio-Economic Offences	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
110	Law	Even	MGEC02044	Criminology, Penology and Victimology	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
111	Law	Even	MGEC02045	Environmental Law	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
112	Mass Communication	Even	MGEC02046	Basics of Radio	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
113	Mass Communication	Even	MGEC02047	Film Adhyan (Hinsi)	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
114	Mass Communication	Even	MGEC02048	Meida Lekhan (Hindi)	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
115	Mass Communication	Even	MGEC02049	Corporate Communication & Public Handling Skills	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
116	Pharmacy	Even	MGEC02050	Computer Applications in Pharmacy	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
117	Pharmacy	Even	MGEC02051	Medicinal Chemistry	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
118	Pharmacy	Even	MGEC02052	Herbal Drug Technology	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
119	Pharmacy	Even	MGEC02053	Social and Preventive Pharmacy	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal

120	Pharmacy	Even	MGEC02054	Pharmacovigilance	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
121	Naturopathy	Even	MGEC02055	Natural Health & Wellbeing	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
122	Physiotherapy	Even	MGEC02056	Holistic Wellbeing & Life Skills	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
123	Physiotherapy	Even	MGEC02057	Introduction to Ergonomics & Health Promotion	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
124	Ayurveda	Even	MGEC02058	Essentials of Medical Research Methodology	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
125	Ayurveda	Even	MGEC02059	Introcuctory Course to Ritushodhana (Seasonal Bio-Purification)	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
126	Ayurveda	Even	MGEC02060	Kriya Kapla Techniques (Local Procedures for Eyes and ENT)	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
127	Allied	Even	MGEC02061	Nutraceuticals and Health Foods	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
128	Allied	Even	MGEC02062	Sports Nutrition	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal
129	Dental	Even	MGEC02063	Biomedical Waste Sciences	Theory	4	0	0	4	60	24	20	10	10	40	16											40	Theory + Internal

UNIVERSITY UMBRELLA (ABILITY ENHANCEMENT COMPULSORY COURSES)

BATCH : 2021-22

										Theory		Theory (Internal)					Practical				Practical (Internal)							
Sr. No.	Faculty	Semester	Subject Code	Nomenclature	Theory/ Practical	L	T	P	Credits	Max	Pass	Midterm	Assignment	Professional Activities	Max	Pass	Demonstration/Presentation	Viva-voce	Max	Pass	Attendance	Project/Laboratory Work	Midterm	Conduct/Demonstration	Max	Pass	Overall Pass Marks	Scheme of Examinations (Theory+Internal +Practical+Oral/ Theory+Internal +Practical/ Theory+Practical
					ASSIGNED MARKS																							
1		Both	AECC01001	English/MIL	Theory	2	0	0	2	60	24	20	10	10	40	16											40	Theory + Internal
2		Both	AECC01002	Environmental Science	Theory	2	0	0	2	60	24	20	10	10	40	16											40	Theory + Internal
3		Both	AECC01003	Human Value & Ethics	Theory	2	0	0	2	60	24	20	10	10	40	16											40	Theory + Internal
4		Both	AECC01004	Soft Skills	Theory	2	0	0	2	60	24	20	10	10	40	16											40	Theory + Internal

UNIVERSITY UMBRELLA (VALUE ADDED/SKILL ENHANCEMENT COURSES)

BATCH : 2021-22

										Theory		Theory (Internal)					Practical				Practical (Internal)							
Sr. No.	Faculty	Semester	Subject Code	Nomenclature	Theory/ Practical	L	T	P	Credits	Max	Pass	Midterm	Assignment	Professional Activities	Max	Pass	Demonstration/Presentatio	Viva-voce	Max	Pass	Attendance	Project/Laboratory Work	Midterm	Conduct/Demonstration	Max	Pass	Overall Pass Marks	Scheme of Examinations (Theory+Internal +Practical+Oral/ Theory+Internal +Practical/ Theory+Practical
					ASSIGNED MARKS																							
1	Behavioural	Odd	VASE01001	Managing Student's Mental Health	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
2	Behavioural	Odd	VASE01002	Psychology of Love and Relationship	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
3	Behavioural	Odd	VASE01003	Peace Education	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
4	Behavioural	Odd	VASE01004	Psycho-Socio Issues of Special Children	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
5	Behavioural	Odd	VASE01005	Educational Audiology	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
6	Behavioural	Odd	VASE01006	Psychology of Speech	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
7	Education	Odd	VASE01007	Digital Tools in Education	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
8	Education	Odd	VASE01008	Education in the Era of Pandemic	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
9	Fashion	Odd	VASE01009	Basics of Drawings	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
10	Engineering	Odd	VASE01010	Introduction to MAT Lab	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
11	Engineering	Odd	VASE01011	Solid Waste Management	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
12	Engineering	Odd	VASE01012	Computer Network	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
13	Science	Odd	VASE01013	Cyber Security	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
14	Science	Odd	VASE01014	Occupational Health and Safety	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
15	Science	Odd	VASE01015	Scientivic Writing using LaTeX	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
16	Nursing	Odd	VASE01016	Adolescent Health and Counselling	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
17	Nursing	Odd	VASE01017	Compassionate, Respectful and Caring	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
18	Nursing	Odd	VASE01018	Good Parenting	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
19	Nursing	Odd	VASE01019	Child Abuse	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
20	Nursing	Odd	VASE01020	Fundamentals of Patient Safety	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
21	Hotel Management	Odd	VASE01021	Event Management	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
22	Managemewnt	Odd	VASE01022	Digital and Social Media Marketing	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
23	Managemewnt	Odd	VASE01023	Finance for Non-Finance Professionals	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
24	Managemewnt	Odd	VASE01024	Hsospital Infection Control	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
25	Agricultural	Odd	VASE01025	Agricultural Heritage	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
26	Agricultural	Odd	VASE01026	Mushroom Production	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
27	Agricultural	Odd	VASE01027	Organic Vegetable Production Technology	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
28	Agricultural	Odd	VASE01028	Intellectual Property Rights	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
29	Law	Odd	VASE01029	Competition Law and Policy	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
30	Law	Odd	VASE01030	Real Estate Laws	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
31	Mass Communication	Odd	VASE01031	Public Speaking	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
32	Mass Communication	Odd	VASE01032	Verbal Ability & Critical Reasoning	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
33	Mass Communication	Odd	VASE01033	Literature and Life	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
34	Pharmacy	Odd	VASE01034	Antimicrobinal Resistance	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
35	Pharmacy	Odd	VASE01035	Professional Code of Ethics in Pharmacy	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
36	Naturopathy	Odd	VASE01036	Yoga for Health and Wellness	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
37	Physiotherapy	Odd	VASE01037	Women Health	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
38	Physiotherapy	Odd	VASE01038	Exercise for Health Living	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
39	Ayurveda	Odd	VASE01039	Basics of Sanskrit Language	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
40	Allied	Odd	VASE01040	Basic Course in Biomedical Waste Management	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
41	Allied	Odd	VASE01041	Computer Application in Biology	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
42	Allied	Odd	VASE01042	Food Preservation Techniques	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
43	Allied	Odd	VASE01043	Hospital Patient Handling, Legal and Medical Issues	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
44	Allied	Odd	VASE01044	Introduction to Web Development	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal

45	Behavioural	Even	VASE02001	Behavioural Skills Training	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
46	Behavioural	Even	VASE02002	Social Anxiety	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
47	Behavioural	Even	VASE02003	Psychology of Gender	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
48	Behavioural	Even	VASE02004	Disability & Rehabilitation	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
49	Behavioural	Even	VASE02005	Applied Behaviour Analyses	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
50	Behavioural	Even	VASE02006	Psychology of Hearing	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
51	Behavioural	Even	VASE02007	Speech & Language Pathology	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
52	Education	Even	VASE02008	Life Long Learning	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
53	Education	Even	VASE02009	Virtual & Augmented Reality in Education	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
54	Fashion	Even	VASE02010	Influential Fashion	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
55	Engineering	Even	VASE02011	3D Painting	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
56	Engineering	Even	VASE02012	Natural Disaster Mitigation and Management	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
57	Engineering	Even	VASE02013	Computer Hardware and Troubleshooting	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
58	Science	Even	VASE02014	Handwriting and Personality	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
59	Science	Even	VASE02015	Science for Competition	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
60	Nursing	Even	VASE02016	HIV and Family Education	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
61	Nursing	Even	VASE02017	Health Workforce Training	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
62	Nursing	Even	VASE02018	Hi Impact Presentation and Teaching Skill	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
63	Nursing	Even	VASE02019	Cyberbullying : Rule to Stop	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
64	Nursing	Even	VASE02020	Professionalism	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
65	Hotel Management	Even	VASE02021	Entrepreneurship in Hotel Business	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
66	Management	Even	VASE02022	Motivation for Employee at Work	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
67	Management	Even	VASE02023	Basics of Entrepreneurship & Business Plan	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
68	Agricultural	Even	VASE02024	Protected Cultivation	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
69	Agricultural	Even	VASE02025	Landscaping	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
70	Agricultural	Even	VASE02026	Renewable Energy and Green Technology	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
71	Agricultural	Even	VASE02027	Principles of Orgtanic Farming	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
72	Law	Even	VASE02028	Intellectual Property Rights	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
73	Mass Communication	Even	VASE02029	Mobile Journalism	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
74	Mass Communication	Even	VASE02030	Art of Public Speaking & Presentation Skills	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
75	Mass Communication	Even	VASE02031	Cinematic Study and Indian Society	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
76	Pharmacy	Even	VASE02032	Impact of Chemical Hazards	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
77	Pharmacy	Even	VASE02033	Rational Use of Medicines	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
78	Naturopathy	Even	VASE02034	Self Management of Excessive Tension	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
79	Physiotherapy	Even	VASE02035	Introduction to Community Health & Fitness	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
80	Physiotherapy	Even	VASE02036	Geriatric Care	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
81	Allied	Even	VASE02037	Microbes in Everyday Life	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
82	Allied	Even	VASE02038	Basic Knowledge on Hospital Laboratories	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
83	Allied	Even	VASE02039	Vaccines and its Applications	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
84	Allied	Even	VASE02040	Nutrition and Wellnes	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
85	Allied	Even	VASE02041	Radiation Hazards and Protection	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal
86	Allied	Even	VASE02042	Medical Equipment Handling	Theory	2	0	0	2	30	12	10	5	5	20	8											20	Theory + Internal

Semester 1st

1. Name of the Department: Computer Science & Engineering						
2. Course Name	Applied Physics	**L**	**T**		**P**	
3. Course Code		3	0		0	
4. Type of Course (Category A)		**Core ()**	**ID (✓)**	**VAC ()**		
5. Type of Course (Category B)		**Compulsory()**	**DE()**	**BSC(✓)**	**EAS()**	**VAC()**
6. Pre-requisite (if any)	Intermediate courses	**7. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**		**Practical = 0**		

9. Course Description:

Engineering physics course provide an opportunity to students to learn fundamental concepts of physics and apply these concepts in today's rapidly changing and highly technical/engineering environment. This course also emphasizes the solid foundations of modern scientific principles.

10. Course Objectives:

1) To give students a basic exposure to Physics that will better prepare them for more rigorous courses that will be taken later on.
2) To make students learn and understand basic concepts and principles of physics to analyze practical engineering problems and apply its solutions effectively and meaningfully.

11. Course Outcomes (COs):

At the completion of this course, students will be able to:

1. Describe the behavior of and make predictions regarding the phenomena of the physical world.
2. Apply fundamental principles of physics to solve problems relating to waves, crystal structure, band theory of solids, quantum physics and special theory of relativity.
3. Understand the importance of record-keeping and have practiced its use during labs and/or lectures.

12. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Wave Optics**

Interference: Coherent sources, conditions for sustained interference. Division of Wave-Front - Fresnel’s Biprism, Division of Amplitude- Newton’s Rings, applications.

Diffraction: Difference between interference and diffraction, Fraunhofer and Fresnel diffraction. Fraunhofer diffraction through a single slit, Plane transmission diffraction grating, dispersive power and resolving power of grating.

Polarization: Polarized and unpolarized light, uniaxial crystal, double refraction, Nicol prism, Quarter and Half wave plates, Detection and production of different types of polarized light.

Unit - 2	**Number of lectures = 09**	**Title of the unit: Crystal Structure and Band theory of solids**

Crystal Structure: Space lattice, unit cell and translation vector, Miller indices, simple crystal structure, Bragg's law, defect in solids.

Free Electron Theory: Elements of classical free electron theory and its limitations. Drude's theory of conduction, quantum theory of free electrons, Fermi level, density of states, Fermi-Dirac distribution function.

Band Theory of solids: Origin of energy bands, Kroning-Penney model ,E-K diagrams, Brillouin zones, Concept of effective mass and holes, Classification of solids into metals, semiconductors and insulators, Hall effect and its applications.

Unit - 3	Number of lectures = 08	Title of the unit: Special Theory of Relativity Laser and Quantum Physics

Special Theory of Relativity: Postulates of special theory of relativity, Lorentz transformations. Consequences of LT (length contraction and time dilation). Variation of mass with velocity, Mass energy equivalence.

Quantum Physics: Inadequacies of classical physics, introduction to quantum mechanics-simple concepts, Black body radiations Discovery of Planck's constant, wave particle duality, phase velocity and group velocity. Schrodinger wave equations-time dependent and time independent, Expectation value, particle in a one-dimensional box.

Unit - 4	Number of lectures = 09	Title of the unit: LASER and Electromagnetic theory

LASER: Spontaneous and Stimulated emission, characteristics of laser beam, principle of laser, lasing action, three level laser, four level laser, He-Ne laser, applications.

Fiber Optics: Propagation of light in optical fibers, numerical aperture, V-number, single and multimode fibers, attenuation, dispersion, applications**.**

Electromagnetic theory: Gradient, divergence and curl, stokes theorem, gauss- divergence theorem, gauss law, faraday law, ampere circuital law, displacement current, Maxwell's equation.

13. Brief Description of self-learning / E-learning component

To understand basic concepts in detail, students may get study materials on following links.
https://onlinecourses.nptel.ac.in/noc18_ph02
https://ocw.mit.edu/courses/physics/

14. Books Recommended

Text Books:

1. Modern Physics for Engineers – S.P.Taneja (R. Chand)

Reference Books:

2. Engineering Physics – SatyaPrakash (PragatiPrakashan)
3. Modern Engineering Physics – A.S.Vasudeva (S. Chand)
4. Perspectives of Modern Physics - Arthur Beiser (TMH)
5. Optics - AjoyGhatak (TMH)
6. Fundamentals of Physics – Resnick & Halliday (Asian Book)
7. Introduction to Electrodynamics- David J. Griffiths (PEARSON)

Design Thinking

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Design Thinking**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE ()**	**BSC ()**	**OE ()**	**EAS (✓)**
5. Pre-requisite (if any)	**NA**	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		**Tutorials = 0**	**Practical = 0**			

8. Course Description

Design thinking is a systematic method of solving problems. This method is unique that it starts and ends with humans. The design thinkers start by observing, interviewing or just plain experiencing a situation. Then, they proceed to improve the situation of the humans by solving problems for them. This course familiarizes you with the concept of "innovation" and the journey of a design idea from the identification of a problem to a final solution that has a positive impact on a large community of users.

9. Learning Objectives:

1. To expose the student with state-of-the-art perspectives, ideas, concepts, and solutions related to the design and execution of innovation driven projects using design thinking principles.
2. To develop an advance innovation and growth mindset form of problem identification and reframing, foresight, hindsight and insight generation.
3. To prepare the mindset and discipline of systemic inspiration driven by an educated curiosity aimed find new sources of ideas, new connections and new models specially outside their regular operating atmosphere.
4. To propose a concrete, feasible, viable and relevant innovation project/challenge.

10. Course Outcomes (COs): The students will be able to: -

1. Understand the concepts of design thinking approaches.
2. Create design thinking teams and conduct design thinking sessions.
3. Apply both critical thinking and design thinking in parallel to solve problems.
4. Apply some design thinking concepts to their daily work.

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Introduction to Design Thinking**
What Is Design Thinking? Preparing Your Mind for Innovation, Empathize Phase: Customer Journey Mapping, Analyze Phase: 5-Whys and How might we..., Idea Generation, Free Brainstorming & Make/Test Phase: Prototype, Experimentation.		
Unit – 2	**Number of lectures = 10**	**Title of the unit: Innovation by Design**
The Seven Concerns, Design Thinking and Collaboration, Challenges to Innovation, Understanding Users, Arriving at Design Insights, Prototyping for User Feedback, The First C: The Cause, Crossing the first Pitfall, Trial and Error, User Feedback for Development, New users, New needs to meet, Knowing the Context.		
Unit – 3	**Number of lectures = 11**	**Title of the unit: Context, Comprehension, Check and Cause**
The Second C: The Context, The Basic Need, Ingenious Attempt, Further Insights, The Working Rig, Concepts Generation, Experiencing the Product, Refinements. The Third C: The Comprehension, Understanding Constraints, Positioning the Product, Exploring Possibilities, More Experiment, Understanding the Technology, At the 2nd Valley of Death, Finishing Touches. The Fourth C: The Check and Cause, the product, the Users and the Context, The Prototyping, User Needs, The Crucial Step Missed.		
Unit – 4	**Number of lectures = 11**	**Title of the unit: Conception, Crafting and Connection**

The Fifth C: The Conception, Synchronic Studies, One Product, many problems, Concept Clusters, From Idea to Product, Prototyping, Material and Technologies, Collaborative Efforts.
The Sixth C: The Crafting, Recap, The Manufacturing Challenge, The User Feedback, The Iterative Process.
The Seventh C: The Connection, The Seed for Innovation, Pinnacle for Innovation, The Innovation Timeline, The Innovation Champions, The Innovation Domain, The Innovation Template, The Serial Innovation.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E- Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

http://sgtlms.org

Journal papers; Patents in the respective field.

13. Books Recommended

Text Book

1. Innovation By Design by Chakravarthy, BattulaKalyana, and JanakiKrishnamoorthy, Springer India, 2013, ISBN 978-81-322-0901-0

Reference Books

2. Innovation by Design: How Any Organization Can Leverage Design Thinking to Produce Change, Drive New Ideas, and Deliver Meaningful Solutions by Thomas Lockwood, New Page Books, US; 1st edition (28 November 2017), ISBN: 1632651165.

3. Innovation by Design by Gerard Gaynor, Amacom, A Division of American Management Associ135 West 50th Street New York, NY, United States, ISBN:978-0-8144-0696-0

Computer Fundamental

1. Name of the Department: Computer Science & Engineering

2. Course Name	**Computer Fundamental**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (Category A)		**Core (✓)**	**ID ()**		**VAC ()**	
5. Type of Course (Category B)		**Compulsory(✓)**	**DE()**		**BSC()**	
6. Pre-requisite (if any)	Basic Knowledge of Computers	**7. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)

Lectures = 36	**Tutorials = 0**	**Practical = 0**

9. Brief Syllabus

The course of introductory computation and problem solving includes the approach to design an algorithm to solve a logical problem. The details of flow chart and the steps to create a flow chart are included in the course. C Programming language is included in the course.

10. Learning objectives:

1. To be able to develop the programs using C programming language.
2. To prepare the flow chart for any logical kind of problem.

11. Course Outcomes (COs):

At the completion of this course, students will be able to:

1. Design a flow chart for a problem to solve.
2. Develop live software projects using C programming languages.

12. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Introduction to Computer System**

An introduction of Computer System: Number System, Conversion: Base-2 to Base-n(3,4,5,6,7,8,9,10,11,12,13,14,15,16),Floating decimal no convert to base-n(2,3,4,5,6,7,8,9,10,11,12,13,14,15,16) Hex-Decimal no convert to base-n(2,4,8,32), Common Bus concept, Different Units of Computer System, Binary codes, ASCII, Processor, Memory- Primary, Secondary; Input-Output Devices; Storage Devices-Magnetic and Optical

Unit - 2	**Number of lectures = 9**	**Title of the unit: Computer programming/Networks**

Computer Programming/Networks: Program formats, header file, if- else statement, for statement, nested for, while statement, do While statement, Program concept: prime no, math function, conversion (number system), pattern, Computer Networks concepts, Network Topologies: Bus, Star, Ring, Hybrid, Tree, Complete, Irregular; Types of Networks: LAN, MAN and WAN.

Unit - 3	**Number of lectures = 9**	**Title of the unit: C Language: Basic**

Basics of 'C' Language

C Fundamentals, Basic data types, local and external variables and scope, operators; expressions, decision control structure, selection statements, loops control; case controls; functions, recursive functions, Structures, Unions.

Unit - 4	**Number of lectures = 8**	**Title of the unit: C Language: Advanced**

Advanced features of C Language: Pointers; Arrays Strings literals, arrays of strings, storage classes, type's qualifiers, Low level programming (Bitwise operators, Bit fields in structures, other low level techniques).

13. Brief Description of self-learning / E-learning component

14. Books Recommended (3 Text Books + 2-3 Reference Books)

TEXT BOOKS:

1. Fundamentals of Computers by P.K. Sinha, 7th Editions
2. Fundamentals of Computing and C Programming, R. B. Patel, Khanna Publications, 2010, New Delhi.

REFERENCE BOOKS:

1. The Complete Reference –PC Hardware by Craig Zacker and John Rourkee, TMH 2010
2. Let Us C by YashwantKanetkar , BPB Publications.11th Edition 2011
3. The C Programming Language by Dennis M Ritchie, Brian W. Kernigham, 1988, PHI.
4. Information technology, Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin, 1998, TMH
5. Theory and problem of programming with C, Byron C Gottfried, TMH

Entrepreneurship

1. Name of the Department: Management Studies						
2. Course Name	**Entrepreneurship**	**L(3)**	**T(0)**		**P(0)**	
3. Course Code						
4. Type of Course (Category A)		**Core ()**	**ID(✓)**		**VAC ()**	
5. Type of Course (Category B)		**Compulsory()**	**DE()**	**BSC()**		**EAS(✓)**
6. Pre-requisite (if any)	**Basic Business Studies knowledge**	**7. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**				

9. Brief Syllabus

Entrepreneurship Development is a challenging, applicable degree program that integrates management concepts in a technical and innovative setting as required by today's dynamic business environment. It develops graduates with relevant skills preparing students for entry into management careers in business, government, public, or social service organizations. Industry-trained faculty translates theory to practice; advising students through the diversity of the curriculum, project-based learning, and internships.

10. Learning objectives:

The objective of the course is to

1. To make the students aware of the importance of entrepreneurship opportunities available in the society for the entrepreneur.
2. Acquaint them with the challenges faced by the entrepreneur.

11. Course Outcomes (COs):

Upon completion of this course, graduates will be able to:

1. Explain the major concepts in the functional areas of accounting, marketing, finance, and management.
2. Evaluate the legal, social, and economic environments of business.
3. Describe the global environment of business.
4. Describe and explain the ethical obligations and responsibilities of business.
5. Apply decision-support tools to business decision making.

12. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Introduction: Entrepreneur**

Evolution, Characteristics, Types, Functions of Entrepreneur - Distinction between an Entrepreneur and a Manager, Concept, Growth of Entrepreneurship in India, Role of Entrepreneurship in Economic Development. Rural Entrepreneurship: Concept, Need, Problems, Rural Industrialization in Retrospect, How to Develop Rural Entrepreneurship, NGOs and Rural Entrepreneurship

Unit – 2	**Number of lectures = 8**	**Title of the unit: Women Entrepreneurship**

Concept, functions, Growth of Women Entrepreneurs, Problems, Development of Women Entrepreneurs Small Enterprises: Definition, Characteristics, Relationship between Small and Large Units, Rationale, Objectives, Scope, Opportunities for an Entrepreneurial Career, Role of small Enterprise in Economic development

Unit - 3	**Number of lectures = 8**	**Title of the unit: Project Identification And Selection (PIS)**

Meaning of Project, Project Identification, Project Selection, Project Formulation: Meaning, Significance, Contents, Formulation, Project Report, Specimen of a Project Report,		
Unit - 4	**Number of lectures = 10**	**Title of the unit: Financing of Enterprises**
Need for Financial Planning, Sources of finance, Capital Structure, Term-loan, Sources of Short-Term Finance, Capitalization, Financial Institutional, Commercial Banks, Other financial institutions		

13. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT ELearning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.

14. Books Recommended

Text Books

1. Roy Rajeev, Entrepreneurship Oxford Latest Edition
2. E. Gordon & K. Natarajan Entrepreneurship Development Himalaya 2008
3. Coulter Entrepreneurship in Action PHI 2nd Edition

Reference Books

1. P. C. Jain Handbook For New Entrepreneur Oxford Latest Edition
2. S. S. Khanka Entrepreneurial Development S. Chand Latest Edition
3. Thomas W. Zimmerer & Norman M. Scarborough Essentials of Entrepreneurship and small business management PHI 4th Edition
4. Dr. Vidya Hattangadi Entrepreneurship Himalaya 2007
5. Vasant Desai Small Scale Industries and Entrepreneurship Himalaya 2008
6. Dr. v. B. Angadi, Dr. H. S. Cheema & Dr. M. R. Das Entrepreneurship, Growth, and Economic IntegrationA linkage Himalaya 2009

Communication Skills-I

1. Name of the Department: Centre for Languages and Communication

2. Course Name	**Communication Skills-I**	**L**	**T**	**P**
3.Course Code		**2**	**0**	0

4.Type of Course (use tick mark)	**Core ()**	**HSC (✔)**	**PE ()**	**OE ()**

5.Pre-requisite (if any)	English at +2 level	**6.Frequency (use tick marks)**	Even ()	Odd (✔)	Either Sem ()	Every Sem ()

7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)

Lectures = 24	**Tutorials = 0**	**Practical = 0**

8.Brief Syllabus:

The aim of this course is to develop students' basic communication skills in the context that they will most need those skills: graduate school. Within the context of going abroad to present a paper on their graduate research, students will learn skills needed for traveling (e.g. asking for/giving directions, making reservations), negotiations, survey taking, and problem solving, as well as be introduced to skills involved in making a presentation at a conference. Additionally, students will learn to start and continue a conversation naturally, using a number of communication strategies such as asking follow-up questions and giving extended answers. They will also learn about turn taking and how to control the flow of a conversation by adding information. Finally, writing skills will be practiced with a short essay using the Online Homework Submission and Evaluation System.

9. Learning objectives:

1. To enhance the communication skills in a effective manner.
2. To develop communication skills as well as positive personality traits.
3. To enhance usage of English vocabulary and grammar.
4. To make students competent in professional and technical communication.

10.Course Outcomes (COs):

1. Able to communicate and expand the knowledge of communication.
2. Able to communicate in English confidently.
3. Able to improve pronunciation and accent.
4. Able to improve listening and speaking skills.
5. Able to improve reading and writing skills.

11.Unit wise course details:

Unit-1	**Number of lectures = 06**	**Title of the unit: Effective Communication**

Introduction to Communication, Importance of Communication, Process of communication, Barriers to communication and ways to overcome the barriers to communication, Interviews clipping followed by exercises.

Unit – 2	**Number of Lectures=06**	**Title of the unit: Conversation Skills**

Greetings and introducing oneself, framing questions and answers, Role play, buying: asking details etc. Word formation strategies, vocabulary building, One-word substitution, Antonyms, Synonyms, Homophones, Homonyms

Unit - 3	**Number of lectures = 06**	**Title of the unit: Reading Comprehension and Pronunciation**

Simple narration and Stories, Simple Passages, Newspaper unparticles clippings, Pronunciation: Syllable andStress.Sentences: Types, Tenses, Parts of speech, Articles, Phrasal verbs

Unit - 4	**Number of lectures = 06**	**Title of the unit: Listening and Writing Comprehension**

Types of Reading, Regular reading session: Newspaper, Articles, and Stories etc.
Correct the sentences, Letter Writing, Brief introduction to Types of Letter, Format of Letter, Précis Writing, Paragraph Writing, Report Writing, Difference between Report and Proposal

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal:

https://elearning.sgtuniversity.ac.in/general/

13. Books Recommended

Text Book:

1. **Communication Skills in English,** D. G. Saxena and KuntalTamang, Top Quark, 2011

Reference Books:

1. **Improve your Writing**, V.N. Arora, Lakshmi Chandra, Oxford University Press, New Delhi 2014
2. **Fluency In English II**, Promodini Varma, MuktiSanyal, OUP India 2006
3. **Complete Course in English**, Robert J. Dixson PHI Private Limited 2009
4. **Effective Technical Communication** M Asharaf Rizvi Tata McGraw Hill Education Private Limited 2005
5. **English Grammar in Context**, R K Agnihotri and A L Khanna RatnaSagar 1996
6. **Professional Communication**, Malti Agrawal Krishna Educational Publishers 2013

Object Oriented Programming

<table>
<tr><td colspan="7">1. Name of the Department: - Computer Science Engineering</td></tr>
<tr><td>2. Course Name</td><td>Object Oriented Programming</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (Category A)</td><td>Core (✓)</td><td colspan="2">ID()</td><td colspan="2">VAC ()</td></tr>
<tr><td colspan="2">5. Type of Course (Category B)</td><td>Compulsory(✓)</td><td colspan="2">DE()</td><td colspan="2">BSC()</td></tr>
<tr><td>6. Pre-requisite (if any)</td><td>C</td><td>7. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (□)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">9. Course Description</td></tr>
<tr><td colspan="7">Students learn how to write programs in an object-oriented high level programming language. Topics covered include problem solving, programming concepts, classes and methods, control structures, arrays, and strings.</td></tr>
<tr><td colspan="7">10. Learning Objectives:
1. To Know the Basics of Programming
2. To understand how to use programming in day to day applications.</td></tr>
<tr><td colspan="7">11. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">1. Knowledge of programming language.
2. Be aware about OOP's concept.
3. Basic understanding on programming.</td></tr>
<tr><td colspan="7">12. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction: Object oriented programming, characteristics of object orientated languages, classes,
C++ basics: Program Statements, Variables and constants, Loops and Decisions.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Functions: Defining a function, function arguments & passing by value, arrays & pointers, function & strings, functions & structures.
Classes & Objects: Defining class, class constructors and destructors, operator overloading.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Class Inheritance: Derived class & base class; Virtual, Friends and Static functions; Inheritance and its types, Polymorphism.
Exception Handling: Try Throw, Catch, Throwing an Exception, Catching an Exception.</td></tr>
<tr><td>Unit – 4</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Function Templates, Overloading Template Functions, Class Template, Class Templates and Non- Type Parameters, Templates and Inheritance, Templates and Friends, Templates and Static Members.
Input/output files: Streams, buffers & iostreams, header files, redirection, file input and output</td></tr>
</table>

13. **Brief Description of self-learning / E-learning component**

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/Journal
papers; Patents in the respective field.

14. **Books Recommended**

Text books:

1. Object Oriented Programming with C++ by E Balagurusamy, 2001, Tata McGraw- Hill, New Delhi.

Reference books:

1. Object Oriented Programming in Turbo C+ + by Robert Lafore, PearsonEducation, NewDelhi.
2. The Complete Reference in C++ by Herbert Schildt, 2002, TMH, NewDelhi.
3. Object Oriented Programming Using C++ by Kamthane, Pearson Education,New Delhi.
4. C + + How to Program by H M Deitel and P J Deitel, 1998, Prentice Hall, India,New Delhi.

Computer Fundamentals Lab

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Computer Fundamentals Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (Category A)</td><td>Core (✓)</td><td colspan="2">ID()</td><td colspan="2">VAC ()</td></tr>
<tr><td colspan="2">5. Type of Course (Category B)</td><td>Compulsory(✓)</td><td colspan="2">DE()</td><td colspan="2">BSC()</td></tr>
<tr><td>6. Pre-requisite (if any)</td><td></td><td>7. Frequency (use tick marks)</td><td>Even</td><td>Odd (□)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
</table>

9. Course Description

10. Learning objectives:

1. To understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
2. To understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
3. To have the ability to write a computer program to solve specified problems

11. Course Outcomes (COs):

1. Understand the features of C++ supporting object oriented programming
2. Understand the relative merits of C++ as an object oriented programming language
3. Understand the features of C++ supporting object oriented programming
4. Understand the relatives merits of C++ as an object oriented programming language

12. List of Experiments

Sr. No.	Title
1	Assembly and disassembly of a Desktop Computer with connections.
2	Operating System Installation-Formatting, Partitioning
3	Additional Hardware Installation like printer, mobile, scanner.
4	Application Software Installation-MS Office and CD/DVD Writing
5	To connect two PC's using the interconnecting devices and transfer the data between them.
6	To study various connections and ports used in computer communication. PS/2 port and its specification, VGA Port and its specification, Serial port and its specification and applications, Parallel Ports and its specification, USB Port and its specification, RJ45 connector, DVI Monitor port.
7	To study various cards used in a Computer System. (Ethernet Card, Sound Card, Video/Graphics Card, Network Interface card ,TV Tuner Card, Accelerator card)
8	Write a program to find the largest of three numbers. (if-then-else)
9	Write a program to find the largest number out of ten numbers (for-statement)
10	Write a program to find roots of quadratic equation using functions and switch statements.
11	Write a program using arrays to find the largest and second largest no. out of given 50 nos.
12	Write a program to multiply two matrices.
13	Write a program to check that the input string is a palindrome or not.
14	Write a program to concatenate two strings.
15	Write a program which manipulates structures (write, read, and update records).
16	Write a program which creates a file and writes into it supplied input.

Object Oriented Programming Lab

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Object Oriented Programming Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (Category A)</td><td>Core (✓)</td><td colspan="2">ID()</td><td colspan="2">VAC ()</td></tr>
<tr><td colspan="2">5. Type of Course (Category B)</td><td>Compulsory(✓)</td><td colspan="2">DE()</td><td colspan="2">BSC()</td></tr>
<tr><td>6. Pre-requisite (if any)</td><td></td><td>7. Frequency (use tick marks)</td><td>Even</td><td>Odd (□)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 48</td></tr>
<tr><td colspan="7">9. Course Description</td></tr>
<tr><td colspan="7">10. Learning objectives:
1. To understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
2. To understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
3. To have the ability to write a computer program to solve specified problems</td></tr>
<tr><td colspan="7">11. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">1. Understand the features of C++ supporting object oriented programming
2. Understand the relative merits of C++ as an object oriented programming language
3. Understand the features of C++ supporting object oriented programming
4. Understand the relatives merits of C++ as an object oriented programming language</td></tr>
<tr><td colspan="7">12. List of Experiments</td></tr>
<tr><td colspan="7">1. Simple C++ programs to implement various control structures.
a. if statement
b. switch case statement and do while loop
c. for loop
d. while loop
2. Programs to understand structure &unions.
a. structure
b. union
3. Programs to understand pointer arithmetic.
4. Functions &Recursion.
a. recursion
b. function
5. Inline functions.
6. Programs to understand different function call mechanism.
a. call by reference
b. call by value
7. Programs to understand storage specifiers.
8. Constructors &destructors.
9. Use of –this pointer using class
10. Programs to implement inheritance and function overriding.</td></tr>
</table>

a. multiple inheritance access Specifiers
b. hierarchical inheritance – function overriding / virtual Function

11. Programs to overload unary & binary operators as member function &non member function.
    a. unary operator as member function
    b. binary operator as non member function

12. Programs to understand friend function & friend Class.

Communication Skills-I Lab

1. Name of the Department: Centre for Languages and Communication						
2. Course Name	**Communication Skills-I Lab**	**L (0)**	**T (0)**		**P (2)**	
3. Course Code						
4. Type of Course (use tick mark)		**Core (✓)**	**EAS ()**		**HSMC ()**	
5. Pre-requisite (if any)	English at +2 level	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 24**			

8.Brief Syllabus:

The aim of this course is to develop students' basic communication skills in the context that they will most need those skills: graduate school. Within the context of going abroad to present a paper on their graduate research, students will learn skills needed for traveling (e.g. asking for/giving directions, making reservations), negotiations, survey taking, and problem solving, as well as be introduced to skills involved in making a presentation at a conference. Additionally, students will learn to start and continue a conversation naturally, using a number of communication strategies such as asking follow-up questions and giving extended answers. They will also learn about turn taking and how to control the flow of a conversation by adding information. Finally, writing skills will be practiced with a short essay using the Online Homework Submission and Evaluation System.

9. Learning objectives:

1. To enhance usage of English vocabulary and grammar
2. To develop communication skills as well as positive personality traits
3. To make students competent in professional and technical communication

10. Course Outcomes (COs):

1. Students will be able to improve their listening skills
2. They will be able to communicate in English confidently
3. Their pronunciation and accent will be improved
4. Their writing skills will be enhance

11. Lab Components

Sr. No.	Title	CO covered
Module 1	Meeting People, My Family, Asking Questions, and Colors around you, Holiday Gateways, Home Sweet Home, It's my Life, Food for Thought, Making Friends, Buying Things, At The Park, Who's This? Home Improvement, The Calendar, Time Gone By, Know your Planet, What Did you do? Going Places, Do's and Don'ts, Parts of the Body, Better than the Best, Leisure Time, A Look into The Future, How do you Feel?	I & ii
Module 2	Introduction to Consonant Sounds, Sounds in the English Language, Vowel Sounds, Pronunciation and Voice Modulation, Pronunciation & Voice Modulation, Tenses, Apply for learning, Active Listening, News Report one, E-Mail Etiquette,	ii & iv

	Effective Writing.		
Module 3	Pronunciation, Intonation, Modulation, Consonant sounds, Vowel Sounds, Syllable, Syllable Stress, Pronunciation Grammar (Adjective), Pronunciation Grammar (Prepositions), Pronunciation Grammar (Subject Verb Agreement), Pronunciation Grammar (The Simple Present Tense, Present Continuous Tense), Pronunciation Grammar (The Simple Past Tense), Pronunciation Grammar(The Simple Future Tense)	iii	

Universal Human Values

1. **Name of the Department:** Management Studies							
2. **Course Name**	**Universal Human Values**	**L**		**T**		**P**	
3. **Course Code**		**2**		**0**		**0**	
4. **Type of Course (Category A)**		**Core ()**		**ID (✓)**		**VAC ()**	
5. **Type of Course (Category B)**		**Compulsory()**	**DE ()**	**BSC()**		**MC(✓)**	
6. **Pre-requisite (if any)**	Basic Knowledge of Human Values	7. **Frequency (use tick marks)**		Even ()	Odd (✓)	Either Sem ()	Every Sem ()
8. **Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)**							
Lectures =24		**Tutorials = 0**		**Practical = 0**			

9. Brief Syllabus

Introduction to Value Education, Harmony in the Human Being, Harmony in the Family and Society and Harmony in the Nature, Social Ethics

10. Learning objectives:

The objective of this course is to:

1. To assist students in understanding the differences between values and skills, and in understanding the need, basic guidelines, content and the process of value education.
2. To help students initiate a process of dialog within themselves to understand what they 'really want to be' in their lives and professions
3. To help students understand the meaning of happiness and prosperity for human beings.
4. To help students understand harmony at all the levels of human living and to lead an ethical life.

11. Course Outcomes (COs):

On completion of this course, the students will be able to

1. Understand the significance of value inputs in a classroom and start applying them in their life and profession
2. Distinguish between values and skills, happiness and accumulation of physical facilities, the Self and the Body, Intention and Competence of an individual, etc.
3. Understand the value of harmonious relationships based on trust and respect in their life and profession
4. Understand the role of a human being in ensuring harmony in society and nature.
5. Distinguish between ethical and unethical practices, and start identifying a strategy to actualize a harmonious environment wherever they work.

12. Unit wise detailed content

Unit-1	**Number of lectures = 6**	**Title of the unit: Introduction to Value Education**
Value Education, Definition, Concept and Need for Value Education, The Content and Process of Value Education, Basic Guidelines for Value Education, Self exploration as a means of Value Education, Happiness and Prosperity as parts of Value Education.		
Unit – 2	**Number of lectures =**	**Title of the unit: Harmony in the Human Being**

	7	
Human Being is more than just the Body, Harmony of the Self ('I') with the Body, Understanding Myself as Co-existence of the Self and the Body, Understanding Needs of the Self and the needs of the Body, Understanding the activities in the Self and the activities in the Body.		
Unit – 3	**Number of lectures = 6**	**Title of the unit: Harmony in the Family and Society and Harmony in the Nature**
Family as a basic unit of Human Interaction and Values in Relationships, The Basics for Respect and today's Crisis: Affection, e, Guidance, Reverence, Glory, Gratitude and Love, Comprehensive Human Goal: The Five Dimensions of Human Endeavour, Harmony in Nature: The Four Orders in Nature, The Holistic Perception of Harmony in Existence.		
Unit – 4	**Number of lectures = 5**	**Title of the unit: Social Ethics**
The Basics for Ethical Human Conduct, Defects in Ethical Human Conduct, Holistic Alternative and Universal Order, Universal Human Order and Ethical Conduct, Human Rights violation and Social Disparities.		

13. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/

Journal papers; Patents in the respective field.

14. Books Recommended

TEXT BOOKS

1.A.N Tripathy, New Age International Publishers.
2.Bajpai. B. L , , New Royal Book Co, Lucknow, Reprinted.
3.Bertrand Russell Human Society in Ethics & Politics

REFERENCE BOOKS

1.Corliss Lamont, Philosophy of Humanism
2.Gaur. R.R. , Sangal. R, Bagaria. G.P, A Foundation Course in Value Education, Excel Books.
3.Gaur. R.R. , Sangal. R , Bagaria. G.P, Teachers Manual Excel Books.

Semester 2nd

Applied Mathematics

1. Name of the Department- Computer Science & Engineering							
2. Course Name	**Applied Mathematics**	**L**	**T**		**P**		
3. Course Code		**3**	**0**		**0**		
4. Type of Course (Category A)		**Core ()**	**ID (✓)**		**VAC ()**		
5. Type of Course (Category B)		**Compulsory()**	**DE()**		**BSC(✓)**		
6. Pre-requisite (if any)	+2 math	**7. Frequency (use tick marks)**	Even (□)	Odd ()	Either Sem()	Every Sem ()	
8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)							
Lectures = 36		**Tutorials = 0**	**Practical = 0**				
9. Course Description							
Introduction to applied mathematics and their applications like differential equations, matrix and set theory, recursive programming, multiple integrations and Laplace transform be the tool for solving the real life problems in engineering & sciences. Enhance and develop the ability of using the language of mathematics in analyzing the real world problems of sciences and engineering.							
10. Learning Objectives: **1.** To provide basic and theoretical competencies that is majorly used in Computer Science. To help students understand and appreciate the basic mathematical knowledge which is fundamental to Computer Science. **2.** To aware students about computer, its functions and utilities. **3.** To promote the development of computer-related skills for immediate application to other curricular areas. **4.** To provide a foundation for post- secondary education. **5.** To facilitate the development and application of problem-solving skills in students.							
11. Course Outcomes (COs):							
The students will be able to: - **1.** Derive mathematical models of physical systems. **2.** Solve differential equations using appropriate methods. **3.** Present mathematical solutions in a concise and informative manner. **4.** Solve linear system of equations by direct, iterative methods and determine eigen values and eigen vectors of given square matrix also inverse of the matrix using Cayley Hamilton theorem.							
12. Unit wise detailed content							
Unit-1	**Number of lectures = 9**	Matrices					
Matrices, additions and scalar multiplication, matrix multiplication; Linear system of equations, rank of a matrix, determinants, inverse of matrix, Gauss elimination and Gauss Jordan Methods, E-row methods. Caley Hamilton theorem, Eigen value &eigen vector.							
Unit – 2	**Number of lectures = 9**	Laplace Transforms& application					
Laplace transform & inverse Laplace transform: Solution based on Definition, change of scale property, 1^{st}& 2^{nd} shifting Theorem, LT division by t, LT of the derivative, LT by multiplication by t, Convolution th. And application on LT & Inverse LT.							
Unit – 3	**Number of lectures = 9**	Calculus					

Taylor & Maclaurin series for one and two variables (without proof),Partial derivative, Multiple integral: change of order of integration, Double integration in Cartesian & polar form. Triple integration & Beta and Gamma function.		
Unit – 4	**Number of lectures = 9**	Differential equation & its application
Exact differentia equation, Application of DE of first order and first degree to simple electric circuits, Linear differential equation of 2nd and higher order., Method of variation, Cauchy's and Lagrendre's linear equations, Application of linear differential equations to electric circuits.		

13. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

14. Books Recommended

Text Books

- N. P. Bali and Manish Goyal, A text book of engineering mathematics, Laxmi publication, 2010

Reference Books

- H.K.Dass, A text book of engineering mathematics, S.Chand& Company LTD
- B.S.Grewal, A text book of engineering mathematics, Khanna publication.
- Elements of Engineering Mathematics, Liu, Tata Mac Graw Hills.
- Kolman B, Busby R.C. and Ross S., Engineering Mathematical Structures for Computer Science, Fifth Edition, Prentice Hall of India, New Delhi, 2006.

JAVA Programming

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2.Course Name</td><td>JAVA Programming</td><td>L</td><td colspan="2">T</td><td colspan="3">P</td></tr>
<tr><td>3.Course Code</td><td></td><td>2</td><td colspan="2">0</td><td colspan="3">0</td></tr>
<tr><td colspan="2">4.Type of Course (Category A)</td><td>Core (✓)</td><td colspan="2">ID ()</td><td colspan="3">VAC ()</td></tr>
<tr><td colspan="2">5. Type of Course (Category B)</td><td>Compulsory(✓)</td><td colspan="2">DE()</td><td colspan="3">BSC()</td></tr>
<tr><td>6. Pre-requisite (if any)</td><td>Basic knowledge of programming language e.g. C programming knowledge</td><td>7. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td colspan="2">Every Sem ()</td></tr>
<tr><td colspan="8">8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 24</td><td>Tutorials = 0</td><td colspan="5">Practical =0</td></tr>
<tr><td colspan="8">9. Course Description</td></tr>
<tr><td colspan="8">The revolution in IT (Information Technology) is possible due to evolution of programming languages over the time. With the time, the programming languages become simpler, object oriented, robust and secure to use. Java is one of the programming language that imbibes all the above mentioned features and also, it is used to develop mobile, desktop GUI, web-based, cloud computing applications. This course aims to cover the core concept of the java programming language.</td></tr>
<tr><td colspan="8">10.Learningobjectives:
1. To create, debug and run simple java programs in java SDK environment.
2. To understand the fundamentals of object-oriented programming in java, which includes the definition of classes, methods and use of java libraries.
3. To understand the application of java programming language in different technologies.</td></tr>
<tr><td colspan="8">11. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">1. Understanding the structure and model of the java programming language.</td></tr>
<tr><td colspan="8">2. Using java programming language to develop various applications.</td></tr>
<tr><td colspan="8">3. Develop software using java programming language.</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">12. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 10</td><td colspan="6"></td></tr>
</table>

Importance and features of Java: Language Construct of java including Keywords, constants, Programming language Types and Paradigms, Computer Programming Hierarchy, How Computer Architecture Affects a Language? Why Java? Flavors of Java, Java Designing Goal, Role of Java Programmer in Industry, Features of Java Language, JVM –The heart of Java, Java Magic Bytecode. Installing Java, Java Program Development, Java Source File Structure, Compilation, Executions Lexical Tokens, Identifiers, Keywords, Literals, Comments, Primitive Datatypes, Operators Assignments.

Introducing classes, objects and methods: defining Class Fundamentals, Object & Object reference, Object Life time & Garbage Collection, Creating and Operating Objects, Constructor & initialization code block, Access Control, Modifiers, methods Nested , Inner Class &Anonymous Classes ,Abstract Class & Interfaces Defining Methods, Argument Passing Mechanism , Method Overloading, Recursion, Dealing with Static Members, Finalize() Method, Native Method. Use of –this– reference, Use of Modifiers with Classes & Methods, Design of Accessors and Mutator Methods Cloning Objects, shallow and deep cloning, Generic Class Types.

Unit – 2	**Number of lectures = 4**	

Extending Classes and Inheritance : Use and Benefits of Inheritance in OOP, Types of Inheritance in Java, Inheriting Data members and Methods, Role of Constructors in inheritance, Overriding Super Class Methods, Use of –super‖, Polymorphism in inheritance, Type Compatibility and Conversion Implementing interfaces.

Unit – 3	**Number of lectures = 6**	

Exception Handling: The Idea behind Exception, Exceptions & Errors, Types of Exception, Control Flow In Exceptions, JVM reaction to Exceptions, Use of try, catch, finally, throw, throws in Exception Handling, In-built and User Defined Exceptions, Checked and Un- Checked Exceptions.

Package: Organizing Classes and Interfaces in Packages, Package as Access Protection , Defining Package ,CLASSPATH Setting for Packages , Making JAR Files for Library Packages Import and Static Import Naming Convention For Packages.

Unit – 4	**Number of lectures = 4**	

Array & String: Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array, Operation on String, Mutable & Immutable String, Using Collection Bases Loop for String, Tokenizing a String, Creating Strings using String Buffer.

A Collection of Useful Classes: Utility Methods for Arrays ,Observable and Observer Objects , Date & Times ,Using Scanner Regular Expression, Input/output Operation in Java(java.io Package),Streams and the new I/O Capabilities ,Understanding Streams, The Classes for Input and Output, The Standard Streams, Working with File Object, File I/O Basics, Reading and Writing to Files, Buffer and Buffer Management, Read/Write Operations with File Channel, Serializing Objects .

13. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/

14. Books Recommended

Text Books

I. Java, Herbert Schildt. "The Complete Reference." Complete Reference Series)10th Edition| New York: McGraw-Hill Education(2017).

Reference Books

1. **SAMANTA, DEBASIS. Object-oriented Programming with C++ and Java. PHILearning Pvt. Ltd.,2006.**
2. **https://cse.iitkgp.ac.in/~dsamanta/java/index.htm,https://nptel.ac.in/courses/106/105/106105191/**
3. **E.Balaguruswamy,“ProgrammingwithJava:APrimer”,McGraw-Hill;Sixthedition, 2019.**

Basics of Data Structure

1. Name of the Department: - Computer Science & Engineering						
2. Course Name	**Basics of Data Structure**	**L**	**T**		**P**	
3.Course Code		**3**	**0**		**0**	
4.Type of Course (Category A)		**Core (✓)**	**ID ()**		**VAC ()**	
5. Type of Course (Category B)		**Compulsory(✓)**	**DE()**		**BSC()**	
6. Pre-requisite (if any)		**7. Frequency (use tick marks)**	Even (□)	Odd ()	Either Sem ()	Every Sem ()
8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
9. Course Description						
The course focuses on basic and essential topics in data structures, including array-based lists, linked lists, Skip lists, hash tables, recursion, binary trees, scapegoat trees, red–black trees, heaps, sorting algorithms, graphs, and binary tree.						
10.LearningObjectives: **1.** To impart the basic concepts of data structures and algorithms. **2.** To understand concepts about searching and sorting techniques **3.** To understand basic concepts about stacks, queues, lists, trees and graphs. **4.** To enable them to write algorithms for solving problems with the help of fundamental data structures						
11. Course Outcomes (COs):						
1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness. **2.** For a given Search problem (Linear Search and Binary Search) student will able to implement it. **3.** For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity. **4.** Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity. **5.** Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity						
12. Unit wise detailed content						
Unit-1	**Number of lectures = 08**					
Introduction: Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis, Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis.						
Unit – 2	**Number of lectures = 10**					
ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis. Linked Lists: Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis.						
Unit – 3	**Number of lectures = 08**					

Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.		
Unit – 4	**Number of lectures = 10**	
Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.		

13. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.

14. Books Recommended

Text books:

1. –Fundamentals of Data Structures‖, Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

Reference books:

1. Algorithms, Data Structures, and Problem Solving with C++‖, Illustrated Edition by Mark Allen Weiss, Addison-Wesley Publishing Company
2. –How to Solve it by Computer‖, 2ndImpression by R.G.Dromey, Pearson Education.

Web Development

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Web Development**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✓)**	**PE()**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

Skill development in web programming including mark-up and scripting languages. Introduction to structure and object oriented programming design. Course includes use of XHTML and JavaScript programming languages.

9. Learning objectives:

After going through this course a student should be able to:

1. Use XHTML tags to create simple static webpages
2. format a simple Web page using Cascading Stylesheets
3. state the concepts applicable to web programming; represent data over the Web using XML
4. appreciate the use of Rich Internet Applications, and perform server side scripting using Java Server Pages(JSP).

10. Course Outcomes (COs):

1. To get familiar with the concept of Search Engine Basics.
2. To gain knowledge of Rich Internet Application Technologies
3. To Learn Web Service Essentials
4. To learn different web programming languages
5. To be familiarized with Web Analytics 2.0 , Web 3.0 and Semantic web standards.

11. Unit wise detailed content

Unit-1	**Number of lectures = 09**	

Web 2.0 and XHTML : What is Web 2.0? Introduction to Web 2.0 terms: Search, Content Networks, Blogging, Social Networking, Social Media, Rich Internet Applications (RIAs), Web Services, Mashups, Widgets and Gadgets, Introduction to XHTML and WML, Syntactic Differences between HTML and XHTML, Standard XHTML Document Structure, an example of XHTML covering Basic Syntax, Images, Hypertext Links, Lists and Tables, Creation of an XHTML Form, Internal Linking and Meta Elements.
Using Style Sheets :CSS: Inline Styles, Embedded Style Sheets, Linking External Style Sheets, Style Specification Formats Selector Forms, Color, Property Value Forms, Font Properties, List Properties, Alignment of Text, The Box Model, Background Image.

Unit – 2	**Number of lectures = 09**	
Introduction to XML : XML Basics, XML Document Structure, XML Namespaces, Document Type Definitions, XML Schemas, Displaying XML Documents. **Introduction to WAP and WML :**WAP and WML Basics, WML formatting and links, , WML variables, Example.		
Unit – 3	**Number of lectures = 09**	
JSP – Basic : Basic JSP Lifecycle, JSP Directives and Elements, Scriptlets, Expressions, Action Elements, Standard Actions, Comments and Template Data, JSP variables, The out Object, Request, response, sessions and application objects. **JSP Application Development :** Example applications using JSP, What is JDBC? Need for JDBC, Database Drivers, Connection using JDBC API.		
Unit – 4	**Number of lectures = 09**	
The Server Side Scripting : Server side scripting and its need ,Two-Tier, Three-Tier, N-Tier and Enterprise Architecture, Various Languages/ Technologies for server scripting ,HTTP Methods (such as GET, POST, HEAD, and so on) , Purpose ,Technical characteristics, Method selection, Use of request and response primitives, Web container – Tomcat.		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/		
13. Books Recommended		
Text Books Mastering HTML, CSS & Javascript Web Publishing by Lemay Laura **Reference Books** 1. XHTML Black Book by Steven Holzner, 2000. 2. CGI Programming on the World Wide Web. O'ReillyAssociates. 3. Web Technologies By Achyut S Godbole ,AtulKahate, 2003,T.M.H. 4. Scott Guelich, Shishir Gundararam, Gunther Birzniek; CGI Programing with Perl 2/eO'Reilly. 5. Doug Tidwell, James Snell, Pavel Kulchenko; Programming Web services, O'Reilly 6. Intranets by James D.Cimino, 1997, JaicoPubl. 7. Internet and Web Technologies – Raj Kamal, 2002, T.M.H.		

Computer Architecture

<table>
<tr><td colspan="7">1. Name of the Department: Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Computer Architecture</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (√)</td><td colspan="2">PE()</td><td colspan="2">OE()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 36</td><td colspan="2">Tutorials = 0</td><td colspan="2">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description Introduction to organizational Basic building block diagram of a digital computer system. As the course progresses each major block ranging from Processor to I/O will be discussed in their full architectural detail. The course talks primarily about Computer Organization and Architecture issues, Architecture of a typical Processor, Memory Organization,
I/O devices and their interface and System Bus organization etc.</td></tr>
<tr><td colspan="7">9. Learning objectives:
Provide the skills needed for building computer system for various applications in a career in Computer Science field.</td></tr>
<tr><td colspan="7">10. Course Outcomes:</td></tr>
<tr><td colspan="7">1. To understand the basic knowledge of Computer system and its component and functioning of each components.
2. To understand and analyze computer architecture and organization, computer arithmetic, and CPU design.
3. To understand I/O system and interconnection structures of computer system.
4. To understand and analyze I/O techniques and functioning of memory.
5. To understand various types of buses in a computer system and illustrate how data transfers is performed.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Functional Modules - Basic operational concepts - Bus structures - Software performance – Memory locations and addresses – Memory operations – Instruction and instruction sequencing – Addressing modes – Assembly language – Basic I/O operations– Stacks and queues.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures =9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Addition and subtraction of signed numbers – Design of fast adders – Multiplication of positive numbers - Signed operand multi-plication and fast multiplication – Integer division – Floating point numbers and operations.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Fundamental concepts – Execution of a complete instruction – Multiple bus organization – Hardwired control – Micro programmed control - Pipelining – Basic concepts – Data hazards –Instruction hazards – Influence on Instruction sets – Data path and control consideration – Superscalar operation.</td></tr>
<tr><td>Unit – 4</td><td>Number of lectures =9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Basic concepts – Semiconductor RAMs - ROMs – Speed - size and cost – Cache memories - Performance consideration – Virtual memory- Memory Management requirements – Secondary storage.</td></tr>
</table>

12. Brief Description of self learning / E-learning component.

This learning method gives students to find out their learning capability. Students involve some sort of choice in this learning. As self directed learning learners can determine which modules or scenarios to review again and again.

13. Books Recommended

Tex tBooks

1) Computer Organization and Architecture – Designing for Performance - William Stallings, Pearson Education, 9th Edition, 2012.

14. Reference Books Recommended

1) Computer Organization - Carl Hamacher, ZvonkoVranesic and SafwatZaky, 5thEdition, McGraw- Hill, 2011

2) Computer Organisation and Design - Patterson, Elsevier Pub., 4th Edition,2011

3) Computer Organization and Design: The hardware / software interface - David A.Patterson and John L.Hennessy, Morgan Kaufmann, 5th Edition, 2010

4) Computer Architecture and Organization - John P.Hayes, Tata McGraw Hill,3rdEdition,2017.

JAVA Programming Lab

1. Name of the Department- Computer Science & Engineering					
2. **Course Name**	**JAVA Programming Lab**	**L**	**T**	**P**	
3. Course Code		**0**	**0**	**4**	
4. Type of Course (Category A)		**Core (✓)**	**ID ()**	**VAC ()**	
5. Type of Course (Category B)		**Compulsory(✓)**	**DE()**	**BSC()**	
6. Pre-requisite (if any)	Knowledge of C	**7. Frequency (use tick marks)**	Even (✓) / Odd ()	Either Sem ()	Every Sem ()
8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)					
Lectures = 0		**Tutorials = 0**	**Practical = 48**		

9.Course Description

The revolution in IT (Information Technology) is possible due to evolution of programming languages over the time. With the time, the programming languages become simpler, object oriented, robust and secure to use. Java is one of the programming language that imbibes all the above mentioned features and also, it is used to develop mobile, desktop GUI, web-based, cloud computing applications. This course aims to cover the core concept of the java programming language.

10.Learningobjectives:

1. To create, debug and run simple java programs in java SDK environment.
2. To understand the fundamentals of object-oriented programming in java, which includes the definition of classes, methods and use of java libraries.
3. To understand the application of java programming language in different technologies.

11.Course Outcomes (COs):

Understanding the structure and model of the java programming language.

Using java programming language to develop various applications.

Develop software using java programming language.

12. List of Experiments	Outcome Covered
1. Write a program to swap two values using object reference. Your program should have a swap function.	1
2. Write an application that accepts one command line argument; display the line of reporting if number is even or odd.	2
3. WAP that describes a class person. It should have instance variables to record name, age and salary. Create a person object. Set and display its instance variables.	3
4. Write a program to show the concept of Constructors.	1
5. WAP that shows passing object as parameter.	2
6. WAP that illustrates method overriding.	2
7. WAP to illustrate dynamic polymorphism.	1

Basics of Data Structure Lab

1. Name of the Department:- Computer Science & Engineering						
2. Course Name	**Basics of Data Structure Lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**4**	
4. Type of Course (Category A)		**Core (✓)**	**ID ()**		**VAC ()**	
5. Type of Course (Category B)		**Compulsory(✓)**	**DE()**		**BSC()**	
6. Pre-requisite (if any)		**7. Frequency (use tick marks)**	Even (□)	Odd ()	Either Sem ()	Every Sem ()
8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 48**			
9. Course Description						
The lab work focuses on basic programming for data structures such as array-based lists, linked lists, recursion, binary trees, red–black trees, heaps, sorting algorithms using programming language C/C++.						

10.Learningobjectives:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. To understand basic concepts about stacks, queues, lists trees and graphs.
4. To enable them to write algorithms for solving problems with the help of fundamental data structures

11. Course Outcomes (COs):

1. For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
2. For a given Search problem (Linear Search and Binary Search) student will able to implement it.
3. For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
4. Student will able to write an algorithm Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort and compare their performance in term of Space and Time complexity.
5. Student will able to implement Graph search and traversal algorithms and determine the time and computation complexity

12.List of Experiments	**Outcome Covered**
1. Revision of programs of Data Structures from pervious semester: Insertion Sort, Bubble Sort, Selection Sort, Linear Search, Binary Search	1
2. Write a Program to Implement a Linked List	3
3. Write a Program to Implement a Doubly Linked List	3
4. Write a Program to Implement a Stack Dynamically	3
5. Write a Program to Implement a Queuedynamically	3
6. Write a Program to Implement a Circular Linked List	3
7. Write a Program to Implement Binary Search Tree	5
8. Write a Program to Implement Inorder	5

9. Write a Program to implement Postorder	5
10. Write a Program to implement Pre order	5
11. Write a Program to implement Heap sort.	4
12. Write a program to implement Breadth First search	2
13. Write a program to implement Depth First search	2
14. Write a Program to implement Dijkstra_s Algorithm	5
15. Write a Program to Implement Bubble Sort using Recursion	4
16. Write a Program to Implement Insertion Sort using RecursioN	4
17. Write a Program to Implement Selection Sort using Recursion	4
18. Write a Program to Implement Linear Search using Recursion	2
19. Write a Program to Implement Linear Search using Recursion	2

Web Development lab

Name of the Department- Computer Science & Engineering						
1. Course Name	**Web Development lab**	**L**	**T**		**P**	
2. Course Code		**0**	**0**		**2**	
3. Type of Course (use tick mark)		**Core (✓)**	**PE()**		**OE ()**	
4. Pre-requisite (if any)		**5. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 24**			

7. Course Description:

Skill development in web programming including mark-up and scripting languages. Introduction to structure and object oriented programming design. Course includes use of XHTML and JavaScript programming languages.

8. Learning objectives:

1. Design and implement dynamic websites with good aesthetic sense of designing and latest technical know-how's.
2. Have a Good grounding of Web Application Terminologies, Internet Tools, E – Commerce and other web services.
3. Get introduced in the area of Online Game programming.

9. Course Outcomes (COs):

1. WEBBASICS: Design web pages through coding using HTML and DHTML.
2. Integrated Development Tool: Frontpage2000/Dreamweaver
3. BROWSER SIDE SCRIPTING using JavaScript with a focus on
4. Event Handling and Validation
5. SERVER SIDE SCRIPTING:
6. PHP SYNTAX, variables, loops and constructs.
7. JAVA GRAPHICS

10. List of Experiments

1. Create a Web Page using basic tags in html 5
2. Write a program to create all types of list in HTML
3. Create a table using Html 5 and CSS
4. Write a program using labels, radio buttons, and submit buttons
5. Create a simple webpage using HTML
6. Use frames to Include Images and Videos.
7. Add a Cascading Style sheet for designing the web page.
8. Design a web page with validation using JavaScript.
9. How to make all fields of a form mandatory in java script
10. Create a registration form and validate it using java script
11. Write a program to maintain session in PHP
12. Perform data base connectivity in PHP
13. Create a dynamic web page using PHP

11. Brief Description of self-learning / E-learning component

https://html-iitd.vlabs.ac.in/

Engineering Graphics and Design Lab

1. Name of the Department- Mechanical Engineering							
2. Course Name	**Engineering Graphics and Design Lab**	**L (0)**		**T(0)**		**P(2)**	
3. Course Code							
4. Type of Course (Category A)		**Core ()**	**ID (✓)**	**VAC ()**			
5. Type of Course (Category B)		**Compulsory()**	**DE ()**	**BSC()**		**EAS(✓)**	
6. Pre-requisite (if any)	**Geometry and Drawing at +2 Level**	**7. Frequency (use tick marks)**		Even (✓)	Odd ()	Either Sem ()	Every Sem ()
8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)							
Lectures =0		**Tutorials = 0**		**Practical = 24**			

9. Brief Syllabus

Engineering Graphics and design is considered as language of engineers. This course is introduced to provide basic understanding of importance of designing aspects in engineering applications. The topics are covered in a sequence and starts from the basic concepts of introduction to computer aided design and then designing of planes and solids. Towards the end of the course it is expected that students would be matured to visualize the engineering components from any drawing sheet, followed by the projection techniques. A number of chosen problems will be solved to illustrate the concepts clearly.

10. Learning objectives:

- **i)** To understand the basic concepts of drawing and projection techniques.
- **ii)** To enhance the knowledge of reading the layouts.
- **iii)** To develop designs.
- **iv)** To develop engineering imagination which is essential for creation of successful designs.

11. Course Outcomes (COs):

- **i)** Clarity in Drawing
- **ii)** Can read shop layout and industrial layouts
- **iii)** Design any layout by using projection techniques.

12. Lab Experiment

Sr. No.	**Title**	**CO Covered**
1	Different types of lines with illustration and application.	i, ii
2	Design sheet layout with dimensioning and lettering.	ii
3	Applications of drawing commands	i, iii
4	Projection of points in four quadrants.	i
5	Projection of straight lines in parallel, perpendicular and inclined planes.	i
6	Projection of plane in perpendicular positions.	i

7	Projection of cones and solid cylinders with axes parallel, perpendicular and inclined to both reference planes.	i
8	Projection of prisms and pyramid.	i, ii, iii
10	Design Orthographic projection of simple machine elements.	i, ii, iii
11	Design Isometric projection of simple machine elements.	i, ii. iii
12	Design Sectional views of simple machine elements.	i, ii, iii

<table>
<tr><td colspan="7">1. Name of the Department: Environment Science</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Environment Science</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>2</td><td>0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (Category A)</td><td colspan="2">Core ()</td><td>ID (✓)</td><td colspan="2">VAC ()</td></tr>
<tr><td colspan="2">5. Type of Course (Category B)</td><td colspan="2">Compulsory()</td><td>DE()</td><td colspan="2">MC(✓)</td></tr>
<tr><td>6. Pre-requisite (if any)</td><td>Basic Knowledge of Environment</td><td colspan="2">7. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">8. Total Number of Lectures, Tutorials, Practical-0</td></tr>
<tr><td colspan="3">Lectures = 24</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="8">9. Brief Syllabus
The course intends to introduce students the objective of environmental sciences and the importance of conservation of natural resources. The students will learn about the sources, effects and control measures of air, water, soil, noise, thermal pollution. They will also be made aware of global environmental issues. The students will understand the need of sustainable development, environment pacts, role of information technology in the environment. The students will be explained basic principles of green building and environmental remedial measures.</td></tr>
<tr><td colspan="8">10. Learning objectives:
i. To develop awareness about our environmental scenarios.
ii. To develop a concern about sustainable development through future strategies.</td></tr>
<tr><td colspan="8">11. Course Outcomes (COs)
On completion of this course, the student should be able to:
i. Understand about environment and its components and Problems associated with natural resources and their sustainable use.
ii. Sources of pollution in air, water and soil and Solid waste management and natural Disaster management.
iii. Understanding about environmental and social issues, ecosystems, biodiversity.
iv. Understanding of role of information technology to address environmental issues through human involvement.</td></tr>
<tr><td colspan="8">12. Unit-wise Detailed Content</td></tr>
<tr><td>Unit-1</td><td colspan="2">Number of lectures=6</td><td colspan="5">Title of the unit: Multi-disciplinary Approaches and Environmental Pollution and Control Technologies</td></tr>
<tr><td colspan="8">Introduction and Components of the Environment, Factors leading to Environment Degradation. Environmental Pollution; Air Pollution, Water pollution and Noise Pollution. Solid waste (E-wastes): Sources, and Remedial Measures.</td></tr>
<tr><td>Unit – 2</td><td colspan="2">Number of lectures=6</td><td colspan="5">Title of the unit: Natural Resources</td></tr>
<tr><td colspan="8">Natural Resources: Renewable and Non-Renewable resources; Water resources: use and Over utilization of surface and ground water, Role of Dams. Changes in agricultural ways: Water logging, Salinity; Mineral Resources: Use and Over-exploitation; Land resources: Man induces Landslides, Soil Erosion, and Desertification; Energy resources: Use of Alternate Energy Sources.</td></tr>
<tr><td>Unit – 3</td><td colspan="2">Number of lectures=6</td><td colspan="5">Title of the unit: Eco-Systems and its Characteristics</td></tr>
<tr><td colspan="8">Ecosystem: Classification, Structure, and Function of an ecosystem, Food Chains, Food Webs, and Ecological Pyramids. Biogeochemical cycles, Biomagnification, Introduction and characteristic features of the following Eco-systems: Forest ecosystem, Desert ecosystem, Aquatic Eco-systems.</td></tr>
<tr><td>Unit – 4</td><td colspan="2">Number of lectures=6</td><td colspan="5">Title of the unit: Bio-diversity and Global Environmental Issues</td></tr>
<tr><td colspan="8">Definition, Genetic, Species and Ecosystem diversity. Threats to biodiversity: habitat loss, poaching of wildlife, impact of mankind on wildlife; conservation of biodiversity: In-Situ and Ex-situ</td></tr>
</table>

conservation. Global Environmental Issues: Ozone depletion and Ozone depleting substances (ODS). Deforestation and Desertification, Acid Rain and Global Warming. Concept of Green Building. Legal Aspects Air Act, Water Act, Forest Act, Wild life Act.
13. Brief Description of self-learning / E-learning component E-Learning, the online platform, will involve the NPTEL and SWAYAM portal system for the holistic knowledge. Power Point Presentation will be used. Online Lecture series will be beneficial for the students. Online assignment will be designated to students at large. Seminars will be conducted for the broad-spectrum knowledge.
14. Books Recommended (1Text Books + 5 Reference Books)
TEXT BOOKS: • Environmental Studies, An inditaBasak, Pearson Education, 2009. **REFERENCE BOOKS:** • Tata McGraw Hill Education Private Limited, 2007. • Environmental Studies, Suresh K. Dhameja, S.K. Kataria and Sons, 2008. • Environmental Science: towards a sustainable future by Richard T. Wright. 2008 PHL Learning Private Ltd. New Delhi. • Environmental Engineering and science by Gilbert M. Masters and Wendell P. Ela. 2008 PHI Learning Pvt. Ltd.

Semester 3rd

Operating System

<table>
<tr><td colspan="7">1.NameoftheDepartment-Computer Science & Engineering</td></tr>
<tr><td>2.Course Name</td><td>~~Operating~~ Systems</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3.Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4.Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE()</td><td colspan="2">OE()</td></tr>
<tr><td>5.Pre-requisite (if any)</td><td></td><td>6.Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8.Course Description</td></tr>
<tr><td colspan="7">The course aims to explore the importance of the operating system and its function. The different techniques used by the operating system to achieve its goals as resource manager. The course also explores how application interacts with the operating system and how the operating systems interact with the machine.</td></tr>
<tr><td colspan="7">9. Learning Objectives
1. To learn the mechanisms of OS to handle processes and threads and their communication
2. To learn the mechanisms involved in memory management in contemporary OS
3. To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
4. To know the components and management aspects of concurrency management
5. To learn to implement simple OS mechanisms</td></tr>
<tr><td colspan="7">10.Course Outcomes (COs):</td></tr>
<tr><td colspan="7">1. Create processes and threads.</td></tr>
<tr><td colspan="7">2. Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, and Response Time.</td></tr>
<tr><td colspan="7">3. For a given specification of memory organization develop the techniques for optimally
a. allocating memory to processes by increasing memory utilization and for improving the access time.</td></tr>
<tr><td colspan="7">4. Design and implement file management system.</td></tr>
<tr><td colspan="7">5. For a given I/O devices and OS (specify) develop the I/O management functions in OS as part
a. of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.</td></tr>
<tr><td colspan="7">11.Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 08</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction: Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS-Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 10</td><td colspan="5"></td></tr>
<tr><td colspan="7">Processes: Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time,
Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.</td></tr>
</table>

Unit – 3	Number of lectures = 08	
Inter-process Communication: Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation, Peterson Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader & Writer Problem, Dinning Philosopher Problem etc., Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Bankers algorithm, Deadlock detection and Recovery.		
Unit – 4	**Number of lectures = 10**	
Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition–Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, first in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU). Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks		

12.Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.

13.Books Recommended

Text book:

I. Operating System Concepts Essentials, 9th Edition by Avi Silber schatz, Peter Galvin, Greg Gagne, Wiley Asia Student Edition.

Reference books:

- **I.** Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin Publishing
- **II.** Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison Wesley
- **III.** Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and Associates
- **IV.** Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.

Database Management Systems

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science Engineering</td></tr>
<tr><td>2. Course Name</td><td>Database Management Systems</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2"></td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Workshop Technology</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">The course, Database Management Systems, provides an introduction to the management of database systems. The course emphasizes the understanding of the fundamentals of relational systems including data models, database architectures, and database manipulations. The course also provides an understanding of new developments and trends such as Internet database environment and data warehousing. The course uses a problem-based approach to learning</td></tr>
<tr><td colspan="7">9. Learning Objectives:
I. To understand the different issues involved in the design and implementation of a database system.
II. To study the physical and logical database designs, database modeling, relational, hierarchical, and networkmodels
III. To understand and use data manipulation language to query, update, and manage database
IV. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), DataWarehousing.
V. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing aDBMS.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs): On completion of the course,</td></tr>
<tr><td colspan="7">I. For a given query write relational algebra expressions for that query and optimize the developedexpressions</td></tr>
<tr><td colspan="7">II. For a given specification of the requirement design the databases using E-R method and normalization.</td></tr>
<tr><td colspan="7">III. For a given specification construct the SQL queries for Open source and Commercial DBMS - MYSQL, ORACLE, andDB2.</td></tr>
<tr><td colspan="7">IV. For a given query optimize its execution using Query optimizationalgorithms</td></tr>
<tr><td colspan="7">V. For a given transaction-processing system, determine the transaction atomicity,consistency, isolation, anddurability.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Database System Architecture: Data Abstraction, Data Independence, Instance and Schema, Three level Architecture of DBMS, Advantages of DBMS Approach over File Approach, Data Definition Language (DDL), Data Manipulation Language (DML).
Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, Reduction of ER diagram into tables.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 10</td><td colspan="5"></td></tr>
</table>

Relational query languages: Relational algebra and various operations, Tuple and domain relational calculus, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server Relational database design: Functional dependency, Armstrong's axioms, Normal forms-INF, 2NF, 3NF, BCNF, Dependency preservation, Lossless design. SQL Queries		
Unit – 3	**Number of lectures = 08**	
File Organization:- Sequential file organization, Index File Organization, Direct Files, B-trees, Hashing		
Unit – 4	**Number of lectures = 9**	
Transaction processing: Concurrency control, ACID property, Serializability, Locking and timestamp based protocols, Multi-version and optimistic Concurrency Control schemes Database recovery and its techniques, Database Security: Authentication, Authorization and access control, SQL Injection		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E- Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.		
13. Books Recommended **Textbook:** **I.** Database System Conceptsǁ,6th Edition by Abraham Silberschatz, Henry F.Korth, S. Sudarshan,McGraw-Hill. **Reference books:** **I.** PrinciplesofDatabaseandKnowledge–BaseSystemsǁ,Vol1byJ.D.Ullman,Computer Science Press. **II.** Fundamentals of Database Systemsǁ,5th Edition by R. Elmasriand S. Navathe, Pearson Education **III.** Foundations of Databasesǁ, Reprint by Serge Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley		

Operating System Lab

1.Name of the Department- Computer Science Engineering						
2.Course Name	**Operating System Lab**	**L**	**T**		**P**	
3.Course Code		**0**	**0**		**2**	
4.Type of Course (use tick mark)		**Core (✓)**	**PE()**		**OE()**	
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures =0		**Tutorials = 0**	**Practical = 24**			
8.Course Description						

9. Learning Objectives

- **I.** To learn the fundamentals of OperatingSystems.
- **II.** To learn the mechanisms of OS to handle processes and threads and theircommunication
- **III.** To learn the mechanisms involved in memory management in contemporaryOS
- **IV.** To gain knowledge on distributed operating system concepts that includesarchitecture, Mutual exclusion algorithms, deadlock detection algorithms and agreementprotocols
- **V.** To know the components and management aspects of concurrencymanagement
- **VI.** To learn to implement simple OSmechanisms

10.Course Outcomes (COs):

- **I.** Create processes and threads.
- **II.** Develop algorithms for process scheduling for a given specification of CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time.
- **III.** For a given specification of memory organization develop the techniques for optimally allocating memory to processes by increasing memory utilization and for improving the access time.
- **IV.** Design and implement file managementsystem.
- **V.** For a given I/O devices and OS (specify) develop the I/O management functions in OS aspart of a uniform device abstraction by performing operations for synchronization between CPU and I/O controllers.

List of Experiments	**Outcome Covered**
1. Basics of UNIX commands.	I
2. Shell programming	II
3. Implementation of CPU scheduling. a) Round Robin b) SJF c) FCFS d) Priority	II
4. Implement all file allocation strategies	IV
5. Implement Semaphores	V
6. Implement File Organization Techniques	IV
7. Implement Bankers algorithm for Dead Lock Avoidance	III
8. Implement an Algorithm for Dead Lock Detection	II
9. Implement the all page replacement algorithms a) FIFO b) LRU c) LFU	IV
10. Implement Shared memory and IPC	V
11. Implement Paging Technique f memory management.	III
12. Implement Threading & Synchronization Applications	IV

Database Management Systems Lab

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science Engineering</td></tr>
<tr><td>2. Course Name</td><td>Database Management Systems Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE ()</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="7">9. Learning Objectives:
I. To understand the different issues involved in the design and implementation of a database system.
II. To study the physical and logical database designs, database modeling, relational, hierarchical, and networkmodels
III. To understand and use data manipulation language to query, update, and manage database
IV. To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency, distributed database, and intelligent database, Client/Server (Database Server), DataWarehousing.
V. To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing DBMS</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs): On completion of the course,</td></tr>
<tr><td colspan="7">I. Design and implement a database schema for a given problem-domain</td></tr>
<tr><td colspan="7">II. Populate and query a database using SQL DML/DDLcommands.</td></tr>
<tr><td colspan="7">III. Declare and enforce integrity constraints on a database using a state-of-the-artRDBMS</td></tr>
</table>

LIST OF EXPERIMENTS	**Outcome Covered**
1. Write the queries for Data Definition and Data Manipulation Language.	I
2. Write SQL queries using Comparison operators (=,<,>,etc).	II
3. Write SQL queries using Logical operators.	I
4. Write SQL query using SQL Operators.	III
5. Write SQL queries for relational algebra.	I
6. Write SQL queries for extracting data from more than one table.	II
7. Write SQL queries for sub queries, nested queries.	II
8. Write a program by the use of PL/SQL.	III
9. Concepts for ROLL BACK, COMMIT & CHECK POINTS.	II
10. Create VIEWS, CURSORS and TRGGERS & write ASSERTIONS.	III
11. Create FORMS and REPORTS.	III

Constitution of India

1. Name of the Department- Computer Science Engineering						
2. Course Name	**Constitution of India**	**L**	**T**		**P**	
3. Course Code		2	0		0	
4. Type of Course (use tick mark)		**Core ()**	**PE()**	**OE()**	**MC(✓)**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem()
7. Total Number of Lectures, Tutorials, Practical						
Lectures= 24		**Tutorials = 0**	**Practical= 0**			

8. Course Description

Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals_ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

9. Learning objectives:

- **I.** To learn the basic principles of classical thermodynamics.
- **II.** To apply the laws of thermodynamics to various systems and analyze the significance of the results.
- **III.** To analyze the performance of thermodynamic gas and vapor power cycles.

10. Course Outcomes (Cos): On completion of this course, the students will be able to

- **I.** Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- **II.** Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- **III.** Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- **IV.** Discuss the passage of the Hindu Code Bill of1956.

11. Unit wise detailed content

Unit-1	**Number of lectures = 6**	**Title of the unit: History of Making of the Indian Constitution**
History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features, Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.		
Unit – 2	**Number of lectures = 6**	**Title of the unit: Organs of Governance**
Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions		
Unit – 3	**Number of lectures = 6**	**Title of the unit: Local Administration**
Local Administration: Districts Administration head: Role and Importance, Municipalities:		

Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayati raj: Introduction, PRI: Zila Panchayat, Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.		
Unit – 4	**Number of lectures = 6**	**Title of the unit: Election Commission**
Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.		
13. Books Recommended		
I.	The Constitution of India, 1950 (Bare Act), Government Publication.	
II.	Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition,2015.	
III.	M. P. Jain, Indian Constitution Law, 7thEdition., Lexis Nexis,2014	

Semester 4th

Design and Analysis of Algorithms

<table>
<tr><td colspan="7">1.Name of the Department- Computer Science Engineering</td></tr>
<tr><td>2.Course Name</td><td>Design and Analysis of Algorithms</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3.Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4.Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE()</td><td colspan="2">OE()</td></tr>
<tr><td>5.Pre-requisite (if any)</td><td></td><td>6.Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8.Course Description
The objective of the course is to teach techniques for effective problem solving in computing. The use of different paradigms of problem solving will be used to illustrate clever and efficient ways to solve a given problem. In each case emphasis will be placed on rigorously proving correctness of the algorithm. In addition, the analysis of the algorithm will be used to show the efficiency of the algorithm over the naive techniques.</td></tr>
<tr><td colspan="7">9. Learning objectives
I. Analyze the asymptotic performance of algorithms.
II. Write rigorous correctness proofs for algorithms.
III. Demonstrate a familiarity with major algorithms and data structures.
IV. Apply important algorithmic design paradigms and methods of analysis.
V. Synthesize efficient algorithms in common engineering design situations</td></tr>
<tr><td colspan="7">10.Course Outcomes (COs):</td></tr>
<tr><td colspan="7">I. For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.</td></tr>
<tr><td colspan="7">II. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.</td></tr>
<tr><td colspan="7">III. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.</td></tr>
<tr><td colspan="7">IV. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.</td></tr>
<tr><td colspan="7">V. For a given model engineering problem model it using graph and write the corresponding algorithm to solve the problems.</td></tr>
<tr><td colspan="7">VI. Explain the ways to analyze randomized algorithms (expected running time, probability of error).</td></tr>
<tr><td colspan="7">11.Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 10</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction: Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Recursion tree method and Masters_ theorem.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 08</td><td colspan="5"></td></tr>
<tr><td colspan="7">Fundamental Algorithmic Strategies: Brute-Force, Greedy, Dynamic Programming, Branch and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques</td></tr>
</table>

for Problem-Solving , Bin Packing, Knap Sack TSP. Heuristics – characteristics and their application domains.		
Unit – 3	**Number of lectures = 08**	
Graph and Tree Algorithms: Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.		
Unit – 4	**Number of lectures = 10**	
Tractable and Intractable Problems: Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cooks theorem, Standard NP-complete problems and Reduction techniques, Advanced Topics: Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE		
12.Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.		
13.Books Recommended		
I. Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill. **Reference books** I. Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson. II. Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, MichaelT Goodrich and Roberto Tamassia, Wiley. III. Algorithms—a Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading,MA. IV. Fundamentals of Algorithms – E. Horowitz et al.		

Software Engineering

<table>
<tr><td colspan="7">1.Name of the Department- Computer Science Engineering</td></tr>
<tr><td>2.Course Name</td><td>Software Engineering</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3.Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4.Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE()</td><td colspan="2">OE()</td></tr>
<tr><td>5.Pre-requisite (if any)</td><td></td><td>6.Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8.Course Description</td></tr>
<tr><td colspan="7">This course covers the fundamentals of software engineering, including understanding system requirements, finding appropriate engineering compromises, effective methods of design, coding, and testing, team software development, and the application of engineering tools.</td></tr>
<tr><td colspan="7">9. Learning Objectives
The program will prepare our students to be successful professionals in the field with solid fundamental knowledge of software engineering.
I. Be successful professionals in the field with solid fundamental knowledge of software engineering
II. Utilize and exhibit strong communication and interpersonal skills, as well as professional and ethical principles when functioning as members and leaders of multi-disciplinary teams
III. Apply their foundations in software engineering to adapt to readily changing environments using the appropriate theory, principles and processes</td></tr>
<tr><td colspan="7">10.Course Outcomes (COs):</td></tr>
<tr><td colspan="7">I. An ability to apply knowledge of mathematics, science, andengineering.</td></tr>
<tr><td colspan="7">II. An ability to design and conduct experiments, as well as to analyze and interpretdata.</td></tr>
<tr><td colspan="7">III. An ability to design a system, component, or process to meet desired needs withinrealistic constraints such as economic, environmental, social, political, ethical, health and safety, Manufacturability, and sustainability.</td></tr>
<tr><td colspan="7">IV. An ability to function on multi-disciplinary teams.</td></tr>
<tr><td colspan="7">V. An ability to identify, formulates, and solves engineeringproblems.</td></tr>
<tr><td colspan="7">VI. An understanding of professional and ethicalresponsibility.</td></tr>
<tr><td colspan="7">VII. An ability to communicate effectively.</td></tr>
<tr><td colspan="7">11.Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 08</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction: The process, software products, emergence of software engineering, evolving role of software, software life cycle models, Software Characteristics, Applications, Software crisis. Software project management: Project management concepts, software process and project metrics Project planning, project size estimation metrics, project estimation Techniques, empirical estimation techniques, COCOMO- A Heuristic estimation techniques, staffing level estimation, team structures, staffing, risk analysis and management, project scheduling and tracking.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 10</td><td colspan="5"></td></tr>
<tr><td colspan="7">Requirements Analysis and specification requirements engineering, system modeling and simulation Analysis principles modeling, partitioning Software, prototyping: , Prototyping methods and tools;</td></tr>
</table>

Specification principles, Representation, the software requirements specification and reviews Analysis Modeling: Data Modeling, Functional modeling and information flow: Data flow diagrams, Behavioral Modeling; The mechanics of structured analysis: Creating entity/ relationship diagram, data flow model, control flow model, the control and process specification; The data dictionary; Other classical analysis methods. System Design: Design concepts and principles: the design process: Design and software quality, design principles; Design concepts: Abstraction, refinement, modularity, software architecture, control hierarchy, structural partitioning, data structure, software procedure, information hiding; Effective modular design: Functional independence, Cohesion, Coupling; Design Heuristics for effective modularity; The design model; Design documentation.		
Unit – 3	**Number of lectures = 08**	
Architectural Design: Software architecture, Data Design: Data modeling, data structures, databases and the data warehouse, analyzing alternative Architectural Designs, architectural complexity; Mapping requirements into software architecture; Transform flow, Transaction flow; Transform mapping: Refining the architectural design. Testing and maintenance: Software Testing Techniques, software testing fundamentals: objectives, principles, testability; Test case design, white box testing, basis path testing: Control structure testing: Black box testing, testing for specialized environments, architectures and applications.		
Unit – 4	**Number of lectures = 10**	
Software Testing Strategies: Verification and validation, Unit testing, Integration testing, Validation testing, alpha and beta testing; System testing: Recovery testing, security testing, stress testing, performance testing; The art of debugging, the debugging process debugging approaches. Software re-engineering , reverse engineering ,restructuring, forward engineering, Software Reliability and Quality Assurance :Quality concepts, Software quality assurance , SQA activities; Software reviews: cost impact of software defects, defect amplification and removal; formal technical reviews: The review meeting, review reporting and record keeping, review guidelines; Formal approaches to SQA; Statistical software quality assurance; software reliability: Measures of reliability and availability ,The ISO 9000 Quality standards: The ISO approach to quality assurance systems.		
12.Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.		
13.Books Recommended		
Text Book: **I.** Software Engineering – A Practitioners Approach, Roger S. Pressman, 2016, MGH. **Reference Books:** **II.** Fundamentals of software Engineering, RajibMall,PHI **III.** Software Engineering by Ian Somerville, Pearson Edu, 5 editions, 1999, AW, **IV.** Software Engineering – David Gustafson, 2002, T.M.H Software Engineering Fundamentals Oxford University **V.** Ali Behforooz and Frederick J. Hudson 1995 JW&S, An Integrated Approach to software engineering by Pankaj jalote , 1991Narosa,		

Medical Imaging Techniques

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Medical Imaging Techniques</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">The objective of this paper is to understand the underlying physics of the medical imaging systems and to give an overview of major modern diagnostic imaging technologies. Also, it supports more in depth investigations into radiography and nuclear medicine imaging modalities.</td></tr>
<tr><td colspan="7">9. Learning Objectives:
After the completion of the course, the candidate should be able to:
1. Manage medical information.
2. Record keeping and lab work.
3. Manage Database and recent trends in Biomedical imaging.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">At the end of the course the student able to
1. Manage medical information.
2. Record keeping and lab work.
3. Manage Database and recent trends in Biomedical imaging.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">MEDICAL INFORMATICS Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues, Computer based medical information retrieval, Hospital management and information System, Functional capabilities of a computerized HIS, E-health services, Health Informatics – Medical Informatics, Bioinformatics.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">COMPUTERISED PATIENT RECORD Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, computerized prescriptions for patients.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING Automated Clinical Laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclear medicine, ultrasound imaging Ultrasonography computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.
COMPUTER ASSISTED MEDICAL DECISION-MAKING Neuro computers and Artificial Neural Networks application, Expert system – General model of CMD, Computer –assisted decision support system-production rule system cognitive model, semester networks , decisions analysis in clinical medicine-computers in the care of critically patients-computer assisted surgery-designing

Unit – 4	**Number of lectures = 9**	

RECENT TRENDS IN MEDICAL INFORMATICS Virtual reality applications in medicine, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery computer aids for the handicapped, computer assisted Instrumentation in Medical Informatics - Computer assisted patient education and health Medical education and health care information.
DATABASES AND COMPUTER NETWORK Basics of databases- Relational, distributed and other types of databases, Integrity and security of databases, DBMS. Popular databases available in medical related applications. Basics of Computer networks- types and topologies

12. Brief Description of self-learning / E-learning component
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- R.D.Lele "Computers in medicine progress in medical informatics", Tata McGraw Hill Publishing computers Ltd,2005, New Delhi.

14. Reference Books

1. Mohan Bansal, "Medical informatics" Tata McGraw Hill Publishing Computers Ltd, 2003 New Delhi.

Design & Analysis of Algorithms Lab

1.Name of the Department- Computer Science Engineering					
2.Course Name	**Design & Analysis of Algorithms Lab**	**L**	**T**		**P**
3.Course Code		**0**	**0**		**2**
4.Type of Course (use tick mark)		**Core (✓)**	**PE()**		**OE()**
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)					
Lecture = 0		**Tutorials = 0**	**Practical = 24**		
8.Course Description					

9. Learning Objectives

i. Analyze the asymptotic performance ofalgorithms.
ii. Write rigorous correctness proofs foralgorithms.
iii. Demonstrate a familiarity with major algorithms and datastructures.
iv. Apply important algorithmic design paradigms and methods ofanalysis.
v. Synthesize efficient algorithms in common engineering designsituations

10.Course Outcomes (COs):

I.	For a given algorithms analyze worst-case running times of algorithms based on asymptotic analysis and justify the correctness of algorithms.
II.	Describe the greedy paradigm and explain when an algorithmic design situation calls for it. For a given problem develop the greedy algorithms.
III.	Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Synthesize divide-and-conquer algorithms. Derive and solve recurrence relation.
IV.	Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. For a given problems of dynamic-programming and develop the dynamic programming algorithms, and analyze it to determine its computational complexity.

List of Experiments	
1. Sort a given set of elements using the Quick sort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.	III
2. Using OpenMP, implement a parallelized Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator.	I
3. (a). Obtain the Topological ordering of vertices in a given digraph. (b). Compute the transitive closure of a given directed graph using Wars hall's algorithm.	II
4. Implement 0/1 Knapsack problem using Dynamic Programming.	III
5. From a given vertex in a weighted connected graph, find shortest	I

paths to other vertices using Dijkstra's algorithm.	
6. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.	IV
7. (a). Print all the nodes reachable from a given starting node ina digraph using BFS method. (b). Check whether a given graph is connected or not using DFS method.	III
8. Find a subset of a given set S= {sl, s2,.... , sn} of n positive integers whose sum is equal to a given positive integer d. For example, if S= {1, 2, 5, 6, 8} and d = 9 there are two solutions{1,2,6}and{1,8}.A suitable message is to be displayed if the given problem instance doesn't have a solution.	II
9. Implement any scheme to find the optimal solution for the Traveling Salesperson problem and then solve the same problem instance using any approximation algorithm and determine the error in the approximation.	III
10. Find Minimum Cost Spanning Tree of a given undirected graph using Prim’s algorithm.	IV
11. Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. Parallelize this algorithm, implement it using OpenMP and determine the speed-up achieved.	IV
12. Implement N Queen's problem using Back Tracking.	III

Research Methodology

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Research Methodology**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (✓)**	**PE()**		**OE ()**	
5. Pre-requisite (if any)	+ 2 Mathematics	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
Course prelude the foundational methods and techniques of academic research in social sciences and engineering. Engineers would examine and be practically exposed to the main components of a research framework i.e., problem definition, research design, data collection & compilations, report writing, presentation and conclude. Course intended for students requiring hands on knowledge of engineering & sciences applications.						
10. Learning Objectives: 1. The primary objective of this course is to develop a research orientation among the engineers. 2. To provide a foundation for post-secondary education. 3. To facilitate the development and application of problem-solving skills in students.						
10. Course Outcomes (COs):						
The students will be able to: - 1. To develop understanding of the basic framework of research process. 2. To develop an understanding of various research designs and techniques. 3. To identify various sources of information for literature review and data collection. 4. To develop an understanding of the ethical dimensions of conducting applied research. 5. To develop an understanding of quality research & scholarly writing.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 9**	Sources and Presentation of Data				
Statistical Data, Methods of Presentation, Presentation or Illustration of Quantitative Data and Qualitative Data. Measures of Location – Averages and Percentiles Measure of central tendency – Averages, Measure of Location – Percentiles.						
Unit – 2	**Number of lectures = 9**	Variability and its Measures				
Types of Variability, Measures of Variability. Normal Distribution and Normal Curve, Demonstration of a Normal Distribution, Normal curve, Relative or Standard Normal Deviate or Variate (Z).						
Unit – 3	**Number of lectures = 9**	Correlation and Regression				
Measures of Relationship between continuous Variables, Types of Correlation, Correlation coefficient from Grouped and Ungrouped series. Regression and Calculation of Regression Coefficient.						

Unit – 4	Number of lectures = 9	Research Methodology

Research Methodology: Meaning of Research, Objective of research, Motivation in research, Types of research, research approaches, research process, & Criteria of good research. Defining the research problems: Selecting the problems, technique involved in defining the problem and conclusion. Research Design: Meaning & Need of research design, different research designs.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- C.R. Kothari, Research Methodology, New Age Publications

14. Reference Books

1. SC Gupta & V K Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons Publications
2. H.C.Saxena, Elementary Statistics, S.Chand Publications.
3. Computers Today, D. H. Sanders, Fourth Edition, McGraw Hill,1988

Research Methodology Lab

1. Name of the Department- Computer Science & Engineering							
2. Course Name	**Research Methodology Lab**	**L**		**T**		**P**	
3. Course Code		**0**		**0**		**2**	
4. Type of Course (use tick mark)		**Core (√)**		**PE()**		**OE ()**	
5. Pre-requisite (if any)	**English as language**	**6. Frequency (use tick marks)**		Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)							
Lectures = 0		**Tutorials = 0**		**Practical = 24**			

8. Course Description

This course focuses on the composition of research papers as well as critical textual analysis and synthesis in academic discourse. Students will receive instruction and practice in conceiving, drafting, revising and completing papers based upon sources that challenge them to seek new information and to reflect upon its relevance to their own observations and experience. This course provides students with a variety of research and writing skills. Activities include writing assignments, readings on composition techniques, readings of literature and criticism, online discussions, and lessons on relevant grammar issues and formatting sound arguments.

9. Learning objectives: Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

10. Course Outcomes (COs):

In this course, students can expect to do the following:

1. Adapt rhetorical processes and strategies for audience, purpose and type of task
2. Organize and produce texts that meet the demands of specific genres, purposes, audiences and stances
3. Employ appropriate mechanics, usage, grammar and spelling conventions
4. Find, analyze, evaluate, summarize and synthesize appropriate source material from both print and electronic environments
5. Present focused, logical arguments that support a thesis
6. Use reliable and varied evidence to support claims, incorporate ideas from sources appropriately, and acknowledge and document the work of others appropriately
7. Use electronic environments to draft, revise, edit and share or publish texts

11. List of Experiments

1) Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness
2) Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction
3) Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.
4) Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key

skills are needed when writing an Introduction, skills needed when writing a Review of the Literature

5) Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

6) Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

Semester 5th

Theory of Computation

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Theory of Computation</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (√)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course provides students a synopsis of latest trends in automotive industry used in evaluation of world. This includes understanding the basic principles of various hybrid and electric vehicles with importance, applications and limitations.</td></tr>
<tr><td colspan="7">9. Learning Objectives:
I. Develop a formal notation for strings, languages andmachines.
II. Design finite automata to accept a set of strings of alanguage.
III. Prove that a given language is regular and apply the closure properties oflanguages.
IV. Design context free grammars to generate strings from a context free language andconvert them into normalforms.
V. Prove equivalence of languages accepted by Push Down Automata and languagesgenerated by context freegrammars
VI. Identify the hierarchy of formal languages, grammars andmachines.
VII. Distinguish between computability and non-computability and Decidability and undecidability.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">I. Write a formal notation for strings, languages andmachines.</td></tr>
<tr><td colspan="7">II. Design finite automata to accept a set of strings of alanguage.</td></tr>
<tr><td colspan="7">III. For a given language determine whether the given language is regular ornot.</td></tr>
<tr><td colspan="7">IV. Design context free grammars to generate strings of context free language.
V. Determine equivalence of languages accepted by Push Down Automata andlanguages generated by context free grammars</td></tr>
<tr><td colspan="7">VI. Write the hierarchy of formal languages, grammars and machines.</td></tr>
<tr><td colspan="7">VII. Distinguish between computability and non-computability and Decidability and undecidability.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 10</td><td colspan="5">Title of the unit: Introduction</td></tr>
<tr><td colspan="7">Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of</td></tr>
</table>

languages, Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata.		
Unit – 2	**Number of lectures = 08**	**Title of the unit: Context-free languages and pushdown automata**
Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic pushdown automata, closure properties of CFLs.		
Unit – 3	**Number of lectures = 08**	**Title of the unit: Context-sensitive languages**
Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.		
Unit – 4	**Number of lectures = 10**	**Title of the unit: Turing machines**
Turing machines: The basic model for Turing machines (TM), Turing-recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, TMs as enumerators. Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rice s theorem, undecidable problems about languages.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Text BooksRecommended

I.	K.L.P Mishra, Theory Of Computer Science: Theory, Automata, And Computation,3rd Edition,PHI,2006

14. Reference Books Recommended

I.	John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia, , 3rd Edition,2016
II.	Dexter C. Kozen, Automata and Computability, Undergraduate Texts in Computer Science, Springer.,2007
III.	Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.,3rdEdition ,2014
IV.	John Martin, Introduction to Languages and The Theory of Computation, Tata McGraw Hill.,4th Edition, 2010

Data Communication and Network

1. Name of the Department- CSE						
2. Course Name	**Data Communication and Network**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (√)**	**PE()**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
This course covers the data communication and computer network. The main contents are: LAN, WAN, MAN & wireless networks Laying architecture of networks, OSI model AM, FM and PM Multiple Access protocol-ALOHA network layer addressing Layer-4 protocol TCP & UDP TCP/IP, Protocols, Internet Protocol, Transmission control, User Datagram Protocol, IP Address classes, Subnet addressing, Internet Email-SMTP, POP, IMAP, FTP NNTP, HTTP, SNMP, TELNET. Includes weekly laboratory						
10. Learning Objectives: I. To understand the concepts of data communication and to study the functions of different layers used in communication the data over network. II. To introduce IEEE standards employed in computer networking. To make the students to get familiarized with different protocols and network components.						
10. Course Outcomes (COs):						
I. Understand the computer networks						
II. Design and analyze LAN						
III. Design and analyze WAN						
IV. Design and analyze MAN						
V. Understand OSI, TCP/IP, HTTP etc						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 9**					
Introduction of Computer Networks, description of LAN, WAN, MAN & wireless networks Basic **terminology of computer networks:** - Bandwidth, physical and logical networks, Bridge, switch, HUB, Modem SCU/DSU **OSI Reference Model:** Laying architecture of networks, OSI model, Function of each layer, Services and Protocols of each Layer. **Physical Layer:** Representation of a bit on physical modem that is in wired network, optical network and wireless network, AM,FM and PM. Different types of media –twisted pair unshielded twisted pair, coaxial cable, optical Fiber cable and wireless.						

Unit – 2	Number of lectures = 9	

Data Link Layer: framing error control and flow control. Error detection & correction CRC block codes parity and check sum, elementary data link protocol, sliding window protocol, channel allocation problem-static and dynamic. Multiple Access protocol-ALOHA, CSMA/CU, Token ring, FDDI. **Network Layer:** network layer addressing, network layer datagram, IP addressed Classes. Sub netting-Sub network, Subnet mask, Routing algorithm-optionally principle, Shortest path routing, hierarchical routing, Broadcast routing, Multicast routing, DHCP, Routing protocol.

Unit – 3	Number of lectures = 9	

Transport layer: Layer-4 protocol TCP & UDP. Three-way handshakes open connection. Introduction to Network Management: Remote Monitoring Techniques: Polling, Traps, Performance Management, Introduction to Network Operating System: Client- Server Infrastructure, WINDOWS nt/2000.

Unit – 4	Number of lectures = 9	Title of the unit: Turing machines

TCP/IP: Introduction History of TCP/IP, Protocols, Internet Protocol , Transmission control, User Datagram Protocol , IP Address classes, Subnet addressing ,Internet Email-SMTP, POP, IMAP, FTP NNTP, HTTP, SNMP, TELNET, **Application Layer:** Domain name system, E-mail, File transfer protocol, HTTP, HTTPS, World Wide Web.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Text Books Recommended

I. Computer Networks: Tanenbaum, PHI, New Delhi, 12th Edition, 2020.

14. Reference Books Recommended

I. Data Communication & Networking, Frouzen Tata McGraw Hill Publications, 8th Edition, 2020.

II. Computer Networking: A Top-Down Approach, Kurose James F., Pearson Education; Ninth edition, 2020.

III. Computer Networks - A System Approach, Elsevier; 14th edition, 2020.

Medical Informatics

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Medical Informatics</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">The objective of this paper is to understand the underlying physics of the medical imaging systems and to give an overview of major modern diagnostic imaging technologies. Also, it supports more in depth investigations into radiography and nuclear medicine imaging modalities.</td></tr>
<tr><td colspan="7">11. LearningObjectives:
After the completion of the course, the candidate should be able to:
1. Handle the Biomedical Equipments at all levels used in Health care systems, from simple electronic design to highly sophisticated computerized equipments.
2. Supervise the operation and service of the equipments used in Medical field.
3. Guide specialists in various diagnostic and therapeutic procedures by acquiring sound knowledge of the functioning of Human body.
4. To undertake teaching and research in the Biomedical Engineering field.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">At the end of the course the student able to
1. define commonly used technical terms from Medicine and Biomedical Engineering.
2. describe bio-signals that emanate from the body
3. learn the working principles of blood flow meters and Physiological assist devices
4. describe the engineering principles of commonly used medical devices and medical imaging systems
5. realize safety requirements of biomedical instrumentation</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Basic imaging principle image modalities, Image properties Projection radiography, interaction between X – Rays and matter, Intensity of an X – Ray, Attenuation, X – Ray Generation and Generators, Beam Restrictors and Grids, Intensifying screens, fluorescent screens and image intensifiers, X – Ray, detectors, Conventional X – Ray radiography, Fluoroscopy, Angiography, Digital radiography</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">COMPUTED TOMOGRAPHY 10 hrs. Basic Principle, Generation of CT machines, Detectors & Detector arrays, Details of Acquisition, Digital image display Radiation Dose, Image quality.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">ULTRASOUND 10 hrs. Acoustic propagation, Attenuation, Absorption and Scattering, Ultrasonic transducers, Transducer Arrays, A mode, B mode, M mode scanners, Tissue characterization, Color Doppler flow imaging, Echocardiography.
RADIO NUCLIDE IMAGING 10 hrs. Interaction of nuclear particles and matter, nuclear sources, Radionuclide generators, nuclear radiation detectors, rectilinear scanner, scintillation camera, SPECT,</td></tr>
</table>

PET, Gamma ray camera, LINAC, molecular imaging.		
Unit – 4	**Number of lectures = 9**	
MAGNETIC RESONANCE IMAGING 10 hrs. Angular momentum, Magnetic dipole moment, Magnetization, Larmor frequency Rotating frame of reference, free induction decay, Relaxation times, Pulse sequences, Generation and Detection of NMR Imager, Slice selection, Frequency encoding, Phase encoding, Spin – Echo imaging, Gradient – Echo imaging, Imaging safety, Biological effects of magnetic field, Introduction to FMRI, EMRI.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

1. K Kirk Shung, Michael B smith &Benjamin M W Tsui, “Principles of Medical Imaging”, Academic press inc, 1992.
2. Jerry L Prince & Jonathan M Links, “Medical Imaging Signals and Systems”, Pearson Prentice Hall, 2006.
3. Jerrold T. Bushberg “The essential Physics of Medical Imaging”, Lippincott Williams and Wilkins, 2002.
4. R S Khandpur, “Hand Book of Biomedical Instrumentation”, Tata McGraw Hill Publication, Second Edition. 2003.
5. Ray H. Hashemi, William G. Bradley, Christopher, J. Lisanti, MRI: The Basics, 2004.
6. Frederick W Kremkau “Diagnostic Ultrasound Principles & Instruments”, Saunders Elsevier, 2005.

Data Communication and Network Lab

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Data Communication and Networks Lab</td><td>L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>0</td><td colspan="2">0</td><td>2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core (√)</td><td colspan="2">PE()</td><td>OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td colspan="2">Computer Network Lab</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem () | Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="3">Practical = 24</td></tr>
<tr><td colspan="7">8. Course Description
This course covers the data communication and computer network. The main contents are: LAN, WAN, MAN & wireless networks Laying architecture of networks, OSI model AM, FM and PM Multiple Access protocol-ALOHA network layer addressing Layer-4 protocol TCP & UDP TCP/IP, Protocols, Internet Protocol, Transmission control, User Datagram Protocol, IP Address classes, Subnet addressing, Internet Email-SMTP, POP, IMAP, FTP NNTP, HTTP, SNMP, TELNET. Includes weekly laboratory</td></tr>
<tr><td colspan="7">9. Learning objectives:
Familiarize students with different Networks components such as switch, routers etc. ·
Make them comfortable in socket programming and internet programming.</td></tr>
<tr><td colspan="7">10.Course Outcomes (COs):</td></tr>
<tr><td colspan="7">I. Understand basic Network Commands.</td></tr>
<tr><td colspan="7">II. Understand the basic functioning of Switches and routers etc.</td></tr>
<tr><td colspan="7">III. Understand the functioning of different layers.</td></tr>
<tr><td colspan="7">11. List of Experiments</td></tr>
</table>

1. Introduction to basic Linux networking commands. (Commands ipconfig and getmac)
2. Introduction to basic Linux networking commands. (Commands tracert and pathping)
3. Introduction to basic Linux networking commands. (Commands arp and ping, netstat, finger)
4. Implement bit stuffing.
5. Implement bit de-stuffing
6. Write a program for hamming code generation for error detection
7. Write a program for hamming code generation for error correction
8. Implement cyclic redundancy check (CRC).
9. Write a program for congestion control using the leaky bucket algorithm.

10 Implementation of the link state routing protocols.
11 Implementation of LZW compression algorithms.
12. Implementation of LZW decompression algorithms.

12. Brief Description of self-learning / E-learning component

http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php
http://www.vlab.co.in/broad-area-electronics-and-communications

Essence of Indian Knowledge Tradition

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science Engineering</td></tr>
<tr><td>2.Course Name</td><td>Essence of Indian Traditional Knowledge</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>2</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td>PE ()</td><td>OE ()</td><td colspan="2">MC (✓)</td></tr>
<tr><td>5. Pre-Requisite</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical</td></tr>
<tr><td colspan="3">Lectures = 24</td><td colspan="2">Tutorials = 0</td><td colspan="2">Practical =0</td></tr>
<tr><td colspan="7">8. Course Description:</td></tr>
<tr><td colspan="7">This course contains details about basic structure of Indian knowledge system (Introduction of Ved, Upved, Upang&Vedang), correlation between modern science and Indian Knowledge system, Yoga health care, different philosophical traditions, Indian Linguistic and Artistic tradition and various case studies.</td></tr>
<tr><td colspan="7">9. Learning Objectives:</td></tr>
<tr><td colspan="7">The course aims at imparting:
I. Basic understanding of Indian Society through a process of thought, reasoning and inferencing.
II. Knowledge about the connections between nature and Society
III. Introduction to Yogic health care, Vedic Science and heritage of Sanskrit Language.
IV. Knowledge about Indian Linguistic and artistic heritage.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">I. At the end of this course, the learner will be able to understand, connect up and explain basics of Indian Traditional Knowledge in modern scientific perspective.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td colspan="2">Number of lectures = 06</td><td colspan="4">Title of the unit: Indian Knowledge system</td></tr>
<tr><td colspan="7">Ashthadash Vidya, 4 Veds, 4 UpVeds, 6 Vedangs, 4 Upangs, Historical Background, Indian Contribution to Global Science, Yogic health Care and Vedic science, Case studies</td></tr>
<tr><td>Unit - 2</td><td colspan="2">Number of lectures = 06</td><td colspan="4">Title of the unit: Philosophical Tradition</td></tr>
<tr><td colspan="7">Common themes, Comparison of Indian philosophies like justice, yog, Jain, Baudh, etc. and their Influence</td></tr>
<tr><td>Unit - 3</td><td colspan="2">Number of lectures = 06</td><td colspan="4">Title of the unit: Indian linguistic Tradition</td></tr>
<tr><td colspan="7">Indians Oral Tradition, The Sanskrit intervention, The contemporary linguistic tradition, Vedic literature etc.</td></tr>
<tr><td>Unit - 4</td><td colspan="2">Number of lectures = 06</td><td colspan="4">Title of the unit: Indian Artistic Tradition</td></tr>
<tr><td colspan="7">Early Indian Art, Rock art, Indus Valley art, Buddhist art, Gupta art, Late Medieval period art, Mughal art and Modern art.</td></tr>
<tr><td colspan="7">12. Brief Description of self-learning / E-learning component</td></tr>
<tr><td colspan="7">The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/</td></tr>
<tr><td colspan="7">Journal papers; Patents in the respective field.</td></tr>
</table>

13. Books Recommended	
Text Book:	
I.	V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya,Vidya Bhavan, Mumbai. 5th Edition,2014
Reference Books:	
I.	Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan,2012, **ASIN:** B008V21FOO
II.	Swami Jitatmanand, Holistic Science and Vedant, Bharatiya Vidya Bhavan
III.	Fritzof Capra, Tao ofPhysics
IV.	Fritzof Capra, The Wave of life VN Jha (Eng. Trans.), Tarkasangraha of AnnamBhatta, International Chinmay Foundation, Velliarnad, Arnakulam Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata
V.	GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with VyasaBhashya
VI.	Vidyanidhi Prakashan, Delhi 2016 RN Jha, Science of Consciousness Psycho therapyand Yoga Practices,Vidyanidhi

Semester 6^{th}

Compiler Design

1. Name of the Department: Computer Science & Engineering						
2. Course Name	**Compiler design**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core (√)**	**PE()**		**OE()**	
5. Pre-requisite (if any)	TOC	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description:

It is capable of creating code for a platform other than the one on which the compiler is running.

Source-to-source Compiler or Trans compiler is a compiler that translates source code written in one programming language into source code of another programming language.

9. Learning Objectives:

I. Provide an understanding of the fundamental principles in compilerdesign

II. Provide the skills needed for building compilers for various situations that one may encounter in a career in ComputerScience.

III. Learn the process of translating a modern high-level language to executable code required for compilerconstruction.

10. CourseOutcomes:

At the end of the course student will be able to:

I. Understand fundamentals of compiler and identify the relationships among different phases of the compiler.

II. Understand the application of finite state machines, recursive descent, production rules, parsing, and language semantics.

III. Analyze & implement required module, which may include front-end, back-end, and a small set of middle-end optimizations.

IV. Use modern tools and technologies for designing new compiler.

11. Unit wise detailed content

Unit-1	**Number of lectures =10**	**Title of the unit: Introduction**

Introduction to Compiler, Phases and passes, Bootstrapping, Finite state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX-compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG.

Unit - 2	**Number of lectures =8**	**Title of the unit: Basic Parsing Techniques**

Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR (0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, and implementation of LR parsing tables.

Unit - 3	**Number of lectures = 8**	**Title of the unit: Syntax-directed Translation**

Syntax-directed Translation schemes, Implementation of Syntax directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser. More about translation: Array references in arithmetic expressions, procedures call, declaration sand case statements.		
Unit - 4	**Number of lectures = 10**	**Title of the unit: Symbol Tables**
Data structure for symbols tables, representing scope information. Run-Time Administration: Implementation of simple stack al-location scheme, storage allocation in block structured language. Error Detection & Recovery: Lexical Phase errors, syntactic phase errors semantic errors. **Code Generation:** Selected Topics: Algebraic Computation, Fast Fourier Transform, String Matching, Theory of NP-completeness, Approximation algorithms and Randomized algorithms.		
12. Brief Description of self learning / E-learning component		
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant		
lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/		
13. Text Books Recommended		
I. ALFREDVAUTORAHO, JEFFREYDAUTORULLMAN–Principles of Compiler Design‖. Addison-Wesley, 2002		
14. Reference Books Recommended		
I. Aho,Sethi&Ullman,Compilers: Principles, Techniques and Tools, Pearson Education,2nd edition, 2006		
II. Charles Fischer and Ricard LeBlanc,Crafting a Compiler with C‖, Pearson Education , 1991		
III. V Raghvan, ― Principles of Compiler Design‖, TMH, 2009		

Artificial Intelligence

<table>
<tr><td colspan="9">Name of the Department- Computer Science and Engineering</td></tr>
<tr><td>1.Course Name</td><td>Artificial Intelligence</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>2. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">3. Type of Course (use tick mark)</td><td>Core (√)</td><td colspan="2">PE()</td><td colspan="2">OE ()</td></tr>
<tr><td>4. Pre-requisite (if any)</td><td>Knowledge of linear algebra, developing algorithms</td><td>5. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">6. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">7. Course Description</td></tr>
<tr><td colspan="7">Artificial intelligence (AI) is a research field that studies how to realize the intelligent human behaviors on a computer. The ultimate goal of AI is to make a computer that can learn, plan, and solve problems autonomously.</td></tr>
<tr><td colspan="7">8. Learning objectives:
I. The objective of the course is to present an overview of artificial intelligence (AI) principles and approaches.
II. Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic, and learning. Students will implement a small AI system in a team environment.
III. The knowledge of artificial intelligence plays a considerable role in some applications students develop for courses in the program.</td></tr>
<tr><td colspan="7">9. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">Upon successful completion of this course students will:</td></tr>
<tr><td colspan="7">I. Students will be able to design a knowledge based system,.</td></tr>
<tr><td colspan="7">II. Students have read and analyzed important historical and current trends addressing artificial intelligence.</td></tr>
<tr><td colspan="7">III. Students will be familiar with terminology used in this topical area,</td></tr>
<tr><td colspan="7">10. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 08</td><td colspan="5">Title of the unit: Introduction</td></tr>
<tr><td colspan="7">Describing the eras of computing, difference between deterministic and probabilistic systems, types of AI, main focus of AI, practical applications of AI, machine learning introduction, types of machine learning , neural network introduction, importance, applications, NLP introduction, different NLP processes, tools and services for NLP, identifying NLP use cases, defining CV, history of CV and its advancement with AI , listing tools and services for CV, identifying CV use cases ,what is cognitive computing, characteristics of cognitive systems, the landscape of cognitive computing in the industry.</td></tr>
</table>

Unit – 2	Number of lectures = 10	Title of the unit: IBM Watson
What is IBM Watson, how it works, how Watson technology is made available to developers and organizations, how Watson technology is being applied to solve real world problems Deep QA architecture, why IBM decided to commercialize Watson, evolution of Watson services from the		
original, Deep QA architecture to the present, Recognizing the Watson services available today on the IBM Cloud, Listing the Watson services. **Watson Services:** Capabilities of each Watson service, purpose of training the various Watson services to adapt them to a closed-domain, Listing the Watson services that can be trained, Listing the Watson services that cannot be trained, Describing what Watson Knowledge studio is, Listing the Watson services that can be trained with Watson Knowledge Studio, Using Watson API Explorer to interact with the Watson services REST API, to test your calls to the API, and to view live responses from the server.		
Unit – 3	**Number of lectures = 08**	**Title of the unit: NLP**
What is NLP, different NLP processes, listing tools and services for NLP, Identifying NLP use cases, different components of NLP, challenges within NLP, NLP pipeline, concepts of information extraction and sentiment analysis, capabilities of IBM Watson Natural Language Classifier (NLC) , how to train Watson NLC, capabilities of Watson Natural Language Understanding (NLU) service and its input and output, along with the discovery service, capabilities of the Watson Tone Analyzer service and its input and output, Watson Discovery service instance, Creating a collection, Adding content to a collection, Building queries, Using the DiscoveryAPI.		
Unit – 4	**Number of lectures = 10**	**Title of the unit: Introduction to ChatBot**
What is chatbot, common applications of chatbots, Identifying factors that drive the growing popularity of chatbots, examples of tools and services that you can use to create chatbots, What is a workspace, intent, entity, dialog, dialog nodes, How the nodes in a dialog are triggered, How the dialog flow is processed, The advanced features of a chatbot, Creating a workspace , Defining intents, Defining entities , Building a dialog, Creating a Watson Conversation service instance, Creating a Conversation workspace, Adding intents, Building a dialog, Test in Slack , Defining CV, Know the history of CV and its advancement with AI, Listing tools and services for CV, Identifying CV use cases, Defining the main pipeline within a CV application. Understanding how feature extraction works. Understanding how image classification and recognition works, Defining known techniques and classifiers that are used today for CV, Describing the IBM Watson Visual Recognition service, Listing the features available with Watson Visual Recognition, output provided by the Watson Visual Recognition service, Explaining the capabilities of the default classifier, difference between a default and a custom classifier ,how to train a custom classifier, Creating a Watson Visual Recognition service and obtain the API key value, Using Visual Recognition API methods to: Classifying images, Detecting faces in an image, Recognizing text in an image, Creating and training a custom classifier, Creating Application using Artificial Concepts and IBM Watson, Data Visualization		

11. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/Journal papers;

Patents in the respective field.

12. Books Recommended

I.	The Cambridge Handbook of Artificial Intelligence, Keith Frankish, Cambridge University Press, 2014.
II.	Machine Intelligence: Demystifying Machine Learning, Neural Networks and Deep Learning, Suresh Samudrala, Notion Press; 1 edition,2019.
III.	Artificial Intelligence 3e: A Modern Approach, Russell, Pearson Education India; 3edition, 2015
IV.	ARTIFICIAL INTELLIGENCE Third Edition, Kevin Knight, McGraw Hill Education;3 editions, 2017.

Compiler Design Lab

1.Name of the Department- Computer Science Engineering						
2.Course Name	**Compiler Design Lab**	**L**	**T**		**P**	
3.Course Code		**0**	**0**		**2**	
4.Type of Course (use tick mark)		**Core (√)**	**PE()**		**OE()**	
5.Pre-requisite (if any)		**6.Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lecture = 0		**Tutorials = 0**	**Practical = 48**			
8.Course Description						

10. Learning Objectives

I. Provide an understanding of the fundamental principles in compiler design

II. Provide the skills needed for building compilers for various situations that one may encounter in a career in Computer Science.

III. Learn the process of translating a modern high-level language to executable code required for compiler construction.

10.Course Outcomes (COs):

I. Understand fundamentals of compiler and identify the relationships among different phasesof thecompiler.

II. Understand the application of finite state machines, recursive descent, productionrules, parsing, and language semantics.

III. Analyze & implement required module, which may include front-end, back-end, and a small set of middle-endoptimizations.

List of Experiments	Outcome Covered
1.Practice of LEX/YACC of compiler writing.	I
2. Write a program to check whether a string belong to the grammar or not.	II
3. Write a program to generate a parse tree.	II
4. Write a program to find leading terminals.	III
5. Write a program to find trailing terminals.	III
6. Write a program to compute FIRST of non-terminal.	II
7. Write a program to compute FOLLOW of non-terminal.	II
8. Write a program to check whether a grammar is left Recursion and remove left Recursion.	II
9. Write a program to remove left factoring.	II
10. Write a program to check whether a grammar is operator precedent.	II
11. To show all the operations of a stack.	

Artificial Intelligence Lab

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Artificial Intelligence Lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core (√)**	**PE( )**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 48**			

8. Course Description

9. Learning objectives:

1. To acquire knowledge on intelligent systems and agents, formalization of knowledge, reasoning with and without uncertainty, machine learning and applications at a basic level.
2. To Design appropriate heuristics for a particular problem

10. Course Outcomes (COs):

1. Understand basic principles and techniques of intelligent systems and their practical applications.
2. Formalization and design of systems capable of automated reasoning.
3. Implementation and application of machine learning techniques in prediction problems.
4. Implementation and application of data mining techniques
5. Formalize and implement constraints in search problems

11. List of Experiments

1) Program to implement binary search algorithm.
2) Program to implement quick sort algorithm.
3) Program to implement depth first spanning tree.
4) Program to implement Knapsack problem.
5) Program to implement Strassen Multiplication.
6) Program to implement Matrix Multiplication using Divide and Conquer Approach.
7) Program to implement the Traveling Salesman Problem.
8) Program to implement Depth First Search using Traversal Method.
9) Program to implement Breadth First Search using Traversal Method.
10) Study of Machine Learning and Machine learning algorithms.
11) Program to implement 8 -Queen Problem.
12) Program to implement 15 –Puzzle problem.

12. Brief Description of self-learning / E-learning component

https://nlp-iiith.vlabs.ac.in/

http://vlab.co.in/participating-institute-iiit-hyderabad

Semester 7th

(Industrial Based & Research Based)

Embedded Systems and its Biomedical Applications

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Subject Name</td><td>Embedded Systems and its Biomedical Applications</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3.Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (√)</td><td colspan="2">PE()</td><td colspan="2">OE()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials =0</td><td colspan="4">Practical =0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">9. Course objectives: The students will learn and understand
1. Basic concepts of Embedded Systems
2. Various techniques used for designing an embedded system.
3. Real time system with an examples</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs): On completion of this course, the students will be able to
1. Discuss the basics of embedded systems and its hardware units
2. Identify the various tools and development process of embedded system
3. Demonstrate the various I/O interfacing with microcontroller
4. Create the programming for embedded system design
5. Summarize the real time models, languages and operating systems
6. Design a real time embedded system for biomedical applications.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">System Design</td></tr>
<tr><td colspan="7">Embedded system, Processor embedded into a system, Embedded hardware units and devices in a system, Embedded software in a system, Embedded system architecture, Classifications, Skills required for an embedded system designer. Typical application scenario of embedded systems</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">Embedded Systems Design, Development Process and Tools</td></tr>
<tr><td colspan="7">Complex systems and microprocessor, Design process and metrics in embedded system, Design challenges, Optimizing the design metrics, Issues related to embedded software development, Hardware software codesign, Embedded system design technology, Embedded software development process and tools, Host and Target machine, Linking and Locating Software, Getting embedded software into the target system, Design process</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5">Real World Interfacing</td></tr>
<tr><td colspan="7">Study of microcontroller, Processor and memory organization, Switch, Keypad and LED interfacing, Seven segment display interfacing, Data Acquisition system, A/D, D/A converters, Timers, Counters, Actuators.</td></tr>
<tr><td>Unit – 4</td><td>Number of lectures = 9</td><td colspan="5">Biomedical Applications</td></tr>
<tr><td colspan="7">Body temperature measurement, Stepper motor control. Embedded system in biomedical application Wireless sensor technologies, Body sensor network, Patient monitoring system. Case stud</td></tr>
<tr><td colspan="7">12. Brief Description of self-learning / E-learning component
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/</td></tr>
<tr><td colspan="7">13. Books Recommended</td></tr>
<tr><td colspan="7">Text Books:
1. Raj Kamal, “Embedded Systems Architecture, Programming and Design”, Tata McGrawHill, Second Edition, 2008</td></tr>
</table>

2. Tim Wilhurst, “An Introduction to the Design of Small Scale Embedded Systems, Palgrave, 2004. Reference Books: 1. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2005. 2. Frank Vahid, Tony Givargis, “Embedded Systems Design”, Wiley India, 2006
3. Khandpur R.S, “Hand-book of Biomedical Instrumentation”, Tata McGraw Hill, 2nd Edition, 2003.

Semester 8th

(Research Based)

IPR and Patenting

1. Name of the Department- Computer Science & Engineering					
2. Course Name	**IPR and Patenting**	**L**	**T**	**P**	
3. Course Code		**3**	**0**	**0**	
4. Type of Course (use tick mark)		**Core (√)**	**PE ()**	**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√) / Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)					
Lectures = 36		**Tutorials = 0**	**Practical = 0**		

Course Description:

The course is designed to provide comprehensive knowledge to the students regarding the general principles of IPR, Concept and Theories, Criticisms of Intellectual Property Rights, Issues in IPR and rules of filing Patents.

9. Learning objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

10. Course Outcomes (COs):

1. Understand Intellectual Property assets
2. Assist individuals and organizations in capacity building
3. Work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	**Introduction to Intellectual Property Rights (IPR)**
Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development		
Unit – 2	**Number of lectures = 9**	**Enforcement of Intellectual Property Rights:**
Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement. Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc. Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.		
Unit – 3	**Number of lectures = 9**	**Basics of Patents:**
Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent.		

Patent Rules: Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)

Unit – 4	**Number of lectures = 9**	**Procedure for Filing a Patent (National and International):**
Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication, Time frame and cost, Patent Licensing, Patent Infringement Patent databases: Important websites, Searching international databases.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. LousHarns, 2012, The enforcement of Intellectual Property Rights: A Case Book, 3rd Edition, WIPO Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
7. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
8. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
9. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
10. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
11. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
12. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency

Semester 9th

(Research Based)

Distributed Computing

1. Name of the Department- Computer Science & Engineering						
2. Subject Name	**Distributed Computing**	**L**	**T**		**P**	
3.Course Code		3	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 36		**Tutorials =0**	**Practical =0**			

8. Course Description: The course introduces the main principles underlying distributed systems: processes, communication, naming, synchronization, consistency, fault tolerance, and security. Students will be familiar with some of the main paradigms in distributed systems: object-based systems, file systems, web-based and coordination-based systems. On the completion of the unit, students will understand the fundamentals of distributed computing and be able to design and develop distributed systems and applications.

9. Course objectives: The students will learn and understand

1. To provide students with contemporary knowledge in distributed systems
2. To equip students with skills to analyze and design distributed applications.
3. To provide master skills to measure the performance of distributed synchronization algorithms

10. Course Outcomes (COs): On completion of this course, the students will be able to

1. Demonstrate knowledge of the basic elements and concepts related to distributed system technologies;
2. Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object based middleware.
3. Analyze the various techniques used for clock synchronization and mutual exclusion
4. Demonstrate the concepts of Resource and Process management and synchronization algorithms
5. Demonstrate the concepts of Consistency and Replication Management
6. Apply the knowledge of Distributed File System to analyze various file systems like NFS, AFS and the experience in building large-scale distributed applications.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	**Introduction to Distributed Systems**

Characterization of Distributed Systems: Issues, Goals, and Types of distributed systems, Distributed System Models, Hardware concepts, Software Concept.
Middleware: Models of Middleware, Services offered by middleware, Client Server model.

Unit – 2	**Number of lectures = 9**	**Communication**

Layered Protocols, Inter process communication (IPC): MPI, Remote Procedure Call (RPC), Remote Object Invocation, Remote Method Invocation (RMI).
Message Oriented Communication, Stream Oriented Communication, Group Communication.

Unit – 3	**Number of lectures = 9**	**Synchronization**

Clock Synchronization, Logical Clocks, Election Algorithms, Mutual Exclusion, Distributed Mutual Exclusion-Classification of mutual Exclusion Algorithm, Requirements of Mutual Exclusion Algorithms, Performance measure.
Non Token based Algorithms: Lamport Algorithm, Ricart–Agrawal's Algorithm, Maekawa's Algorithm.
Token Based Algorithms: Suzuki-Kasami's Broadcast Algorithms, Singhal's Heuristic Algorithm, Raymond's Tree based Algorithm, Comparative Performance Analysis

Unit – 4	**Number of lectures = 9**	**Resource and Process Management**

Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach.

Introduction to process management, process migration, Threads, University of Mumbai, B. E. (Computer Engineering), Rev. 2016 114 Virtualization, Clients, Servers, Code Migration.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal.

13. Books Recommended

Text Books:

1. Andrew S. Tanenbaum and Maarten Van Steen, ―Distributed Systems: Principles and Paradigms, 2nd edition, Pearson Education.
2. George Coulouris, Jean Dollimore, Tim Kindberg, "Distributed Systems: Concepts and Design", 4th Edition, Pearson Education, 2005.

Reference Books:

1. A. S. Tanenbaum and M. V. Steen, "Distributed Systems: Principles and Paradigms", Second Edition, Prentice Hall, 2006.
2. M. L. Liu, ―Distributed Computing Principles and Applications‖, Pearson Addison Wesley, 2004

AI & Soft Computing

1. Name of the Department- Computer Science & Engineering						
2. Subject Name	**AI & Soft Computing**	**L**	**T**		**P**	
3.Course Code		3	0		0	
4. Type of Course (use tick mark)		**Core (√)**	**PE()**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 36		**Tutorials =0**	**Practical =0**			

8. Course Description: This course enables learning on different graph traversal techniques (BFS & DFS) along with enhanced search algorithms like A* algorithm. Genetic algorithms are discussed along with Min-Max algorithms. Expert systems also discussed in detail along with Fuzzy logic in SC.

9. Course objectives: The students will learn and understand

1. To conceptualize the basic ideas and techniques of AI and SC.
2. To distinguish various search techniques and to make student understand knowledge representation and planning.
3. To become familiar with basics of Neural Networks and Fuzzy Logic.
4. To familiarize with Hybrid systems and to build expert system.

10. Course Outcomes (COs): On completion of this course, the students will be able to

1. Identify the various characteristics of Artificial Intelligence and Soft Computing techniques.
2. Choose an appropriate problem solving method for an agent to find a sequence of actions to reach the goal state.
3. Analyze the strength and weakness of AI approaches to knowledge representation, reasoning and planning.
4. Construct supervised and unsupervised ANN for real world applications.
5. Design fuzzy controller system. 6 Apply Hybrid approach for expert system design.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	Introduction to Artificial Intelligence(AI) and Soft Computing
Intelligent Agents: Agents and Environments, Rationality, Nature of Environment, Structure of Agent, types of Agent Soft Computing: Introduction of soft computing, soft computing vs. hard computing, various types of soft computing techniques.		
Unit – 2	**Number of lectures = 9**	Problem Solving
Problem Solving Agent, Formulating Problems, Example Problems Uninformed Search Methods: Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Method: A* Search Optimization Problems: Hill climbing Search, Simulated annealing, Genetic algorithm		
Unit – 3	**Number of lectures = 9**	Knowledge, Reasoning and Planning
Knowledge based agents, First order logic: syntax and Semantic, Knowledge Engineering in FOL Inference in FOL: Unification, Forward Chaining, Backward Chaining and Resolution. Planning Agent, Types of Planning: Partial Order, Hierarchical Order, Conditional Order.		
Unit – 4	**Number of lectures = 9**	Fuzzy Logic & Expert System

Introduction to Fuzzy Set: Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, membership functions, Fuzzy Logic: Fuzzy Logic basics, Fuzzy Rules and Fuzzy Reasoning.

Fuzzy inference systems: Fuzzification of input variables, Defuzzification and fuzzy controllers.

Expert system : Introduction, Characteristics, Architecture, Stages in the development of expert system

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal.

13. Books Recommended

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence a Modern Approach ―Second Edition" Pearson Education.
2. Samir Roy and Chakraborty, ―Introduction to soft computing‖, Pearson Edition.
3. S.N.Sivanandam, S.N.Deepa "Principles of Soft Computing" Second Edition, Wiley Publication.
4. S.Rajasekaran and G.A.VijayalakshmiPai "Neural Networks, Fuzzy Logic and Genetic Algorithms" PHI Learning.
5. N.P.Padhy, ―Artificial Intelligence and Intelligent Systems‖, Oxford University Press.

Reference Books:

1. Elaine Rich and Kevin Knight ―Artificial Intelligence‖ Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
2. Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill.
3. Zimmermann H.S "Fuzzy Set Theory and its Applications"Kluwer Academic Publishers.
4. Hagan, Demuth, Beale,"Neural Network Design" CENGAGE Learning, India Edition.
5. J.-S.R.Jang "Neuro-Fuzzy and Soft Computing" PHI 2003.
6. JacekM.Zurada "Introduction to Artificial Neural Sytems" Jaico Publishing House.

Distributed Computing Lab

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Distributed Computing Lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core (✓)**	**PE ()**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even	Odd (✓)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 24**			

Course Description:

The course introduces the main principles underlying distributed systems: processes, communication, naming, synchronization, consistency, fault tolerance, and security. Students will be familiar with some of the main paradigms in distributed systems: object-based systems, file systems, web-based and coordination-based systems. On the completion of the unit, students will understand the fundamentals of distributed computing and be able to design and develop distributed systems and applications.

9. Learning objectives:

1. To provide students with contemporary knowledge in distributed systems
2. To equip students with skills to analyze and design distributed applications.
3. To provide master skills to measure the performance of distributed synchronization algorithms.

10. Course Outcomes (COs):

1. Demonstrate knowledge of the basic elements and concepts related to distributed system technologies;
2. Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object based middleware.
3. Analyze the various techniques used for clock synchronization and mutual exclusion
4. Demonstrate the concepts of Resource and Process management and synchronization algorithms
5. Demonstrate the concepts of Consistency and Replication Management
6. Apply the knowledge of Distributed File System to analyze various file systems like NFS, AFS and the experience in building large-scale distributed applications.

11. List of Experiment

1. Client/server using RPC/RMI.
2. Implementation of multi tread application
3. Inter-process communication
4. Group Communication
5. Load Balancing Algorithm.
6. Name Resolution protocol.
7. Election Algorithm.
8. Clock Synchronization algorithms.
9. Mutual Exclusion Algorithm.
10. Deadlock management in Distributed systems
11. Distributed File System
12. CORBA

AI & Soft Computing Lab

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>AI & Soft Computing Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (✓)</td><td colspan="2">PE ()</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
</table>

Course Description:

This course enables learning on different graph traversal techniques (BFS & DFS) along with enhanced search algorithms like A* algorithm. Genetic algorithms are discussed along with Min-Max algorithms.

Expert systems also discussed in detail along with Fuzzy logic in SC.

10. Learning objectives:

1. To conceptualize the basic ideas and techniques of AI and SC.
2. To distinguish various search techniques and to make student understand knowledge representation and planning.
3. To become familiar with basics of Neural Networks and Fuzzy Logic.
4. To familiarize with Hybrid systems and to build expert system.

10. Course Outcomes (COs):

1. To realize the basic techniques to build intelligent systems
2. To create knowledge base and apply appropriate search techniques used in problem solving.
3. Apply the supervised/unsupervised learning algorithm.
4. Design fuzzy controller system.

11. List of Experiment

1. Identify the problem PEAS Description• Problem formulation•
2. Introduce AI programming Language
3. Start Implementation Knowledge Representation and Create• Knowledge Base
4. Implement search algorithms to reach goal state
5. To implement Mc-Culloch Pitts Model for a problem
6. To implement Fuzzy Controller system
7. To implement Basic Supervised / Unsupervised Neural Network learning rules for a problem
8. Case study on Hybrid Systems
9. Case study of an Application

	List of Department Electives					
Specialization	**Block Chain**	**Internet of Things**	**Cyber Security & Forensics**	**Bio Informatics**	**Full Stack Developer**	**Electronics**
DE-I	Programming Language – Python	Wireless Ad-hoc and sensor Networks	Programming Language – Python	Fundamental Biology	Programming Language –Python	Digital Devices Development
DE-II	Introduction to Blockchain	Embedded System Architecture	Network Security	Cell and Molecular Biology	Basics of Front End Development	PIC Microcontroller Programming
DE-III	Blockchain Architecture Design and Use Cases	Introduction to Cloud Computing	Cryptography Fundamentals	Analytical Bio Informatics	Software Design	IoT Inerfacing with Arduino
DE-IV	Crypto Currency Technologies	Sensors and Actuator Devices	Cyber Security	Biological Database	ReactJS Development	Instrumentation Engg
DE-V	Blockchain and Distributed Ledger Technology	Software defined Networks	Disaster recovery and business continuity management	System Biology	UI / UX Design	Biomedical Image Processing
DE-VI	Cryptography	Architecting smart IoT Devices	Android Security	Computational biology	The Web Developer Bootcamp	Wireless Sensor Network
DE-VII	Public Blockchain-Ethereum	Design of Smart Systems	Digital Watermarking and Steganography	Molecular modelling and drug design	Backend Development	Speech Processing
DE-VIII	Bitcoin Mining	Cognitive IoT	Biometrics	Bio inspired Computing	Basics of DevOps & Deployment	5G: Architecture & Technology
DE-IX	Design and Development of Blockchain Applications	Application of IoT in Robotics	Mobile Application Security & Penetration Testing	Dataware housing and Mining for Bioinformatics	Mobile App Development	ARM Processor
DE-X	Emerging areas in Blockchain	Data Sciences in IOT	Cyber Forensics and investigation	Machine Learning for Bioinformatics	Big Data	Real Time Embedded System
DE-XI	Programming Fundamentals : Golang and Solidity	Privacy & Security in IoT	Risk Analysis and Assessment	Computer Aided Drug Design	Cloud Application Development & Deployment	VLSI Design
DE-XII	Blockchain for Cyber Security	Internet of things sensing and actuatur devices	Cloud Security Essentials	Bioprocess Engineering	Virtualization and Cloud Computing	Signal & System

Block Chain

Programming Language- Python

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2.Course Name</td><td>Programming Language – Python</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">EAS ()</td><td colspan="2">BSE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Operating System</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (□)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
</table>

Course Rationale: The course begins with the concepts of Python Programming Language with Libraries.

Course Objectives:

Objectives: The objective of this course is to teach students the concepts of Python Programming Language with Libraries.

Learning & Course Outcomes:

On completion of this course, the students are expected to learn
1. Python programming, Data Structure.
2. Learn Libraries Numpy, Pandas with the use of Data Analysis.

UNIT – I

Python programming Basic: Python interpreter, I Python Basics, Tab completion, Introspection, %run command, magic commands, matplotlib integration, python programming, language semantics, scalar types. Control flow

Data Structure, functions, files: tuple, list, built-in sequence function, dict, set, functions, namescape, scope, local function, returning multiple values, functions are objects, lambda functions, error and exception handling, file and operation systems

UNIT – II

NumPy: Array and vectorized computation: Multidimensional array object. Creating ndarrays, arithmetic with numpy array, basic indexing and slicing, Boolean indexing, transposing array and swapping axes, universal functions, array-oriented programming with arrays, conditional logic as arrays operations, file input and output with array

Pandas: Pandas data structure, series, DataFrame, Index Object, Reindexing, dropping entities from an axis, indexing, selection and filtering, integer indexes, arithmetic and data alignment, function application and mapping, soring and ranking, correlation and covariance, unique values, values controls and membership, reading and writing data in text format

UNIT –III

Visualization with Matplotlib: Figures and subplots, colors, markers, line style, ticks, labels, legends, annotation and drawing on sublots, matplotlib configuration

UNIT –IV

Plotting with pandas and seaborn: line plots, bar plots, histogram, density plots, scatter and point plots, facet grids and categorical data

Reference Books:

- Learning Python: Powerful Object-Oriented Programming by Lutz M - Shroff; Fifthedition
- Python: The Complete Reference by Martin C. Brown - McGraw Hill Education; Forthedition
- Pandas for Everyone: Python Data Analysis by Daniel Y. Chen - Pearson Education; Firstedition

Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

Programming in Python Lab

1. Name of the Department: CSE						
2. Course Name	**Programming in Python Lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 00		**Tutorials = 0**	**Practical = 48**			

Python is next generation multi-purpose programming language that allows different users to create applications of various domains. Students will be able to learn primary fundamentals of python programming and potential of python is to achieve modern computing requirements.

8. Learningobjectives:

1. Master the fundamentals of writing Pythonscripts.
2. Learn core Python scripting elements such as variables and flow controlstructures.
3. Discover how to work with lists and sequencedata.
4. Write Python functions to facilitate codereuse.
5. Use Python to read and writefiles

9. CourseOutcomes:

After completion of this course, student will be able to
1. To learn basics ofPython
2. To develop console application in python
3. To develop database application inpython
4. To develop basic machine learningapplication

List of Experiments	**Outcome Covered**
1. Implement a Python program to Calculate GCD of two numbers.	I
2. Implement a Python Program to calculate the square root of a number by Newton's Method.	I
3. Implement a Python program to calculate the exponentiation of a number.	II
4. Implement a Python Program to calculate the maximum from a list of numbers.	III

5. Implement a Python Program to perform Search	II
6. Implement a Python Program to perform Liner search	IV
7. Implement a Python Program to perform Binary search	III
8. Implement a Python Program to perform insertion sort.	II
9. Implement a Python Program to perform selection sort.	IV
10. Implement a Python program to multiply matrices.	III
11. Implement a Python program to Calculate the most frequent words in a text read from a file.	II
12. Implement function overloading with different function signatures.	IV
13. Implement concept of class, instances and inheritance.	IV
14. Implement internal and external library.	III
15. Solve algorithmic problems by program using different problem-solving strategies.	III
16. Search content using regular expression library in python.	IV
17. Implement Matrix multiplication using multi-threading in python	III

Introduction to BlockChain

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Introduction to BlockChain**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)	Basic Programming & Cryptography	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

The course begins with the introduction of Blockchain Technology which is widely utilized in all engineering applications. The students are then introduced to the concept of Decentralization, on which Blockchain Technology Works. The course further emphasizes on the concept of Smart Contract, Digital Identity, and Bitcoin. Then the students are introduced about the implementation of Ethereum and Solidity in Blockchain Technology.

9. LearningObjectives:

1. Impart strong technical understanding of Blockchain technologies
2. Learn how the individual components of the Bitcoin protocol make the whole system tick: transactions, script, blocks, and the peer-to-peer network.
3. Discuss a few of the many best practices exclusive to smart contracts and Dapps that will improve your basic Dapp design.

10. Course Outcomes (COs):

The students will be able to:-

1. Blockchain Technology landscape
2. How Bitcoins works in practice: its storage, security measures, and types of services
3. How to build & test compelling blockchain applications using the Ethereum Blockchain

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	Introduction to Blockchain Technology

The growth of blockchain technology, Distributed systems, The history of blockchain and Bitcoin, Electronic cash, Blockchain, Peer-to-peer, Distributed ledger, Cryptographically-secure, Append-only, Updateable via consensus, Generic elements of a blockchain, How blockchain works, How blockchain accumulatesblocks, Benefits and limitations of blockchain, Tiers of blockchain technology, Features of a blockchain, Types of blockchain, Distributed ledgers, Distributed Ledger Technology, Public blockchains, Private blockchains, Semiprivate blockchains, Sidechains, Permissioned ledger, Shared ledger, Fully private and proprietary blockchains, Tokenized blockchains, Tokenless blockchains, Consensus, Consensus mechanism, Types of consensus mechanisms, Consensus in blockchain, CAP theorem and blockchain. Decentralization using blockchain, Methods of decentralization, Routes to decentralization, Blockchain and full ecosystem decentralization, Smart contracts, Decentralized Organizations, Platforms for decentralization

Unit – 2	**Number of lectures = 9**	Satoshi’s Bitcoin

What Is Bitcoin?, History of Bitcoin, Bitcoin Uses, Users, and Their Stories, Getting Started. How Bitcoin Works: Transactions, Blocks, Mining, and the Blockchain, Bitcoin Transactions, Constructing a Transaction, Bitcoin Mining, Mining Transactions in Blocks, Spending the Transaction. Introduction, Bitcoin Addresses, Implementing Keys and Addresses in Python, Wallets, Advanced Keys and Addresses. Introduction, Transaction Lifecycle, Transaction Structure, Transaction Outputs and Inputs, Transaction Chaining and Orphan Transactions, Transaction Scripts and Script Language, Standard Transactions		
Unit – 3	**Number of lectures = 9**	**The Bitcoin Network** and Advanced Theories
Nodes Types and Roles, The Extended Bitcoin Network, Network Discovery, Full Nodes, Exchanging "Inventory", Simplified Payment Verification (SPV) Nodes. EthereumBasics :Components of a Blockchain, The Birth of Ethereum, Ethereum's Four Stages of Development, Ethereum: A General-Purpose Blockchain, Ethereum's Components, Ethereum and Turing Completeness, From General-Purpose Blockchains to DecentralizedApplications (DApps), The Third Age of the Internet, Ethereum's Development Culture, Why Learn Ethereum? Ether Currency Units, Choosing an Ethereum Wallet, Control and Responsibility, Getting Started with MetaMask		
Unit – 4	**Number of lectures = 9**	Ethereum Clients
Ethereum Networks, Running an Ethereum Client, The First Synchronization of Ethereum-Based Blockchains, Remote Ethereum Clients.Smart Contracts and Solidity:What Is a Smart Contract?, Life Cycle of a Smart Contract, Introduction to Ethereum High-Level Languages, Building a Smart Contract with Solidity, The Ethereum Contract ABI, Programming with Solidity, Gas Considerations, Vulnerabilities and Vyper, Comparison to Solidity, Decorators, Function and Variable Ordering, Compilation, Protecting Against Overflow Errors at the Compiler Level, Reading and Writing		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", Packt Publishing, 2018.
- Andreas M. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Publications, 2nd Edition.
- Melanie Swan, "Blockchain: Blueprint for a new economy", O'Reilly Publications, First Edition.

14. Reference Books

- Mark Gates, " Ethereum: Complete Guide to Understanding Ethereum, Blockchain, Smart Contracts, ICOs, and Decentralized Apps", Inverted Forest Publishing, 2016
- Chris Dannen, "Introducing Ethereum and Solidity", APress Publishing, 2017.
- EladErom, "The Blockchain Developer", APress Publishing, 2017
- Andreas M. Antonopoulos, "Mastering Bitcoin: Programming the Open Blockchain", O'Reilly Publications, First Edition

Blockchain Architecture Design and Use Cases

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Blockchain Architecture Design and Use Cases**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

The primary objective of this course is to make the students familiar with such emerging technologies. Students are expected to understand the cryptographic concept behind the Blockchain technology and differentiate the technical aspect of Blockchain with that of Bitcoin commercial aspect. Students are supposed to understand and learn the use-cases and applications aspects of blockchain with implementation options

4. **LearningObjectives:**
1. Understand the difference between Blockchain and Bitcoin
2. Understand the strength and limitations of Blockchain
3. Understand the Application domain and use-cases of Blockchain
4. Understand consensus mechanism and mining process in Blockchain
5. Implement small Blockchain experimentations
6. Have introductory knowledge about Ethereum and Solidity

10. Course Outcomes (COs):

The students will be able to:-
1. Understand the concept of cryptocurrency and security features blockchain
2. Understand the concept of consensus mechanism and permissioned blockchain.
3. Practical applications of the blockchain in various domains.
4. Understand the concept of hyperleger,

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

Introduction to Blockchain: Digital Money to Distributed Ledgers , Design Primitives: Protocols, Security, Consensus, Permissions, Privacy. Blockchain Architecture and Design: Basic crypto primitives: Hash, Signature,) Hashchain to Blockchain, Basic consensus mechanisms.

Unit – 2	**Number of lectures = 9**	

Consensus: Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Blockchain consensus protocols Permissioned Blockchains: Design goals, Consensus protocols for Permissioned Blockchains Mining: What is mining, Mining Difficulty, Miner, Mining pool, Mining pool methods

Unit – 3	**Number of lectures = 9**	

Hyperledger Fabric (A): Decomposing the consensus process, Hyperledger fabric components, Chaincode Design and Implementation

Hyperledger Fabric (B): Beyond Chaincode: fabric SDK and Front End (b) Hyperledger composer tool

Unit – 4	**Number of lectures = 9**	

Use case 1 : Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance Use case 2: Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc Use case 3: Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems Blockchain Cryptography, Privacy and Security on Blockchain
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/
13. Books Recommended
Text Books • Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
14. Reference Books
• Blockchain by Melanie Swa, O'Reilly • Hyperledger Fabric - https://www.hyperledger.org/projects/fabric 4. • Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

Blockchain Architecture Design and Use Cases Lab

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Blockchain Architecture Design and Use Cases Lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 48**			

8. Course Description

Learning objectives:

1. Impart strong technical understanding of Blockchain technologies
2. Introduce application areas, current practices, and research activity
3. Develop familiarity of current technologies, tools, and implementation strategies

9. Course Outcomes (COs):

1. Blockchain technology landscape
2. Applications and implementation strategies
3. Implementation and application of blockchain
4. Understand the State-of-the-art, open research challenges, and future direction

10. List of Experiments

1) Basic Cryptography Concepts for Blockchain
2) Overview of Blockchain
3) Creating and Building Up Bitcoin Wallet.
4) Building a Private Ethereum Network and Deploying Smart Contract
5) Introduction to Solidity.
6) Ethereum Smart Contract
7) CLUSTERING MODEL
8) Creating and Building Up Crypto Token.
9) Creating a Business Network using Hyperledger.
10) Simple Project on Data Pre-processingHyperledger.

11. Brief Description of self-learning / E-learning component

https://nlp-iiith.vlabs.ac.in/

http://vlab.co.in/participating-institute-iiit-hyderabad

Crypto Currency Technologies

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Crypto Currency Technologies</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2"></td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course aims to introduce interested students to cryptographic primitives, demonstrate how cryptographic primitives can be leveraged to construct secure electronic currencies like Bitcoin, and explore howthe core principles can be leveraged in other areas and future pursuits..</td></tr>
<tr><td colspan="7">9. LearningObjectives:
1. To learn the fundamentals of Blockchain.
2. To obtain knowledge about technologies of Blockchain.
3. To incorporate the models of Blockchain- Ethereum.
4. To learn the models of Hyperledger Fabric.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Define and Explain the fundamentals of Cryptocurrency
2. Illustrate the technologies of Cryptocurrency
3. Describe the models of Cryptocurrency
4. Analyze and demonstrate the CryptocurrencY</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction to Cryptography
Digital Signatures, Cryptographic Hash Functions

Cryptographic Data Structures
Hash Pointers, Append-Only Ledgers (Block Chains), Merkle Trees</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Bitcoin's Protocol
Keys as Identities, Simple Cryptocurrencies, Decentralization through Distributed Consensus Incentives, Proof of Work (Mining), Application-Specic Integrated Circuit (ASIC) Mining and ASIC-resistant Mining, Virtual Mining (Peercoin)</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

Engineering Details
Bitcoin Blocks, Hot and Cold Storage, Splitting and Sharing Keys, Proof of Reserve, Proof of Liabilities

Anonymity, Pseudonymity, Unlinkability
Statistical Attacks (Transaction Graph Analysis), Network-layer De-anonymization, Chaum's Blind Signatures, Single Mix and Mix Chains, Decentralized Mixing, Zero-Knowledge Proof, Cryptocurrencies

Unit – 4	**Number of lectures = 9**	

Cryptocurrency Technologies
Smart Property, Ecient micro-payments, Coupling Transactions and Payment (Interdependent Transactions), Public Randomness Source, Prediction Markets, Escrow transactions, Green addresses, Auctions and Markets, Multi-party Lotteries

12. Brief Description of self-learning / E-learning component
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Bitcoin and Cryptocurrency Technologies. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder and Jeremy Clark.

14. Reference Books

- Bitcoin: A Peer-to-Peer Electronic Cash System. Satoshi Nakamoto.
- How the Bitcoin protocol actually works. Michael Nielsen.

Blockchain and Distributed Ledger Technology

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Blockchain and Distributed Ledger Technology</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Blockchain technology and distributed ledgers have been hailed as a turning point in scaling information technology services at a global level. Although the digital currency Bitcoin is the best-known Blockchain application today, the technology is set to play a much broader role in cyber security innovation.</td></tr>
<tr><td colspan="7">10. LearningObjectives:

1. Understand what is a blockchain and a distributed ledger
2. Develop or extend the ability to think critically about cybersecurity
3. Understand the challenges of scaling information technology services across organizational barriers and at a global level.
4. Analyse the security of basic cryptographic primitives like hash functions and digital signatures</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">1. Understand how blockchain systems (mainly Bitcoin and Ethereum) work.
2. To securely interact with them.
3. Design, build, and deploy smart contracts and distributed applications.
4. Integrate ideas from blockchain technology into their own projects</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">Introduction to Blockchain Technology</td></tr>
<tr><td colspan="7">Introduction to Blockchain
Blockchain concepts, evolution, structure, characteristics, a sample blockchain application, the blockchain stack, benefits and challenges, What is a Blockchain, Public Ledgers, Blocks in a Blockchain, Blockchains as public ledgers, Transactions, Distributed consensus. Building a block: Elements of Cryptography-Cryptographic Hash functions, Merkle Tree, Elements of Game Theory.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">Satoshi’s Bitcoin</td></tr>
<tr><td colspan="7">Blockchain Architecture and Use cases
Design methodology for blockchain applications, blockchain application templates, blockchain application development, Ethereum, Solidity, Sample use cases from Industries, Business problems.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5">The Bitcoin Network and Advanced Theories</td></tr>
<tr><td colspan="7">Decentralized applications (Dapps)
Dapps, implementing Dapps, Ethereum Dapps, case studies related to Dapps, Byzantine fault tolerance, proof-of-work vs proof-of-stake, Security and Privacy of Blockchains, smart contract vulnerabilities, Scalability of Blockchains</td></tr>
</table>

Unit – 4	Number of lectures = 9	Ethereum Clients

Distributed Ledger Technology

Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Text Books

Blockchain applications: a hands-on approach, Bahga A., Madisetti V., VPT, 2017.

14. Reference Books

1. Beginning Blockchain, A Beginner's Guide to Building Blockchain Solutions, Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress, 2018.
2. Blockchain A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph J. Bambara and Paul R. Allen, McGraw Hill, 2018.
3. Blockchain enabled Applications Vikram Dhillon, David Metcalf and Max Hooper, Apress, 2017,
4. The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology, William Mougayar, Wiley, 2016.
5. Blockchain Science: Distributed Ledger Technology, Roger Wattenhofer, Inverted Forest Publishing; 3rd edition, 2019.

Cryptography

1. Name of the Department- Computer Science & Engineering							
2. Course Name	Cryptography	**L**	**T**		**P**		
3. Course Code		**3**	**0**		**0**		
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**		
5. Pre-requisite (if any)	Some expertise in a programming language, like C, C++, Python, Java, etc	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem()	Every Sem ()	
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)							
Lectures = 36		**Tutorials = 0**	**Practical = 0**				
8. Course Description							
1. Discuss the cryptography and its need to various applications **2.** Design and Develop simple cryptography algorithms **3.** Understand the cyber security and need cyber Law							
11. LearningObjectives: 1. Learn the main areas of Modern Cryptography, including their main problem statements and the rigorous mathematical approaches used to formalize them 2. Learn and describe how various cryptographic algorithms and protocols work, pointing out the main techniques used in them, and proving/disproving most basic properties, such as correctness of decryption, digital signatures, authentication tags, and key agreement							
10. Course Outcomes (COs):							
The students will be able to:- **1.** Evaluate functionality, security and performance properties of cryptography methods used as components of complex security solutions **2.** Analyze the impact of errors or different designs of cryptography algorithms and protocols 5. Describe the applications of cryptography algorithms and protocols to real-life problems and many implementation issues in developing these solutions							
11. Unit wise detailed content							
Unit-1	**Number of lectures = 9**						
Introduction - Cyber Attacks, Defence Strategies and Techniques, Guiding Principles, Mathematical Background for Cryptography - Modulo Arithmetic's, The Greatest Comma Divisor, Useful Algebraic Structures, Chinese Remainder Theorem, Basics of Cryptography - Preliminaries, Elementary Substitution Ciphers, Elementary Transport Ciphers, Other Cipher Properties, Secret Key Cryptography – Product Ciphers, DES Construction.							
Unit – 2	**Number of lectures = 9**						
Public Key Cryptography and RSA – RSA Operations, Why Does RSA Work?, Performance, Applications, Practical Issues, Public Key Cryptography Standard (PKCS), Cryptographic Hash - Introduction, Properties, Construction, Applications and Performance, The Birthday Attack, Discrete Logarithm and its Applications - Introduction, Diffie-Hellman Key Exchange, Other Applications.							
Unit – 3	**Number of lectures = 9**						

IEEE 802.11 Wireless LAN Security - Background, Authentication, Confidentiality and Integrity, Viruses, Worms, and Other Malware, Firewalls – Basics, Practical Issues, Intrusion Prevention and Detection - Introduction, Prevention Versus Detection.		
Unit – 4	**Number of lectures = 9**	
Types of Instruction Detection Systems, DDoS Attacks Prevention/Detection, Web Service Security – Motivation, Technologies for Web Services, WS- Security, SAML, Other Standards. Network service providers not to be liable in certain cases, Miscellaneous Provisions.		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/		
13. Books Recommended		
Text Books 1. Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition (Chapters-1,3,4,5,6,7,8,9,10,11,12,13,14,15,19(19.1- 19.5),21(21.1-21.2),22(22.1-22.4),25		

Cryptography lab

1. Name of the Department: Computer Science & Engineering						
2. Course Name	**Cryptography lab**	**L (0)**	**T (0)**		**P (2)**	
3. Course Code						
4. Type of Course (use tick mark)		**Core ()**	**EAS ()**		**BSC ()**	
Pre-requisite (if any)		**Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 48**			

8. Brief Syllabus

1. Discuss the cryptography and its need to various applications
2. Design and Develop simple cryptography algorithms

Understand the cyber security and need cyber Law

9. Learning Objectives:

1. Learn the main areas of Modern Cryptography, including their main problem statements and the rigorous mathematical approaches used to formalize them
2. Learn and describe how various cryptographic algorithms and protocols work, pointing out the main techniques used in them, and proving/disproving most basic properties, such as correctness of decryption, digital signatures, authentication tags, and key agreement

10 Course Outcomes (COs):

The students will be able to:-

1. Evaluate functionality, security and performance properties of cryptography methods used as components of complex security solutions

2. Analyze the impact of errors or different designs of cryptography algorithms and protocols 5. Describe the applications of cryptography algorithms and protocols to real-life problems and many implementation issues in developing these solutions

11. Lab Experiment

Sr. No.	**Title**	**CO covered**
1	Implementation of Caesar Cipher technique	**ii**
2	Implement the Play fair Cipher	**ii**
3	Implement the Pure Transposition Ciphe	**i**
4	Implement DES Encryption and Decryption	**i**

5	Implement the AES Encryption and decryption	**i**
6	Implement RSA Encryption Algorithm	**iii**

12. Brief Description of self-learning / E-learning component

http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/index.php

Public Blockchain- Ethereum

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Public Blockchain-Ethereum</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course is intended to study the basics of Blockchain technology. During this course learner will explore various aspects of Blockchain technology like application in various domains. By implementing learner will have idea about private and public Blockchain, and smart contract</td></tr>
<tr><td colspan="7">9.LearningObjectives:
1. Impart strong technical understanding of Blockchain technologies
2. Learn how the individual components of the Bitcoin protocol make the whole system tick: transactions, script, blocks, and the peer-to-peer network.
3. Discuss a few of the many best practices exclusive to smart contracts and Dapps that will improve your basic Dapp design.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Understand and explore the working of Blockchain technology (Understanding)
2. Analyze the working of Smart Contracts (Analyze)
3. Apply the learning of solidity and de-centralized apps on Ethereum (Apply).</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">Introduction of Cryptography and Blockchain:</td></tr>
<tr><td colspan="7">What is Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions And Blocks, P2P Systems, Keys As Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">BitCoin and Cryptocurrency:</td></tr>
<tr><td colspan="7">What is Bitcoin, The Bitcoin Network, The Bitcoin Mining Process, Mining Developments, Bitcoin Wallets, Decentralization and Hard Forks, Ethereum Virtual Machine (EVM), Merkle Tree, Double-Spend Problem, Blockchain And Digital Currency, Transactional Blocks, Impact Of Blockchain Technology On Cryptocurrency.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5">Introduction to Ethereum:</td></tr>
<tr><td colspan="7">What is Ethereum, Introduction to Ethereum, Consensus Mechanisms, How Smart Contracts Work, Metamask Setup, Ethereum Accounts, Receiving Ether’s What's a Transaction?, Smart Contracts.</td></tr>
<tr><td>Unit – 4</td><td>Number of lectures = 9</td><td colspan="5">Ethereum Clients</td></tr>
</table>

Ethereum Networks, Running an Ethereum Client, The First Synchronization of Ethereum-Based Blockchains, Remote Ethereum Clients. Smart Contracts and Solidity: What Is a Smart Contract?, Life Cycle of a Smart Contract, Introduction to Ethereum High-Level Languages, Building a Smart Contract with Solidity, The Ethereum Contract ABI, Programming with Solidity, Gas Considerations, Vulnerabilities and Vyper, Comparison to Solidity, Decorators, Function and Variable Ordering, Compilation, Protecting Against Overflow Errors at the Compiler Level, Reading and Writing

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, decentralization, and smart contracts explained", Packt Publishing, 2018.
- Andreas M. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly Publications, 2nd Edition.
- Melanie Swan, "Blockchain: Blueprint for a new economy", O'Reilly Publications, First Edition.

14. Reference Books

- Mark Gates, " Ethereum: Complete Guide to Understanding Ethereum, Blockchain, Smart Contracts, ICOs, and Decentralized Apps", Inverted Forest Publishing, 2016
- Chris Dannen, "Introducing Ethereum and Solidity", APress Publishing, 2017.
- EladErom, "The Blockchain Developer", APress Publishing, 2017
- Andreas M. Antonopoulos, "Mastering Bitcoin: Programming the Open Blockchain", O'Reilly Publications, First Edition

Bitcoin Mining

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Bitcoin Mining**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)	Computer Basics	**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
This course covers the technicalaspects of public distributed ledgers, blockchain systems, cryptocurrencies, and smartcontracts. Students will learn how these systems are built, how to interact with them, how todesign and build secure distributed applications.						
9.LearningObjectives: 1. To learn the fundamentals of Bitcoin and Blockchain. 2. To obtain knowledge about technologies of Bitcoin. 3. To incorporate the models of Blockchain. 4. To learn the models of Hyperledger Fabric.						
10. Course Outcomes (COs):						
The students will be able to:- 1. Understand how blockchain systems (mainly Bitcoin) work, 2. To securely interact with them, 3. Design, build, and deploy smart contracts and distributed applications, 4. Integrate ideas from blockchain technology into their own projects.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 9**					
Bitcoin Basics Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoinscripting, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, BlockMining, Block propagation and block relay. Bitcoin Basics Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.						
Unit – 2	**Number of lectures = 9**					
Distributed Consensus Importance, Distributed consensus in open environments, Consensus in a Bitcoin network, Consensus in Bitcoin- Bitcoin Consensus, Proof of Work (PoW), HashcashPoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.						
Unit – 3	**Number of lectures = 9**					

Introduction to Blockchain
Basic idea, Public Ledgers, Blockchain as public ledgers, Bitcoin, Blockchain 2.0, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, The Chain and the Longest Chain, Cryptocurrency to Blockchain 2.0, Permissioned Model of Blockchain.

Basic Crypto Primitives
Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency.

Unit – 4	**Number of lectures = 9**	

Cryptocurrency:
History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

Cryptocurrency Regulation:
Stakeholders, Roots of Bit coin, Legal Aspects-Crypto currency Exchange, Black Market and Global Economy.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

14. Reference Books

- Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
- Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System

Design and Development of Blockchain Applications

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Design and Development of Blockchain Applications**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)	Computer Basics	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						

Blockchain is an emerging technology platform for developing decentralized applications and data storage, over and beyond its role as the technology underlying the cryptocurrencies.. Public blockchain platforms allow us to guarantee these properties with overwhelming probabilities even when untrusted users are participants of distributed applications with ability to transact on the platform. Even though, blockchain technology has become popularly known because of its use in the implementation of Cryptocurrencies such as Bitcoin, Ethereum, etc.The concept and applications of Blockchain have now spread from cryptocurrencies to various other domains, including business process management, smart contracts, IoT and so on.

3. LearningObjectives:

1. Explain Blockchain Basics &design principles of Ethereum.
2. Explain Blockchain Applications-Its structure &Systems .
3. Interact with a blockchain system by sending and reading transactions.
4. Design, build, and deploy a real world application& business models through blockchain.
5. Evaluate security, privacy, and efficiency of a given blockchain systems

10. Course Outcomes (COs):

The students will be able to:-

1. Design, build, and deploy blockchain applications
2. To understand the technology behind blockchain
3. To comprehend the issues related to blockchain
4. To study the real-world applications of blockchain

I.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	**Blockchain Technology**

Blockchain Basics, Blockchain Evolution, Blockchain Structure, Blockchain Characteristics, Blockchain Application Example: Escrow, Blockchain Stack: Decentralized Computation Platform-Ethereum, Decentralized Storage Platform: Swarm, Decentralized Messaging Platform-Whisper, Smart Contracts, Decentralized Applications, Tools and Interfaces.

Unit – 2	**Number of lectures = 9**	**Domain Specific Blockchain Applications**

Blockchain Applications: Internet of Things, Medical Record Management System, FinTech, Industrial and Manufacturing, Domain Name Service and future of Blockchain.

Unit – 3	Number of lectures = 9	Blockchains for real-world Applications

Blockchains for real-world Applications

Manufacturing and production, supply chain management, logistics and transportation, Internet of things, e-voting, healthcare, product life cycle, knowledge and innovation management, new business models and applications

Unit – 4	Number of lectures = 9	Blockchain Components and Applications Templates

Blockchain Application Components, Design Methodology for Blockchain Applications, Blockchain Application Templates: Many to one, Many to one for IoT applications, Many to many or Peer to Peer, One to One for Financial Applications

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

1. Blockchain Applications: A Hands-On Approach “ArshdeepBahga, Vijay Madisetti”.

14. Reference Books

1. Beginning Blockchain, A Beginner’s Guide to Building Blockchain Solutions, Bikramaditya Singhal, Gautam Dhameja, Priyansu Sekhar Panda, Apress, 2018.
2. Blockchain A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph J. Bambara and Paul R. Allen, McGraw Hill, 2018.
3. Blockchain enabled Applications Vikram Dhillon, David Metcalf and Max Hooper, Apress, 2017,
4. The Business Blockchain: Promise, Practice, and Application of the Next Internet Technology, William Mougayar, Wiley, 2016.
5. Architecture for Blockchain Applications, Xu, Xiwei, Weber, Ingo, Staples, Mark.

Design and Development of Blockchain Applications Lab

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Design and Development of Blockchain Applications Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
</table>

8. Course Description

Blockchain is an emerging technology platform for developing decentralized applications and data storage, over and beyond its role as the technology underlying the cryptocurrencies.. Public blockchain platforms allow us to guarantee these properties with overwhelming probabilities even when untrusted users are participants of distributed applications with ability to transact on the platform. Even though, blockchain technology has become popularly known because of its use in the implementation of Cryptocurrencies such as Bitcoin, Ethereum, etc.The concept and applications of Blockchain have now spread from cryptocurrencies to various other domains, including business process management, smart contracts, IoT and so on.

9 LearningObjectives:

1. Explain Blockchain Basics &design principles of Ethereum.
2. Explain Blockchain Applications-Its structure &Systems .
3. Interact with a blockchain system by sending and reading transactions.
4. Design, build, and deploy a real world application& business models through blockchain.
5. Evaluate security, privacy, and efficiency of a given blockchain systems

10. Course Outcomes (COs):

The students will be able to:-

1. Design, build, and deploy blockchain applications
2. To understand the technology behind blockchain
3. To comprehend the issues related to blockchain
4. To study the real-world applications of blockchain

11. List of Experiments:

1. Create a Simple Blockchain in any suitable programming language.
2. Use Geth to Implement Private Ethereum Block Chain.
3. Build Hyperledger Fabric Client Application.
4. Build Hyperledger Fabric with Smart Contract.
5. Create Case study of Block Chain being used in illegal activities in real world.
6. Using Python Libraries to develop Block Chain Application.
7. Write a program to generate Hash key.
8. Using Java Libraries to develop Block Chain Applications.
9. Write a program to create public key in Blockchain.

10 Write a program to create private Key in Blockchain.

Emerging areas in Blockchain

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Emerging areas in Blockchain</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(v)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>NIL</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Blockchain is an emerging technology platform for developing decentralized applications and data storage, over and beyond its role as the technology underlying the cryptocurrencies. The basic tenet of this platform is that it allows one to create a distributed and replicated ledger of events, transactions, and data generated through various IT processes with strong cryptographic guarantees of tamper resistance, immutability, and verifiability. This technology itself holds much more promise in various emerging areas such as time stamping, logging of critical events in a system, recording of transactions, trustworthy e-governance etc. This course covers the technical aspects of public distributed ledgers, blockchain systems, cryptocurrencies, and its applications. Students will learn how these systems are built, how to design and build secure distributed applications.</td></tr>
<tr><td colspan="7">9. Learning Objectives:
1. Students will able to understand how blockchain systems work,
2. To securely interact through Blockchain system,
3. They will come to know about various emerging applications of it,
4. Integrate ideas from blockchain technology into their own projects and domain.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Explain design principles of Bitcoin in Blockchain.
2. Able to interact with various Blockchain applications.
3. Design, build, and deploy a blockchain application.
4. Evaluate security, privacy, and efficiency of a given blockchain system in different domain.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction: Basic ideas behind blockchain, how it is changing the landscape of digitalization, introduction to cryptographic concepts required, Hashing, public key cryptosystems, private vs public blockchain and use cases, Hash Puzzles, Introduction to Bitcoin Blockchain, The future of Bitcoin.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

Uses of Blockchain in E-Governance and Land Registration: Potential uses by the government include collecting taxes, issuing passports, recording land transfers and generally ensuring the integrity of records and services, Documenting Land Users' Rights, Land administration, Intellectual Property, Blockchain Notary. Identity Management: Academic Records, Blockchain Music, . Birth, Marriage, and Death Certificates, Passports etc.		
Unit – 3	**Number of lectures = 9**	
Blockchains for Trade Finance: Cryptocurrency, The financial services industry, How are companies planning to use blockchain? Stock exchanges application, Blockchain for insurance, Cross Border Connectivity - Trusted Data Transfer, Post-trading activity, The mortgage industry, Cross-border trade, Shipping and supply chain management, Proxy voting and elections.		
Unit – 4	**Number of lectures = 9**	
More Emerging Applications of Blockchain: Medical Information Systems: blockchain in healthcare, Blockchain in media, entertainment and advertising to reduced cost, eliminate fraud and increase transparency. Financial model framework, Projecting new revenue and savings, Expanded economic impact and analysis of costs, Internet of Things (IoT): Energy Cyber Physical System, Blockchain in Aviation Systems, smart homes.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016

14. Reference Books

- Blockchain Applications: A Hands-on Approach, Book by Arshdeep Bahga and Vijay K. Madisetti
- Blockchain Technology and Applications, Pethuru Raj, Kavita Saini, Chellammal Surianarayanan, CRC press, 2021.
-

Programming Fundamentals: Golang and Solidity

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Programming Fundamentals : Golang and Solidity</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Golang is next generation multi-purpose programming language that allows different users to create applications of various domains. Students will be able to learn primary fundamentals of Go and Solidity programming and potential of Go is to achieve modern computing requirements.</td></tr>
<tr><td colspan="7">9. LearningObjectives:
1. The objective of this course is to teach students the concepts of Statistics, probability,
2. probability distribution, and other statistical methods to solve various engineering problem
3. Master the fundamentals of writing Go and Solidity
4. Learn core Golangand Solidity such as variables and flow control structures.
5. Discover how to work with lists and sequence data.
6. Write Goand Solidity functions to facilitate code reuse.
7. V. Use Golangand Solidity to read and write files</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. To acquire programming skills in core Golang and Solidity .
2. To acquire Object Oriented Skills in Golang and Solidity.
3. To develop the skill of designing Graphical user Interfaces in Golang and Solidity.
4. To develop the ability to write database applications in Golang and Solidity.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Go – Overview, Environment Setup , Program Structure , Basic Syntax , Data Types , Variables , Constants , Operators , Decision Making , Loops , Functions , Scope Rules</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Go – Strings , Arrays , Pointers , Structures , Slice , Range , Maps , Recursion , Type Casting , Interfaces , Error Handling</td></tr>
</table>

Unit – 3	Number of lectures = 9	
Solidity – Overview , Environment Setup , Basic Syntax , First Application , Comments , Types , Variables , Variable Scope , Operators , Loops , Decision Making , Strings , Arrays , Enums , Structs , Mappings , Conversions , Ether Units , Special Variables , Style Guide		
Unit – 4	**Number of lectures = 9**	
Solidity – Functions , Function Modifiers , View Functions , Pure Functions , Fallback Function, Function Overloading , Mathematical Functions , Withdrawal Pattern , Restricted Access , Contracts , Inheritance , Constructors , Abstract Contracts , Interfaces , Libraries , Assembly , Events , Error Handling		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Go Programming Language, The (Addison-Wesley Professional Computing Series)

14. Reference Books

1. An introduction to programming in Go : Caleb doxsey.
2. Introducing Go: Build Reliable, Scalable Programs : Caleb Doxsey
3. Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain

Blockchain for Cyber Security

1. Name of the Department:- Computer Science Engineering							
2. Course Name	**Blockchain for Cybersecurity**	**L**	**T**		**P**		
3. Course Code		**3**	**0**		**0**		
4. Type of Course (use tick mark)		**Core ()**	**PE()**		**OE ()**		
5. Pre-requisite (if any)	C	**6. Frequency (use tick marks)**	Even ()	Odd ()	Either Sem ()	Every Sem ()	
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)							
Lectures = 36		**Tutorials = 0**	**Practical=0**				
8. Course Description							
This course enables the students to gain in-depth knowledge of cyber security in blockchain applications. It consist of various attacks of cyber security.							
9. Learning Objectives: 1. To learn various types of algorithms and its applications of Cyber Security and Ethical Hacking using forensic detection 2. To identify insights on how to apply Cyber Security, Ethical Hacking to solve a interdisciplinary problems. 3. To acquire the hands-on skills and the knowledge required for job competency.							
10. Course Outcomes (COs):							
1. Understand, appreciate, employ, design, and implement appropriate security technologies and policies to protect computers and digital information. 2. Identify & Evaluate Information Security threats and vulnerabilities in Information Systems and apply security measures to real time scenarios 3. Identify common trade-offs and compromises that are made in the design and development process of Information Systems							
11. Unit wise detailed content							
Unit-1	**Number of lectures = 08**						
Foundations of Cyber Security Concepts: Essential Terminologies: CIA, Risks, Breaches, Threats, Attacks, Exploits. Information Gathering (Social Engineering, Foot Printing & Scanning)Open Source/ Free/ Trial Tools: nmap, zenmap, Port Scanners, Network scanners, Cyber Threat Landscape and Security Challenges, International Security Alliance (ISA)							
Unit – 2	**Number of lectures = 8**						

Security Must Evolve: Describe some serious and urgent changes in the security mindset, such as zero trust approach, breach acceptance, and changes in the security foundation. Introduction to Blockchain and Ethereum, describe blockchain from its birth and its continuous adaption in various industries and verticals.

Unit – 3	**Number of lectures = 10**	
Internet Security, Cloud Computing &Security, Social Network sites security, Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Authorization, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, IT Audit, Authentication. Open Web Application Security Project (OWASP), Web Site Audit and Vulnerabilities assessment. Open Source/ Free/ Trial Tools: WinAudit, Zap proxy (OWASP), burp suite, DVWA kit.		

Unit – 4	**Number of lectures = 10**	
Blockchain on the CIA security Trait, Security measures design to protect one or fact of the CIA triad , Deploying PKI Based Identity with Blockchain, Architecture, Structure and API client integration, Two Factor Authentication with Blockchain, Blockchain-Based DNS security Platform, Deploying Blockchain Based DDos Protection, Facts about Blockchain and Cyber Security.		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.		
13. Books Recommended		
Text books: **Hands-On Cybersecurity with Blockchain by Rajneesh Gupta, Packt Publications.** **Reference books:** I. Gupta Sarika, "Information and Cyber Security", Khanna Publishing House, Delhi. II. William Stallings, "Cryptography and Network Security", Pearson Education/PHI, 2006		

Internet of Things

Wireless Ad-hoc and sensor Networks

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Wireless Ad-hoc and sensor Networks	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)	Basics of Networking	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course will provide students with an understanding of wireless adhoc and sensor networks enable them to recognize the wide range of applicability of these networks and provide them with an understanding of the major design issues including topics such as protocol mechanisms and resource constraints.

9.LearningObjectives:

1. Learn Ad-hoc network and Sensor Network fundamentals.
2. Understand the different routing protocols.
3. Have an in-depth knowledge on sensor network architecture and design issues.
4. Understand the transport layer and security issues possible in Ad-hoc networks.

10. Course Outcomes (COs):

The students will be able to:

5. Know the basics of Ad-hoc networks and Wireless Sensor Networks.
6. Apply this knowledge to identify the suitable routing algorithm based on the network and user requirement.
7. Apply the knowledge to identify appropriate physical and MAC layer protocols.
8. Understand the transport layer and security issues possible in Ad-hoc and sensor networks.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

Wireless AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS: Fundamentals of Wireless Communication Technology -The Electromagnetic Spectrum - Radio propagation Mechanisms - Characteristics of the Wireless channel mobile ad hoc networks (MANETs) - Applications of Ad Hoc and Sensor Networks - Design Challenges in Ad hoc and Sensor Networks. Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Example commercial applications of Ad hoc networking.

Unit – 2	**Number of lectures = 9**	

MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS: Issues in designing a MAC Protocol - Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks - Design Goals of a MAC Protocol for Ad Hoc Wireless Networks - Classification of MAC Protocols -Contention based protocols - Contention based protocols with Reservation Mechanisms - Contention based protocols with Scheduling Mechanisms - Multi channel MAC - IEEE 802.11.

Unit – 3	**Number of lectures = 9**	

ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS Networks: Routing Protocol: Issues in designing a routing protocol for Ad hoc networks - Classification- proactive routing - reactive routing (on-demand) - hybrid routing - Transport Layer protocol for Ad hoc networks - Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks -Classification of Transport Layer solutions-TCP over Ad hoc wireless - Network Security - Security in Ad Hoc Wireless Networks - Network Security Requirements

Unit – 4	**Number of lectures = 9**	

WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS: Single node architecture: hardware and software components of a sensor node -WSN Network architecture: typical network architectures -data relaying and aggregation strategies -MAC layer protocols: self-organizing - Hybrid TDMA/FDMA and CSMA based MAC -IEEE 802.15.4.

WSN ROUTING, LOCALIZATION & QOS: Issues in WSN routing –OLSR - Localization –Indoor and Sensor Network Localization - absolute and relative localization - triangulation - QOS in WSN - Energy Efficient Design – Synchronization.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Holger Karl , Andreas willig, ―Protocol and Architecture for Wireless Sensor Networks‖, John wiley publication, Jan 2006.
- C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Pearson Education, 2008.
- Labiod. H, "Wireless Adhoc and Sensor Networks", Wiley, 2008.
- Li, X, "Wireless ad -hoc and sensor Networks: theory and applications", Cambridge University Press, 2008.

14. Reference Books

- Feng Zhao, Leonidas Guibas, ―Wireless Sensor Networks: an information processing approach‖, Elsevier publication, 2004.
- Charles E. Perkins, ―Ad Hoc Networking‖, Addison Wesley, 2000.
- I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, ―Wireless sensor networks: a survey‖, computer networks, Elsevier, 2002, 394 - 422.
- Carlos De Morais Cordeiro, Dharma Prakash Agrawal "Ad Hoc & Sensor Networks: Theory and Applications", World Scientific Publishing Company, 2nd edition, 2011.
- Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication.
- Holger Karl and Andreas Willig "Protocols and Architectures for Wireless Sensor Networks", Wiley, 2005 (soft copy available).
- Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley, 2007(soft copyavailable).
- Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003(soft copy available).

Wireless Ad-hoc and sensor Networks Lab

1. Name of the Department- Computer Science & Engineering

2. Course Name	**Wireless Ad-hoc and sensor Networks Lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)	Basics of Networking	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 48**			

8. Course Description

This course will provide students with an understanding of wireless adhoc and sensor networks enable them to recognize the wide range of applicability of these networks and provide them with an understanding of the major design issues including topics such as protocol mechanisms and resource constraints.

9. LearningObjectives:

1. Learn Ad-hoc network and Sensor Network fundamentals.
2. Understand the different routing protocols.
3. Have an in-depth knowledge on sensor network architecture and design issues.
4. Understand the transport layer and security issues possible in Ad-hoc networks.

10. Course Outcomes (COs):

The students will be able to:

1. Describe the unique issues in ad-hoc/sensor networks.
2. Describe current technology trends for the implementation and deployment of wireless ad-hoc networks.
3. Discuss the challenges in designing MAC, routing and transport protocols for wireless ad-hoc networks.
4. Discuss the challenges in designing routing and transport protocols for wireless Ad-hoc networks

11. List of Experiments

Installation of NS2 in Ubuntu 12.04 Linux.

Build and exchange data in simple infrastructure and Adhoc network by using personal computer and Android based mobile.

Develop sample wireless network in which implement AODV and AOMDV protocol.

Calculate the time to receive reply from the receiver using NS2.

Generate graphs which show the transmission time for packet.

Implement wireless network. Capture data frame and identify fields using NS2.

Configure Wireless Access Point (WAP) and build different networks.

Implement Mobile device as a wireless access point.

Communicate between two different networks

Case study on Security in wireless Ad hoc wireless Networks.

12. Brief Description of self-learning / E-learning component

http://vlabs.iitkgp.ac.in/

Embedded System Architecture

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Embedded System Architecture**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)	Basic knowledge of Microprocessors and microcontrollers	**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

.In this class, the fundamentals of embedded system hardware and firmware design will be explored. Issues such as embedded processor selection, hardware/firmware partitioning, glue logic, circuit design, circuit layout, circuit debugging, development tools, firmware architecture, firmware design, and firmware debugging will be discussed. The Intel 8051, a very popular microcontroller, will be studied. The architecture and instruction set of the microcontroller will be discussed, and a wirewrapped microcontroller board will be built and debugged by each student. The course will culminate with a significant final project which will extend the base microcontroller board completed earlier in the course. Learning may be supplemented with periodic guest lectures by embedded systems engineers from industry. Depending on the interests of the students, other topics may be covered.

10. LearningObjectives:

1. To understand the major components that constitute an embedded system
2. To implement programs in embedded to solve well- defined problems on an embedded platform
3. To develop familiarity with tool used to develop an embedded environment

10. Course Outcomes (COs):

The students will be able to:-

1. Understand hardware and software design requirements of embedded systems.
2. Analyze the embedded systems' specification and develop software programs
3. Evaluate the requirements of programming Embedded Systems, related software architectures and tool chain for Embedded Systems

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	Overview of Embedded Systems

Overview of Embedded Systems: Definition of embedded system, Characteristics of an Embedded System, Types of Embedded Systems, and quality attributes of embedded systems, Challenges in Embedded System Design, Application and Domain specific embedded systems.

Unit – 2	**Number of lectures = 9**	Embedded Communication Protocols

Core of Embedded Systems: Basics of Architecture: Vonneuman architecture, Harvard Architecture, RISC and CISC controllers,Architecture of PIC18F microcontroller, Registers & Memory of PIC18F, Special function registers.

Network Embedded Systems: Why Network Embedded Systems, Common Methods Of Networking,

Examples Of Networked Embedded Systems. Controller Area Network: basics of CAN, CAN physical layer, CAN message format, Error control, error process, error detection, CAN applications.		
Unit – 3	**Number of lectures = 9**	Embedded Systems development Environment
Embedded Communication Protocols: **E**mbedded Networking: Introduction–Serial / Parallel Communication–Serial communication protocols - RS232 standard – RS485 – Synchronous Serial Protocols - Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I2C) –Wireless communication: WLANs, Bluetooth, Piconet, Scatter net **Embedded System development environment** - IDE, Types of file generated on cross compilation, disassembler / decompile, simulator, emulator and debugging, embedded product development life-cycle, trends in embedded industry.		
Unit – 4	**Number of lectures = 9**	**Embedded Systems Security**
Networked Embedded Systems Security: Security threats of embedded systems, effect of the attacks, challenges in security of embedded systems, counter measures **Controller Area Network:** Controller Area Network – Underlying Technology, CAN Overview – Selecting a CAN Controller – CAN development tools. Implementing CAN open Communication layout and requirements – Comparison of implementation methods – Micro CAN open – CAN open source code – Conformance test – Entire design life cycle.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Embedded Systems Architecture Programming and Design by Raj Kamal, II edition, Tata MC Graw-Hill
- Designing Embedded Systems with PIC Microcontrollers: principles and applications by Tim Wilmshurst, Elsevier

14. Reference Books

- Tammy Noergard, “Embedded system architecture”, Elsevier, 2006.
- Embedded Systems Design by Steve Heath, II edition, Newnes publications
- Embedded Systems Architecture: A Comprehensive Guide for Engineers and Programmers by Tammy Noergaard, Elsevier.

Introduction to Cloud Computing

<table>
<tr><td colspan="6">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Introduction to Cloud Computing</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description
Cloud Computing has transformed the IT industry by opening the possibility for infinite or at least highly elastic scalability in the delivery of enterprise applications and software as a service (SaaS).</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="7">9. Learning objectives:
This module gives students the skills and knowledge to understand how Cloud Computing Architecture can enable transformation, business development and agility in an organization.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">1. Describe cloud computing concepts
2. Identify various cloud services
3. Evaluate various cloud delivery models
4. Assess cloud characteristics and service attributes, for compliance with enterprise objectives
5. Contrast the risks and benefits of implementing cloud computing</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 09</td><td colspan="5"></td></tr>
<tr><td colspan="7">Cloud Computing Overview – Origins of Cloud computing, Cloud components, Essential characteristics, On-demand self-service, broad network access, Location independent resource pooling, Rapid elasticity, measured service.

Cloud architecture: Cloud delivery model – SPI framework, SPI evolution, SPI vs. traditional IT Model

Virtualization – Concepts, Types of Virtualization & its benefits, Introduction to Various Virtualization OS.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 09</td><td colspan="5"></td></tr>
</table>

Cloud Computing Architecture: Introduction - The cloud reference model - Types of clouds - Economics of the cloud.

Cloud Deployment Model: Public clouds, Private clouds, Community clouds, Hybrid clouds, Advantages and Disadvantages, Comparison models.

Unit – 3	**Number of lectures = 09**	

Software as a Service (SaaS): Introduction to Infrastructure as a Service delivery model, Characteristics, Architecture, Applicability of IaaS in the industry. SaaS service providers, Google App Engine, Salesforce.com and Google Platform, Benefits, Operational benefits, Economic benefits, Evaluating SaaS.

Platform as a Service (PaaS): Introduction to Platform as a Service delivery model, Characteristics, patterns, Architecture. PaaS service providers: Right Scale, Salesforce.com, Services and Benefits.

Unit – 4	**Number of lectures = 09**	

Infrastructure as a Service (IaaS): Introduction to Software as a Service delivery model, characteristics, Architecture, Applicability of SaaS in the industry. IaaS service providers, Amazon EC, Amazon EC2 service level agreement, Recent developments.

Benefits: Future directions a. Cloud Domain and scope of work, Cloud as PaaS, SaaS,Cloud Computing Programming Introduction Trends and market of cloud.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

1. Cloud Computing: Concepts, Technology & Architecture, Erl, Pearson Education India; 1 edition, 2014
2. Cloud Computing: Fundamentals By Timothy Chou's.

Reference Books

1. The Basics of Cloud Computing: Understanding the Fundamentals of Cloud Computing in Theory and Practice 1st Edition byDerrick Rountree (Author), Ileana Castrillo (Author).
2. “Cloud Computing, A Practical Approach” Toby Velte, Anthony Velte, Robert Elsenpeter, McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.

Introduction to Cloud Computing Lab

1. Name of the Department- Computer Science & Engineering							
2. Course Name	**Introduction to Cloud Computing Lab**	**L**	**T**		**P**		
3. Course Code		**0**	**0**		**2**		
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**		
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()	
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)							
Lectures = 0		**Tutorials = 0**	**Practical = 24**				

8. Course Description

Cloud Computing has transformed the IT industry by opening the possibility for infinite or at least highly elastic scalability in the delivery of enterprise applications and software as a service (SaaS).

9. Learning objectives:

This module gives students the skills and knowledge to understand how Cloud Computing Architecture can enable transformation, business development and agility in an organization

10. Course Outcomes (COs):

1. Describe cloud computing concepts
2. Identify various cloud services
3. Evaluate various cloud delivery models
4. Assess cloud characteristics and service attributes, for compliance with enterprise objectives
5. Contrast the risks and benefits of implementing cloud computing

11. List of Experiments

Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.

1. Install Google App Engine. Create hello world app and other simple web applications using python.
2. Use GAE launcher to launch the web applications.
3. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
4. Find a procedure to transfer the files from one virtual machine to another virtual machine.
5. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
6. Install Hadoop single node cluster and run simple applications like word count.
7. Install Google App Engine.
8. To Create hello world app
9. To create simple web applications using java.

List of projects:

- Online Book Store using Cloud Computing
- University Campus Online Automation Using Cloud Computing

- Student Information using Cloud Computing

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using Virtual Link.

Sensors and Actuator Devices

1. **Name of the Department- Computer Science & Engineering**							
2. Course Name	**Sensors and Actuator Devices**				L	T	P
3. Course Code					3	0	0
4. Type of Course (use tick mark)	Core ()		PE(✓)		OE()		
5. Pre-requisite (if any)	Measurements and Instrumentation	6. Frequency (use tick marks)	Even (✓)	Odd ()	Either Sem ()	Every Sem ()	
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)							
Lectures = 36		Tutorials = 00		Practical = 0			

8. Brief Syllabus: This course deals with the different type of sensors and transducers. This also describe their role to know the domain status. It alos deals with the process to further processing of sensing elements.

9. Learning objectives: By the completion of the course, you should be able to:
1. Educate students to understand the functioning of different types of sensors & their role in order to sense various parameters.
2. To utilize the status of different signal parameters in the real time application to conrol the working.

10. Course Outcomes: On completion of this course, the students will be able to
1. Select the correct sensor for an given problem.
2. And also capable to interface that sensor with the processor for further processing.

11. Unit wise detailed content

Unit-1	Number of lectures = 12	Introduction to Sensors

Principle of sensing & transduction , classification of sensors, Resistive sensors, Inductive sensor, Ferromagnetic plunger type, short analysis;

Unit - 2	Number of lectures = 8	Capacitive sensors: & Piezoelectric sensors

variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type,

Stretched diaphragm type: microphone, response characteristics;

Piezoelectric element: piezoelectric effect, crystal model, force & stress sensing, ultrasonic sensors.

Unit - 3	Number of lectures = 6	Thermal sensors

Material expansion type: solid, liquid, gas & vapor;

Resistance change type: RTD materials, tip sensitive & stem sensitive type.

Thermo emf sensor: Thermoelectric power, Junction semiconductor type IC and PTAT Type;

Radiation sensors: LDR, Photovoltaic cells, photodiodes;

Unit - 4	Number of lectures = 8	Magnetic Sensors
Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics;		
12. Brief Description of self learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/		
13. Books Recommended • Sensor & transducers, D. Patranabis, 2nd edition, PHI • Instrument transducers, H.K.P. Neubert, Oxford University press. • Measurement systems: application & design, E. A. Doebelin, Mc Graw Hill.		

Software Defined Networks

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Software Defined Networks</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td></td><td colspan="2">0</td><td colspan="2"></td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course introduces about software defined networking, an emerging paradigm in computer networking that allows a logically centralized software program to control the behavior of an entire network.</td></tr>
<tr><td colspan="7">11. LearningObjectives:
1. To aware students about Software Defined Networks
2. To promote the development of computer-related skills for immediate application toother curricularareas.
3. To provide a foundation for post-secondaryeducation.
4. To facilitate the development and application of problem-solving skills instudents.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Explain the key benefits of SDN by the separation of data and control planes
2. Interpret the SDN data plane devices and Openflow Protocols
3. Implement the operation of SDN control plane with different controllers
4. Apply techniques that enable applications to control the underlying network using SDN
5. Describe Network Functions Virtualization components and their roles in SDN</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">SDN Background and Motivation
Evolving network requirements-The SDN Approach: Requirements, SDN Architecture, Characteristics of Software-Defined Networking, SDN and NFV-Related Standards: Standards-Developing Organizations, Industry Consortia, Open Development Initiatives.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">SDN Data plane and OpenFlow

SDN data plane: Data plane Functions, Data plane protocols, Openflow logical network Device: Flow table Structure, Flow Table Pipeline, The Use of Multiple Tables, Group Table- OpenFlow Protocol.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

SDN Control Plane

SDN Control Plane Architecture: Control Plane Functions, Southbound Interface, Northbound Interface, Routing, ITU-T Model- OpenDaylight-REST- Cooperation and Coordination Among Controllers.
SDN Application Plane

SDN Application Plane Architecture: Northbound Interface, Network Applications, User Interface-Network Services Abstraction Layer: Abstractions in SDN, Frenetic- Traffic Engineering Measurement and Monitoring- Security- Data Center Networking- Mobility and Wireless.

Unit – 4	**Number of lectures = 9**	

Network Functions Virtualization

Background and Motivation for NFV- Virtual Machines- NFV Concepts: Simple Example of the Use of NFV, NFV Principles, High-Level NFV Framework, NFV Benefits and Requirements-NFV Reference Architecture: NFV Management and Orchestration.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Software Defined Networks: A Comprehensive Approach by Paul Goransson and Chuck Black,Morgan Kaufmann Publications, 2014
- SDN - Software Defined Networks by Thomas D. Nadeau & Ken Gray, O'Reilly, 2013

14. Reference Books

- Feamster, Nick, Jennifer Rexford, and Ellen Zegura. "The road to SDN: an intellectual history of programmable networks." ACM SIGCOMM Computer Communication Review 44.2 (2014): 87-98..
- Kreutz, Diego, et al. "Software-defined networking: A comprehensive survey." Proceedings of the IEEE 103.1 (2015): 14-76.

Architecting Smart IoT Devices

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Architecting smart IoT Devices	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**4**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
4. This course will teach you how to develop an embedded systems device. In order to reduce the time to market, many pre-made hardware and software components are available today.						
12. LearningObjectives: 1. Identify different IoT Applications with IoT architecture. 2. Identify, test and interconnect components/parts of IoT system. 3. . Identify and test various parts of embedded system. 4. Identify and select various types of sensors used in Smart City.						
10. Course Outcomes (COs):						
1. Identify and test Smart Lighting system and its components 2. Identify, select, install and troubleshoot different module / devices used in SMART Street Light based on IoT and Cloud Technology. 3. Identify, select, install and troubleshoot different module / devices used in SMART Parking 4. Identify, select, install and troubleshoot different module / devices used in SMART Traffic.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 9**					
Fundamentals of Iot Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog,						
Unit – 2	**Number of lectures = 9**					
Edge and Cloud in IoT – Functional Blocks of an IoT Ecosystem -Sensors, Actuators, and Smart Objects – Open Hardware Platforms for IoT.						

Unit – 3	**Number of lectures = 9**	
Routing over Low Power and Lossy Networks (RPL) – Application Transport Methods: Application Layer Not Present, Supervisory Control and Data Acquisition (SCADA) -Application Layer Protocols: CoAP and MQTT – Service discovery – mDNS.		

Unit – 4	Number of lectures = 9	
Smart and Connected Cities: Street Layer, City Layer, Data Center Layer and Services Layer, Street Lighting, Smart Parking Architecture and Smart Traffic Control – Smart Transportation – Connected Cars.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, CISCO Press, 2017.

14. Reference Books

1. Perry Lea, “Internet of things for architects”, Packt, 2018.
2. Jan Ho”ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyle, “From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence”, Elsevier, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key Applications and Protocols”, Wiley, 2012.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.

Architecting Smart IoT Devices Lab

<table>
<tr><td colspan="7">1. Name of the Department: Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Architecting smart IoT Devices Lab</td><td>L (0)</td><td colspan="2">T (0)</td><td colspan="2">P (2)</td></tr>
<tr><td>3. Course Code</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">EAS ()</td><td colspan="2">BSC ()</td></tr>
<tr><td>Pre-requisite (if any)</td><td></td><td>Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="7">8. Brief Syllabus
This course will teach you how to develop an embedded systems device. In order to reduce the time to market, many pre-made hardware and software components are available today.</td></tr>
<tr><td colspan="7">13. Learning Objectives:
1. Identify different IoT Applications with IoT architecture.
2. Identify, test and interconnect components/parts of IoT system.
3. Identify and test various parts of embedded system.
4. Identify and select various types of sensors used in Smart City.</td></tr>
<tr><td colspan="7">10 Course Outcomes (COs):
1. Identify and test Smart Lighting system and its components
2. Identify, select, install and troubleshoot different module / devices used in SMART Street Light based on IoT and Cloud Technology.
3. Identify, select, install and troubleshoot different module / devices used in SMART Parking
4. Identify, select, install and troubleshoot different module / devices used in SMART Traffic.</td></tr>
</table>

11. Lab Experiment

Sr. No.	Title	CO covered
1	Development Tools and Environments. Debugging Basics. Debugging Specials.	**ii**
2	Real-Time Scheduling. Synchronisation and Communication web tour. Device Drivers. Multithreading Design.	**ii**

3	Hardware & Software for EmS	**i**
4	Study of a few Embedded Processor Families. MCU, SOC, FPGA. Cache, pipeline and coupling	**i**
5	Networks. Software Components	**i**
6	OS for IoTEvaluation reports on the embedded OS	**iii**

12. Brief Description of self-learning / E-learning component

http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/index.php

Design of Smart Systems

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Design Of Smart Systems</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course equips students with essential tools frequently used to impart intelligence to a variety of systems. After reviewing examples of smart systems found in consumer/industrial products, the course provides introduction to theoretical/algorithmic tools of smart systems. Applications of these tools in the design and development of smart systems are illustrated. Students are expected to gain expertise in at least one aspect of smart systems. Simulation and hardware projects enable students to develop prototype smart products. This subject provide knowledge aboutSmart systems essentials and design processOptimization theorySignal processing, System identification, Estimation and control theory,Integrated smart system design, robotics, AI & Automation.</td></tr>
<tr><td colspan="7">14. LearningObjectives:
1. Tounderstandaboutthesmartsystemtechnologiesanditsroleinrealtimeapplications
2. Toexpose studentstodifferentopen sourceplatformsand Attributes.
3. Tofamiliarize thedesignand developmentofembedded systembasedsystemdesign.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Students will develop more understanding on the concepts ofsmart system design and itspresentdevelopments.
2. Studentswillstudyaboutdifferentembeddedopen sourceandcosteffective techniquesfordevelopingsolutionforreal timeapplications.
3. Students will acquire knowledge on different platforms and Infrastructure for Smart systemdesign.
4. Studentswilllearn theartof implementingembeddedsystemforsmartapplicationsandcontrol.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">INTRODUCTION</td></tr>
<tr><td colspan="7">Overview of smart system design and requirements- Hardware and software selection & co-design-Communications-smart sensors and actuators-Open-source resources for embedded system- android for embedded system - Embedded system for Ecommerce- Embedded system for Smart card design and development –Recent trends.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">MOBILE EMBEDDED SYSTEM</td></tr>
<tr><td colspan="7">Design requirements-Hardware platform- OS and Software development platform- Mobile Apps development- Applications: heart beat monitoring, blood pressure monitoring, mobile banking and appliances control.</td></tr>
</table>

Unit – 3	Number of lectures = 9	HOME AUTOMATION & SMART APPLIANCES AND ENERGY MANAGEMENT
Home Automation System Architecture-Essential Components- Linux and Raspberry Pi – design and real time implementation. Overview- functional requirements-Embedded and Integrated Platforms for Energy Management- Energy Measurement Techniques for Smart Metering-Smart Embedded Appliances Networks – Security Considerations.		
Unit – 4	**Number of lectures = 9**	**EMBEDDED SYSTEMS AND ROBOTICS**
Robots and Controllers-components - Aerial Robotics -Mobile Robot Design- Three-Servo Ant Robot-Autonomous Hexacopter System.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

1. ThomasBräunl,EmbeddedRobotics,Springer,2003.

14. Reference Books

1. Grimm, Christoph, Neumann, Peter, Mahlknech andStefan, Embedded Systems for SmartAppliances andEnergyManagement ,Springer2013.
2. RajKamal, *EmbeddedSystems*- Architecture,.ProgrammingandDesign",McGraw- Hill, 2008
3. NilanjanDey, Amartya Mukherjee, Embedded Systems and Robotics with Open Source Tools,CRC press,2016.
4. KarimYaghmour,EmbeddedAndroid,O'Reilly,2013.
5. StevenGoodwin ,SmartHome Automation with Linuxand RaspberryPi,Apress,2013
6. C.K.Toh,"AdHocmobile wireless networks",Prentice Hall,Inc,2002.
7. KazemSohraby,DanielMinoliand TaiebZnati,"WirelessSensorNetworksTechnology,Protocols, andApplications",JohnWiley& Sons,2007.
8. Anna Ha´c,"WirelessSensorNetwork Designs",JohnWiley&SonsLtd,2003.
9. RobertFaludi,"WirelessSensorNetworks",O'Reilly,2011.

Cognitive IoT

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Cognitive IoT</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="8">8. Course Description</td></tr>
<tr><td colspan="8">This course will describe the market around the Internet of Things (IoT), the technology used to build these kinds of devices, how they communicate, how they store data, and the kinds of distributed systems needed to support them. Divided into four modules, we will learn by doing. We will start with simple examples and integrate the techniques we learn into a class project the architecture of IoT systems & Design of Iot Systems, inwhich we design and build an actual IoT system. The client will run in an emulated ARMenvironment, communicating using common IoT protocols with a cloud enabled backend system. We provide knowledge about Iot Platforms & Cloud based platforms.</td></tr>
<tr><td colspan="8">15. LearningObjectives:
1. To understand what is Internet of things
2. Describe architecture, Design, underlying technologies, platforms and cloud interface</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="8">The students will be able to:-
1. Explain what is internet of things.
2. Explain architecture and design of IoT
3. Describe the objects connected in IoT
4. Understand the underlying Technologies.
5. Understand the platforms in IoT
6. Understand cloud interface to IoT.</td></tr>
<tr><td colspan="8">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="6">INTRODUCTION TO INTERNET OF THINGS</td></tr>
<tr><td colspan="8">What is the Internet of Things? Internet of Things Definitions and Frameworks : IoT Definitions, IoTArchitecture, General Observations, ITU-T Views, Working Definition, IoT Frameworks, Basic NodalCapabilities,PhysicalDesignofIoT:IoTProtocols,LogicalDesignofIoT:Functionalblock,communication Model, Communication API's, IoT Enabling Technologies: WSN, cloud computing, Bigdata Analytics, communication Protocols, Embedded systems, IoT levels and Deployment templates:Level1toLevel 5</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="6">IoT NETWORK ARCHITECTURE AND DESIGN</td></tr>
<tr><td colspan="8">TheoneM2MIoTStandardizedArchitecture, TheIoTWorldForum (IoTWF) StandardizedArchitecture,ASimplifiedIoTArchitecture,IoTprotocolstack,TheCoreIoTFunctionalStack,IoTDataManagement andComputeStack:FogComputing,EdgeComputing,TheHierarchyofEdge,Fog,andCloudIoTandM2M: Introductionto M2M,DifferencebetweenIoTandM2M, SDNandNFVforIoT</td></tr>
</table>

Unit – 3	Number of lectures = 9	SMART OBJECTS: THE “THINGS” IN IoT&ADDRESSING TECHNIQUES FOR THE IoT

Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects: CommunicationsCriteria,IoTAccessTechnologies:IEEE802.15.4,IEEE802.15.4gand802.15.4e,IEEE1901.2a, LoRaWAN.
AddressCapabilities,IPv6ProtocolOverview,IPv6Tunneling,IPsecinIPv6,HeaderCompression Schemes,QualityofServiceinIPv6,MigrationStrategiestoIPv6,MobileIPV6technologiesfortheIoT:ProtocolDetails,IPv6overlow-powerWPAN(6LoWPAN).

Unit – 4	Number of lectures = 9	IoT PLATFORMS&IoT PHYSICAL SERVERS AND CLOUD OFFEREINGS

WhatisanIoTDevice,ExemplaryDevices:RaspberryPi,RaspberryPiInterfaces,OtherIoTDevices: pcDuino,BeagleBoneBlack,CubieBoard,ARDUINO.
IntroductiontocloudstoragemodelsandcommunicationAPI’s,WAMP-AutoBahnforIoT,Pythonwebapplicationframework,DesigningaRESTfulwebAPI,AMAZONwebservicesforIoT,SkyNetIoT messagingplatform,IoTcasestudies:HomeAutomation,Cities,Environment

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

2. Internet of Things: A Hands-On Approach ArshdeepBahga, Vijay Madisetti VPT – Paperback2015 978-0996025515628/-2
3. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet ofThings David Hanes, Gonzalo Salgueiro, Patrick Grossetete Cisco Press – Paperback – 16 Aug2017 978-1-58714-456-1599/-
4. Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2MCommunicationsDanielMinoliWillyPublications-2013978-1-118-47347-4,466/-

14. Reference Books

10. Smart Internet of things projects AgusKurniawanPackt - Sep 2016 978-1- 78646- 651-8 2 TheInternetof ThingsKey Olivier WillyPublication2nd Edition 978-
11. Applications and protocols Hersents 119- 99435-0, 3 The Internet of Things ConnectingObjectsto theWebHakimaChaouchi,WillyPublications978-1-84821-140-7

Application of IoT in Robotics

1. Name of the Department- Computer Science & Engineering					
2. Course Name	**Application of IoT in Robotics**	**L**	**T**		**P**
3. Course Code		**3**	**0**		**0**
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem() / Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)					
Lectures = 36		**Tutorials = 0**	**Practical = 0**		
8. Course Description					

5. This course will teach you how to develop an embedded systems device. In order to reduce the time to market, many pre-made hardware and software components are available today.

6. Learning Objectives:

1. Identify different IoT Applications with IoT architecture.
2. Identify, test and interconnect components/parts of IoT system.
3. . Identify and test various parts of embedded system.
4. Identify and select various types of sensors used in Smart City.

10. Course Outcomes (COs):

1. Identify and test Smart Lighting system and its components
2. Identify, select, install and troubleshoot different module / devices used in SMART Street Light based on IoT and Cloud Technology.
3. Identify, select, install and troubleshoot different module / devices used in SMART Parking
4. Identify, select, install and troubleshoot different module / devices used in SMART Traffic.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues

Unit – 2	**Number of lectures = 9**	

Protocol Standardization for IoT –Efforts –M2M and WSN Protocols –SCADA and RFIDProtocols –Issues with IoT Standardization –Unified Data Standards –Protocols –IEEE802.15.4–BACNet Protocol–Modbus –KNX –Zigbee–Network layer –APS layer –Security

Unit – 3	**Number of lectures = 9**	

IoT Open source architecture (OIC)-OIC Architecture & Design principles-IoT Devices and deployment models-IoTivity : An Open source IoT stack -Overview-IoTivity stack architecture-Resource model and Abstraction.

Unit – 4	Number of lectures = 9	
IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT-A, Hydra etc.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", CISCO Press, 2017.

14. Reference Books

1. Perry Lea, "Internet of things for architects", Packt, 2018.
2. Jan Ho"ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things -Introduction to a New Age of Intelligence", Elsevier, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key Applications and Protocols", Wiley, 2012.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

Application of IoT in Robotics LAB

<table>
<tr><td colspan="8">1. Name of the Department: Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Application of IoT in Robotics LAB</td><td>L (0)</td><td colspan="2">T (0)</td><td colspan="2">P (2)</td></tr>
<tr><td>3. Course Code</td><td></td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">EAS ()</td><td colspan="2">BSC ()</td></tr>
<tr><td>Pre-requisite (if any)</td><td></td><td>Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 48</td></tr>
<tr><td colspan="7">8. Brief Syllabus
This course will teach you how to develop an embedded systems device. In order to reduce the time to market, many pre-made hardware and software components are available today.</td></tr>
<tr><td colspan="7">16. LearningObjectives:
1. Identify different IoT Applications with IoT architecture.
2. Identify, test and interconnect components/parts of IoT system.
3. . Identify and test various parts of embedded system.
4. Identify and select various types of sensors used in Smart City.</td></tr>
<tr><td colspan="7">1. Identify and test Smart Lighting system and its components
2. Identify, select, install and troubleshoot different module / devices used in SMART Street Light based on IoT and Cloud Technology.
3. Identify, select, install and troubleshoot different module / devices used in SMART Parking
4. Identify, select, install and troubleshoot different module / devices used in SMART Traffic.</td></tr>
</table>

11. Lab Experiment

Sr. No.	**Title**	**CO covered**
1	Case Studies: Multiple robots, machine interface, robots in manufacturing and non-manufacturingapplications, robot cell design, selection of robot.	**ii**
2	Why IoT and Robotics Tech Are Evolving Together	**ii**
3	Forward and Inverse kinematics of two axis planar articulated robot using analytical and DH algorithm using Lego NXT	**i**
4	Forward and Inverse kinematics to control hand movements in NAO.	**i**

5	Study and selection of Gripper.	**i**
6	Analysis and Simulation using Fanuc Robo guide software and real time Programming of Fanuc M 710i robot.	**iii**

12. Brief Description of self-learning / E-learning component

http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/index.php

Data Sciences in IoT

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Data Sciences in IOT</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Basic Python</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Course introduces to fundamental concepts of IOT and data science. The course brings very interesting blend of IOT and data science also provide the feature of visualization.The Internet of Things (IoT) which makes up a good proportion of IoT tries to analyze the data they record and turn the data into meaningful information</td></tr>
<tr><td colspan="7">17. LearningObjectives:
1. To aware students about IOT and data science.
2. To promote the technique of merged data science and iot and opportunities in domain.
3. To provide deep knowledge of data visualization in IOT data sets.
4. To aware the students about the machine learning algorithms.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Demonstrate the working of IoT.
2. Identify the need of cloud computing for IoT
3. Apply Machine Learning Algorithms for IoT data
4. Predict and visualize output using Data Analytics tools</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction to Internet of Things (IoT)- Concepts and definitions of IoT-History of IoT –IoT data vs big data- IoT Analytics lifecycle and Techniques-IoT complete Technology chain- Applications of IoT.Opportunities and challenges in IoT .Introduction to data science Combining and Merging datasets – Reshaping and Pivoting – Data Transformation – String Manipulation, Regular Expressions.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">GoupBy Mechanics – Data Aggregation – GroupWise Operations and Transformations – Pivot Tables and CrossTabulations – Date and Time Date Type tools – Time Series Basics – Data Ranges, Frequencies and Shifting. Data Acquisition by Scraping web applications –Submitting a form - Fetching web pages – Downloading web pagesthrough form submission – CSS Selectors.</td></tr>
</table>

Unit – 3	Number of lectures = 9	
Matplot lib package – Plotting Graphs – Controlling Graph – Adding Text – More Graph Types – Getting and setting values – Patches.		
Unit – 4	**Number of lectures = 9**	
Principles and foundation of Artificial intelligence and IoT – Machine Learning Paradigms for IoT – Supervised learning for IoT-Linear regression-Logistic regression-SVM – Decision Tree - Naïve's bayesDeep Learning for IoT-Neural Network.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Rajkumar Buyya, Amir Vahid Dastjerdi," Internet of Things: Principles and Paradigms", Elsevier,2016.
- R. Chandrasekaran," Essentials of Cloud computing", 2nd Edition, Chapman and Hall/CRC, 2015.
- Amita Kapoor, "Hands on Artificial intelligence for IoT", 1 st Edition, Packt Publishing, 2019.

14. Reference Books

- John Soldatos, "Building Blocks for IoT Analytics", River Publishers,2016
- John E. Rossman, "The Amazon way on IoT", Volume 2, John E. Rossman publication, 2016.

Privacy and security in IoT

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Privacy and security in IoT</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Basics of Information Technology, Discrete Mathematics, Computer Network</td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">The course begins with the introduction of classical cryptography and mathematics used in modern cryptography. The student are then introduced to Symmetric key algorithm, Asymetric key algorithm hash function Digital signature in real life.
The course further emphasizes on the concept of Digital certificate, E-mail security, Web security.</td></tr>
<tr><td colspan="7">LearningObjectives:
1. Develop understanding among the students about the various encryption techniques and concept of Public key cryptography.
2. Demonstrate methods to apply hash functions, digital signature and security practices which are adopted
3. Teach use and application of usage and development of the security services</td></tr>
<tr><td colspan="7">Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Understand several types of attacks and Cryptographic protocols
2. Calculate hash values, implement Digital Signature and Digital certificate.
3. Compare within different Network Security applications and Firewalls.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">Mathematical Background</td></tr>
<tr><td colspan="7">FOUNDATIONS OF CRYPTOGRAPHY TECHNIQUES: Services, Mechanisms and attacks - Network security model- Classical Encryption techniques. FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields - Modular arithmetic – Euclid’s algorithm - Finite fields - Polynomial Arithmetic – Prime numbers-Fermat's and Euler's theorem - Testing for primarily - The Chinese remainder theorem - Discrete logarithms.
Symmetric and Asymmetric Algorithm: Data Encryption Standard - Block cipher principles - block cipher modes of operation - Advanced Encryption Standard (AES) - Triple DES - Blowfish - RC5 algorithm. Public key cryptography: Principles of public key cryptosystems - The RSA algorithm - Key management</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">Hash Function and System Security Practice</td></tr>
</table>

Authentication and Hash Functions: requirement – Authentication function – MAC – Hash function – Security of hash function and MAC –MD5 – SHA – HMAC – CMAC – Digital signature and authentication protocols – DSS – EI Gamal – Schnorr Algorithm

Network Security Authentication applications – Kerberos – X.509 Authentication services – Internet Firewalls for Trusted System: Roles of Firewalls – Firewall related terminology- Types of Firewalls – Firewall designs – SET for E-Commerce Transactions. Intruder – Intrusion detection system – Virus and related threats – Countermeasures – Firewalls design principles – Trusted systems – Practical implementation of cryptography and security.

Unit – 3	**Number of lectures = 9**	**Email and Web Security**

E-mail security: Security Services for E-mail - attacks possible through E-mail – establishing keys privacy - authentication of the source - Message Integrity - Non-repudiation - Pretty Good Privacy-S/MIME.

Unit – 4	**Number of lectures = 9**	**IpSecurity** and **Web Security**

IPSecurity: Overview of IPSec – IP and IPv6 - Authentication Header - Encapsulation Security Payload (ESP) - Internet Key Exchange (Phases of IKE, ISAKMP/IKE Encoding).

Web Security: SSL/TLS Basic Protocol - computing the keys - client authentication - PKI as deployed by SSL Attacks fixed in v3 - Exportability - Encoding - Secure Electronic Transaction (SET).

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education.
- Behrouz A. Forouzan, Cryptography & Network Security, 2nd Edition, Tata McGraw Hill

14. Reference Books

R1: Alfred J. Menezes, Paul C. van Oorschot, Scott A. Vanstone, "Handbook of Applied Cryptography", CRC Press, 1997.

R2: OdedGoldreich, "Foundations of Cryptography: A Primer", Second Edition, NOW Publishers, USA.

R3: Charlie Kaufman and Radia Perlman, Mike Speciner, “Network Security, Private Communication in Public World”, Second Edition, Prentice Hall of India, 2002.

Internet of Things Sensing & Actuator Devices

1. **Name of the Department- Computer Science & Engineering**

2. Course Name	Sensors and Actuator Devices	L	T	P
3. Course Code		3	0	0

4. Type of Course (use tick mark)	Core ()	PE(✓)	OE()

5. Pre-requisite (if any)	Measurements and Instrumentation	6. Frequency (use tick marks)	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)

Lectures = 36	Tutorials = 00	Practical = 0

8. Brief Syllabus: This course deals with the different type of sensors and transducers. This also describe their role to know the domain status. It alos deals with the process to further processing of sensing elements.

9. Learning objectives: By the completion of the course, you should be able to:
   1. Educate students to understand the functioning of different types of sensors & their role in order to sense various parameters.
   2. To utilize the status of different signal parameters in the real time application to conrol the working.

10. Course Outcomes: On completion of this course, the students will be able to
    1. Select the correct sensor for an given problem.
    2. And also capable to interface that sensor with the processor for further processing.

11. Unit wise detailed content

Unit-1	Number of lectures = 12	Introduction to Sensors

Principle of sensing & transduction , classification of sensors, Resistive sensors, Inductive sensor, Ferromagnetic plunger type, short analysis;

Unit - 2	Number of lectures = 8	Capacitive sensors: & Piezoelectric sensors

variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type,
Stretched diaphragm type: microphone, response characteristics;
Piezoelectric element: piezoelectric effect, crystal model, force & stress sensing, ultrasonic sensors.

Unit - 3	Number of lectures = 6	Thermal sensors

Material expansion type: solid, liquid, gas & vapor;
Resistance change type: RTD materials, tip sensitive & stem sensitive type.
Thermo emf sensor: Thermoelectric power, Junction semiconductor type IC and PTAT Type;
Radiation sensors: LDR, Photovoltaic cells, photodiodes;

Unit - 4	Number of lectures = 8	Magnetic Sensors

Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics;

12. Brief Description of self learning / E-learning component
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

- Sensor & transducers, D. Patranabis, 2nd edition, PHI
- Instrument transducers, H.K.P. Neubert, Oxford University press.
- Measurement systems: application & design, E. A. Doebelin, Mc Graw Hill.

Cyber Security & Forensics

Programming Language- Python

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2.Course Name</td><td>Programming Language – Python</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">EAS ()</td><td colspan="2">BSE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Operating System</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
</table>

Course Rationale: The course begins with the concepts of Python Programming Language with Libraries.

Course Objectives:

Objectives: The objective of this course is to teach students the concepts of Python Programming Language with Libraries.

Learning & Course Outcomes:

On completion of this course, the students are expected to learn

1. Python programming, Data Structure.
2. Learn Libraries Numpy, Pandas with the use of Data Analysis.

UNIT – I

Python programming Basic: Python interpreter, I Python Basics, Tab completion, Introspection, %run command, magic commands, matplotlib integration, python programming, language semantics, scalar types. Control flow

Data Structure, functions, files: tuple, list, built-in sequence function, dict, set, functions, namescape, scope, local function, returning multiple values, functions are objects, lambda functions, error and exception handling, file and operation systems

UNIT – II

NumPy: Array and vectorized computation: Multidimensional array object. Creating ndarrays, arithmetic with numpy array, basic indexing and slicing, Boolean indexing, transposing array and swapping axes, universal functions, array-oriented programming with arrays, conditional logic as arrays operations, file input and output with array

Pandas: Pandas data structure, series, DataFrame, Index Object, Reindexing, dropping entities from an axis, indexing, selection and filtering, integer indexes, arithmetic and data alignment, function application and mapping, soring and ranking, correlation and covariance, unique values, values controls and membership, reading and writing data in text format

UNIT –III

Visualization with Matplotlib: Figures and subplots, colors, markers, line style, ticks, labels, legends, annotation and drawing on sublots, matplotlib configuration

UNIT –IV

Plotting with pandas and seaborn: line plots, bar plots, histogram, density plots, scatter and point plots, facet grids and categorical data

Reference Books:

- Learning Python: Powerful Object-Oriented Programming by Lutz M - Shroff; Fifthedition
- Python: The Complete Reference by Martin C. Brown - McGraw Hill Education; Forthedition
- Pandas for Everyone: Python Data Analysis by Daniel Y. Chen - Pearson Education; Firstedition

Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

Programming in Python Lab

<table>
<tr><td colspan="7">1. Name of the Department: CSE</td></tr>
<tr><td>2. Course Name</td><td>Programming in Python Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 00</td><td>Tutorials = 0</td><td colspan="4">Practical = 48</td></tr>
<tr><td colspan="7">8.Course Objective: Python is next generation multi-purpose programming language that allows different users to create applications of various domains. Students will be able to learn primary fundamentals of python programming and potential of python is to achieve modern computing requirements.</td></tr>
<tr><td colspan="7">9.Learningobjectives:
1. Master the fundamentals of writing Pythonscripts.
2. Learn core Python scripting elements such as variables and flow controlstructures.
3. Discover how to work with lists and sequencedata.
4. Write Python functions to facilitate codereuse.
5. Use Python to read and writefiles</td></tr>
<tr><td colspan="7">10. CourseOutcomes:
After completion of this course, student will be able to
1. To learn basics ofPython
2. To develop console application in python
3. To develop database application inpython
4. To develop basic machine learningapplication</td></tr>
<tr><td colspan="4">List of Experiments</td><td colspan="3">Outcome Covered</td></tr>
<tr><td colspan="4">1. Implement a Python program to Calculate GCD of two numbers.</td><td colspan="3">I</td></tr>
<tr><td colspan="4">2. Implement a Python Program to calculate the square root of a number by Newton's Method.</td><td colspan="3">I</td></tr>
<tr><td colspan="4">3. Implement a Python program to calculate the exponentiation of a number.</td><td colspan="3">II</td></tr>
<tr><td colspan="4">4. Implement a Python Program to calculate the maximum from a list of numbers.</td><td colspan="3">III</td></tr>
<tr><td colspan="4">5. Implement a Python Program to perform Search</td><td colspan="3">II</td></tr>
</table>

6. Implement a Python Program to perform Liner search	IV
7. Implement a Python Program to perform Binary search	III
8. Implement a Python Program to perform insertion sort.	II
9. Implement a Python Program to perform selection sort.	IV
10. Implement a Python program to multiply matrices.	III
11. Implement a Python program to Calculate the most frequent words in a text read from a file.	II
12. Implement function overloading with different function signatures.	IV
13. Implement concept of class, instances and inheritance.	IV
14. Implement internal and external library.	III
15. Solve algorithmic problems by program using different problem-solving strategies.	III
16. Search content using regular expression library in python.	IV
17. Implement Matrix multiplication using multi-threading in python	III

Network Security

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Network Security</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course covers the underlying principles and techniques for network and communication security. Practical examples of security problems and principles for countermeasures are given. The course also surveys cryptographic and other tools used to provide security and reviews how these tools are utilized in protocols and applications.</td></tr>
<tr><td colspan="7">18. Learning Objectives:
1. To understand basics of Network Security.
2. To be able to secure a message over insecure channel by various means
3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Develop Concept of Security needed in Communication of data through computers and networks along with Various Possible Attacks.
2. Understand Various Encryption mechanisms for secure transmission of data and management of key required for required for encryption.
3. Understand authentication requirements and study various authentication mechanisms</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction to security attacks - services and mechanism - introduction to cryptography - Conventional Encryption: Conventional encryption model - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and blockciphers - Modern Block Ciphers: Block ciphers principals - Shannon’s theory of confusion anddiffusion - fiestal structure - data encryption standard(DES) - strength of DES - differential and linearcrypt analysis of DES - block cipher modes of operations - triple DES – AES.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Confidentiality using conventional encryption - traffic confidentiality - key distribution - random number generation - Introduction to graph - ring and field - prime and relative prime numbers - modular arithmetic - Fermat’s and Euler’s theorem - primarily testing - Euclid’s Algorithm - Chinese Remainder theorem - discrete algorithms.
Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffle-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography – Elgamel encryption - Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks – security of hash functions and MACS.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service - electronic mail security-pretty good privacy (PGP) - S/MIME.</td></tr>
<tr><td>Unit – 4</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

Web Security: Secure socket layer and transport layer security - secure electronic transaction (SET) - System Security: Intruders - Viruses and related threads - firewall design principals – trusted systems.
IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- William Stallings, "Crpyptography and Network security Principles and Practices", Pearson/PHI
- Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN13:9780133354690.
-

14. Reference Books

- Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing – Prentice Hall of India.
- W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education

Cryptography Fundamentals

<table>
<tr><td colspan="8">Name of the Department- Computer Science and Engineering</td></tr>
<tr><td>Course Name</td><td>Cryptography Fundamentals</td><td>L</td><td colspan="2">T</td><td colspan="3">P</td></tr>
<tr><td>Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="3">0</td></tr>
<tr><td colspan="2">Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="3">OE ()</td></tr>
<tr><td>Pre-requisite (if any)</td><td></td><td>Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td colspan="2">Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">Total Number of Lectures, Tutorials, Practical (assuming 12weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="5">Practical = 0</td></tr>
<tr><td colspan="8">Course Description</td></tr>
<tr><td colspan="8">The course covers theory and practice of computer security, focusing in particular on the security aspects of the web and Internet. System security issues, such as viruses, intrusion, and firewalls, will also be covered.</td></tr>
<tr><td colspan="8">Learning objectives:
1. Explain the importance and application of each of confidentiality, integrity, authenticationand availability
2. Understand various cryptographic algorithms.
3. Understand the basic categories of threats to computers andnetworks
4. Describe public-keycryptosystem.
5. To defend the security attacks.</td></tr>
<tr><td colspan="8">Course Outcomes (COs):</td></tr>
<tr><td colspan="8">On completion of this course, the students will be able to</td></tr>
<tr><td colspan="8">1. Identify basic security attacks and services
2. Use symmetric and asymmetric key algorithms for cryptography
3. Analyze Key Management techniques and importance of number Theory.
4. Understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions works..</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td colspan="8">Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 08</td><td colspan="6">Title of the unit: Attacks on Computers and Computer Security</td></tr>
<tr><td colspan="8">Introduction: The need for security, Security approaches, Principles of security, Types of Security attacks.Introduction to Number Theory: Divisibility and the Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Prime Numbers and The Chinese Remainder Theorem.</td></tr>
</table>

Unit – 2	**Number of**	**Title of the unit: Symmetric key Ciphers**
	lectures = 10	
Cryptography: Concepts and Techniques: Introduction, Plain text and Cipher text, Substitution Techniques, Transposition Techniques, Stenography. Block Cipher principles &Algorithms: Stream Ciphers vs. Block Ciphers,Feistel networks,Data Encryption Standard (DES)**,**International Data Encryption Algorithm (IDEA)Basics of finite fields**,**Advanced Encryption Standard (AES), Principles of Pseudorandom Number Generation: PRNGs, TRNGs.		
Unit – 3	**Number of lectures = 08**	**Title of the unit:Asymmetric key Ciphers**
Asymmetric key Ciphers: Symmetric vs. Asymmetric Cryptography, Principles of public key cryptosystems, RSA Algorithm, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography. Key Management and Distribution: Key Establishment Using Symmetric-Key and Asymmetric Techniques, Distribution of Public Keys.		
Unit – 4	**Number of lectures = 10**	**Title of the unit: Data Integrity Algorithms**
Applications of Cryptographic Hash Functions: Security Requirements of Hash Functions, Hash Algorithms (MD5 and SHA-1), Principles of Message Authentication Codes, HMAC, CMAC Principles of Digital Signatures, Elgamal Digital Signature Scheme, Digital Signature Algorithm (DSA).		
Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course- category/Journal papers; Patents in the respective field.		
Books Recommended		
i. W. Stallings, Cryptography and Network Security: Principles and Practice, 7th Ed. Pearson Publishers, 2017. (ISBN No.: 978-0-13-44446-11)		
ii. Cryptography and Network Security : Atul Kahate, Mc Graw Hill Edition		
iii. Understanding Cryptography: Christof Paarand Jan Pelzl,Springer Heidelberg Dordrecht London New York,ISBN 978-3-642-04100-6.		
iv. D. R. Stinson, Cryptography: Theory and Practice, 3rd Ed. Boca Raton, FL: Chapman & Hall/CRC, 2005. (ISBN No.: 978-1-58-488508-5)		
v. Information Security, Principles and Practice: Mark Stamp, Wiley India.		
vi. Principles of Computer Security: WM.Arthur Conklin, Greg White, TMH		
vii. Introduction to Network Security: Neal Krawetz, CENGAGE Learning		

Cryptography Fundamental Lab

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Cryptography Fundamental Lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even(✓)	Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 24**			

Course Description: Cryptography is the practice of techniques used to protect the secure transmission of information. This course is an excellent starting point to understand what is cryptography, learn how cryptography is used, and understand hash, symmetric, and asymmetric cryptographic algorithms.

1. Learning Objectives:

1. Explain the importance and application of each of confidentiality, integrity, authentication and availability
2. Understand various cryptographic algorithms.
3. Understand the basic categories of threats to computers and networks
4. Describe public-key Cryptosystem.

10. Course Outcomes (COs):

1. Understand security concepts and type of attacks and network security algorithms.
2. Apply symmetric and asymmetric key cryptography technique to encrypt and decrypt text.
3. Apply the knowledge of symmetric key algorithm.
4. Apply Cryptography Hash Function for message authentication and to solve other applications.
5. Understand the concept of security with different key management things.

11. List of Experiments

- Write a program to perform encryption and decryption for Ceaser cipher.
- Write a program to implement Rail fence Cipher technique.
- Write a program to implement the DES algorithm logic.
- User A want to send message “welcome to SGT University” to user B by using AES algorithms encrypt it and decrypt it at receiver end.
- Write a program to implement RSA algorithm.
- Implement the Diffie-Hellman Key Exchange mechanism using HTML and JavaScript.
- Write a program to implement Secure Hash Algorithm.
- Calculate the message digest of a text using the MD5 algorithm in JAVA.
- Write a program to implement digital Signature.

Cyber Security

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Cyber Security</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>NIL</td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Cyber Security courses aims to equip students with the knowledge and skills required to defend the computer operating systems, networks and data from cyber-attacks. Any industry that transacts online or carries sensitive data is in need of a Cyber Security professional to safeguard its data from such delinquents.</td></tr>
<tr><td colspan="7">19. Learning Objectives:
1. To familiarize various types of cyber-attacks and cyber-crimes
2. To give an overview of the cyber laws
3. To study the defensive techniques against these attacks</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Understand cyber-attacks, types of cybercrimes, cyber laws.
2. Understand how to protect them self and ultimately the entire Internet community from such attacks.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.</td></tr>
<tr><td>Unit – 3</td><td colspan="2">Number of lectures = 9</td><td colspan="4"></td></tr>
<tr><td colspan="7">Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.</td></tr>
</table>

Unit – 4	**Number of lectures = 9**	
Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations. Cybercrime and Cyber terrorism: Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
- B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

14. Reference Books

- Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.
- Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group

Disaster Recovery and Business Continuity Management

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Disaster Recovery and Business Continuity Management**	**L** **3**		**T** **0**		**P** **0**
3. Course Code						
4. Type of Course (use tick mark)		**Core ()**	**EAS()**	**BSC ()**		
5. Pre-requisite (if any)	**Basic Environmental Knowledge**	**6. Frequency (use tick marks)**		Even ()	Odd (✓)	Either Sem () / Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials =**				

8. Brief Syllabus

This course focuses on two aspects of Cyber Security: analysis and assessment of risk plus how to minimize it, and, how to extract and use digital information from a wide range of systems and devices. The course is structured so that all students cover the same introductory material, but then choose to specialize in either Cyber Security or Digital Forensics. Any aforesaid science graduate who requires keen interest & knowledge of IT programming languages with basic knowledge of math beyond calculus.

9. Learning objectives:

This course focuses on two aspects of Cyber Security: analysis and assessment of risk plus how to minimize it, and, how to extract and use digital information from a wide range of systems and devices. The course is structured so that all students cover the same introductory material, but then choose to specialize in either Cyber Security or Digital Forensics. Any aforesaid science graduate who requires keen interest & knowledge of IT programming languages with basic knowledge of math beyond calculus.

10. Course Outcomes (COs):

1. Understand the concept of business continuity
2. Learn the importance of a BCP(business continuity planing)
3. See how load balancing maintains business continuity
4. Discover how a DCP(Disaster recover plan) is a second line of defense
5. Learn how to choose the right fail over solution

11. Unit wise detailed content

Unit-1	**Number of lectures = 10**	**Title of the unit: Introduction**

Introduction to Business Continuity Management (BCM) and Disaster Recovery (DR) -Terms and definitions - BCM principles - BCM life cycle - (BCM program management, Understanding the organization - Determining business continuity strategy, Developing and implementing a BCM response, BCM exercising, Maintaining and

reviewing BCM arrangements, Embedding BCM in the organization's culture)- BCM in business: Benefits and consequence - Contemporary landscape: Trends and directions.		
Unit – 2	**Number of lectures = 10**	**Title of the unit: Business Impact Analysis**
BCM and DR–The relationship with Risk Management - Risk Management concepts and framework - Concepts of threat, vulnerabilities and hazard - Risk Management process - Risk assessment, risk control options analysis, risk control implementation, risk control decision, and risk reporting -Business Impact Analysis (BIA) concept, benefits and responsibilities - BIA methodology - Assessment of financial and operational impacts, identification of critical IT systems and applications, identifications of recovery requirements and BIA reporting - Relationship between BIA and Risk Management.		
Unit - 3	**Number of lectures = 8**	**Title of the unit: Business Continuity Strategy and Business Continuity Plan (BCP) Development**
Business continuity strategy development framework - Cost-benefit assessment - Site assessment and selection - Selection of recovery options - Strategy considerations and selection - Linking strategy to plan - Coordinating with External Agencies -Business continuity plan contents - Information Systems aspects of BCP - Crisis Management - Emergency response plan and crisis communication plan - Awareness, training and communication - Plan activation - Business Continuity Planning Tools.		
Unit - 4	**Number of lectures = 8**	**Title of the unit: Business Continuity Plan Testing and Maintenance**
Test plan framework - Types of testing – Business Continuity Plan Testing - Plan maintenance requirements and parameters - Change management and control -Business Continuity Plan Audits. Disaster Recovery – Definitions - Backup and recovery - Threat and risk assessment - Site assessment and selection - Disaster Recovery Road map - Disaster Recovery Plan (DRP)preparation - Vendor selection and implementation - Difference between BCP and DRP - Systems and communication security during recovery and repair.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT ELearning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.

13. Books Recommended

Text Book:

- The Disaster Recovery Handbook by Michael Wallace (Author) and Lawrence Webber (Author) (2010), AMACOM

Reference Books:

- William H. Dennen and Bruce R. Moore, WCB Publishers, Iowa.
- John M. Wallace and Peter V. Hobbs, Atmospheric Science: An Introductory Survey, Academic Press, New York,
- Egbort Bocker and Rienk Van Grondille, Environmental Physics, John Wiley and Sons Ltd
- Barbar W. Murk et. al., Environmental Geology, John Wiley and Sons, New York

Android Security

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Android Security**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)	Computer Basics	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
The Android operating system has several built-in security features to protect application users from attackers (e.g., network sniffers, malicious app writers, device thieves, and more). This course teaches important information about the Android platform but also focuses on these defensive programming techniques which developers must know in order to write secure apps..						

9.LearningObjectives:

1. Appreciate the risks to Android applications.
2. Understand the structure of Android package files.
3. Understand the Android security model and the protections provided by the Android OS.
4. Apply defensive programming techniques for common Android vulnerabilities.

10. Course Outcomes (COs):

The students will be able to:-

1. Describe different components of Android applications
2. Identify possible vulnerabilities
3. Secure coding examples

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

Introduction to Mobile Security

Building Blocks – Basic security and cryptographic techniques, Security of GSM Networks, Security of UMTS Networks, LTE Security, WiFi and Bluetooth Security, SIM/UICC Security

Mobile Malware and App Security

Unit – 2	**Number of lectures = 9**	

Security Model

Android Security Model, IOS Security Model, Security Model of the Windows Phone, SMS/MMS, Mobile Geolocation and Mobile Web Security, Security of Mobile VoIP Communications

Unit – 3	**Number of lectures = 9**	

Introduction to Android APP Development Architecture, Code Layout, SDK review Understand the structure of Android package files. Explore the role of security in the software development life cycle and how best to create secure applications.		
Unit – 4	**Number of lectures = 9**	
Appreciate the risks to Android applications. Understand the Android security model and the protections provided by the Android OS. Apply defensive programming techniques for common Android vulnerabilities.		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/		
13. Books Recommended		
Text Books • Mobile Application Security, Himanshu Dviwedi, Chris Clark and David Thiel, 1st Edition		
14. Reference Books		
• Security of Mobile Communications, Noureddine Boudriga, 2009		

Android Security Lab

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Android Security Lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core ()**	**PE (✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even	Odd (✓)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 24**			

Course Description:

Android Security is the course focusing specifically on the various security concerns of the Android platform. e explore the Android architecture and security model, permission system and enforcement, encryption, known exploits, memory protections, data protection, device management as well as tools security researchers use to find Android vulnerabilities.

2. Learningobjectives:

1. The lab teaches the basics of building an Android app. Students will become familiar with the Android SDK
2. The lab familiarizes students with Apktool. A tool used to decompile and reassemble applications. They will also learn about other Android SDK components like BroadcastReceivers and the Android Manifest file.
3. The lab implements a man in the middle attack using a WiFi Pineapple rogue access point. Students will learn how to setup the WiFi Pineapple and use its dashboard.
4. The lab requires students to implement two Android applications. The first app teaches students how to use the LocationManager class to send device access point information to a remote server

10. Course Outcomes (COs):

1. By the end of the course students will be able to recognizes mobile computing platforms and mobile computing
2. Students recognize the concept of android security for mobile devices.
3. Students recognize the virus such as malware, Trojans , cyber threats & Security threats for android computing devices.
4. Understands the basic technologies used by the Android platform. Recognizes the structure of an Android security tools & project.

11. List of Experiments

Digital Watermarking and Steganography

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Digital Watermarking and Steganography</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>NIL</td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Digital watermarking technology can be used to guarantee authenticity and can be applied as proof that the content has not been altered since insertion. To provide a comprehensive overview on different aspects of mechanisms and techniques for information security.</td></tr>
<tr><td colspan="7">10. Learning Objectives:
1. To learn about the watermarking models and message coding
2. To learn about watermark security and authentication.
3. To learn about stegnography. Perceptual models</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Know the History and importance of watermarking and steganography
2. Analyze Applications and properties of watermarking and steganography
3. Demonstrate Models and algorithms of watermarking.
4. Possess the passion for acquiring knowledge and skill in preserving authentication of Information
5. Identify theoretic foundations of steganography and steganalysis</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction: Information Hiding, Steganography and Watermarking – History of watermarking – Importance of digital watermarking – Applications – Properties – Evaluating watermarking systems. Watermarking models & message coding: Notation – Communications – Communication based models – Geometric models – Mapping messages into message vectors – Error correction coding – Detecting multi-symbol watermarks.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Watermarking with side information & analyzing errors: Informed Embedding – Informed Coding – Structured dirty-paper codes - Message errors – False positive errors – False negative errors – ROC curves – Effect of whitening on error rates.</td></tr>
</table>

Unit – 3	**Number of lectures = 9**	
Perceptual models: Evaluating perceptual impact – General form of a perceptual model – Examples of perceptual models – Robust watermarking approaches - Redundant Embedding, Spread Spectrum Coding, Embedding in Perceptually significant coefficients Watermark security & authentication: Security requirements – Watermark security and cryptography – Attacks – Exact authentication – Selective authentication – Localization – Restoration.		
Unit – 4	**Number of lectures = 9**	
Steganography: Steganography communication – Notation and terminology – Informationtheoretic foundations of steganography – Practical steganographic methods – Minimizing the embedding impact – Steganalysis		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, Ton Kalker. "Digital Watermarking and Steganography", Margan Kaufmann Publishers, New York, 2018.

14. Reference Books

- Michael Arnold, Martin Schmucker, Stephen D. Wolthusen, "Techniques and Applications of Digital Watermarking and Contest Protection", Artech House, London, 2013.
- Juergen Seits, "Digital Watermarking for Digital Media", IDEA Group Publisher, New York, 2015.
- Peter Wayner, "Disappearing Cryptography – Information Hiding: Steganography & Watermarking", Morgan Kaufmann Publishers, New York, 2012.

Biometrics

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Biometrics</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td>4. Type of Course (use tick mark)</td><td></td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>NIL</td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Biometric recognition, or simply biometrics, is the science of establishing the identity of a person based on physical or behavioral attributes. In this course we will cover the three primary modalities of biometric recognition, namely fingerprint, face, and iris.</td></tr>
<tr><td colspan="7">11. Learning Objectives:
1. To develop a fundamental knowledge in the phases of biometric system for identification and verification tasks.
2. To quantitatively and qualitatively evaluate the strength and weaknesses of several biometric modalities from measures, such as error metrics, usability, and public perception, and apply these skills to emerging biometric technologies.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The student should be able to:
1. Demonstrate knowledge engineering principles underlying biometric systems.
2. Analyze design basic biometric system applications.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction - Biometric fundamentals – Biometric technologies – Biometrics vs traditional techniques – Characteristics of a good biometric system – Benefits of biometrics – Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Physiological Biometrics - Leading technologies: Finger-scan – Facial-scan – Irisscan – Voice-scan – components, working principles, competing technologies, strengths and weaknesses – Other physiological biometrics: Hand-scan, Retinascan – components, working principles, competing technologies, strengths and weaknesses – Automated fingerprint identification systems. Behavioural Biometrics: Leading technologies: Signature-scan – Keystrokescan – components, working principles, strengths and weaknesses.</td></tr>
</table>

Unit – 3	**Number of lectures = 9**	
Standards in Biometrics - Assessing the Privacy Risks of Biometrics – Designing Privacy - Sympathetic Biometric Systems – Need for standards – different biometric standards - Categorizing biometric applications. Multi biometrics and multi factor biometrics - two-factor authentication with passwords - tickets and tokens – executive decision - implementation plan.		
Unit – 4	**Number of lectures = 9**	
Signature and handwriting technology - Technical description – classification – keyboard / keystroke dynamics- Voice – data acquisition - feature extraction - characteristics - strengths – weaknesses-deployment.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Anil K. Jain, Patrick Flynn, and Arun A. Ross, “Handbook of Biometrics”, Springer, 2018.

14. Reference Books

- L C Jain, I Hayashi, S B Lee, U Halici, Intelligent Biometric Techniques in Fingerprint and Face Recognition CRC Press, 2014.
- John R. Vacca, “Biometric Technologies and Verification Systems”, Elsevier Inc, 2017

Mobile Application Security & Penetration Testing

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Mobile Application Security & Penetration Testing</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Basic Java/IOS programming skills.</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Course benefits the career of Penetration Testers and IT security personnel in charge of defending their organization’s applications and data.</td></tr>
<tr><td colspan="7">(i) LearningObjectives:
1. To understand the different types of vulnerabilities that affect mobile applications and have the practical knowledge to attack and exploit them.
2. To perform real world attacks on Android Devices and Apps.
3. To learn How to Fuzz mobile apps.
4. To learn Mobile applications reverse engineering.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Perform real world attacks on Android Devices and Apps.
2. Learn Mobile applications reverse engineering.
3. Perform Penetration tests of mobile applications.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">ANDROID PENTESTING:Android Architecture, Setting up a Test Environment , Android Build Process , Reversing APKs , Device Rooting , Android Application Fundamentals , Network Traffic , Device and Data Security , Tapjacking , Static Code Analysis , Dynamic Code Analysis</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">iOS PENTESTING: iOS Architecture, Device Jailbreaking, Setting up a Testing Environment, iOS Building Process, Reversing iOS Apps, iOS Application Fundamentals, iOS Testing Fundamentals, Network Traffic, Device Administrator, Dynamic Analysis</td></tr>
</table>

Unit – 3	**Number of lectures = 9**	

. **Reversing APKs**: APKTool , Dex2Jar , JD-GUI , Smali/Backsmali , Obfuscation , Additional APK Contents , Hardware Optimization , OEM Apps
. **Device Rooting**: What is Rooting , SuperUser and SuperSU, . Potential Issues , Custom ROMs , OmniROM and CyanogenMod,Google Nexus, Implication of Rooting , Rooting for Testing

Unit – 4	**Number of lectures = 9**	

Device and Data Security: Data Storage, Internal Storage, External Storage. Device Administration API ,MDM Solutions , Root Detection , Third-Party Code , SDK ,Libraries , Device Tracking
Static Code Analysis :Static Code Analysis, Vulnerable Code Snippet, . Vulnerability Exploitation , SQL Injection , Selection query, Direct Using User Input , Partial Parametrization, Full Parametrization,ContentProviders, ContentResolver , Path/Directory Traversal, Vulnerable Activities , android permission , intentMessage, Vulnerable Receivers , Vulnerable Services ,Shared Preferences , Local Databases, . Sqlite3, .Tools :. Drozer , QARK

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

Mobile Application Penetration Testing,**Vijay Kumar Velu** ,2016.

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14. Reference Books

- “The Pentester Blueprint” by Phillip J. Wylie and Kim Crawley, Wiley 2021.
- “Penetration Testing For Dummies” by Robert Shimonski, 2020
- “AWS Penetration Testing” by Jonathan Helmus,2019.

Mobile Application Security & Penetration TestingLab

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Mobile Application Security & Penetration TestingLab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">4</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course will walk you through the process of identifying security issues on Android and iOS applications, using a wide variety of techniques including Reverse Engineering, Static/Dynamic/Runtime and Network Analysis.</td></tr>
<tr><td colspan="7">9. LearningObjectives:
1. 1 Teaches students mobile application programming.
2. Teaches you how to jailbreak or root iOS/Android devices.
3. Teaches give you a certification without any effort.
4. You can memorize to pass a multiple-choice test.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. To acquaint students with the practical aspects of Design.
2. To understand the importance of User engagement and Experience.
3. To learn various development techniques</td></tr>
<tr><td colspan="7">11. Lab Experiments</td></tr>
</table>

Sr. No.	Title	CO Covered
1	To implement Device Rooting.	1
2	To implement Tapjacking.	1,2
3	To implement Android Virtual Machine, Dalvik Executable (DEX), Optimized DEX (ODEX) , Android NDK.	2
4	To learn Using Emulators, AVD Manager, Create Virtual Device, System Images, Start the emulator.	1,3
5	To implement Reversing APKs 4.1. , APKTool 4.2. , Dex2Jar.	3
6	To implement Su, SuperUser and SuperSU rooting.	2,3
7	To implement Proxy Configuration. Burp Suite, CA Certificates.	3

8	To learn Device Administration API, MDM Solutions,. Root Detection.	1
9	To implement SQL Injection. Selection query, Direct Using User Input.	2
10	To implement Vulnerable Activities.	1,2

Cyber Forensics and Investigation

1. Name of the Department:- Computer Science Engineering						
2. Course Name	Cyber Forensics and investigation	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)	C	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
This course enables the students to gain in-depth knowledge in the field of Computer forensics & Cyber Crime						
9. Learning Objectives: • To impart the basic concepts of Cyber Forensics. • To understand different types of cyber attacks. • To understand analysis of data to identify evidence, Technical Aspects & Legal Aspects related to cyber crime.						
10. Course Outcomes (COs):						
1. Understand the fundamentals of Computer Forensics 2. Learn the issues of Data Acquisition and Data Recovery 3. Explore networking in cyber forensics 4. To learn, analyze and validate Forensics Data 5. To study the tools and tactics associated with Cyber Forensics						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 08**					
Introduction to Cyber forensics: Information Security Investigations, Corporate Cyber Forensics, Scientific method in forensic analysis, investigating large scale Data breach cases. Analyzing Malicious software. Types of Computer Forensics Technology, Types of Military Computer Forensic Technology, Types of Law Enforcement: Computer Forensic Technology, Types of Business Computer Forensic Technology, Specialized Forensics Techniques, Hidden Data and How to Find It, Spyware and Adware, Encryption Methods and Vulnerabilities, Protecting Data from Being Compromised Internet Tracing Methods, Security and Wireless Technologies, Avoiding Pitfalls with Firewalls Biometric Security Systems.						

Unit – 2	Number of lectures = 10	
Types of Computer Forensics Systems: Internet Security Systems, Intrusion Detection Systems, Firewall Security Systems, Storage Area Network Security Systems, Network Disaster Recovery Systems, Public Key Infrastructure Systems, Wireless Network Security Systems, Satellite Encryption Security Systems, Instant Messaging (IM) Security Systems, Net Privacy Systems, Identity Management Security Systems, Identity Theft, Biometric Security Systems.		
Unit – 3	**Number of lectures = 08**	
Windows Forensic Analysis: Window artifacts, Evidence volatility, System time, Logged on user(s), Open files, MRUs, Network information, Process information, Service information, Windows Registry, Start up tasks, Memory dumping; Document Forensics: PDF structure, PDF analysis, MS Office Document structure and analysis, Macros, Windows thumbnails, Android Thumbnails.		
Unit – 4	**Number of lectures = 10**	
Forensic Tools and Processing of Electronic Evidence: Introduction to Forensic Tools, Usage of Slack space, tools for Disk Imaging, Data Recovery, Vulnerability Assessment Tools, Encase and FTK tools, Anti Forensics and probable counters, retrieving information, process of computer forensics and digital investigations, processing of digital evidence, digital images, damaged SIM and data recovery, multimedia evidence, retrieving deleted data: desktops, laptops and mobiles, retrieving data from slack space, renamed file, ghosting, compressed files.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Text books:

I. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, 2nd Edition, Charles River Media, 2005

Reference books:

II. Christof Paar, Jan Pelzl, Understanding Cryptography: A Textbook for Students and Practitioners, 2 nd Edition, Springer’s, 2010

III. Ali Jahangiri, Live Hacking: The Ultimate Guide to Hacking Techniques & Countermeasures for Ethical Hackers & IT Security Experts, Ali Jahangiri, 2009

IV. Computer Forensics: Investigating Network Intrusions and Cyber Crime (Ec-Council Press Series: Computer Forensics), 2010

V. Guide to Computer Forensics And Investigations Nelson, Bill ; Phillips, Amelia; Enfinger, Frank; Steuat, Christopher Thomson Course Technology.

VI. Computer Forensics – Computer Crime Scene Investigation.Vacca, John R. Charles RiverMedia

Risk Analysis and Assessment

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Risk Analysis and Assessment</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td>4. Type of Course (use tick mark)</td><td></td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Risk and Management Concepts</td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Course introduces to impart knowledge on environmental risk assessment and risk management.</td></tr>
<tr><td colspan="7">5. LearningObjectives:
1. Have a broader view on the relevant literature on risk analysis and management
2. Acquire state-of-the-art quantitative techniques for modeling risk factors and managing risk.
3. Estimate the category of risk and able to take necessary actions against it.
4. Analyzation and assessment of the risk in the projects.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students completing the course will have ability to

1. carryout hazard identification and accounting, risk characterization and consequence determination, event tree and fault tree modeling and Probabilistic risk assessments.
2. develop management plans including risk communication and emergency preparedness planning
3. plan environmental risk assessment of industries and hazardous activities</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1 Introduction</td><td>Number of lectures = 8</td><td colspan="5"></td></tr>
<tr><td colspan="7">Sources of Environmental hazards- Types of Risk-Environmental, Safety and ecological risks- Risk assessment framework- Regulatory perspectives and requirements- Risk Analysis and Management – Social benefit Vs technological risks- Path to risk analysis- Perception of risk- Risk assessment in different disciplines.</td></tr>
<tr><td>Unit – 2ELEMENTS OF ENVIRONMENTAL RISK ASSESSMENT</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

Hazard identification and accounting – Properties, processes and parameters that control fate and transport of contaminants – – Dose Response Evaluation – Slope Factors- Dose Response calculations and Dose Conversion Factors – Risk Characterization and consequence determination- Estimation of carcinogenic and non-carcinogenic risks to human health- – Exposure Assessment – Exposure Factors -Multimedia and multipath way exposure modeling of contaminant concentrations in air, water, soils and vegetation

Unit – 3 TOOLS AND METHODS FOR RISK ASSESSMENT	**Number of lectures = 10**	

HAZOP and FEMA methods- Cause failure analysis – Event tree and fault tree modeling and analysis – Vulnerability assessment – Uncertainty analysis – Methods in Ecological risk assessment – Probabilistic risk assessments- Radiation risk assessment- Data sources and evaluation.

Unit – 4 Project Risks	**Number of lectures = 7**	

- Importance of project risk assessment, Various components of project risk, Introduction to operational risk, Three aspects of the senior management support, Execution risk Financing risk, Technology risk Project contingency provision, Funding of projects Evaluation of project risk

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
- Kolluru Rao, Bartell Steven, Pitblado R and Stricoff, “Risk Assessment and Management Handbook”, McGraw Hill Inc., New York, 1996.
- Kofi Asante Duah, “Risk Assessment in Environmental management”, John Wiley and sons, Singapore, 1998.

14. Reference Books

- Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.
- Mark Burman, Risks and Decisions for Conservation and environmental management,Cambridge University Press, 2005

Cloud Security Essentials

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Cloud Security Essentials	**L**	**T**		**P**	
3. Course Code		**3**	**0**			
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)	**Basic knowledge of computer, Database Management System (DBMS)** and **Net working.**	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

In cloud computing, we can manipulate, configure and access the hardware and software remotely. In general, cloud computing is accessing and storing the files and databases over the internet instead of accessing it on your computer's hard drive.Cloud computing offers platform independence, the software is not required to be installed on any PC. There is portability in cloud computing.

6. LearningObjectives:

1. Understand the computing paradigm and cloud computing
2. Understand the architecture of cloud computing
3. Understand and use the service models and deployments
4. Work on any real cloud service
5. Understand the service management and security of cloud

10. Course Outcomes (COs):

The students will be able to:-

1. Clarify the different definitions of cloud computing and its characteristics.
2. Explain the principles of hardware virtualization and its importance for cloud computing.
3. Motivate the importance of data centers for clouds, and explain how to design and construct a data center.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

INTRODUCTION Overview of computing paradigms, Recent trends in computing, evolution of cloud computing, Overview of cloud computing, Cloud computing-Concepts, properties, characteristics, Role of open standards.Cloud computing architecture, Cloud service delivery models (XAAS), Cloud Deployment models

Unit – 2	**Number of lectures = 9**	

INFRASTRUCTURE AS A SERVICE Introduction, Hypervisors, Resource virtualization, Examples, How to implement IAAS
PLATFORM AS A SERVICE Introduction, Cloud Platform and Management, Examples, How to implement PAAS
SOFTWARE AS A SERVICE Introduction, Web services, Web 2.0, Web OS, Examples, How to implement SAAS

Unit – 3	**Number of lectures = 9**	

SERVICE MANAGEMENT IN CLOUD COMPUTING Service Orchestration -Cloud computing and Service Management, Service Level Agreements (SLAs), Billing & Accounting, Comparing scaling hardware, economics of scaling, managing data. Cloud performance, Existing project experience

Unit – 4	**Number of lectures = 9**	

CLOUD SECURITY Infrastructure security, Data Security, Storage Identity and Access Management, Access Control, Trust and Reputation, Authentication in Cloud computing,
CASE STUDY ON OPEN SOURCE AND REAL CLOUD SERVICS Eucalyptus, VMware Cloud, IBM Bluemix, Google Cloud services, Amazon Web services

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- . Barrie Sosinsky: "Cloud Computing Bible", Wiley-India, 2010

14. Reference Books

- . RajkumarBuyya, James Broberg, Andrzej M. Goscinski: "Cloud Computing: Principles and Paradigms", Wiley, 2011
- Nikos Antonopoulos, Lee Gillam: "Cloud Computing: Principles, Systems and Applications", Springer, 2012
- Ronald L. Krutz, Russell Dean Vines: "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley-India, 2010
- Tim Mather, Subra Kumara swamy, ShahedLatif, Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, O'Reilly Media, 2009.

Bio Informatics

Fundamental Biology

<table>
<tr><td colspan="6">1. Name of the Department-</td></tr>
<tr><td>2. Course Name</td><td>Fundamental Biology</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Students will know about the applications in various fields such as prokaryotic and eukaryotic biodiversity, plant, animal and molecular biology.</td></tr>
<tr><td colspan="7">7. LearningObjectives:
The objective of the course is to introduce the students with basics of biological system both at the cellular, biochemical and molecular level and provide an understanding of its applications in various fields such as prokaryotic and eukaryotic biodiversity, plant, animal and molecular biology.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. At the end of the course, the student must be able to understand the fundamentals of biology, biological diversity and their applications in agriculture and medical biotechnology.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">INTRODUCTION TO MICROORGANISMS
Diversity in biological systems, Cell biology and cell structure, Difference between Prokaryotes & Eukaryotes. Kingdom systems. Five-kingdom classification, General characters, Brief account on Ecology, Morphology, Nutrition, Locomotion and Reproduction, useful and harmful effects of Bacteria, Viruses, Algae, Fungi and Protozoans.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">PLANT BIOLOGY
Plant Biology: Concepts of Growth, Meristems. Development of different plant organs; Plant growth regulators;Photosynthesis: Plant & Bacterial photosynthesis; oxygenic and anoxygenic photosynthesis; chlorophyll as trapper of solar energy, photosynthetic reaction centres, Hill reaction, PS I & PS II, Photophosphorylation - cyclic & noncyclic; Dark reaction & CO2 fixation. Economic Importance of Plants.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">ANIMAL BIOLOGY
Introduction of body as a whole, Cells and Tissue Organization, Electrolytes and Body fluids. Physiology: Digestive system, Circulatory systems & Blood, Respiratory system and Endocrine system, Neuromuscular system, Sensory systems - hearing, taste, smell and visual receptors.</td></tr>
</table>

BASIC MOLECULAR BIOLOGY: Genetics: DNA as genetic material, Structure of DNA, DNA replication, Transcription, Translation, Genes to proteins to protein function, Gene expression and regulation, Recombinant DNA technology.

Unit – 4	**Number of lectures = 9**	

APPLICATIONS OF BIOTECHNOLOGY

Drugs and Chemicals from Plants & Animals, Definition and importance (in general) of Biofuels, Biofertilizers, Biopesticides, Bioindicators and Biosensors, Microbial Enzymes, Single Cell Protein (SCP), Monoclonal Antibodies, Introduction to Transgenic Plants & Animals.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Introduction to biology and biotechnology, second edition, K.Vaitaidyanath, K. Pratap Reddy, and K.Satya Prasad, BS Publications.

14. Reference Books

- H.G. Rehen and G.Reed, biotechnology Volume I & 2
- Basic Biotechnology, Second Edition, by Colin Ratledge and Bjorm Kristiansen, Cambridge University Press.
- Anatomy and Physiology In Health and Disease,K. J.W. Wilison and A. Waugh, Churchill & Livingston.
- Plant Physiology F.B Salisbury & C.W. Ross 4th edition Thomson Wadsworth
- Dr. C.C. Chatterjee, Human Physiology (11th Edition) Vol I and II, Medical Allied Agency, Kolkata, 1987.

Fundamental BiologyLab

<table>
<tr><td colspan="6">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Fundamental Biology Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Learning objectives:
1. Develop skills to work in a biology lab and use common biology laboratory equipment and methods.
2. Think like a biologist and be able to recognize broad patterns and develop critical thinking.
3. Understand the scientific method i.e. observe, ask questions, design hypotheses, make predictions, design experiments, conduct experiments, collect data, record and organize data, analyze data, draw conclusions and communicate your findings</td></tr>
<tr><td colspan="7">9. Course Outcomes (COs):
1. Develop skills to present scientific findings in the form of figures, data summaries, formal scientific writing, and oral presentations.</td></tr>
<tr><td colspan="7">10. List of Experiments</td></tr>
<tr><td colspan="7">1) Lab Safety / Intro. to Microscopes,
2) Cell Structure
3) Water, Diffusion & Osmosis
4) Cell Division (mitosis / meiosis)
5) Introduction to Genetics
6) Photosynthesis
7) Biotechnology & Electrophoresis
8) Evolution
9) Respiration & Fermentation
10) SimUText: Keystone Predator
11) Ecology: Statistics & Graphing</td></tr>
<tr><td colspan="7">11. Brief Description of self-learning / E-learning component</td></tr>
</table>

Cell and Molecular Biology

<table>
<tr><td colspan="7">1. Name of the Department-</td></tr>
<tr><td>2. Course Name</td><td>Cell and Molecular Biology</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">4</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Cell and molecular biology enable researchers to study the minute world of microbes and cells. This course will provide a full overview of the world of cell and microbiology. ... Further on in the course, we touch upon more complex subjects such as: DNA and RNA; protein structures; and movement along cellular pathways.</td></tr>
<tr><td colspan="7">8. LearningObjectives:
By doing this course well, students will develop basic knowledge and skills in cell and molecular biology and become aware of the complexity and harmony of the cell. As students proceed through the modules, they will be able to apply this knowledge, skill, and awareness to topics like the following:
1) Basic properties of cells
2) Prokaryotic and eukaryotic cells
3) Viruses
4) Biological molecules: carbohydrates, lipids, proteins, and nucleic acids
5) Techniques used in cell and molecular biology
6) Enzymes
7) Metabolism</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">1. Know cell and molecular biology history.
2. Know cellular functioning and composition.
3. Describe the chemical foundations of cell biology.
4. Know the DNA properties of cell biology.
5. Describe protein structure and function.
6. Describe cellular membrane structure and function.
7. Describe basic molecular genetic mechanisms.
8. Know the Cell Cycle
9. Describe the signaling pathways that control gene activity.
10. Know the transport of ions and small molecules across cell membranes.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

Structural organization of Plant and animal Cell:
Cell wall: structure, function and biogenesis. Plasma membrane; structure, models, functions, sites for ATPases,ion carriers, channels and pumps . Plasmodesmata: structure, role in movement of molecules, camparison with gap junctions. Plant vacuole: Tonoplast membrance, ATPases as storgaeg, organelle. Structure and fuctions of microbodies: Golgi apparatus, lysosomes, endoplasmic reticullum

Unit – 2	**Number of lectures = 9**	

Chloroplast and mitochondria: Structure, genome organization, gene expression, nucleochloroplastic interactions, biogenesis of mitochondria Nucleus: structure, nuclear pores, nucleosome organization, nucleolus The cytoskeleton: Organization and role of microtubules and microfilaments, motor movements implications in flagellar and other movements.

Unit – 3	**Number of lectures = 9**	

Cell cyle and apoptosis: Control mechanisms, role of cyclins, cyclin-dependent kinases, cytokinesis and cell plate formation, mechanisms of programmed cell death 6. Gene expression: DNA structure; A, B, and Z forms; replication, damage and repair Transcription, promoters and transcription factors, splicing, mRNA transport, rRNA biosynthesis, differences in propkaryotes and eukaryotes Translation; structure of ribosome, mechanism of translation initation, elongation and termination, structure and role of tRNA

Unit – 4	**Number of lectures = 9**	

Regulation of gene expression in prokaryotes and eukaryotes. Protein sorting: Targeting of proteins to organelles

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Lewin, B. 2000. Genes VII Oxford University, Press, New York
- Alberts, B. Bray, D., Lewis, J. Raff, M., Roberts, K. and Watson, J.D. 1999, Molecular biology of the cell. Garland Publishing, Inc. New York.

14. Reference Books

- Wolfe, S.L. 1993, Gruissem, W. and Jones, R.L. 2000, Biochemistry and molecular biology of plants, American society of plant physiologists, Maryland, USA
- Frifelder, D. Molecular Biology. John and Bartlett Publishers, inc., Boston, USA

Analytical Bio-Informatics

1. Name of the Department- Computer Science & Engineering					
2. Course Name	**Analytical Bio-Informatics**	**L**	**T**		**P**
3. Course Code		**3**	**0**		**0**
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem () / Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)					
Lectures = 36		**Tutorials = 0**	**Practical = 0**		

8. Course Description

Analytical Bio-Informatics focus on a data science approach on how to collect, store, analyze and visualize very large set of biological data. This course will provide a broad overview this field as well as the foundation techniques required to process, analyze, and use biological data for scientific discovery and applications using data mining and machine learning.

9. Learning Objectives:

1. To get introduced to the basic concepts of bioinformatics and its significance in biological data analysis.
2. Explain about the methods to characterize and manage the different types of Biological data.
3. Development of models for better interpretation of biological data to extract knowledge.
4. Learn how to implement data analytics for biological problems solutions through data mining.

10. Course Outcomes (COs):

The students will be able to:-

1. Describe and interpret concepts of bioinformatics for bio data analysis.
2. Use different types of data analysis tools and its utility in bioinformatics.
3. To understand how some of the commonly used bioinformatics tools work.
4. Able to develop models for interpretation of biological data to extract knowledge using data mining and machine learning.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

Introduction to Bioinformatics and Related Databases: Introduction of bioinformatics, biological databases and their growth, concept of homology, pair wise sequence alignment, dot-matrix plot. Types of big data in bioinformatics. Introduction to biological database: Designing of biological databases, Types of biological database: Primary database, Secondary database, Composite database.

Unit – 2	**Number of lectures = 9**	

Bioinformatics Analysis: Micro array data analysis, Gene–gene network analysis, Pathway analysis, Disease network analysis, Evolutionary data analysis, Protein-Protein interaction analysis, sequence analysis. Tissue level expression analysis with RNA-sequencing, Understanding whole genome sequencing and whole exome sequencing. Graphical visualization tools like Cytoscape.

Unit – 3	**Number of**	

<table>
<tr><td></td><td>lectures = 9</td><td></td></tr>
<tr><td colspan="3">Application of Data Mining in Bio-data analysis: DNA/protein sequence Analysis, Genome analysis, Protein Structure Analysis, Pathway analysis, microarray data analysis, annotation, gene ontology, gene mapping. Biological data mining tools: Entrez, Blast, sequence retrieval system (SRS). Data Mining Applications: Data mining for Biomedical and DNA Data Analysis.</td></tr>
<tr><td>Unit – 4</td><td>Number of lectures = 9</td><td></td></tr>
<tr><td colspan="3">Machine Learning Approaches to Bioinformatics: Machine Learning Approaches; Bioinformatics Medical Imaging Applications of Deep Learning, Decision tree induction, Bayesian classification, Rule based classification, HMM, ANN based classification (back-propagation), Support vector machines (SVM), Neural Network(NN) in bioinformatics.</td></tr>
<tr><td colspan="3">12. Brief Description of self-learning / E-learning component
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/</td></tr>
<tr><td colspan="3">13. Books Recommended</td></tr>
<tr><td colspan="3">Text Books
• Gregg Hartvigsen, A Primer in Biological Data Analysis Using R, Columbia University Press, 2014</td></tr>
<tr><td colspan="3">14. Reference Books</td></tr>
<tr><td colspan="3">• Data mining in bioinformatics by Wang et al, Springer-Verlag, 2005
• Data Mining: Concepts and Techniques by Jiawei Han and Micheline Kamber, 2000</td></tr>
</table>

Analytical Bioinformatics lab

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Analytical Bioinformatics Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE (✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even(✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
</table>

8.Course Description:

1. How sequences may be aligned to other similar, but not identical sequences
2. How the elements in the sequences may have evolved, and what methods are useful to analyze that evolution
3. How 3 dimensional structure and function might be predicted from the sequences
4. How the human genome DNA is sequenced
5. How technologies can exploit the uniqueness of the genetic sequence in order to build gene detection arrays

9.Learningobjectives:

1. Provide an introduction to what bioinformatics is and why it is important
2. Provide an overview of the application areas of bioinformatics, with a focus on the topics that will be taught in the course
3. Explain what type of knowledge will be gained from the course

10. Course Outcomes (COs):

1. To get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.
2. Describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics.
3. Explain about the methods to characterize and manage the different types of Biological data.
4. Classify different types of Biological Databases.

11. List of Experiments

(i) Introduction to UNIX basic commands and UNIX Filters.
Basic scripting.
Regular expressions.
File i/o & control statement.
Subroutines & functions.
Writing scripts for automation.

(ii) Perl programming and applications to Bioinformatics.
Genbank.
Protein Data Bank .
Uniprot.

(iii) Types of Biological Databases and Using it.
Use of BLAST, FASTA (Nucleic Acids & Protiens).
Use of Clustal W.
Use of EMBOSS.

(iv) Sequence Analysis Tools
Use of Phyllip.

(v) Phylogenetic Analysis
Homology Modeling – Swissmodeller.
Any Open Source Software.

(vi) Molecular Modeling

12. Brief Description of self-learning / E-learning component

Biological DataBase

1. Name of the Department:- Computer Science Engineering						
2. Course Name	Biological Database	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)	C	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
This course enables the students to gain in-depth knowledge in the field of Biological Database. It collection of biological data arranged in computer readable form that enhances the speed of search and retrieval and convenient to use is called biological database.						
10. Learning Objectives: 1. To impart the basic concepts of Biological Databases 2. To Classify different types of Biological Databases.What are the relationships/differences between primary and derived sequence databases?						
10. Course Outcomes (COs):						
1. To gain knowledge about various Biological databases that provide information about nucleic acids and protein. 2. Introduction to Biological databases and database systems. 3. Overview about types and Biological data and database search tools. 4. Describe about the different types of Biological databases. 5. Explain about different types of protein and other organism specific databases.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 08**					
Introduction to Biological data and databases – Types of Biological data:- Genomic DNA, Complementary DNA, Recombinant DNA, Expressed sequence tags, Sequence-Tagged Sites, Genomic survey sequences; Primary Databases:- GenBank, EMBL, DDBJ; Composite Databases:- NRDB, UniProt; Literature Databases:- Open access and open sources, PubMed, PLoS, Biomed Central, NAR databases; Bioinformatic Resources:- NCBI, EBI, ExPASy, RCSB.						

Unit – 2	Number of lectures = 10	
Genome Databases – Viral genome database:-ICTVdb; Bacterial Genomes database:-Genomes OnLine Database –GOLD, Microbial Genome Database-MBGD; Genome Browsers:- Ensembl, VEGA genome browser, NCBI-NCBI map viewer, KEGG, MIPS, UCSC Genome Browser; Archeal Genomics, Eukaryotic genomes with special reference to model organisms:-Yeast(SGD), Drosophila (FlyBase), C.elegans (WormBase), Rat, Mouse, Human (OMIM / OMIA), plants – Arabidopsis thaliana (TAIR), Rice, PlasmodiumDB, etc.		
Unit – 3	**Number of lectures = 08**	
Sequence Databases – Nucleotide sequence Databases:- GenBank, EMBL, DDBJ; Protein sequences Databases:- Swiss-Prot, TrEMBL, UniProt, UniProtKB, UniParc, UniRef, UniMES; Sequence motifs Databases:- Prosite, ProDom, Pfam, InterPro, Gene Ontology; Sequence file formats:- GenBank, FASTA, PIR, ALN/ClustalW2.		
Unit – 4	**Number of lectures = 10**	
Structure and derived databases – Primary structure databases:- PDB, NDB, MMDB; Secondary structure databases:-Structural Classification of Proteins –SCOP, Class Architecture Topology Homology –CATH, Families of Structurally Similar Proteins –FSSP, Catalytic Site Atlas –CSA; Molecular functions / Enzymatic catalysis databases:- KEGG ENZYME database; Protein-Protein interaction database:- STRING; Chemical Structure database:- Pubchem; Gene Epression database:- GEO, SAGE.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Text books:

VII. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004

Reference books:

I. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009

II. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999

System Biology

<table>
<tr><td colspan="7">1. Name of the Department :</td></tr>
<tr><td>2. Course Name</td><td>System Biology</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course will introduce the student to contemporary Systems Biology focused on mammalian cells, their constituents and their functions. Biology is moving from molecular to modular. As our knowledge of our genome and gene expression deepens and we develop lists of molecules (proteins, lipids, ions) involved in cellular processes, we need to understand how these molecules interact with each other to form modules that act as discrete functional systems. These systems underlie core subcellular processes such as signal transduction, transcription, motility and electrical excitability. In turn these processes come together to exhibit cellular behaviors such as secretion, proliferation and action potentials. What are the properties of such subcellular and cellular systems? What are the mechanisms by which emergent behaviors of systems arise? What types of experiments inform systems-level thinking? Why do we need computation and simulations to understand these systems?</td></tr>
<tr><td colspan="7">9.LearningObjectives:
Systems biology seeks to study biological systems as a whole, contrary to the reductionist approach that has dominated biology. Such a view of biological systems emanating from strong foundations of molecular level understanding of the individual components in terms of their form, function and interactions is promising to transform the level at which we understand biology.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">1. Learn basics of system biology.
2. Network Analysis in System Biology.
3. Analysis of biological network.
4. Concept of mathematical model for system biology.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 8</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction to System Biology - Concepts and working principles of System Biology - Practical applications of System Biology in Life Sciences, Online database, Bioinformatics Basics, Analysis of gene expression.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 8</td><td colspan="5"></td></tr>
<tr><td colspan="7">System Biology platforms Proprietary system Biology platform. Microarray data analysis - Microarray analysis platforms, Clustering of expression data, Use of orthologs, Proteomics, Metabolomics.</td></tr>
</table>

Unit – 3	Number of lectures = 6	
Microarray technology & Metabolomics - Application of Microarrays in Life Sciences, Gene regulatory networks, MAPman, Interactomics.		
Unit – 4	**Number of lectures = 8**	
Mathematical models of networks: Feed forward and feedback loop, Network topology, Comparison of protein and neural networks, Input and decision-making circuits, System biology analysis.		

13. Books Recommended

Text Books

14. Reference Books

- System Biology: Computational Systems Biology (Hardcover) by Andres Kriete (Editor), Roland Eils (Editor)
- Stochastic Modelling for Systems Biology. ISBN-10 1-58488-540-8 and ISBN-13 978-158488-540-5
- Microarray Data Analysis: Gene Expression Data Analysis. A Beginner's Guide By: Helen Causton (Imperial College), J Quackenbush and AlvisBrazma (The European Bioinformatics Institute)
- A Practical Approach to Microarray Data Analysis (Hardcover) by Daniel P. Berrar (Editor), Werner Dubitzky (Editor), Martin Granzow (Editor)
- 1. Systems Biology: Properties of Reconstructed Networks by Bernhard O.Palsson Cambridge University Press(January 16, 2006)
- 2. Bioinformatics: A practical approach by Shui Qing Ye. 2008 CRC Press.

Computational Biology

<table>
<tr><td colspan="7">Name of the Department- Computer Science and Engineering</td></tr>
<tr><td>Course Name</td><td>Computational Biology</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>Pre-requisite (if any)</td><td>Basic Knowledge of Biology and computer programming</td><td>Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">Total Number of Lectures, Tutorials, Practical (assuming 12weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">Course Description</td></tr>
<tr><td colspan="7">Computational Biology, a highly relevant and fast-growing subfield in biology, is an interdisciplinary effort to bring computer science, machine learning, and data mining techniques to the wet lab environment, automating experiments and providing objective, quantitative results.</td></tr>
<tr><td colspan="7">Learning objectives:
1. Explain the importance computation methods in biology.
2. Understand the principles and some methods of genomics, gene expression and proteomics
3. Analyze metabolomic, proteomics, and protein-protein interaction experiments.
4. Understand the concept of gene Prediction.</td></tr>
<tr><td colspan="7">Course Outcomes (COs):</td></tr>
<tr><td colspan="7">On completion of this course, the students will be able to</td></tr>
<tr><td colspan="7">1. Identify basics of computational biology.
2. Explain about the BLAST Algorithm.
3. Explain about different protein prediction Techniques.
4. Understand the gene finding methods, Markov chain and HMM models.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="7">Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 08</td><td colspan="5">Title of the unit: Introduction to Computational Biology</td></tr>
<tr><td colspan="7">History of Computational Biology, The Central Dogma of Molecular Biology: DNA, Transcription, RNA, Translation, Proteins. Need of Computational in biology, Biological databases: Integration of databases, Applications and problems in informationretrieval from biological database.</td></tr>
<tr><td>Unit – 2</td><td rowspan="2">Number of lectures = 10</td><td colspan="5" rowspan="2">Title of the unit: Genomic Analysis</td></tr>
<tr><td></td></tr>
</table>

Definition of Sequence alignment – Local and Global alignment concepts – Methods for sequence alignment: Dot matrix – Scoring matrices: PAM and BLOSUM matrices,Sequence Alignment using Dynamic Programming: Needleman and Wunsch algorithm, Smith-Waterman algorithm. FASTA and BLAST – Statistics of alignment score – P value and E value.		
Unit – 3	**Number of lectures = 08**	**Title of the unit:Proteomics**
Introduction to Protein Structure; Structure Comparison and Classification, Predicting Protein Structure: Chou-Fasman, GOR methods (SOPMA)and Neural network concepts.		
Unit – 4	**Number of lectures = 10**	**Title of the unit: Computational Genetics**
Gene finding methods: content and signal methods, Analysis and prediction of regulatory regions, Probabilistic models: Markov chain, Random walk – Hidden Markov models, Gene identification and other applications, Human Genetics, SNPs, and Genome Wide Associate Studies.		
Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course- category/Journal papers; Patents in the respective field.		
Books Recommended		
i. ManolisKellis, Computational Biology: Genomes, Networks, Evolution. MIT,2016.		
ii. J.Pevsner, Bioinformatics and Functional Genomics, John-Wiley and Sons, 2009.		
iii. David W. Mount, Bioinformatics – Sequence and Genome analysis, Cold Spring Harbor Laboratory Press, New York, 2001.		
iv. Konopka, Andrzej K Konopka, M James C Crabbe Compact Handbook Of Computational Biology-Science – 2004.		
v. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press, New Delhi 2003.		

Computational BiologyLab

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Computational BiologyLab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
</table>

8. Course Description:

The main aim of thisComputational Biology Labcourse is to explore the bioinformatics Resources. Provides an opportunity to practically verify the theoretical concepts. It also helps the student to be familiar with the various Computational Biology tools.

9.Learningobjectives:

1. Understand the basic features of databases
2. Analyze the importance of sequence similarity
3. Apply concepts of various gene prediction methods.

10. Course Outcomes (COs):

1. Understand the basic features of databases
2. Analyze the single and multiple sequence alignment concepts.
3. Apply concepts for biological research

11. List of Experiments

- Knowledge of different biological database:Protein and gene sequence data bases (NCBI, DDBJ, EMBL, SWISS PROT, PIR), Structure databases: (MMDB, PDB, FSSP, CATH, SCOP), Pathway Databases: (KEGG, BRENDA, METACYC, ECOCYC), Bibliographic database: (PUBMED, MEDLINE)
- Sequence retrieval from biological database
- Analysis of protein sequence using R
- Sequence similarity searching of nucleotide and protein sequences
- Finding homologous sequences
- Multiple sequence alignment
- Dynamic programming method- local and global alignment
- Gene prediction methods

Molecular Modelling and Drug Design

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Molecular Modelling and Drug Design	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

The main goal of this course is to gain some knowledge on modern approaches used in molecular modeling. The course emphasizes on the powerful computer-based technologies and approaches used to identify and design molecules, and drug design.

10. LearningObjectives:

1. To impart the modern approaches used in molecular modeling.
2. To understand computer-based technologiesused to identify and design molecules.
3. To understand about the approaches used in drug discovery and design.

10. Course Outcomes (COs):

The students will be able to:

1. Know the basics of molecular modeling.
2. Apply this knowledge to identify modern approaches used in molecular modeling.
3. Understand about the computer-based technologies used to identify and design molecules.
4. Understand about theapproaches used in drug discovery and design.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

Quantum mechanics & concepts in molecular modeling: Introduction – coordinate systems – potential energy surfaces – introduction to quantum mechanics – postulates – Schrodinger wave equation – hydrogen molecule – Born-Oppenheimer approximation, introduction to computer hardware and software

Unit – 2	**Number of lectures = 9**	

Molecular mechanics and energy minimization: Empirical force field models – Bond stretching – angle bending – torsional term – nonbonding interactions – thermodynamics properties using a forcefield – derived and non-derived energy minimization method – simplex – sequential univariate method – steepest descent method – conjugate gradient method- Newton-Rapson method.

Unit – 3	Number of lectures = 9	

Molecular Dynamics and Monte Carlo simulation: Introduction – Using single Model – time steps – Multiple steps – Setting up MD – energy conservation in MD Simulation Examples – Monte Carlo – Random number generation – Difference in MD & MC.

Homology modeling: Comparative modeling of proteins – comparison of 3D structure – Homology – steps in homology modeling – tools – databases – side chain modeling – loop modeling.

Unit – 4	Number of lectures = 9	

Drug design: General approach to discovery of new drugs - lead discovery – lead modification – physiochemical principles of drug action – drug stereo chemistry –drug action - 3D database search – computer aided drug design – docking - molecular modeling in drug design – structure based drug design – pharmacophores - QSAR.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- A. R.Leach - Molecular Modeling Principles and Application, 2nd edition, Longman Publications, 1996.
- D. Baxivanis and Foulette - Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiely Indian Edition, 2001

14. Reference Books

- T K Attwood, D J parry-Smith, Introduction to Bioinformatics, Pearson Education, 1st Edition, 11th Reprint 2005.

Bio-Inspired Computing

<table>
<tr><td colspan="7">1. Name of the Department-</td></tr>
<tr><td>2. Course Name</td><td>Bio-Inspired Computing</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Bio-inspired computing, short for biologically inspired computing, is a field of study which seeks to solve computer science problems using models of biology. It relates to connectionism, social behavior, and emergence.</td></tr>
<tr><td colspan="7">9.LearningObjectives:
1. To Learn bio-inspired theorem and algorithms
2. To Understand random walk and simulated annealing
3. To Learn genetic algorithm and differential evolution
4. To Learn swarm optimization and ant colony for feature selection
5. To understand bio-inspired application in image processing</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">Upon completion of the course, the students should be able toImplement and apply bio-inspired algorithms
1. Explain random walk and simulated annealing
2. Implement and apply genetic algorithms
3. Explain swarm intelligence and ant colony for feature selection
4. Apply bio-inspired techniques in image processing.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">INTRODUCTION
Introduction to algorithm - Newton ' s method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Metaheuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">RANDOM WALK AND ANEALING
Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle Strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION

Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA variants - schema theorem - convergence analysis - introduction to differential evolution - variants - choice of parameters - convergence analysis - implementation.

SWARM OPTIMIZATION AND FIREFLY ALGORITHM

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - variants- Ant colony optimization toward feature selection

Unit – 4	**Number of lectures = 9**	

APPLICATION IN IMAGE PROCESSING

Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine- Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Eiben, A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.
- Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013
- Xin-She Yang ,Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing",Elsevier 2016

14. Reference Books

- Xin-She Yang, "Nature Ispired Optimization Algorithm,Elsevier First Edition 2014
- Yang ,Cui,XIao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013

Dataware Housing and Mining for Bioinformatics

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Dataware housing and Mining for Bioinformatics**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)	Biology, statistics.	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						

This course helps the students to understand the overall architecture of a data warehouse and methods for data gathering and data pre-processing using OLAP tools. The different data mining models and techniques will be discussed in this course. Data mining and data warehousing applications in bioinformatics will also be explored.

9.LearningObjectives:

1. Learn to develop and use datawarehouse.
2. Learn methods for data mining.
3. Apply data mining techniques in biological datasets.
4. Learn feature selection methods

10. Course Outcomes (COs):

The students will be able to: -

1. thorough understanding of various datawarehousing components and architecture.
2. various types of data models.
3. how to perform feature selection and derive association rules
4. how to perform various types of data mining, including clustering.

11. Unit wise detailed content

Unit-1INTRODUCTION TO DATA MINING:	**Number of lectures = 9**	

Motivation, Importance, Definition of Data Mining, Kind of Data,Data Mining Functionalities, Kinds of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of A Data Mining System With A Database or Data Warehouse System, Major Issues In Data Mining, Types of Data Sets and Attribute Values, Basic Statistical Descriptions of Data, Data Visualization, Measuring Data Similarity. PREPROCESSING: Data Quality, Major Tasks in Data Preprocessing, Data Reduction, DataTransformation and Data Discretization, Data Cleaning and Data Integration.

Unit – 2 Data Warehousing:	**Number of lectures = 9**	

Basic Concepts, Data Warehouse Architecture, Benefits of a data warehouse, Three-tier Decision Support Systems (DSS), DataMart, Online Analytical Processing (OLAP) Engine, OLAP Servers (ROLAP, MOLAP, HOPAP), Multidimensional Data Model, Data Cube, Warehouse schema (Star schema, Snowflake schema); Enterprise Warehouse.

<table>
<tr><td colspan="3"></td></tr>
<tr><td>Unit – 3Classification, Clustering and Outlier analysis of the data</td><td>Number of lectures = 9</td><td></td></tr>
<tr><td colspan="3">CLASSIFICATION: Basic Concepts, Decision Tree Induction, Bayesian Classification Methods, Rule-Based Classification, Model Evaluation and Selection, Techniques to Improve Classification Accuracy: Ensemble Methods, Handling Different Kinds of Cases in Classification
Basic Concepts of Cluster Analysis, Clustering structures, Major Clustering Approaches, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Clustering High-Dimensional Data, Constraint-Based and User-Guided Cluster Analysis,
OUTLIER ANALYSIS: Why outlier analysis, Identifying and handling of outliers, DistributionBasedOutlier Detection: A Statistics-Based Approach, Classification-Based Outlier Detection, Clustering-Based Outlier Detection.</td></tr>
<tr><td>Unit – 4 Data Mining in Bioinformatics.</td><td>Number of lectures = 9</td><td></td></tr>
<tr><td colspan="3">Relational database management system (RDBMS), sequence query language (mySQL)- Overview, Tables, Queries, creating and using database. Application of Data Mining in Biodata analysis: DNA/protein sequence Analysis, Genome analysis, Protein Structure Analysis, Pathway analysis, microarray data analysis, annotation, gene ontology, gene mapping Introduction to biological database: Designing of biological databases, Types of biological database: Primary database, Secondary database, Composite database. Biological data mining tools: Entrez, Blast, sequence retrieval system (SRS)</td></tr>
<tr><td colspan="3">12. Brief Description of self-learning / E-learning component
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/</td></tr>
<tr><td colspan="3">13. Books Recommended</td></tr>
<tr><td colspan="3">Text Books
• Principles of Data Mining, by David Hand, HeikkiMannila, and Padhraic Smyth;
• Bioinformatics: Sequence and Genome Analysis, by David Mount;Div. articles TBA</td></tr>
<tr><td colspan="3">14. Reference Books</td></tr>
<tr><td colspan="3">• Data Mining: Concepts and Techniques by Jiawei Han and Micheline Kamber, 2000
• Data Mining Techniques, A. K. Pujari, UniversityPress, Hyderabad, 2006
• Mount, D. W.: Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor. CSHL Press, 2001.
• Data mining in bioinformatics by Wang et al, Springer-Verlag, 2005</td></tr>
</table>

Dataware housing and Mining for Bioinformatics LAB

1. Name of the Department- Computer Science & Engineering

2. Course Name	**Dataware housing and Mining for BioinformaticsLab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core (√)**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)

Lectures = 0	**Tutorials = 0**	**Practical = 48**

8. Course Description

Learning objectives:

1. To learn principles, concepts and applications of data warehousing and data mining.
2. To introduce the task of data mining as an important phase of knowledge recovery process
3. Design a data warehouse or data mart to present information needed by management in a form that is usable for management client

4. Course Outcomes (COs):

1. Design a data mart or data warehouse for any organization
2. Extract knowledge using data mining techniques
3. Adapt to new data mining tools.
4. Explore recent trends in data mining such as web mining, spatial-temporal mining

5. List of Experiments

1) Basic Cryptography Concepts for Blockchain
2) Overview of Blockchain
3) Creating and Building Up Bitcoin Wallet.
4) Building a Private Ethereum Network and Deploying Smart Contract
5) Introduction to Solidity.
6) Ethereum Smart Contract
7) CLUSTERING MODEL
8) Creating and Building Up Crypto Token.
9) Creating a Business Network using Hyperledger.

6. Brief Description of self-learning / E-learning component

https://nlp-iiith.vlabs.ac.in/

http://vlab.co.in/participating-institute-iiit-hyderabad

Machine Learning for Bioinformatics

<table>
<tr><td colspan="7">Name of the Department- Computer Science and Engineering</td></tr>
<tr><td>Course Name</td><td>Machine Learning for Bioinformatics</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>Pre-requisite (if any)</td><td></td><td>Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">Total Number of Lectures, Tutorials, Practical (assuming 12weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">Course Description</td></tr>
<tr><td colspan="7">This course focuses on machine learning algorithms for analyzing biological data. The course will introduce the main topics in this area, such as analysis of genome sequences, protein structures, gene networks, and so on. We will cover some of the traditional algorithms for these tasks, but the main focus is on the role of deep learning and data mining in computational biology and bioinformatics.</td></tr>
<tr><td colspan="7">Learning objectives:
1. Learn what is machine learning
2. Learn algorithms used in machine learning.
3. Learn how to implement machine learning for biological problems.
4. Apply machine learning to practical projects.
5. Use machine learning and data mining in one project.</td></tr>
<tr><td colspan="7">Course Outcomes (COs):</td></tr>
<tr><td colspan="7">On completion of this course, the students will be able to</td></tr>
<tr><td colspan="7">1. Understand about biological data and its diversity.
2. Different types of machine learning and its utility in bioinformatics
3. Application of Hidden Markov Model and Artificial neural networks to different types of bioinformatics data.
4. Understand about microarray gene expression data.</td></tr>
<tr><td colspan="7"></td></tr>
<tr><td colspan="7">Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 08</td><td colspan="5">Title of the unit: Introduction</td></tr>
<tr><td colspan="7">Biological Data in Digital Symbol Sequences, Genomes—Diversity, Size, and Structure, Proteins and Proteomes, Information Content of Biological Sequences, Prediction of Molecular Function and Structure, Machine-Learning Foundations:Introduction: Bayesian Modeling, The Cox Jaynes Axioms, The Simplest Sequence Models.</td></tr>
</table>

<table>
<tr><td>Unit – 2</td><td>Number of
lectures = 10</td><td>Title of the unit: Machine Learning Algorithms</td></tr>
<tr><td colspan="3">Introduction, Dynamic Programming, Gradient Descent, EM/GEM Algorithms, Markov-Chain Monte-Carlo Methods, Simulated Annealing, Evolutionary and Genetic Algorithms, Neural Networks: Introduction, Universal Approximation Properties, Backpropagation Algorithm.</td></tr>
<tr><td>Unit – 3</td><td>Number of
lectures = 08</td><td>Title of the unit:Neural Networks: Applications</td></tr>
<tr><td colspan="3">Sequence Encoding and Output Interpretation, Sequence Correlations and Neural Networks, Prediction of Protein Secondary Structure, Applications for DNA and RNA Nucleotide Sequences, Prediction Performance Evaluation, Different Performance Measures.</td></tr>
<tr><td>Unit – 4</td><td>Number of
lectures = 10</td><td>Title of the unit: Hidden Markov Models</td></tr>
<tr><td colspan="3">Introduction, Prior Information and Initialization, Applications of HMMs:Protein Applications, DNA and RNA Applications,Advantages and Limitations of HMMs.
Microarrays and Gene Expression: Introduction to Microarray Data, Probabilistic Modeling of Array Data, Clustering, Gene Regulation.</td></tr>
<tr><td colspan="3">Brief Description of self-learning / E-learning component
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-

category/Journal papers; Patents in the respective

field.</td></tr>
<tr><td colspan="3">Books Recommended</td></tr>
<tr><td colspan="3">i. Baldi, P. and Brunak, S. 2001 Bioinformatics: The machine learning approach, The MIT Press.</td></tr>
<tr><td colspan="3">ii. Edward Keedwell and Ajit Narayanan (2005), Intelligent Bioinformatics: The Application of Artificial Intelligence Techniques to Bioinformatics Problems, Wiley</td></tr>
<tr><td colspan="3">iii. David W. Mount, Bioinformatics – Sequence and Genome analysis, Cold Spring Harbor Laboratory Press, New York, 2001.</td></tr>
<tr><td colspan="3">iv. P Baldiand S Brunak, BIOINFORMATICS: The Machine Learning Approach</td></tr>
<tr><td colspan="3">v. Husmeier D, Dybowski R, and Roberts S (2005), Probabilistic Modeling in Bioinformatics and Medical Informatics, Springer</td></tr>
</table>

Computer Aided Drug Design

1. Name of the Department-						
2. Course Name	**Computer Aided Drug Design**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

1. The course will cover structure and target based design, molecular modeling, quantum mechanics, drug likeness properties, QSAR and pharmacokinetic and dynamics using several software's.

5. LearningObjectives:

Upon completion of this course the student should be able to:

1. Role of CADD in drug discovery
2. Different CADD techniques and their applications.
3. Various strategies to design and develop new drug like molecules.
4. Working with molecular modeling software's to design new drug molecules.
5. The in silico virtual screening protocols

10. Course Outcomes (COs):

1. The subject is designed to impart knowledge on the current state of the art techniques involved in computer assisted drug design

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

Introduction to Computer Aided Drug Design (CADD) History, different technique sand applications Quantitative Structure Activity Relationships: Basics History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pisubstituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters

Unit – 2	**Number of lectures = 9**	

Quantitative Structure Activity Relationships: Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations 3D-QSARapproaches and contour map analysis Statistical methods used in QSAR analysis and importance of statistical parameters.

Molecular Modeling and Docking:

Molecular and Quantum Mechanics in drug design. Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation. Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE&BchE)

Unit – 3	**Number of lectures = 9**	

Molecular Properties and Drug Design: Prediction and analysis of ADMET properties of new molecules and its importance in drug design. De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design. c) Homology modeling and generation of 3D-structure of protein

Unit – 4	**Number of lectures = 9**	

Pharmacophore Mapping and Virtual Screening Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping In Silico Drug Design and Virtual Screening Techniques Similarity based methods and Pharmacophore based screening, structure based In-silico virtual screening protocols

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Computational and structural approaches to drug discovery, Robert M StroudandJanet.FMoore,RCS Publishers.
- Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor&Francisgroup..
- Drug Design by Ariens Volume 1 to 10,Academic Press, 1975, Elsevier Publishers.
- Principles of Drug Design by Smith andWilliams, CRC Press, Taylor &Francis..

14. Reference Books

- The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers.
- Medicinal Chemistry by Burger, Wiley Publishing Co.
- An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford University Press.
- Wilson and Gisvold’s Text book of Organic Medicinal andPharmaceutical Chemistry, Ippincott Williams & Wilkins.
- Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers.
- Computational and structural approaches to drug design edited byRobert M Stroudand Janet. F Moore

Bioprocess Engineering

<table>
<tr><td colspan="5">1. Name of the Department-</td></tr>
<tr><td>2. Course Name</td><td>Bioprocess Engineering</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Bioprocess engineering is a specialization of chemical engineering; it deals with the design and development of equipment and processes for the manufacturing of products such as agriculture, food, feed, pharmaceuticals, nutraceuticals, chemicals and polymers and paper from biological material and treatment of waste water.

Expertise in this field is a combination of knowledge in biotechnology and engineering. Bioprocess engineers develop concept technologies in the bioprocess space – anything that takes into account producing a product from biological material such as yeast, fungi, bacteria, algae, viruses, mammalian cells or any type of biological single cell process.</td></tr>
<tr><td colspan="7">6. LearningObjectives:
In this course students will learn key methods of microbial production (e.g. fermentation, recombinant protein production and purification). Practice in research project planning, in different methods for biotechnology, and in report writing and seminar presentation will train the student for conducting a scientific research project.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">1. Use correct biological terms to describe and analyze phenomena/problems in bioprocesses
2. Explain major differences between different cell types (such as Gram-negative/ Gram-positive bacteria, simple eukaryotes vs. mammalian cells) and their respective cell growth requirements in bioprocesses.
3. Explain how environmental conditions influence cell growth and means to achieve optimal cell growth in large scale.
4. Analyze kinetics of cell growth or enzyme-catalyzed reactions and identify limiting factors
5. Design or select appropriate bioreactor models based upon bioproducts and cell lines and other process criteria.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

Media Preparation, Media design and optimization. Microbial growth patterns and kinetics in batch culture, Microbial growth parameters, Environmental conditions affect growth kinetics, Kinetics of thermal death of microorganisms, Heat Generation by microbial growth, Quantitative analysis of microbial growth by direct & indirect methods.		
Unit – 2	**Number of lectures = 9**	
Sterilization: concept and methods. Type of Sterilizations, Batch heat sterilization of liquids, Estimation of sterilizer efficiency, Continuous heat sterilization of liquids, Sterilization of air: Methods &Mechanism, Design of depth filter and estimation of its efficiency. Stoichiometric calculations, Theoretical prediction of yield coefficients, Stoichiometry of growth and product formation, Maximum possible yield, Theoretical oxygen demand, Stoichiometry of single-cell protein synthesis.		
Unit – 3	**Number of lectures = 9**	
Ideal Reactor Operation: Batch, Fed Batch & Continuous operation of mixed bioreactors, Microbial pellet formation, Kinetics and dynamics of pallet formation. Chemo state with immobilized cells, Chemo state with cell recycle, substrate utilization and product formation in bioreactor, Scale up of Bioreactors		
Unit – 4	**Number of lectures = 9**	
Role of diffusion in Bioprocessing, Convective mass transfer, Gas-liquid mass transfer, Oxygen uptake in cell cultures, Factor affecting cellular oxygen demand, Oxygen transfer in bioreactors, Measurement of volumetric oxygen transfer coefficient, Oxygen transfer in large bioreactor.		
Text Boks &Reference Books		
1. Principles of Microbe and cell cultivation- S. John Pirt, Butterworth Publication. 2. Bioprocess Engineering Principles – P. M. Doran, 5th ed. 3. Hand Book Of Bioengineering- Skalak R & Shu Chien, 4th ed. 4. Biochemical Engg. Bailly &Ollis, Academic Press 5. Introduction to Chemical Engg. Series, MCH Int. Series. 6. Biochemical & Biological Engg. Science, N. Blakebraugh, Academic Press 7.”Principles of fermentation technology” by P F Stanbury and A Whitaker, Pergamon press. 8. “Bioprocess Technology – Kinetics & Reactors” by A Moser, Springer-Verlag.		

Full Stack Developer

Programming Language- Python

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2.Course Name</td><td>Programming Language – Python</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">EAS ()</td><td colspan="2">BSE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Operating System</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
</table>

Course Rationale: The course begins with the concepts of Python Programming Language with Libraries.

Course Objectives:

Objectives: The objective of this course is to teach students the concepts of Python Programming Language with Libraries.

Learning & Course Outcomes:

On completion of this course, the students are expected to learn
3. Python programming, Data Structure.
4. Learn Libraries Numpy, Pandas with the use of Data Analysis.

UNIT – I

Python programming Basic: Python interpreter, I Python Basics, Tab completion, Introspection, %run command, magic commands, matplotlib integration, python programming, language semantics, scalar types. Control flow

Data Structure, functions, files: tuple, list, built-in sequence function, dict, set, functions, namescape, scope, local function, returning multiple values, functions are objects, lambda functions, error and exception handling, file and operation systems

UNIT – II

NumPy: Array and vectorized computation: Multidimensional array object. Creating ndarrays, arithmetic with numpy array, basic indexing and slicing, Boolean indexing, transposing array and swapping axes, universal functions, array-oriented programming with arrays, conditional logic as arrays operations, file input and output with array

Pandas: Pandas data structure, series, DataFrame, Index Object, Reindexing, dropping entities from an axis, indexing, selection and filtering, integer indexes, arithmetic and data alignment, function application and mapping, soring and ranking, correlation and covariance, unique values, values controls and membership, reading and writing data in text format

UNIT –III

Visualization with Matplotlib: Figures and subplots, colors, markers, line style, ticks, labels, legends, annotation and drawing on sublots, matplotlib configuration

UNIT –IV

Plotting with pandas and seaborn: line plots, bar plots, histogram, density plots, scatter and point plots, facet grids and categorical data

Reference Books:

- Learning Python: Powerful Object-Oriented Programming by Lutz M - Shroff; Fifthedition
- Python: The Complete Reference by Martin C. Brown - McGraw Hill Education; Forthedition
- Pandas for Everyone: Python Data Analysis by Daniel Y. Chen - Pearson Education; Firstedition

Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

Programming in Python Lab

<table>
<tr><td colspan="7">1. Name of the Department: CSE</td></tr>
<tr><td>2. Course Name</td><td>Programming in Python Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 00</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="7">Python is next generation multi-purpose programming language that allows different users to create applications of various domains. Students will be able to learn primary fundamentals of python programming and potential of python is to achieve modern computing requirements.</td></tr>
<tr><td colspan="7">6. Learningobjectives:
1. Master the fundamentals of writing Pythonscripts.
2. Learn core Python scripting elements such as variables and flow controlstructures.
3. Discover how to work with lists and sequencedata.
4. Write Python functions to facilitate codereuse.
5. Use Python to read and writefiles</td></tr>
<tr><td colspan="7">7. CourseOutcomes:

After completion of this course, student will be able to
1. To learn basics ofPython
2. To develop console application in python
3. To develop database application inpython
4. To develop basic machine learningapplication</td></tr>
<tr><td colspan="4">List of Experiments</td><td colspan="3">Outcome Covered</td></tr>
<tr><td colspan="4">1. Implement a Python program to Calculate GCD of two numbers.</td><td colspan="3">I</td></tr>
<tr><td colspan="4">2. Implement a Python Program to calculate the square root of a number by Newton's Method.</td><td colspan="3">I</td></tr>
<tr><td colspan="4">3. Implement a Python program to calculate the exponentiation of a number.</td><td colspan="3">II</td></tr>
<tr><td colspan="4">4. Implement a Python Program to calculate the maximum from a list of numbers.</td><td colspan="3">III</td></tr>
</table>

5. Implement a Python Program to perform Search	II
6. Implement a Python Program to perform Liner search	IV
7. Implement a Python Program to perform Binary search	III
8. Implement a Python Program to perform insertion sort.	II
9. Implement a Python Program to perform selection sort.	IV
10. Implement a Python program to multiply matrices.	III
11. Implement a Python program to Calculate the most frequent words in a text read from a file.	II
12. Implement function overloading with different function signatures.	IV
13. Implement concept of class, instances and inheritance.	IV
14. Implement internal and external library.	III
15. Solve algorithmic problems by program using different problem-solving strategies.	III
16. Search content using regular expression library in python.	IV
17. Implement Matrix multiplication using multi-threading in python	III

Basics of Front End Development

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Basics of Front End Development</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course will provide students with an understanding of front-end development enable them to implement various technologies to develop interactive web pages. This course provides all the skills necessary for web application front-end design and development.</td></tr>
<tr><td colspan="7">9.LearningObjectives:
1. To impart the basic concepts of front-end development.
2. To understand various technologies such as HTML,CSS, XML and JavaScript to develop static and dynamic web pages.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">1. For a given conceptual problem student will able to understand the basic process of front-end development and their application domains.
2. The knowledge of various technologies will enable student to implement these technologies to make interactive web pages.
3. Student will able to write a program using these technologies to implement the basic concepts of design and development.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">HTML:Introduction, History of HTML, Structure of HTML Document: Text basics, elements,nesting elements, structure elements, list, tables, frames, Hyperlinks: Images and Multimedia, Links and webs, Document Layout, Forms</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">CSS Introduction: CSSSyntax, CSS Id & Class, CSS How. CSS Styling: Styling Backgrounds, Styling Text, Styling Fonts, Styling Links, Styling Lists, Styling Tables. CSS Box Model: CSS Border, CSS Outline, CSS Margin, CSS Padding

CSS Advanced:CSS Grouping/Nesting, CSS Dimension, CSS Display, CSS Positioning, CSS Floating, CSS Align, CSS Pseudo-class, CSS Pseudo-element, CSS Navigation Bar, CSS Image Gallery, CSS Image Opacity, CSS Image Sprites. CSS Media Types, CSS Attribute Selectors</td></tr>
</table>

Unit – 3	**Number of lectures = 9**	
XML: Introduction of XML- Some current applications of XML, Features of XML, Anatomy of XML document, The XML Declaration, Element Tags- Nesting and structure, XML text and text formatting element, Table element, Mark-up Element and Attributes, Document Type Definition (DTD), types. XML Objects, Checking Validity, Understanding XLinks, XPointer, Event-driven Programming, XML Scripting		
Unit – 4	**Number of lectures = 9**	
JavaScript: Introduction to JavaScript, datatypes, variables, operators, statements, conditional statements, functions, recursive functions, arrays, regular expressions, objects, properties and methods, JavaScript objects, JavaScript DOM, form validation, cookies and events, object oriented programming with JavaScript-creating objects and classes, constructors, inheritance.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- HTML Black Book: Steven Holzner, Dremtech press
- Web Technologies, Black Book, Dreamtech Press
- Web Applications: Concepts and Real World Design, Knuckles, Wiley-India
- Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel Pearson.
- Beginning HTML, XHTML, CSS, and JavaScript, John Duckett Wiley-India
- Beginning CSS: Cascading Style Sheets for Web Design,Ian Pouncey, Richard York Wiley-India
- Learning Web Technologies: HTML, Javascript , Kogent Wiley-India

14. Reference Books

- Paul Deitel , Harvey Deitel, Abbey Deitel ,“Internet and world wide web – How to Program”, Prentice Hall
- JavaScript & JQuery: Interactive Front-end Web Development,Jon Duckett,1st edition,Wiley-India

Software Design

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Software Design	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
This course will offer a wide perspective on software design covering the full life cycle of software design and development. This would be inclusive of technical design, testing, quality measures and reliability. At the end of the course, the students will be able to design efficient and reliable software.						

8. LearningObjectives:

1. Learn Software design fundamentals.
2. Understand the software design processes and principles.
3. Have an in-depth knowledge on software design methodologies and diagrams.
4. Understand about the software reliability, assurance and various testing techniques.

10. Course Outcomes (COs):

The students will be able to:

1. Know the basics of Software design fundamentals.
2. Apply this knowledge to identify the suitable software design processes and principles.
3. Apply the knowledge to identify appropriate software design methodologies.
4. Understand about the object-oriented design and use case diagrams.
5. Understand about the software reliability, assurance and various testing techniques.
6. Design efficient and reliable software by solving case studies.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

Overview and Software Design Processes: Introduction, Evolving Role of Software, Software Characteristics, Software Applications, Introduction of Software design, Software design life cycle, Serial or Linear Sequential Development Model, Iterative Development Model, The incremental Development Model, The Parallel or Concurrent Development Model.

Unit – 2	**Number of lectures = 9**	

Software Design Principles: Introduction, System Models: Data-flow models, Semantic data models, Object models, Inheritance models, Object aggregation, Service usage models, Data Dictionaries, Software Design: The design process, Design Methods, Design description, Design strategies, Design quality; Architectural Design: System structuring, Architectural Mapping using Data Flow-User Interface Design- Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components,The repository model, The client–server model, The abstract machine model, Control models, Modular decomposition, Domain-specific.

Unit – 3	Number of lectures = 9	

Software Design Methodologies: Structured Methods:Data flowmodel, Entity-relationship model, Structural model,Object-oriented Model.

Object Oriented Design: Objects, Object Classes & Inheritance, Inheritance, Object identification, An object-oriented design example, Object aggregation, Service Usage, Object Interface Design: Design evolution, Function oriented design, Data –flow design, Structural Decomposition: Detailed design,

Use Case Diagrams: Class Diagram, Activity Diagram, Sequence Diagram, Collaboration Diagram, Component Diagram and Deployment Diagram.

Unit – 4	Number of lectures = 9	

Software Reliability, Testing Techniques and Assurance: Failure and Faults, Reliability Models: Basic Model, Logarithmic Poisson Model, Software Testing Fundamental, Testing Principles, Control Structure Testing, Boundary Value Analysis, Testing GUIs, Testing Documentation and Help Facilities,Verification and Validation: Validation Testing, Validation Test Criteria, Test Strategies: Top-Down Testing, Bottom-Up Testing, Thread testing, Stress testing, Back-to-back testing, Testing methods and tools: Testing through reviews, Black-box testing (Functional testing), White box testing (glass-box testing), Testing software change, Additional requirements in testing OO Systems, System Testing Acceptance Testing, Regression testing, Metrics Collection, Computation, and Evaluation, Test and QA plan, Managing Testing Functions.

Case Study: Introduction, System Requirements, Architectural Alternatives.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Rajib Mall, Fundamentals of Software Engineering, PHI.
- Richard Fairley, Software Engineering Concepts, Tata McGraw Hill,1997.
- R. S. Pressman, "Software Engineering – A practitioner‟s approach", 5th Ed., McGraw Hill Int. Ed., 2001.

14. Reference Books

- Pankaj Jalote, An Integrated Approach to Software Engineering, Narosa Publishing House,1991.
- S.L. Pfleeger, Software Engineering, Pearson.
- Carlo Ghezzi, Mehdi Jazayeri, Fundamentals of Software Engineering, PHI
- Stephen R. Schach, "Classical & Object Oriented Software Engineering", IRWIN, 1996.
- James Peter, W. Pedrycz, "Software Engineering", John Wiley & Sons.
- Sommerville, "Software Engineering", Addison Wesley, 1999.

Software Design Lab

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Software Design Lab	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 24**			

8. Course Description

This course will offer a wide perspective on software design covering the full life cycle of software design and development. This would be inclusive of technical design, testing, quality measures and reliability. At the end of the course, the students will be able to design efficient and reliable software.

9. LearningObjectives:

1. To impart state-of-the-art knowledge on Software design and UML in an interactive manner using Rational Rose Enterprise Edition Tool.
2. Present case studies to demonstrate the practical applications of different concepts
3. Provide a scope to the students where they can solve small, real life problems

10. Course Outcomes (COs):

The students will be able to:

1. Know the basics of Software design fundamentals.
2. Understand the use of Rational Rose Enterprise Edition.
3. Apply this knowledge to identify the suitable software design processes and principles.
4. Apply the knowledge to identify appropriate software design methodologies.
5. Understand about the object-oriented design and use case diagrams.
6. Understand about the software reliability, assurance and various testing techniques.
7. Design efficient and reliable software by solving case studies.

11. List of Experiments

1. Write down the problem statement for a suggested system of relevance.
2. Do requirement analysis and develop Software Requirement Specification Sheet (SRS) for suggested system.
3. To perform the function oriented diagram: Data Flow Diagram (DFD) and Structured chart.
4. To perform the user's view analysis for the suggested system: Use case diagram.
5. To draw the structural view diagram for the system: Class diagram, object diagram.
6. To draw the behavioral view diagram : State-chart diagram, Activity diagram
7. To perform the behavioral view diagram for the suggested system: Sequence diagram, Collaboration diagram
8. To perform the implementation view diagram: Component diagram for the system.
9. To perform the environmental view diagram: Deployment diagram for the system
10. To perform various testing using the testing tool unit testing, integration testing for a sample code of the suggested system.
11. To Prepare time line chart/Gantt Chart/PERT Chart for selected software project.

Note: Choose any one project and do the above exercises for that project:

- Student Result Management System
- Library management system
- Video library management system
- Resource management system
- Accounting system
- Fast food billing system
- Bank loan system
- Blood bank system

12. Brief Description of self-learning / E-learning component

http://vlabs.iitkgp.ernet.in/

ReactJs Development

1. Name of the Department-						
2. Course Name		**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

Introduction to the ReactJS JavaScript library for JS developers, starting from the very basics such as React components and JSX, props, state and more.

10. LearningObjectives:

1. Understand how Single Page React application is different than traditional web development frameworks.
2. Code using new ES6 language features.
3. Develop an application from scratch using React 16.
4. Understand the benefits of unidirectional data flow.

10. Course Outcomes (COs):

1. Easy to Learn and this library is lightweight and concerns itself with the application's view layer only.
2. Components Are Reusable.
3. Optimum Performance with Virtual DOM.
4. Good Abstraction.
5. Complemented by Flux Architecture.
6. JSX for Templating.
7. Awesome Developer Tools.
8. React Native.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

React JS Introduction

React,Need React,React version history,Just React - Hello World,Using create-react-app,Anatomy of react project,Running the app. Components:Significance of component architecture, Types of components, Functional, Class based, Pure, Component Composition.State and Props,Lists

Unit – 2	**Number of lectures = 9**	

Component life cycle, Events, Managing errors. Forms : Controlled Form Components, Uncontrolled Form Components, Handling inputs efficiently, Render Props , Higher Order Components.		
Unit – 3	**Number of lectures = 9**	
Portals introduction, Event bubbling, Global and Shared Data: Unidirectional Data Flow, Challenges with Props, Context APIs, Introduction to Hooks: The use State hook, use Contexthook, use Reducer hook. Routing: Routing in a React application, Routing with React Router, Nested Routes and Parameters, Protecting Routes.Isomorphic React:		
Unit – 4	**Number of lectures = 9**	
Code splitting and Suspense. Isomorphic React: Server-Side Rendering, SSR with React. State Management and Redux, Actions and Reducer for the Catalog, Using Redux Hooks, Middleware and Persistence.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- The Road to Learn React: Your journey to master plain yet pragmatic React.js by Robin Wieruch
- React in Action by Mark Tielens Thomas
- React Quickly by AzatMarden

14. Reference Books

- FullStack React
- React.js Essentials: A fast-paced journey
- React Cookbook

UI / UX Design

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**UI / UX Design**	**L**	**T**		**P**	
3. Course Code			**0**			
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)	Computer Basics	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course is designed to teach both the theory and practice behind the design thinking process. Ultimately, the course will use design thinking to take students through the design of the User Experience (UX) and User-Interface (UI) of a product or service of their creation.

11. LearningObjectives:

1. To aware students about Design Process.
2. understand the definition and principles of UI/UX Design in order to design with intention and discover the industry- standard tools and specific project deliverables in UI/UX.
3. students will be introduced to the creative and systematic design and user-friendly based solving issues and creative problems by addressing pragmatic design through UX-UI (user experience- user interface).

10. Course Outcomes (COs):

The students will be able to:-

1. Undertake individual assignments and select readings to help students reflect on their experience and help assess for the class learning objectives
2. Effectively co-create under the guidance of the tutor by using established design thinking processes and UX/UI tools that will be taught throughout the course.
3. Test assumptions and prototype potential design solutions while creating professional goals.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

UXD Principles

What is UXD,Designing for multi-device environments, What you need to master, What are you trying to communicate, Why is user experience important

The UXD Ecosystem

Identify the project parameters, Brand presence, Marketing campaign, Content source, eCommerce applications,Social networking applications, Responsive considerations, Proposal preparation, Creating the proposal, Title page, Executive summary, Project outline and approach, Assumptions, Deliverables, Project scoping, Legal considerations, Pricing and payment structures, Statements of work

Project approach

Project objectives, UXD process.,Waterfall / Agile / Modified approaches

Unit – 2	**Number of lectures = 9**	

Business objectives

Status quo analysis, Heuristic analysis, Stakeholder input, Roles and responsibilities, Consolidating outcomes

User Research
Research basics, User group definitions, Research techniques, Contextual inquiry, Research analysis

Content Strategy
Personas, Advanced personas, The empathy map, When, where, who, what, why and how of UXD, Content strategy longevity, Tips on content

Transitioning - Definition to Design
Ideation, Visualisation, Storyboarding essentials, Prioritization, Maintaining good tension, Conflict management, Documentation

Unit – 3	**Number of lectures = 9**	

UXD Design Principles
Visual design, Unity and variety, Focal point, Economy of elements, Balance and proportion, Interaction, Association and affordance, Economy of motion, Responsive design, Pschycology, The effects of good UXD design, Flow and Interaction, Guiding principles

Sitemaps and flow tasks
Tools of the trade, Pagestack, Decision points, Conditions, Common errors, Misalignment, Typographic considerations, Task flows, Swim lanes

Wireframing and Annotating
Annotating essentials, Wireframing essentials, Toolkits, Wireframing 101, Sample processing, Sketching, Digital wireframes, Visual design, Responsive design, Wireframes vs Prototypes

Unit – 4	**Number of lectures = 9**	

Prototyping models
Prototyping boundaries, Wireframing vs realistic prototypes, HTML and WYSIWYG editors, Designer tools for prototyping, Designer / developer workflows, Post-prototyping

Design user testing
Visual design mockups exploration, Choosing a design testing approach, Qualitative and quantitative research, In-person and remote research, Moderated and automated techniques, Usability testing, Research, Logistics, Facilitation, Analysing results, Crafting recommendations

From design to development
Visual design, Development, Quality assurance, Alpha testing, Launching you project, Support, Post launch activities, Analytics, Post mortem

Flexible Content Strategies
Approaching content strategies, Flex content creation, CMS's, Delivering across devices, Delivering across apps, Flexible architecture, Personalising content

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Laws of UX: Using Psychology to Design Better Products &Services ,O'Reilly Media; 1st edition

14. Reference Books

- **100 Things Every Designer Needs to Know About People, New Riders; 2nd edition**

- V. Rajaraman, Fundamentals of Computers, 3rd Edition , PHIPublications
- Anita Goel, Computer Fundamentals, PearsonEducation.
- Computers Today, D. H. Sanders, Fourth Edition, McGraw Hill,1988
- Marmel, Elauue, MS Office Projects 2007, WileyIndia

The Web Developer Bootcamp

1. Name of the Department- Computer Science & Engineering

2. Course Name	**The Web Developer Bootcamp**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)	.	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)

Lectures = 36	**Tutorials = 0**	**Practical = 0**

8. Course Description:

This course introduced to planning and designing effective web pages; implementing web pages by writing HTML and CSS code; enhancing web pages with the use of page layout techniques, text formatting, graphics, images, and multimedia; and producing a functional, multi-page website.

9. LearningObjectives:

1. To learn the basics principle of websites.
2. To understand the key concepts front end technology.
3. To learn about HTML and how to use it.
4. To learn how to create a style in web pages.
5. Understand how websites work and how HTML, CSS and JavaScript contribute.
6. Understand how the internet works.

10. Course Outcomes (COs):

1. To coding with HTML, CSS and JavaScript
2. To develop a website.
3. To create web page using HTML & CSS.
4. To building strong expertise on express framework to develop responsive web application.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

Introduction To Web Design & HTML: Basic principles involved in developing a web site , Planning process , Web Design , Designing rules, Brief History of Internet ,World Wide Web. **HTML:** What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, HTML Tags and Elements, Mark up tags, Heading tags, Paragraphstags, Line Breaks tag, and Formatting tags. Elements of HTML, Internal Linking and Meta Elements, Working with Text, Lists, Tables, Frames, hyperlinks, Images, Multimedia, Forms and controls.

Unit – 2	**Number of lectures = 9**	

Cascading Style Sheets: Concept of CSS , CSS selectors and properties, How to use CSS in HTML, CSS Styling(Background, Text Format, Controlling Fonts) ,Inline Styles, Embedded Style Sheets, Linking External Style Sheets, Working with block elements and objects, CSS with Lists and Tables, CSS Id and Class , Box Model(Introduction, Border properties, Padding Properties, Margin properties).

Unit – 3	**Number of lectures = 9**	

JavaScript: The Fundamentals of Code Starting code with alerts and prompts. Understand Variables and Data Types in JavaScript Variable naming in JS Working with strings and numbers Randomisation and logical operators Loops, collections and Conditionals. Functions and invocation patterns, Operators, Statements, JS Objects and Prototypes.

Unit – 4	**Number of lectures = 9**	

BOOTSTRAP 4: Learn the fundamentals of implementing responsive web design. How to use Balsamiq to mockup and wireframe websites. The fundamentals of UI design for websites. How to install the Bootstrap framework. Understanding the Bootstrap grid layout system. How to use bootstrap containers to layout your website easily. Learn to use other Bootstrap components such as buttons. Adding symbols using Font Awesome. Learn to use Bootstrap carousels. Add Bootstrap cards to your website. Using Bootstrap navigation bars.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended:

Text Books: Mastering HTML, CSS &Javascript Web Publishing by Laura Lemay, Rafe Colburn, 15 July 2016

14. Reference Books:

- Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, ASP.NET, XML and Ajax, Black Book: HTML, Javascript, PHP, Java, Jsp, XML and Ajax, Black Book by Kogent Learning Solutions Inc. , 1 January 2009

- Web Technologies, Black Book, 2018,

The Web Developer Bootcamp Lab

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>The Web Developer Bootcamp Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 12</td></tr>
</table>

8. Course Description: This course introduced to designing effective web pages and to implementing web pages by writing HTML, CSS code and javaScript Code.

Learning objectives:

1. To understand the key concepts front end technology.
2. To learn about HTML and how to use it.
3. To learn how to create a style in web pages.
4. Understand how websites work and how HTML, CSS and JavaScript contribute.

9. Course Outcomes (COs):

1. To coding with HTML, CSS and JavaScript
2. To develop a website.
3. To create web page using HTML & CSS.
4. To building strong expertise on express framework to develop responsive web application.

10. List of Experiments:

1. Write a program to create list in HTML.
2. Write a program to create a table using HTML and CSS
3. Write a program to create registration form using HTML and CSS
4. Write a program to get multiplication using function in JavaScript
5. Write a program to show dialog box using JavaScript.
6. Write a program to add a class attributes to style the table as a basic Bootstrap table.
7. Write a program to add zebra-stripes to the table.
8. Write a program to add a class that will add borders on all sides of the table and cells.
9. Write a program to add a class that will enable a hover state on the table rows.
10. Write a program to add a class that will make the table more compact by cutting cell padding in half.

11. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/

Backend Development

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Backend Development</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(□)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>.</td><td>6. Frequency (use tick marks)</td><td>Even (□)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description:
This course cover hands-on experience and exposure to implement backend scenarios to read, write and update data. This course builds strong foundation for web application development based on client-server architecture.</td></tr>
<tr><td colspan="7">9. LearningObjectives:
1. To learn the basics of databases and back end technology.
2. To understand the key concepts and principles of back end technology.
3. List and explain the business benefits of database
4. To learn about node.js and how to use it for server-side scripting.
5. To learn how to create a database, table, index and manipulating data stored in a table.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):
1. To develop a scalable and reliable backend web applications that can handle high volume concurrent connections, which is the need of modern day web application.
2. To create a database, table and manipulating data stored in a table.
3. To building strong expertise on express framework to develop responsive web application</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction To Backend Development:Introduction, Database, Significance of Database, Database System Applications, Server side programming,Installing Node, Installing Code Editor, Java Script Introduction, JS elements and objects.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Node Essentials:• Introduction to Node.js,What is Node.js, NPM, Modules, Node Program , First HTTP Server , HTTP Introduction, HTTP Parameters, HTTP Messages, HTTP Request, HTTP Response and Web Request, JSON, Nodemon, and More Advanced Functionality.</td></tr>
</table>

Unit – 3	**Number of lectures = 9**	

Node and Express | Fortunes API: Setting Up The Fortunes API, JSON for Fortunes, First Express Endpoint , Random Fortune or One by ID , Fortunes Post Method, Clean the Fortunes Post Method and Use Postman, Update Fortunes with Put, Delete Fortunes.

Unit – 4	**Number of lectures = 9**	

SQL, Database, and PostgreSQL: Introduction to SQL, Relational Model, PostgreSQL, PSQL Installation, Create Tables and Insertion, Creating SQL Scripts, Selecting Table Data, Relational Tables, Joining Tables.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended:

Text Books: Beginning Node.js Paperback – 4 December 2014 by Basarat Syed

14. Reference Books:

- Node.Js Web Development: Create real-time server-side applications with this practical, step-by-step guide Paperback – 1 January 2016 by David Herron
- Full-Stack React, TypeScript, and Node: Build cloud-ready web applications using React 17 with Hooks and GraphQL Kindle Edition by David Choi.

Basics of DevOps& Deployment

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Basics of DevOps& Deployment</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>.</td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
</table>

8. Course Description:

This course covers starting point for an individual or organization wishing to embarkupon the DevOps journey. It will provide you core understanding of fundamental DevOps values, practices and techniques.

9. LearningObjectives:

1. Explain the drivers responsible for the emergence of DevOps
2. Understand the key concepts and principles of DevOps
3. List and explain the business benefits of DevOps and continuous delivery
4. Explain the CALMS model and why each element is key for DevOps transition
5. Explain the benefits of DevOps practices in the Software Deliver y Lifecycle (SDLC) such as test, infrastructure, and build anddeployment automation
6. Describe how DevOpsutilises Lean and Agile methodologies to drive product-focused development

10. Course Outcomes (COs):

1. To learn the history of DevOps
2. To learn conceptual framework for the integration of Dev and Ops groups.
3. To explore cross-functional team structures that lead to team agility.
4. To learn how automating the software deployment process.
5. To learn which metrics are suitable for measuring team performance.
6. To provide foundation for creation of business value across software development life-cycle.
7. To learn several methodologies, frameworks and approaches that areclosely linked to the values of core DevOps and Agile practices.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

Introduction of DevOps: Emergence of DevOps, History of DevOps, Transformation with DevOps and Agile, Business Case for DevOps.

Benefits of DevOps: Agile Practices, Focus on Products and Service, Autonomy of Teams, Introducing CALMS.

Unit – 2	**Number of lectures = 9**	

Culture: Team Behaviours, Team Agility, Cross-functional Deliver y Teams, Job Satisfaction, Servant Leadership.

Automation: Continuous Integration, Environment Management, Release Management, Test

Automation, Deployment, Data and Data Management.		
Unit – 3	**Number of lectures = 9**	
Measurement: Aligning Goals, Delivery Metrics, Operational Metrics, Metric Analysis, Lead and Cycle Time. **Roles:**DevOps Evangelist, Automation Architect, Cloud Infrastructure Engineer, Software Developer, Software Test, Security Engineer, Database Administrator, Product Owner.		
Unit – 4	**Number of lectures = 9**	
Practices and Techniques: Continuous Integration, Testing and Deployment, Infrastructure As Code, Test-Driven Deployment, Integrated Toolchains, Distributed Version Control, Production Monitoring **Methods and Approaches for DevOps Teams:**DevOps Topologies and Target Operating Models, Scrum Development Deliver y, Kanban Workflow, Transformational Leadership, Full-Stack Engineering, Collective Ownership		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/		
13. Books Recommended: **Text Books:** • Jennifer Davis, Ryn Daniels, "What Is DevOps? ", Released by O'Reilly Media, Inc., ISBN: 9781492039877, April 2018		
14. Reference Books: • Gene Kim, Patrick Debois , John Willis, Jez Humble, "The DevOps Handbook: How to Create World-Class Agility, Reliability, and Security in Technology Organizations Paperback – Illustrated", by October 6, 2016. • Jennifer Davis &Ryn Daniels, "EffectiveDevOps: Building A Culture of Collaboration, Affinity, and Tooling at Scale". • SanjeevSharma,"TheDevops Adoption Playbook: A Guide to Adopting DevOps in a Multi-Speed IT Enterprise". • JoakimVeron ,"Practical DevOps: Harness the power of DevOps to boost your skill set and make your IT organization perform better".		

Mobile Apps Development

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Mobile Apps Development</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Computer Basics</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course provides a basic understanding of Android development, including the use of content providers, creating audio and video services. This course focuses on helping people become an Android application developer and releasing high-quality apps to the marketplace. Learn about the various stages of development on the Android platform and study topics related to UI, application services, permissions and security, graphics and video resources, data persistence, monitoring tools, mobile app marketing, application hosting and more. Develop core Java development skills while you explore key concepts for building rich applications using advanced features. Learn from instructors and guest speakers working in the industry.</td></tr>
<tr><td colspan="7">12. LearningObjectives:
1. Learn thesetupand installation ofAndroid
2. LearnAndroidApp development
3. LearnuserinterfacesandControls.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Gainknowledge ofsetupandinstallation ofAndroid
2. GainAppdevelopmentknowledge
3. GainknowledgeofuserinterfacesonMobileApps.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">Unit I: Installation and Setup on Android</td></tr>
<tr><td colspan="7">Environment Setup – Installation & Setup of SDK tools on Windows; Installing platforms and samples; Creating an Android Virtual Device (emulator); Installing Eclipse on a Windows machine; Installing the Android Development Tools; Preparing an Android device for development.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">Android App Development</td></tr>
<tr><td colspan="7">Overview of Android development; Understanding project creation and structure; Working with the AndroidManifest.xml file; Creating and managing activities; Using explicit intents; Using implicit intents; Creating and using resources; Understanding security and permissions; Debugging an app</td></tr>
</table>

Unit – 3	Number of lectures = 9	User interface and Controls
Understanding units and layout; Using layout managers; Working with text controls; Building button controls; Building list controls; Building custom list layouts; Other interesting controls.		
Unit – 4	**Number of lectures = 9**	**Graphics and Animation &Supporting Multiple Screens**
Creating and using styles; Creating and using themes ; Creating icons; Creating NinePatchdrawables, Setting up frame-by-frame animation; Showing tween animation; Working in 2D graphics. Understanding screen size and density; Providing alternate layouts.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

1. Mobile Apps for Android (IBM ICE).

14. Reference Books

1. David Tainar - Mobile Computing: Concepts Methodologies, Tools & Applications.
2. Barbara L Ciaramtaro - Mobile technology consumption.

Mobile Application Development Lab

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Mobile App Development Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core (□)</td><td colspan="2">PE ()</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even</td><td>Odd (□)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 36</td></tr>
<tr><td colspan="7">8. Course Description: This course introduces students to programming technologies, design and development related to mobile
Applications. Topics include accessing device capabilities, industry standards, operating systems, and Programming for mobile applications using an OS Software Development Kit (SDK). Upon completion,
Students should be able to create basic applications for mobile devices.</td></tr>
<tr><td colspan="7">9. Learningobjectives:
1. To facilitate students to understand android SDK
2. To help students to gain a basic understanding of Android application development
3. To inculcate working knowledge of Android Studio development tool</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7"></td></tr>
</table>

4. At the end of this course, students will be able to:
    1. Identify various concepts of mobile programming that make it unique from programming for other platforms,
    2. Critique mobile applications on their design pros and cons,
    3. Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces,
    4. Program mobile applications for the Android operating system that use basic and advanced phone features, and
    5. Deploy applications to the Android marketplace for distribution.

11. List of Experiments

1. Lab exercise:
    1. Develop an application that uses GUI components, Font and Colours
    2. Develop an application that uses Layout Managers and event listeners.
    3. Develop a native calculator application.
    4. Write an application that draws basic graphical primitives on the screen.
    5. Develop an application that makes use of database.
    6. Develop an application that makes use of RSS Feed.
    7. Implement an application that implements Multi threading
    8. Develop a native application that uses GPS location information.
    9. Implement an application that writes data to the SD card.
    10. Implement an application that creates an alert upon receiving a message.
    11. Write a mobile application that creates alarm clock

Big Data

<table>
<tr><td colspan="7">Name of the Department- Computer Science and Engineering</td></tr>
<tr><td>Course Name</td><td>Big Data</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>Pre-requisite (if any)</td><td></td><td>Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">Total Number of Lectures, Tutorials, Practical (assuming 12weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">Course Description</td></tr>
<tr><td colspan="7">Big Data is the hot new buzzword in IT circles. The proliferation of digital technologies with digital st orage and recording media has created massive amounts of diverse data, which can be used for market ing and many other purposes. The concept of Big Data refers to massive and often unstructured data, on which the processing capabilities of traditional data management tools result to be inadequate.</td></tr>
<tr><td colspan="7">Learning objectives:
1.To optimize business decisions and create competitive advantage with Big Dataanalytics
2. To explore the fundamental concepts of big dataanalytics.
3. To learn to analyze the big data using intelligenttechniques.
4. To understand the various search methods and visualization techniques.
5. To learn to use various techniques for mining datastream.
6. To understand the applications using Map ReduceConcepts</td></tr>
<tr><td colspan="7">Course Outcomes (COs):</td></tr>
<tr><td colspan="7">Students will be able to:
1.Work with big data platform and explore the big data analytics techniques businessapplications.
2. Design efficient algorithms for mining the data from largevolumes.
3. Analyze the HADOOP and Map Reduce technologies associated with big dataanalytics.
4. Explore on Big Data applications Using Pig andHive.
5. Understand the fundamentals of various big data analyticstechniques.</td></tr>
<tr><td colspan="7">Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 08</td><td colspan="5">Introduction to Big Data</td></tr>
<tr><td colspan="7">Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 08</td><td colspan="5">Mining data streams</td></tr>
<tr><td colspan="7">Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis- Stock Market Predictions.</td></tr>
</table>

Unit – 3	**Number of lectures = 10**	**Hadoop**
History of Hadoop- the Hadoop Distributed File System – Components of Hadoop Analysing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics-DevelopingaMapReduceApplication-HowMapReduceWorks-AnatomyofaMapReduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce FeaturesHadoop environment.		
Unit – 4	**Number of lectures = 10**	**Frameworks: Applications on Big Data Using Pig and Hive**
– Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphere BigInsights and Streams. **Predictive Analytics**- Simple linear regression- Multiple linear regression- Interpretation 5 of regression coefficients. Visualizations - Visual data analysis techniques- interaction techniques - Systems and applications.		
Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/		
Journal papers; Patents in the respective field.		
Books Recommended		
i. Michael Berthold, DavidJ. Hand,–Intelligent DataAnalysis‖, Springer,2007. ii. Tom White–Hadoop:TheDefinitiveGuide‖ThirdEdition, O‗reillyMedia,2012. iii. ChrisEaton,DirkDeRoos,TomDeutsch,GeorgeLapis,PaulZikopoulos,—UnderstandingBig Data:AnalyticsforEnterpriseClassHadoopandStreamingData‖,McGrawHillPublishing,2012.		

Cloud Application Development & Deployment

<table>
<tr><td colspan="7">1.Name of the Department- Computer Science Engineering</td></tr>
<tr><td>2.Course Name</td><td>Cloud Application Development & deployment</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3.Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4.Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE()</td></tr>
<tr><td>5.Pre-requisite (if any)</td><td></td><td>6.Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7.Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 24</td><td>Tutorials = 0</td><td colspan="4"></td></tr>
<tr><td colspan="7">8.Course Description</td></tr>
<tr><td colspan="7">1. Define cloudcomputing
2. Describe the choices that are available to developers when creating cloud applications
3. Describe infrastructure as a service, platform as a service, and software as a service
4. Describe IBMCloud
5. Describe the architecture of IBMCloud</td></tr>
<tr><td colspan="7">9.Learning objectives</td></tr>
<tr><td colspan="7">10.Course Outcomes (COs):</td></tr>
<tr><td colspan="7">At the end of the course, the student can:
1. Earn basic knowledge of Cloud Technologies in usetoday
2. Strategic plan to move applications and services to theCloud
3. Understand Cloud Segments and Cloud DeploymentModels
4. Importance of security in cloudcomputing

Static Application Development using Service models</td></tr>
<tr><td colspan="7">11.Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 6</td><td colspan="5">HTML 5 and JavaScript</td></tr>
<tr><td colspan="7"></td></tr>
</table>

Describe what htmldoes, List the objectives ofhtml5 • The document types that are supported inhtml5 • The document object model (DOM)tree • Some of the differences between HTML4 andhtml5 • List some HTML document API properties andmethods • How scripting is enabled in browsers • Browser support for HTML5 features • Javascript primitives andobjects • How variables are declared and used injavascript • Javascript control structures • Functions injavascript • The document object model (DOM)hierarchy • The window and documentobjects • Identify the DOM objects that are commonly used in javascript applications for workingwith htmldocuments • Creating HTML webpages • Use style statements in htmldocuments • Connect scripts to documents • Writing javascriptfunctions • Creating interactive alert and confirm windowobjects • Using javascript to modify the document object model(DOM) • Listing new elements inhtml5 • HTML5 structural elements: section, article, header, footer, figure,figcaption • The attributes of the HTML5 input element: tel, email, datetime, number, range,color • Creating a web page and insert a simple HTML5 formlayout • Adding new markupelements • Using input types that include attributes such as email to perform client-side validation • Test theapplication		
Unit – 2	**Number of**	**Essentials of Cloud Application Development**

	lectures = 6	

- Defining cloudcomputing
- Describing the factors that lead to the adoption of cloudcomputing
- Describing the choices that developers have when creating cloudapplications
- Describing infrastructure as a service, platform as a service, and software as a service• Describe IBMCloud
- Describing how Cloud Foundry works with IBMCloud
- Identify the runtimes and services that IBM Cloudoffers

Unit – 3	**Number of lectures = 6**	**Cloud Application development process**

- Describing IBMCloud
- Describing what you can build in IBMCloud
- Describing how to create an application in IBM Cloud
- Describing the IBM Cloud dashboard, catalog, and documentationfeatures
- Describing how the application route is used to test an application in thebrowser
- Describing how to create services in IBMCloud
- Describing how to bind services to an application in IBMCloud
- Describing the environmental variables that are used with IBM Cloudservices
- Describing how to manage your IBM Cloud users andresources
- Explaining how to manage your IBM Cloud account with the Cloud Foundry CLI andIBM Cloud CLI
- Describing how to create a Node.js application that runs on IBMCloud
- Describing the features in IBM Cloud that help you set up a cooperative workstation environment
- Describing the role of Node.js for server-sidescripting
- Describing how to setup and use the IBM Cloud plug-in forEclipse
- Downloading the Eclipse and required plugins for developing cloud applications onEclipse
- Configuring Eclipse to work with the cloud developmentplatform
- Push applications from Eclipse to the cloud developmentplatform
- DescribingDevOps
- Describing the capabilities of IBM Cloud ContinuousDelivery
- Identifying the Web IDE features in IBM Cloud Continuous Delivery
- Describing how to user Git Repos and Issuetracking
- Explaining the pipeline build and deployprocess
- Describing the characteristics of RESTAPIs.
- Explaining the advantages of the JSON dataformat.
- Providing examples of REST APIs using IBMWatson.
- Creating a mobile application by usingKinetise.
- Developing a mobile application UI by using Kinetise dragcontrollers.
- Building a mobile application to test on a realdevice.
- Integrating your mobile application with Cloudant NoSQLDB.
- What is container, what isdocker
- Virtual machine versuscontainer
- Docker concepts and workflow

Docker shared and layered file system

Unit – 4	**Number of lectures = 6**	**Developing Cloud Application with SDK for Node.J & Web Services and Application Deployment**

- Explaining the origin and purpose of the Node.js JavaScriptframework

- Writing a simple web server withNode.js
- Import Node.js modules into yourscript
- Creating an IBM SDK for Node.jsapplication.
- Writing your first Node.js application.
- Deploying an IBM SDK for Node.js application on an IBM Cloudaccount.
- Creating a Node.js module and use it in yourcode.
- Explaining the concept of anonymous callbackfunctions
- Explaining the concept of asynchronous callback functions
- Create a callbackfunction
- Defining a packagedependency
- Creating an Express serverobject
- Handling inbound HTTP method calls for a serverresource
- Creating a callback function to intercept HTTP methodcalls
- Parse JSON data from an HTTPmessage
- Creating a Hello World Expressapplication
- Creating Simple HTML view for yourapplication
- Understanding Expressrouting
- Using third-party modules inNode.js
- Understanding the Watson Natural Language Understandingservice
- Create and Deploy Applications in Kubernetes Cluster onMinikub
- Clone an IBM Cloudapplication.
- Using React to create interactive webpages.
- Using the Fetch API to interact with back-end webservices.
- Understanding the following concepts ofES6:
- o Classes o Arrow functions oPromises.
- Cloud Computing real time application and CaseStudy
- Application Development using real timeplatform
- Launching an application and deployment oncloud
- Kubernetes overview, Kubernetes building blocks, Image, Pods, Simple POD, Config,Scaling, volume, namingetc
- Creating Kubernetes cluster with IBMConsole
- Access IKS Clustering usingCLI
- Application Development to IKSClustering

12.Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/Journal papers; Patents in the respective field.

13.Books Recommended

Virtualization and Cloud Computing

<table>
<tr><td colspan="6">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Virtualization and Cloud Computing</td><td>L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td>OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>Basics of Networking</td><td>6. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd (□)</td><td>Either Sem()</td></tr>
<tr><td colspan="6">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="6">8. Course Description</td></tr>
<tr><td colspan="6">This course gives students an insight into the basics of cloud computing along with virtualization. Cloud computing is one of the fastest growing domain from a while now. It will provide the students basic understanding about cloud and virtualization along with it how one can migrate over it. It gives students the skills and knowledge to understand aboutcloud computing architecture that can enable transformation, business development and agility in an organization.</td></tr>
<tr><td colspan="6">10. LearningObjectives:
1. To aware students about virtualization and cloud computing basics.
2. To aware students about need of migration over cloud.
3. Analyze the components of cloud computing showing how business agility in an organization can be created.
4. Evaluate the deployment of web services from cloud architecture.
5. Critically analyze case studies to derive the best practice model to apply when developing and deploying cloud-based applications.</td></tr>
<tr><td colspan="6">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="6">The students will be able to:
1. Describe the need of virtualization.
2. Describe how one can migrate over cloud.
3. Understand how cloud computing Architecture can enable transformation, business development and agility in an organization.</td></tr>
<tr><td colspan="6">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="4"></td></tr>
</table>

Virtualization and cloud computing: Virtualization, Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations Types of hardware virtualization: Full virtualization - partial virtualization - para virtualization Desktop virtualization: Software virtualization – Memory virtualization - Storage virtualization – Data virtualization – Network virtualization.

Server Virtualization: Understanding Server Virtualization, types of server virtualization, Virtual machine basics, types of virtual machines, hypervisor concepts and types.

Unit – 2	**Number of lectures = 9**	

Understanding Microsoft's Virtualization solutions: Microsoft's Infrastructure Optimization Model, Virtualization and the Infrastructure Optimization Model, Benefits of Virtualization, Achieving the Benefits of Datacenter Virtualization, Achieving the Benefits of Client Virtualization, Achieving the Benefits of Cloud Virtualization, Challenges while migrating to Cloud, Broad approaches to migrating into the cloud, , the Seven-step model of migration into a cloud, Migration Risks and Mitigation, Enterprise cloud computing paradigm.

Unit – 3	**Number of lectures = 9**	

Cloud Computing Overview: Origins of Cloud computing – Cloud components - Essential characteristics , Measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing. Cloud Insights Architectural influences – High-performance computing, Cloud scenarios – Benefits: scalability ,simplicity ,vendors ,security, Limitations – Sensitive information - Application development- security level of third party - security benefits, Regularity issues: Government policies, Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption. Cloud deployment model-Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

Unit – 4	**Number of lectures = 9**	

Application Development: Service creation environments to develop cloud-based applications. Development environments for service development; Amazon, Azure.

Cloud IT Model: Analysis of Case Studies when deciding to adopt cloud computing architecture. How to decide if the cloud is right for your requirements. Cloud based service, applications and development platform deployment so as to improve the total cost of ownership (TCO).

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
- Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008
- Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
- Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008

14. Reference Books

- Publications, 2006. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
- Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010.
- Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010
- Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
- Gautam Shroff, "Enterprise Cloud Computing Technology Architecture Applications", Cambridge University Press; 1 edition, [ISBN: 978-0521137355], 2010
- Dimitris N. Chorafas, "Cloud Computing Strategies" CRC Press; 1 edition [ISBN: 1439834539],2010

Electronics

Digital Devices Development

<table>
<tr><td colspan="6">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Digital Devices Development</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">In addition to familiarization with the combinational and sequential circuits, students will be adept in using one high-level hardware description languages, which is in high demand, for designing combinational or sequential circuits.</td></tr>
<tr><td colspan="7">11. LearningObjectives:
As there are lot of industrial and research based job opening in the area, the course offers a hands-on in designing digital devices on hardware (fabrication) and testing with a holistic approach to the subject, making students ready for the industry or research.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">At the end of this course, Students will be able to
1. Understand and represent numbers in powers of base and converting one from the other
2. Understand basic logic gates, concepts of Boolean algebra and techniques
3. Analyze and design combinatorial as well as sequential circuits
4. Familiar with VHDL design flow</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Number System and Codes: Decimal, Binary, Hexadecimal, Octal, BCD, Conversions, Complements (1_s and 2_s), Signed and unsigned numbers, addition and subtraction, multiplication and subtraction, Gray Codes

Boolean algebra and Logic gates: Boolean algebra- Positive and negative logic. Boolean laws. De Morgan_s theorems, simplification of Boolean expressions-SOP and POS. Logic gates- basic logic gates-AND, OR, NOT, logic symbol and truth table. Derived logic gates (NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. K-map-3 and 4 variable expressions. Characteristics of logic families: Fan In and Fan out, power dissipation and noise Immunity, propagation delay, comparison of TTL and CMOS families.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Combinational logic analysis and design: Multiplexers and Demultiplexers, Adder (half and full) and their use as subtractor, Encoder and Decoder, Code Converter (Binary to BCD and vice versa)</td></tr>
</table>

Unit – 3	Number of lectures = 9	

Sequential logic design: Latch, Flip flop, S-R FF , J-K FF, T and D type FFs, clocked FFs, registers, Counters (ripple, synchronous and asynchronous, ring, modulus)

Unit – 4	Number of lectures = 9	

Introduction to VHDL : A Brief History of HDL, Structure of HDL Module, Comparison of VHDL and Verilog, Design flow, Simulation and Synthesis tools, Translation of VHDL code into a circuit. Code Structure: library, entity, architecture, package. Data object, class constant, variable, signal, file. Modes in, out, inout, buffer. Data types, operators. Concurrent code: Difference between concurrent and sequential code, concurrent code using operators, When statement, Select statement.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

1. M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition)

14. Reference Books

1. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (2019)

2. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India(2020)

3. R. L. Tokheim, Digital Principles, Schaum_s Outline Series, Tata McGraw- Hill.

4. A Verilog HDL Primer – J. Bhasker, BSP, 2013 II Edition.

5. Verilog HDL-A guide to digital design and synthesis-Samir Palnitkar, Pearson, 2nd edition.

Digital Devices Development Lab

1. Name of the Department : Computer Science Engineering						
2. Course Name	Digital Devices Development Lab	L	T		P	
3. Course Code			0		2	
4. Type of Course (use tick mark)		Core ()	PE(✓)		OE()	
5. Pre-requisite (if any)	DE, CAO	6. Frequency (use tick marks)	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =		Tutorials = 00	Practical = 24			

Objective:

To provide a comprehensive understanding of electronic circuits and devices.

The course presents a basic introduction to physical models of the operation of semiconductor devices and examines the design and operation of important circuits that utilize these devices.

List of Experiments

1. The operation of laboratory instrument Cathode Ray Oscilloscope (CRO).
2. The operation of laboratory instrument Digital Storage Oscilloscope (DSO).
3. The operation of laboratory instrument multimeter.
4. The operation of laboratory instrument function generator.
5. The operation of laboratory instrument building simple circuits.
6. The operation of laboratory instrument Testing simple circuits.
7. The operation of laboratory instrument taking measurements on simple circuits.
8. Use standard laboratory equipment to analyze the behavior of basic electronic devices.
9. Use standard laboratory equipment to design.
10. Use standard laboratory equipment to construct simple circuits containing devices.

PIC Microcontroller Programming

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**PIC Microcontroller Programming**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
The PIC theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor.						
12. LearningObjectives: 1. Identify and understand function of different blocks of PIC microcontroller. 2. Develop programs for data transfer, arithmetic, logical and I/O port operations.						
10. Course Outcomes (COs):						
1. Develop programs for PIC18 using "C". 2. Develop program for PIC18 Timers, Serial port and Interrupts using "C". 3. Interface LCD, Keyboard, ADC, DAC, Sensors, Relays, DC motor and Stepper motor with PIC18 microcontroller.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 9**					
PIC Microcontrollers : History, Features and Architecture: Microcontrollers and Embedded Processors, Overview of the PIC18 Family, PIC18 PIN connection, PIC18 Configuration Registers, The WREG Register in PIC18, The PIC18 File Register and access Bank, Use of Instructions with the Default Access Bank, PIC18 Status Register, PIC18 Data Format and Directives, The Program Counter and Program ROM Space in the PIC18, RISC Architecture in the PIC18.						
Unit – 2	**Number of lectures = 9**					
Classification of Instructions and I/O Port Programming: Arithmetic Instructions, Signed Number Concepts and Arithmetic Operations, Logic and Compare Instructions, Rotate Instruction and Data Serialization, BCD and ASCII Conversion, Branch Instructions and Looping, Call Instructions and Stack, PIC18 Time Delay and Instruction Pipeline, I/O Port Programming in PIC18, I/O Bit Manipulation Programming.						

Unit – 3	Number of lectures = 9	
PIC18 Programming in C: Data Types and Time Delays in C, I/O Programming in C, Logic Operations in C, Data Serialization in C, Program ROM Allocation in C, Data RAM Allocation in C.		
Unit – 4	**Number of lectures = 9**	
PIC18 Programming in C: Timer, Serial Port and Interrupt: Programming Timers 0, 1, 2 and 3 in C. 4.2 Counter Programming, Basics of Serial Communication, PIC18 connection to RS232, PIC18 Serial Port Programming in C, PIC18 Interrupts, Programming Timer, External Hardware, Serial communication and Port B change interrupts.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- PIC Microcontroller And Embedded Systems, Mazidi M. A., McKinlay R. D., Causey D, Pearson Education International.

14. Reference Books

1. PIC Microcontroller, Gaonkar R. S, Penram International Publishing (India) Pvt. Ltd.

2. PIC Microcontrollers – Programming in C, Verle Milan, Mikroelektronika, 1 st Edition, 2019.

IoTInerfacing with Arduino

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**IoTInerfacing with Arduino**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
Course introduces to fundamental concepts,describe and explain the evolution IoT.						
13. LearningObjective: 1. Objective is to illustrate and explain the IoT functional and physical architecture.						
10. Course Outcomes (COs):						
1. Describe and explain the requirements and fundamental techniques for IoT. 2. Compare and explain various access technologies for IoT.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 9**					
Introduction to IoT: Architectural Overview, Design principles and needed capabilities, IoT Applications, Sensing, Actuation, Basics of Networking, M2M and IoT Technology Fundamentals-Devices and gateways, Data management, Business processes in IoT, Everything as a Service(XaaS), Role of Cloud in IoT, Security aspects in IoT.						
Unit – 2	**Number of lectures = 9**					
Elements of IoT: Hardware Components- Computing (Arduino, Raspberry Pi), Communication, Sensing, Actuation, I/O interfaces. Software Components- Programming API"s (using Python/Node.js/Arduino) for Communication Protocols-MQTT, ZigBee, Bluetooth, CoAP, UDP, TCP.						
Unit – 3	**Number of lectures = 9**					
IoT Application Development: Solution framework for IoT applications- Implementation of Device integration, Data acquisition and integration, Device data storage- Unstructured data storage on cloud/local server, Authentication, authorization of devices.						
Unit – 4	**Number of lectures = 9**					

IoT Case Studies: IoT case studies and mini projects based on Industrial automation, Transportation, Agriculture, Healthcare, Home Automation, Familiarization with Arduino/Raspberry Pi and perform necessary software installation, I interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Vijay Madisetti, ArshdeepBahga, Ïnternet of Things, "A Hands on Approach", University Press

14. Reference Books

1. Dr. SRN Reddy, RachitThukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs

2. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press

3. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi

4. Adrian McEwen, "Designing the Internet of Things", Wiley

5. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill

6. CunoPfister, "Getting Started with the Internet of Things", O Reilly Media

IoT Interfacing with Arduino Lab

<table>
<tr><td colspan="7">1. Name of the Department : Computer Science Engineering</td></tr>
<tr><td>2. Course Name</td><td>IoT Interfacing with Arduino Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures =</td><td>Tutorials = 00</td><td colspan="4">Practical = 24</td></tr>
</table>

Objectives of the Lab:

1. To form a bridge between the industry and academic institutions to update their knowledge.
2. To understand the need of IoT in the research community and software industry in India.
3. To appreciate differences between Big Data, Cloud Computing and IoT.
4. To understand innovative application's needs such as Smart City, Smart Health, Smart Manufacturing, Smart Agriculture, etc.
5. To train participants in designing and programming the IoT based system.
6. To build industry capable talent, start-up community and entrepreneurial ecosystem for IoT.
7. To understand the reduction of import dependency on IoT components and promote indigenization.
8. To energise research mind-set and reduce costs in research and development by providing neutral and interoperable, multi-technology stack laboratory facilities.
9. To provide environment for product creation, testing and also for validation & incubation.

List of Experiments

1. LED Blink and Pattern Arduino experimental kit based
2. 7 Segment Display Arduino experimental kit based
3. Push Button Arduino experimental kit based
4. LED Pattern with Push Button Control Arduino experimental kit based
5. Push Button Counter Arduino experimental kit based
6. LM35 Temperature Sensor Arduino experimental kit based
7. Push Button Counter Arduino experimental kit based
8. Analog Inputs Arduino experimental kit based
9. Analog Input & Digital Output Arduino experimental kit based
10. IR Sensor Analog Input Arduino experimental kit based
11. LCD 16X2 Display Arduino experimental kit based
12. IR Sensor Based Security System Arduino experimental kit based
13. Night Light Controlled & Monitoring System Arduino experimental kit based
14. Analog Input & Analog Output Arduino experimental kit based
15. LM35 Temperature Sensor with Fire Alarm Arduino experimental kit based

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Instrumentation Engineering			**L**	**T**	**P**
3. Course Code				3	0	0
4. Type of Course (use tick mark)	**Core ()**	**DSE ()**	**AEC ()**	**SEC ()**	**PE (√)**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36	**Tutorials =0**	**Practical = 0**				

8. Course Description:

9. Course Objectives:

This course will provide students with a practical and theoretical knowledge ofInstrumentation Engineering. By the end of the course, students should be able to:

1. Developing adequate knowledge of the instruments, relevant circuits and their working
2. Introduction to electrical instruments and
3. Introduction to measurements techniques.
4. To Emphasis Knowledge on analog techniques used to measure voltage, current, power etc
5. To Emphasis Knowledge on digital techniques used to measure voltage, current, power etc

10. Course Outcomes (COs):

Upon completion of this module, students will be able to:

1. The graduate will get adequate knowledge of the instruments, relevant circuits and their working
2. Capable of describing various electrical instruments
3. Capable of describing various measurements techniques

11. Unit wise detailed content

Unit-1	**Number of lectures = 8**	**Fundamentals of Instrumentation**

Basic concept of Instrumentation system: functional elements of an instrument, electrical equivalents of mechanical and other systems, input-output configurations. Generalized Instrumentation system – Units and standards- Calibration methods- Standards of measurement-Classification, Introduction to mechanical, electrical and electronic instruments.

Unit – 2	**Number of lectures = 9**	**Signals and Systems**

Instruments for generating and analyzing wave forms, square wave, pulse, standard-signal, random noise and function generators, wave analysers, spectrum analysers, Q-meters, vector – voltmeters, vector impedance meters.

Unit – 3	**Number of lectures = 9**	**Analog Instrumentation**

Electronic analog meters: Electronic voltmeters VTVM, TVM, FETVM Voltmeters, electronic – multimeters differential voltmeters. DC voltmeters- Loading- Transfer volt meter- Chopper type– Differential voltmeter – Peak responding voltmeter – True RMS voltmeter – Calibration of DC instruments.		
Unit – 4	**Number of lectures = 9**	**Digital Instrumentation**
Digital Instruments: – Digital multimeters – Digital frequency meter – Digital Measurement of time – Universal counter – Electronic counter – Digital Tachometer- Digital voltmeter– Ramp Type DVM – Dual slope Ramp DVM- Integrating type DVM – Successive approximations type DVM – Resolution and sensitivity of digital meters – General specifications of a DVM, Data acquisition system		
12.	**Brief Description of self-learning / E-learning component**	
13.	**Books Recommended**	

Text Books:

1. **Modern electronic instrumentation measurements techniques by Helfrick and cooper.**
2. **A course in electrical and electronic measurement and instrumentation by A.K.Shawney.**
3. **Electronic Instrumentation by H.S.Kalsi.**

Reference Books:

1. Electronic Instrumentation & Measurements - David A. Bell, PHI, 2003, 2/e.

2. Electronic Test Instruments, Analog and Digital Measurements – Robert A.Witte, Pearson Education, 2004, 2/e.

Biomedical Image Processing

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Bio-Medical Image Processing**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)	Digital Image Processing	**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

Bio-Medical Image Processing helps students to learn about current technology in processing and analysis of bio-medical images; a rapidly growing industry in it. If anyone who is looking forward to a career in medical imaging instrument and software design, medical imaging, medical visualization, medical robotics and augmented reality, this is the key subject one should enroll for. The aim is to teach students advanced technology in processing and analysis of medical images. It would be beneficial to students opting for specialization in medical imaging instrument design, medical imaging, medical visualization, medical robotics and augmented reality, which can use the gained skills in order to develop newer technological innovations and regularize them for high-throughput clinical translation and usage.

1. **Learning Objectives:**

1. The objective of this course is to provide a detail introduction about image and its processing.
2. To understand and to know how an image model is developed and processed.
3. To develop a capacity to analyze the image through various segmentation techniques.
4. To develop a capacity to apply these processing's in medical applications.

10. Course Outcomes (COs):

The students will be able to:-

1. Recognizing and analyzing of image acquisition storage, processing, communication and display.
2. Able to understand the formation of image model and basics enhancements techniques.
3. Learn the image segmentation processing in detail.
4. Able to understand the basic applications of image processing in medical system.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	

Digital Image Processing System: Introduction to Medical Imaging and Analysis Software, Image acquisition storage, processing, communication display. Visual perception: Structure of Human eye, Image formation in human eye, brightness and contrast, adaptation and discrimination, Block's Law and critical fusion frequency photographic film characteristics.

Unit – 2	**Number of lectures = 9**	

Image Model: Uniform and non-uniform sampling, quantization, Image enhancement: Image smoothing, point operators, contrast manipulation, histogram modification, noise clipping, image sharpening, spatial operators, frequency domain method, low pass and high pass filtering, homomorphic filtering, median filtering.		
Unit – 3	**Number of lectures = 9**	
Medical Image Segmentation: Histogram-based methods, Region growing and watersheds, Markov Random Field models, active contours, model-based segmentation, Multi-scale segmentation, semi-automated methods, clustering- based methods, classification-based methods, atlas-guided approaches, multi-model segmentation.		
Unit – 4	**Number of lectures = 9**	
Biomedical Application and Machine Learning for Analysis: Computer Tomography, Emission Tomography, CAT, Radon Transform, CAT, MRI(Magnetic Resonance Imaging), Images, Processing of Radiograph, Angiogram, Sonography including Doppler, Projection Theorem, Back Projection. Deep Learning for Medical Image Analysis: A case study for students to expose them with latest trends in Industry.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.

https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- Rafel C Gonzalez, Richard E Woods, “ Digital Image Processing”, 2nd edition, Aaison-Wesley Publishing Company, New Delhi, 2002.
- William R Hendee, E. Russell Ritenour, “ Medical Imaging Physics”, 4th edition, John Wiley & Sons, Inc., New York, 2002.

14. Reference Books

- Paul Suetens, “Fundamentals of Medical Imaging”, 2nd edition, Cambridge University press, 2009.
- J. Michael Fitzpatrick and Milan Sonka,” Handbook of Medical Imaging, Vol. 2, SPIE Press, 2000.

Wireless Sensor Network

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Wireless Sensor Network</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td>This project requires students to complete a systems project. Knowledge of C is assumed!</td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Wireless sensor networks are pervasive computing systems that consist of sensors embedded in the physical world. These systems have many applications including long-term monitoring of habitats, finding parking spaces in crowded cities, or monitoring the physiology and activity patterns of patients</td></tr>
<tr><td colspan="7">9.LearningObjectives:
The goal of the class is to learn the basic principles behind a Wireless Sensor Network. Following the ISO Open Systems Interconnection (OSI) model, the class presents the particular challenges of designing network protocols, services and applications for WSNs composed of large numbers of constrained devices.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">Class description: This course will cover the latest research in the area of Wireless Sensor Networks. We will cover all aspects of these unique and important systems, from the hardware and radio architecture through protocols and software to applications</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Wireless sensor networks are pervasive computing systems that consist of sensors embedded in the physical world. These systems have many applications including long-term monitoring of habitats, finding parking spaces in crowded cities, or monitoring the physiology and activity patterns of patients</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Medium Access Control Protocols: Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts - Contentionbased protocols - Schedule-based protocols - SMAC - BMAC - Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Routing And Data Gathering Protocols Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols.</td></tr>
<tr><td>Unit – 4</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

Embedded Operating Systems: Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS - OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

1.Kazem Sohraby, Daniel Minoli and TaiebZnati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons, 2007. 2.Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005

14. Reference Books

1.K. Akkaya and M. Younis, "A survey of routing protocols in wireless sensor networks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349

2.Philip Levis, " TinyOS Programming"

3.Anna Ha´c, "Wireless Sensor Network Designs", John Wiley & Sons Ltd,

Wireless Sensor Network lab

1. Name of the Department: Computer Science & Engineering						
2. Course Name	Wireless Sensor Network lab	**L (0)**	**T (0)**		**P (2)**	
3. Course Code						
4. Type of Course (use tick mark)		**Core ()**	**EAS ()**		**BSC ()**	
Pre-requisite (if any)		**Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 24**			
8. Brief Syllabus Wireless sensor networks are pervasive computing systems that consist of sensors embedded in the physical world. These systems have many applications including long-term monitoring of habitats, finding parking spaces in crowded cities, or monitoring the physiology and activity patterns of patients						
9. LearningObjectives: The goal of the class is to learn the basic principles behind a Wireless Sensor Network. Following the ISO Open Systems Interconnection (OSI) model, the class presents the particular challenges of designing network protocols, services and applications for WSNs composed of large numbers of constrained devices.						
10 Course Outcomes (COs): Class description: This course will cover the latest research in the area of Wireless Sensor Networks. We will cover all aspects of these unique and important systems, from the hardware and radio architecture through protocols and software to applications						

11. Lab Experiment

Sr. No.	Title	CO cove red
1	Explain and discuss the basic concepts of wireless sensor network nodes and networks	**ii**
2	Provide an overview on MAC layer protocols and routing algorithms and to discuss their properties	**ii**

3	Implement simpler protocols and algorithms on their own on the course hardware and software platforms	**i**
4	Program simple software programs in C/C++ and use an integrated development environment (IDE) to develop, compile, test and run on the course hardware and software platforms	**i**
5	Describes the RF communication using Wireless sensor nodes	**i**
6	Wireless Sensor Network Duty Cycle Implementation vs. Analysis of Power Consumption	**iii**

12. Brief Description of self-learning / E-learning component

http://vlabs.iitb.ac.in/vlabs-dev/labs/oops/index.php

Speech Precessing

1. Name of the Department- Computer Science & Engineering					
2. Course Name	**Speech Processing**	**L**	**T**	**P**	
3. Course Code		**3**	**0**	**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**	**OE ()**	

5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)		
Lectures = 36	**Tutorials = 0**	**Practical = 0**

8. Course Description

To introduce the characteristics of Speech signals and the related time and frequency domain methods for speech analysis and speech compression.

9. Learning Objectives:

1. To introduce the models for speech production
2. To develop time and frequency domain techniques for estimating speech parameters
3. To introduce a predictive technique for speech compression
4. To understand speech recognition, synthesis and speaker identification.

10. Course Outcomes (COs):

The students will be able to:-

1. Design speech compression techniques
2. Configure speech recognition techniques
3. Design speaker recognition systems
4. Design text to speech synthesis systems

11. Unit wise detailed content

Unit-1	**Number of**	**NATURE OF SPEECH SIGNAL**

	lectures = 9	

speech production mechanism, Classification of speech, sounds, nature of speech signal, models of speech production.

Speech signal processing: purpose of speech processing, digital models for speech signal, Digital processing of speech signals, Significance, short time analysis.

Unit – 2	**Number of lectures = 9**	**Speech Compression**

Sampling and Quantization of Speech (PCM) – Adaptive differential PCM – Delta Modulation -Vector Quantization- Linear predictive coding (LPC) – Code excited Linear predictive Coding (CELP)

Unit – 3	**Number of lectures = 9**	**TIME DOMAIN METHODS FOR SPEECH PROCESSING**

Time domain parameters of speech, methods for extracting the parameters, Zero crossings, Autocorrelation function, pitch estimation.

Unit – 4	**Number of lectures = 9**	**FREQUENCY DOMAIN METHODS FOR SPEECH PROCESSING**

Short time Fourier analysis, filter bank analysis, spectrographic analysis, Format extraction, pitch extraction, Analysis - synthesis systems.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended
Text Books • L.R. Rabiner and R.E Schafer : Digital processing of speech signals, Prentice Hall, 1978.
14. Reference Books
• J.L Flanagan : Speech Analysis Synthesis and Perception - 2nd Edition - Sprenger Vertag, 1972. • I.H.Witten :Principles of Computer Speech , Academic press, 1983.

5G: Architecture & Technology

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**5G: Architecture & Technology**	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
Course introduces to fundamental concepts of 5G, describe and explain the evolution of 5G, system concepts and spectrum challenges.						
2. LearningObjectives: 1. Illustrate and explain the 5G functional and physical architecture and its requirements Explain the architecture, Beamforming and hardware technologies for mmW communications 2. Describe and explain the requirements and fundamental techniques for MTC and D2D Communication 1.						
10. Course Outcomes (COs):						
1. Compare and explain various radio access technologies for 5G networks 2. Illustrate and explain the fundamentals, resource allocation and transceiver algorithms for Massive MIMO						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 9**					
DRIVERS FOR 5G: Historical Trend for Wireless Communication - Mobile Communications Generations: 1G to 4G – Evolution of LTE Technology to Beyond 4G – Pillars of 5G – Standardization Activities -Use cases and Requirements – System Concept – Spectrum and Regulations: Spectrum for 4G – Spectrum Challenges in 5G – Spectrum Landscape and Requirements – Spectrum Access Modes and Sharing Scenarios						
Unit – 2	**Number of lectures = 9**					

5G ARCHITECTURE AND MILLIMETER WAVE COMMUNICATION : 5G Architecture: Software Defined Networking – Network Function Virtualization – Basics about RAN Architecture –High-Level Requirements for 5G Architecture – Functional Architecture and 5G Flexibility – Physical Architecture and 5G Deployment Millimeter Wave Communication: Channel Propagation – Hardware Technologies for mmW Systems – Deployment Scenarios – Architecture and Mobility – Beamforming – Physical layer Techniques.

Unit – 3	**Number of lectures = 9**	

MACHINE TYPE AND D2D COMMUNICATION: MTC: Use cases and Categorization – MTC Requirements – Fundamental Techniques for MTC – Massive MTC – Ultra-reliable Low-latency MTC D2D: from 4G to 5G – Radio Resource Management for Mobile Broadband D2D – Multi-hop D2D Communications for Proximity and Emergency Services – Multi-operator D2D Communication.

Unit – 4	**Number of lectures = 9**	

5G RADIO ACCESS TECHNOLOGIES: Access Design Principles for Multi-user Communications – Multi-carrier with Filtering – Nonorthogonal Schemes for Efficient Multiple Access – Radio Access for Dense Deployments – Radio Access for V2X Communication – Radio Access for Massive Machine-type Communication.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- AsifOseiran, Jose F.Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology", Cambridge University Press, 2019.

14. Reference Books

1. Jonathan Rodriquez, "Fundamentals of 5G Mobile Networks", Wiley, 2019

2. Patrick Marsch, Omer Bulakci, Olav Queseth and Mauro Boldi, "5G System Design – Architectural and Functional Considerations and Long Term Research", Wiley, 2020.

ARM Processor

1. **Name of the Department- Computer Science & Engineering**							
2. Subject Name	ARM Processor				L	T	P
3. Subject Code					3	0	0
4. Type of Course (use tick mark)		Core (√)	PE()		OE()		
5. Pre-requisite (if any)	Microcontroller Architecture and Programming	6. Frequency (use tick marks)	Even ()	Odd (√)	Either Sem ()	Every Sem ()	
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Lectures = 00		Tutorials = 00	Practical = 10				

8. Brief Syllabus

The course introduces ARM Embedded Systems and ARM Processor Fundamentals. Knowledge of ARM Instruction Set is also imparted. This course further teaches about ARM Programming, Exception and Interrupt handling schemes.

9. Course Objectives:

1. Collect knowledge of architecture of ARM 7processor, LPC2148 and assembly programming of ARM.

2. Learn to design, construct, program, verify, analyze and troubleshoot ARM assembly and C language programs and supporting hardware.

10. Course Outcomes: At the end of the course, the students will be able to

1. Understand the features of embedded systems, architecture of ARM7 and applications.

2. Analyse and understand the instruction set and development tools of ARM

11. Unit wise detailed content

Unit-1	Number of lectures = 12	ARM Embedded Systems and ARM Processor Fundamentals
The RISC design philosophy, ARM design philosophy, embedded system hardware- AMBA bus protocol, embedded system software- applications. ARM core data flow model, Registers, CPSR-Processor modes, Banked registers. Pipeline- Characteristics		
Unit - 2	Number of lectures =12	ARM Instruction Set
Fundamentals of ARM instructions, Barrel shifter, Classification and explanation of instructions with examples-Data processing, Branch, Load-store, SWI and Program Status Register instruction.		
Unit – 3	Number of lectures = 10	ARM Programming, Exception and Interrupt handling schemes

Differences between ARM and THUMB, Register usage in Thumb, ARM Thumb Interworking. General Structure of ARM assembly module, Assembler directives, Simple ALP programs on Arithmetic & logical operations, Factorial, string operation, sorting, searching, and Scan.		
Unit – 4	Number of lectures = 08	Exception handling
ARM processor exceptions and modes, vector table, exception priorities, link register offsets. Interrupts- assigning interrupts, interrupt latency, IRQ and FIQ exceptions with example- code for enabling and disabling IRQ and FIQ exceptions, Comparison between exception and interrupts. Interrupt handling schemes- nested interrupt handler, non-nested interrupt handler. Basic interrupt stack design.		
12. Brief Description of self learning / E-learning component The students will be encouraged to learn using the SGT ELearning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/. Journal papers; Patents in the respective field.		
13. Books Recommended 1. ARM System Developer's guide –Andrew N. SLOSS, ELSEVIER Publications, 2016. 2. ARM Assembly Language – William Hohl, CRC Press, ISBN:978-81-89643-04-1 3. ARM System-on-chip Architecture by Steve Furber, Pearson Education, 4. ARM Programming Techniques – from ARM website 5. Embedded Systems: A Contemporary Design Tool- James K. PeckolISBN: 978-0-471- 72180-2 October 2007, ©2008		

ARM Processor lab

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**ARM Processor lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**4**	
4. Type of Course (use tick mark)		**Core (✓)**	**PE ()**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even	Odd (✓)	Either Sem()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 36**			

Course Description:
Advanced RISC Machine (ARM) is a reduced instruction set computing architecture for computer processors, configured for various environments if the embedded system applications need real-time control, fast processing, high-end communication protocol and much other function like ADC, PWM. This ARM Training will discuss the basic concepts of embedded system design, with particular emphasis on hands-on and demonstration sessions on system design using ARM microcontrollers.

3. Learningobjectives:

1. To provide exposure to the students on ARM microcontroller, their architecture, and choose appropriate microcontroller for a real time application.
2. The objective of this course is to give the students a thorough exposure to ARM architecture and make the students to learn the ARM programming & Thumb programming models.

10. Course Outcomes (COs):

1. Describe the programmer's model of ARM processor and create and test assembly level programming.
2. Analyze various types of coprocessors and design suitable co-processor interface to ARM processor.
3. Analyze floating point processor architecture and its architectural support for higher level language.
4. Become aware of the Thumb mode of operation of ARM.
5. Identify the architectural support of ARM for operating system and analyze the function of memory

10. List of Experiments

1. Assembly and C Programming for I/O Programming for ARM processor.
2. Assembly and C programming for Timers & counters operation for ARM processor.
3. Assembly and C programming for Interrupts available in the for ARM processor.
4. Assembly and C programming for serial communication feature for ARM processor..
5. Assembly and C programming for PWM generation for ARM processor..
6. Assembly and C programming for motor control through the for ARM processor.
7. Assembly and C programming for accessing the ADC & DAC interfaced with ARM processor.
8. Assembly and C programming for configure the working of different display devices as LED, LCD etc.
9. Assembly and C programming for reading information through the interfaced sensors wit ARM processor.
10. Interface Actuators & program for ARM processor.

Real time Embedded Systems

1. **Name of the Department- Computer Science & Engineering**

Course Name	Real time Embedded Systems		L	T	P
Course Code			3	0	0
Type of Course (use tick mark)	Core (✓)				
Embedded System	1. Frequency (use tick marks)				

2. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)

Lectures = 36	Tutorials = 0			

3. Brief Syllabus

Introduces microcontrollers and embedded processors. Gives knowledge of embedded system programming. Students can independently design and develop a hardware platform encompassing a microcontroller and peripherals.

4. Learning objectives:

1. To learn the basic concepts of Embedded Systems
2. To gain an understanding of applications of embedded systems involving real-time programming of microcontrollers.

Course Outcomes: On completion of this course, the students will be able to

2. Apply the concepts of embedded system.
3. Design and program for Embedded Systems.

5. Unit wise detailed content

Unit 1	6 Hrs	Unit Basic Fundamentals

Architecture - Features – Resets –Memory Organizations: Program Memory, Data Memory Interrupts –I/O Ports –Timers- CCP Modules- Master Synchronous serial Port (MSSP)- USART –ADC- I2C

Unit II	6 Hrs	PIC Programming

Programming Model, Addressing Modes, Instruction Format, Instruction Set, Programming to PIC, Interfacing actuator with PIC.

Unit III	6 Hrs	ARM Introduction

ARM processor- processor and memory organization, Data operations, Flow of Control, CPU Bus configuration, ARM Bus, Memory devices, Input/output devices, Component interfacing, designing with microprocessor development and debugging, Design Example: Alarm Clock.

Unit: IV	Number of lectures = 8	Real time Operating Systems

I/O subsystems – Network operating systems –Interrupt Routines in RTOS Environment – RTOS Task scheduling models, Interrupt – Performance Metric in Scheduling Models –IEEE standard POSIX functions for standardization of RTOS and inter-task communication functions–List of Basic functions in a Preemptive scheduler – Fifteen point strategy for synchronization between processors.

6. Brief Description of self learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

7. Books Recommended

1. Raj Kamal , Embedded Systems Architecture, Programming and Design, Tata McGraw-Hill, New Delhi, 2003.*ISBN* 0-07-049470-3 2. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Morgan Kaufman Publishers, 2001.*ISBN=0123884365*

VLSI Design

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>VLSI Design</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even (✓)</td><td>Odd ()</td><td>Either Sem()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">Course introduces to fundamental concepts of VLSI Design and describe and explain the evolution of VLSI, system concepts.</td></tr>
<tr><td colspan="7">9.LearningObjectives:
1. Illustrate the VLSI functional architecture.
2. Explain the VLSI physical architecture.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">1. Describe and explain the requirements and fundamental techniques for VLSI.

2. Compare and explain various technologies for VLSI</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Introduction to MOSFETs : MOS Transistor Theory – Introduction MOS Device, Fabrication and Modeling , Body Effect, Noise Margin; Latch-up

MOS Inverter : MOS Transistors, MOS Transistor Switches, CMOS Logic, Circuit and System Representations, Design Equations.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
<tr><td colspan="7">Static Load MOS Inverters, Transistor Sizing, Static and Switching Characteristics; MOS Capacitor; Resistivity of Various Layers, Symbolic and Physical Layout Systems – MOS Layers Stick/Layout Diagrams; Layout Design Rules, Issues of Scaling, Scaling factor for device parameters.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5"></td></tr>
</table>

Combinational MOS Logic Circuits: Pass Transistors/Transmission Gates; Designing with transmission gates, Primitive Logic Gates; Complex Logic Circuits.

Sequential MOS Logic Circuits: SR Latch, clocked Latch and flip flop circuits, CMOS D latch and edge triggered flip flop.

Unit – 4	**Number of lectures = 9**	

Dynamic Logic Circuits; Basic principle, non ideal effects, domino CMOS Logic, high performance dynamic CMOS Circuits, Clocking Issues, Two phase clocking.

CMOS Subsystem Design: Semiconductor memories, memory chip organization, RAM Cells, dynamic memory cell.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
The link to the E-Learning portal.
https://elearning.sgtuniversity.ac.in/course-category/

13. Books Recommended

Text Books

- S. M. Kang and Y. Leblebici, CMOS Digital Integrated Circuits : Analysis and Design, Third Edition, MH, 2012.

14. Reference Books

1. W. Wolf, Modern VLSI Design : System on Chip, Third Edition, PH/Pearson, 2012.

2. N. Weste, K. Eshraghian and M. J. S. Smith, Principles of CMOS VLSI Design : A Systems Perspective, Second Edition (Expanded), AW/Pearson, 2019.

3. J. M. Rabaey, A. P. Chandrakasan and B. Nikolic, Digital Integrated Circuits : A Design Perspective, Second Edition, PH/Pearson, 2019.

4. D. A. Pucknell and K. Eshraghian, Basic VLSI Design : Systems and Circuits, Third Edition, PHI.

5. J. P. Uyemura, CMOS Logic Circuit Design, Kluwer.

6. J. P. Uyemura, Introduction to VLSI Circuits and System, Wiley, 2019.

7. R. J. Baker, H. W. Li and D. E. Boyce, CMOS Circuit Design, Layout and Simulation, PH.

Signal & System

1. Name of the Department- Computer Science & Engineering						
2. Subject Name	**Signal & Systems**	**L** – 3	**T – 0**		**P -0**	
3.Course Code						
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE()**	
5. Pre-requisite (if any)	**Engineering Mathematics-II**	**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical						
Lectures = 42		**Tutorials =0**	**Practical =0**			

8. Course Description

This subject is about the mathematical representation of signals and systems. The most important representations we introduce involve the frequency domain – a different way of looking at signals and systems, and a complement to the time-domain viewpoint. Indeed engineers and scientists often think of signals in terms of frequency content, and systems in terms of their effect on the frequency content of the input signal.

9. Course objectives: The students will learn and understand

1. Determination of system response for a signal.
2. Fourier and Z transform techniques as tool for signal analysis

10. Course Outcomes (COs): On completion of this course, the students will be able to

1. Demonstrate an understanding of the relation among the transfer function, convolution, and the impulse response, by explaining the relationship, and using the relationship to solve forced response problems.
2. Demonstrate an understanding of the relationship between the stability and causality of systems and the region of convergence of their Laplace transforms, by correctly explaining the relationship, and using the relationship to determine the stability and causality of systems.

11. Unit wise detailed content

Unit-1	**Number of lectures = 12**	**Introduction to Signals & Systems**
Definition, types of signals and their representations: continuous-time/discrete-time, periodic/non-periodic, even/odd, energy/power, deterministic/ random, one dimensional/ multidimensional; commonly used signals (in continuous-time as well as in discrete-time): unit impulse, unit step, unit ramp (and their inter-relationships), exponential, rectangular pulse, sinusoidal; operations on continuous-time and discrete-time signals (including transformations of independent variables)		
Unit – 2	**Number of lectures = 10**	**Laplace-Transform (LT) and Z-transform**
One-sided LT of some common signals, important theorems and properties of LT, inverse LT, solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC), One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, solution of difference equations using one-sided ZT, s- to z-plane mapping		
Unit – 3	**Number of lectures = 10**	**Fourier Transforms (FT)**
Definition, conditions of existence of FT, properties, magnitude and phase spectra, Some important FT theorems, Parseval's theorem, Inverse FT, relation between LT and FT, Discrete time Fourier transform (DTFT), inverse DTFT, convergence, properties and theorems, Comparison between continuous time FT and DTFT.		
Unit – 4	**Number of lectures = 10**	**Linear Time Invariant**
Continuous Time Systems: Linear Time invariant Systems and their properties. Differential equation & Block diagram representation, Impulse response, Convolution integral, Frequency response (Transfer Function), Fourier transforms analysis. Discrete Time System: Difference equations, Block diagram		

representation, Impulse response, Convolution sum, MATLAB tutorials.
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University. The link to the E-Learning portal. https://elearning.sgtuniversity.ac.in/course-category/
13. Books Recommended
Text Books: 1. P. Ramakrishna Rao, `Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delh

DEPARTMENT ELECTIVES				
Specialization	**IoT**	**Data Science**	**Cyber Security & Forensics**	**AIML**
DE-XIII	Microcontrollers for IoT Prototyping	Information Visualization	Cyber Attacks Detection and Prevention Systems	Soft Computing Techniques
DE-XIV	Wireless Sensor Networks and IoT	Web Intelligence and Big Data	Cryptosystem	Knowledge Engineering and Intelligent Systems
DE-XV	Signal Processing and Data Analytics	Bigdata Frameworks	Digital Forensics	Deep Learning and its Applications
DE-XVI	Micro Systems & Hybrid Technology	IoT and Cloud Computing	Mobile and Wireless Security	Bio-Inspired Computing
DE-XVII	Cloud and Fog Computing	NoSQL Databases	Malware Analysis	Machine Learning for Signal Processing

IoT

Microcontrollers for IoT Prototyping

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Microcontrollers for IoT Prototyping</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course is aimed to Introduce low power microcontrollers and to develop the skill set of programming low power sensing applications.</td></tr>
<tr><td colspan="7">9. Learning Objectives:
1. Impart the knowledge of various peripheral related to sensing and communication using wired or wireless means.
2. Upgrade the students by introducing them Advanced ARM Cortex microcontrollers
3. Develop the skill set of students to build IoT systems and sensor interfacing.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Design and develop embedded programs for low power microcontrollers for sensor applications.
2. Develop ARM basic and advanced programs.
3. Interface and deploy analog and digital sensors
4. Develop communication system with sensor units
5. Design Develop IoT systems using Wi-Fi CC3200.
6. Program the single board computers to read sensor data and posting in cloud.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">MSP430 microcontrollers</td></tr>
<tr><td colspan="7">Architecture of the MSP430, Memory, Addressing modes, Reflections on the CPU instruction set. Clock system, Exceptions: Interrupts and resets. Functions and subroutines, Mixing C and assembly language, Interrupts, Interrupt service routines, Issues associated with interrupts, Low power modes of operation.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">ARM Cortex MX microcontroller</td></tr>
<tr><td colspan="7">ARM Cortex M4: Assembly language basics, Thumb-2 Technology, ARM Instruction set, Cortex M4 architecture, advantages, peripherals, instruction set, floating point operations, Advanced Cortex MX Microcontroller, core, architecture, on-chip wi-fi.</td></tr>
</table>

Unit – 3	Number of lectures = 9	Display and Communication modules
GPIO, LCD display, graphical display, relays, Peripheral programming SPI, I2C, UART, Zigbee controller. **Sensors interfacing:** Sensors interfacing techniques- Port Programming, ADC, SPI thermometer, I2C thermometer, PWM generation and demodulation, DTH11, single wire thermometer, Frequency counters.		
Unit – 4	**Number of lectures = 9**	**Microcontrollers for IoT**
ESP8266,NodeMCU,TI-CC3200,Access point and station point mode, HTTP, MQTT, transmission and receiving, Intel-Gallileo boards. **Single board computers**: Raspberry pi board, porting Raspbian, sensor interface examples, Python programming for cloud access, sensor systems using Arduino boards. **Cloud interfacing**: Interfacing and data logging with cloud: Thing speak, Things board, Blync platform.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Text Book(s)

1. John H. Davies, “MSP430 Microcontroller Basics”, 2011, 2nd ed., Newnes publishing, New York.

2. Jacob Fraden, “Hand Book of Modern Sensors: physics, Designs and Applications”, 2014, 4th ed., Springer, New York.

Reference Book(s)

1. Sergey Y. Yurish,”Digital Sensors and Sensor Systems: Practical Design”, 2011, 1st ed., IFSA publishing, New York.

2. Jonathan W Valvano, “Introduction to ARM Cortex –M3 Microcontrollers”, 2012, 5th ed., Create Space publishing, New York.

3. Muhammad Ali Mazidi, Shujen Chen, SarmadNaimi, SepehrNaimi, “TI ARM Peripherals Programming and Interfacing: Using C Language”, 2015, 2nd ed., Mazidi and Naimi publishing, New York.

Microcontrollers for IoT Prototyping Lab

1. Name of the Department- Computer Science & Engineering						
2. Course Name	**Microcontrollers for IoT Prototyping Lab**	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 24**			

8. Course Description: This course is aimed to Introduce low power microcontrollers and to develop the skill set of programming low power sensing applications.

9 Learning objectives:

1. Impart the knowledge of various peripheral related to sensing and communication using wired or wireless means.
2. Upgrade the students by introducing them Advanced ARM Cortex microcontrollers.
3. Develop the skill set of students to build IoT systems and sensor interfacing.

10. Course Outcomes (COs):

The students will be able to:-

1. Design and develop embedded programs for low power microcontrollers for sensor applications.
2. Develop ARM basic and advanced programs.
3. Interface and deploy analog and digital sensors
4. Develop communication system with sensor units
5. Design Develop IoT systems using Wi-Fi CC3200.
6. Program the single board computers to read sensor data and posting in cloud.

11. List of Experiments

- Working with MSP430 (CCStudio)

Sub Task 1: Port programming of MSP430 microcontrollers.
Sub Task 2: Analog to Digital Conversion using MSP430 microcontroller.
Sub Task 3: LCD display of characters and numbers.
Sub Task 4: Timer

- Working with ARM (Keil and energia)

Sub Task 1: Peripheral programming of ARM7 board.
Sub Task 2: PWM generation.
Sub Task 3:Configuring CC3200, wifi configuration ,HTTP and MQTT.

- Low power wireless transmission using Zigbee

Sub Task 1 : Interfacing Zigbee controller with MSP 430 microcontroller using SPI/UART.
Sub Task 2: Programming sleep and wake up mode of MSP 430

- IoT systems

Working with Raspberry pi using Python.
Arduino platform
Working with open source clouds.

Wireless Sensor Networks and IoT

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Wireless Sensor Networks and IoT</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course is aimed to to identify and expose the students to the central elements in the design of communication protocols for the WSNs.</td></tr>
<tr><td colspan="7">9. Learning Objectives:

1. To disseminate the design knowledge in analyzing the specific requirements for applications in WSNs regarding energy supply, memory, processing, and transmission capacity
2. To get the perception of mobile ad hoc networks, design, implementation issues, and solutions based on different algorithms and protocols for power management, sensor data routing and query processing.
3. To associate, hardware platforms and software frameworks used to realize dynamic Wireless sensor network</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Assess the applicability and limitations of communication protocols for a real time WSN application.
2. Confirms the behavior of mobile ad hoc networks (MANETs)and correlates the infrastructure based networks.
3. Proactive in understating the routing protocols function and their implications on data transmission delay and bandwidth.
4. Able to establish networks with an attempt to reduce issue of broadcast and flooding techniques.
5. Contribute appropriate algorithms to improve existing or to develop new wireless sensor network applications.
6. Familiarize the protocol, design requirements, suitable algorithms, and the state-of-the-art cloud platform to meet the industrial requirement.
7. On a profound level to implement hardware & software for wireless sensor networks in day to day life</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">Network for embedded systems</td></tr>
<tr><td colspan="7">RS232, RS485, SPI, I2C, CAN, LIN, FLEXRAY.
Embedded wireless communication and Protocols: Bluetooth, Zigbee, Wifi, MiWi, Nrf24, Wireless LAN &PAN, UWB</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">Wireless sensor network (WSN) & WSN (Medium access control)</td></tr>
</table>

Characteristic and challenges, WSN vs Adhoc Networks, Sensor node architecture, Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations. Fundamentals of MAC protocols - Low duty cycle protocols and wakeup concepts, Contention Based protocols, Schedule-based protocols - SMAC – BMAC, Traffic-adaptive medium access protocol (TRAMA), The IEEE 802.15.4 MAC protocol.		
Unit – 3	**Number of lectures = 9**	Sensor Network Architecture
Data Dissemination, Flooding and Gossiping-Data gathering Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design Principles for WSNs- Gateway Concepts, Need for gateway, WSN and Internet Communication, WSN Tunneling		
Unit – 4	**Number of lectures = 9**	IP based WSN & Tiny OS
Circuit switching, packet switching, concept of IPV4, IPV6, 6LOWPAN and IP, IP based WSN, 6LOWPAN based WSN. Tiny OS:Tiny OS for WSN and IoT, M2M communication, Alljoyn network		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.		
13. Books Recommended		

Text Book(s):

1. Holger Karl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks" 2011, 1 st ed., John Wiley & Sons, New Jersey.
2 Jun Zheng, Abbas Jamalipour, "Wireless Sensor Networks: A Networking Perspective", 2014, 1 st ed., Wiley-IEEE Press, USA.

Reference Book(s)

1. Waltenegus W. Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", 2014, 1 st ed., John Wiley & Sons, New Jersey.
2 Ian F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks", 2011, 1 st ed., John Wiley & Sons, New Jersey.
3 Zach Shelby, Carsten Bormann, "6LoWPAN: The Wireless Embedded Internet", 2009, 1 st ed., John Wiley & Sons, New Jersey.

Signal Processing and Data Analytics

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Signal Processing and Data Analytics	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course is aimed to identify and expose the students to the central elements in the design of communication protocols for the WSNs.

9. Learning Objectives:

1. To introduce the concepts of discrete time signal processing and the characterization of random signals.
2. To present the basic theory of modeling the signals and the methods of estimating the unknowns using prediction filters
3. To provide a comprehensive understanding on applying FFT, DCT, and wavelet techniques for extracting the signal features.
4. To provide an overview of analysing big data using intelligent techniques and an in-depth introduction to two main areas of Machine Learning: supervised and unsupervised.

11. Course Outcomes (COs):

The students will be able to:-

1. Apply FFT, DCT wavelet techniques for extracting the features from the big data
2. Develop algorithms that can be used to analyse the real-world univariate and multivariate time series data. 3. Design an approach to leverage data using the steps in the machine learning process.
4. Understand and apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data.
5. Estimate the signal parameters and identify the model using ARMA models and prediction filters.
6. Understand the methods of visualization and analysis of big data.

12. Unit wise detailed content

Unit-1	**Number of lectures = 9**	Discrete Random Signal Processing

Random Processes, Ensemble Average, Gaussian Process, Multi variate Gausssian Process, Stationary process, Autocorrelation, Auto Covariance, Ergodicity, White noise, Power Spectrum, Filtering of Random Process

Unit – 2	**Number of lectures = 9**	Signal Modeling & Feature extraction

ARMA, AR, MA Models. Wiener filter, Linear prediction, Kalman Filter.
Feature extraction: FFT, Power spectrum, DCT, filter banks, Wavelet, Wavelet Packets, Cepstrum

Unit – 3	**Number of lectures = 9**	Time series analysis

Basic analysis, Univariate time series analysis, Multivariate time series analysis, non stationary time series.		
Unit – 4	**Number of lectures = 9**	Machine learning & Big Data Analytics
Machine learning: Supervised learning, generative algorithms, Support Vector machines, Unsupervised learning, K means clustering, Neural network (SOM, ART), Expectation maximization. Big Data Analytics: Introduction Big data analytics, visualization and data exploration, basic and intermediate analysis, linear and logistic regression, decision tree.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Text Book(s)

1. J. G. Proakis, DG. Manolakis and D. Sharma, “Digital signal processing principles, algorithms and applications”, 2012, 4th ed., Person education, USA

2. Sophocles J. Orfanidis, “Inroduction to signal Processing” 2010, 2nd ed., Prentice Hall, New Delhi India.

Reference Books

1. Oppenhiem V. A.V and Schaffer R. W, “Discrete- time signal Processing”, 2014, 3 rd ed., Prentice Hall,. New Delhi, India

2. Thomas A. Runkler, "Data Analytics: Models and Algorithms for Intelligent Data Analysis", 2016, 2 nd ed., Springer Verlag, UK

3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective" 2012, 1 st ed., MIT Press, USA

Signal Processing and Data Analytics Lab

<table>
<tr><td colspan="9">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Signal Processing and Data Analytics Lab</td><td colspan="2">L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td colspan="2">0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td colspan="2">Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td colspan="2"></td><td colspan="2">6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 0</td><td colspan="3">Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="9">8. Course Description: This course is aimed to identify and expose the students to the central elements in the design of communication protocols for the WSNs.</td></tr>
<tr><td colspan="9">9. Learning objectives:
1. To introduce the concepts of discrete time signal processing and the characterization of random signals.
2. To present the basic theory of modeling the signals and the methods of estimating the unknowns using prediction filters
3. To provide a comprehensive understanding on applying FFT, DCT, and wavelet techniques for extracting the signal features.
4. To provide an overview of analysing big data using intelligent techniques and an in-depth introduction to two main areas of Machine Learning: supervised and unsupervised.</td></tr>
<tr><td colspan="9">9. Course Outcomes (COs):
The students will be able to:-
1. Apply FFT, DCT wavelet techniques for extracting the features from the big data
2. Develop algorithms that can be used to analyse the real-world univariate and multivariate time series data.
3. Design an approach to leverage data using the steps in the machine learning process.
4. Understand and apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data.
5. Estimate the signal parameters and identify the model using ARMA models and prediction filters.
6. Understand the methods of visualization and analysis of big data.</td></tr>
<tr><td colspan="9">10. List of Experiments</td></tr>
<tr><td colspan="9">1. Design and implementation of Wiener filter and Kalman filter.
2. Design and implementation of filter banks and wavelets for random process (speech, audio).
3. Design and implementation of Principal Component Analysis (PCA) and Single Value Decomposition (SVD). 4. Design an expert system for simple application (speech recognition, speaker recognition, face recognition). 5. Consider a real time data available in college campus and develop a data analytic system to determine the average, trend and prediction</td></tr>
</table>

Micro Systems & Hybrid Technology

1. Name of the Department- Computer Science & Engineering					
2. Course Name	Micro Systems & Hybrid Technology	**L**	**T**	**P**	
3. Course Code		**3**	**0**	**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**	**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)					
Lectures = 36		**Tutorials = 0**	**Practical = 0**		

8. Course Description:

This course is aimed to introduce the fundamental concepts of MEMS based sensors and actuators.

9.Learning Objectives:

1. To acquaint the students with various materials and material properties for Microsystem designing.
2. To provide comprehensive understanding of various micromachining techniques and expose the students to design, simulation and analysis software.
3. Enhancing the basics of thick film and hybrid technologies for sensor development.

10. Course Outcomes (COs):

The students will be able to:-

1. Identify and understand the fundamental concepts and background of MEMS and Microsystems
2. Familiar with the basics of various sensors and actuators.
3. The students were acquainted with various materials for Microsystem designing.
4. Determine and compare the scaling effects in miniaturizing devices.
5. Recognize and interpret various micromachining techniques and design, analysis and applications of various MEMS devices micromachining tools and techniques
6. Acquainted with thick film and hybrid technologies for sensor development.
7. Incorporate simulation and micro-fabrication knowledge for developing various MEMS devices.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	Introduction to MEMS and Microsystems

MEMS and Microsystems, Miniaturization, Benefits of Microsystems, Typical MEMS and Microsystems products, Evolution of Micro fabrication and Applications.

Unit – 2	**Number of lectures = 9**	Introduction to Sensors and Actuators

Various domains and classification of transducers: electrostatic, piezoelectric, thermal. Sensing principles: electrostatic, resistive, chemical etc. SAW devices. Micro actuators, Design of Micro accelerometers, Engineering Science for Microsystem design and fabrication.

Unit – 3	**Number of lectures = 9**	Micromachining Technologies

Overview of silicon processes techniques, Photolithography, Ion Implantation, Diffusion, Chemical Vapor Deposition, Physical vapor Deposition, Epitaxy, Etching, Bulk micromachining, Surface Micromachining, LIGA and other techniques. MEMS and micro systems applications: Details of application in actual systems, introduction to RF- MEMS, MOEMS, future of smart structures and MEMS leading to NEMS. Packaging, test and calibration of MEMS		
Unit – 4	**Number of lectures = 9**	Hybrid Technology
Thick-film and hybrid technology in sensor production. Basic materials, components, manufacturing Screen manufacturing, Screen printing, Parameters, Comparison: thick- vs. thin film technology Structure dimensions, Assembly and packaging Surface mount technology (SMT) Active and passive devices (SMD), Connection technologies, Packaging.		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.		
13. Books Recommended		

Text Book(s)

1. G.K.Ananthasuresh, K J Vinoy, S Gopalakrishnan, KN Bhatt, V K Aatre," Micro and smart systems", 2012, 1st ed., Wiley, New York.

2. Tai-Ran Hsu, "MEMS & Microsystem, Design and Manufacture", 2017, 1st ed., McGraw Hill India, New Delhi.

Reference Books

1. Mahalick NP, "MEMS", 2017, 1st ed., Tata McGraw Hill, New Delhi

2 Wolfgang Menz, Jürgen Mohr, Oliver Paul, "Microsystem Technology", 2011, 2nd ed., Wiley, New York.

3 Banks H.T. Smith R.C. and Wang Y.Smart, 'Material Structures – Modeling, Estimation and Control', 2011, 1st ed., John Wiley & Sons, NewYork.

4 Massood Tabib – Arar, 'Microactuators – Electrical, Magnetic Thermal, Optical, Mechanical, Chemical and Smart structures', 2014, 1st ed., Kluwer Academic publishers, New York .

Signal Processing and Data Analytics Lab

<table>
<tr><td colspan="9">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Signal Processing and Data Analytics Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2"></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="4">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="3">5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="4">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="9">Course Description: This course is aimed to introduce the fundamental concepts of MEMS based sensors and actuators.
8.</td></tr>
<tr><td colspan="9">Learning objectives:
1 To introduce the fundamental concepts of MEMS based sensors and actuators.
2. To acquaint the students with various materials and material properties for Microsystem designing.
3. To provide comprehensive understanding of various micromachining techniques and expose the students to design, simulation and analysis software.
4. Enhancing the basics of thick film and hybrid technologies for sensor development.</td></tr>
<tr><td colspan="9">9. Course Outcomes (COs):
The students will be able to:-
1. Identify and understand the fundamental concepts and background of MEMS and Microsystems
2. Familiar with the basics of various sensors and actuators.
3. The students were acquainted with various materials for Microsystem designing.
4. Determine and compare the scaling effects in miniaturizing devices.
5. Recognize and interpret various micromachining techniques and design, analysis and applications of various MEMS devices micromachining tools and techniques
6. Acquainted with thick film and hybrid technologies for sensor development.
7. Incorporate simulation and micro-fabrication knowledge for developing various MEMS devices.</td></tr>
<tr><td colspan="9">10. List of Experiments</td></tr>
<tr><td colspan="9">Design and Simulation of MEMS Capacitance based Accelerometer:

In this topic, Students need to design a capacitive accelerometer that has a full scale Measurement range of ± 10 g. The accelerometer may be designed using a closed loop or an open-loop. You need to have reasonable over range protection in your device.
Specification:
Measurement range: ± 10g
Output capacitance: at least tens of fF level
Device simulation results (must take into account parasitic capacitance of your design):
(a) Static analyses: Gap vs. acceleration Capacitance (or differential capacitance) vs. acceleration (identify sensitivity [F/g])
(b) Dynamic analyses: Your device’s response on vibration.</td></tr>
</table>

2. Piezoresistive barometric pressure sensor: In this topic, Students need to design a piezoresistive pressure sensor that has the measurement range of 0 - 1.1 bar. You need to have a reasonable over range protection in your device.

Specification:

Measurement range: 0 -1.1 bar.

Device simulation results:

(i) Strain in the piezoresistor vs. pressure

(ii) Resistance vs. pressure

(iii) Voltage output vs. pressure for Wheatstone bridge circuit output.

Circuit integration issues:

Temperature compensation circuit design

Cloud and Fog Computing

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Cloud and Fog Computing</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
</table>

8. Course Description:

This course is aimed to Introduce cloud computing and enabling technologies

9.Learning Objectives:

1. Explore the need for fog and edge computation
2. Impart the knowledge to log the sensor data and to perform further data analytics

10. Course Outcomes (COs):

At the end of the course student will be able to

1. Deploy their data in the cloud for simple applications
2. Apply the analytics in cloud to extract information
3. Appreciate and deploy fog data processing layers
4. Integrate sensor data to cloud through fog computation layers
5. Understand and implement edge computation
6. Develop edge analytics using python and tensor flow
7. Perform data pushing and processing in commercial clouds

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	Cloud Computing basics and enabling technologies

Cloud Computing basics and enabling technologies: Basics of cloud computing-Need for clouds- concepts and models: Roles and boundaries – Cloud characteristics – Cloud delivery models – Cloud deployment models. Broadband Networks and Internet Architecture – Data Center Technology – Virtualization Technology.
Cloud Virtualisation: Server oriented – Virtual Machines (IaaS), Modern Serverless Configurations- Functions/ (PaaS) Lambda functions – App, Biz function, logics, data ingestion (elasticity, scalability – on demand) DB services, Analytics services (SaaS).

Unit – 2	**Number of lectures = 9**	Cloud Application Development in Python

Python for Cloud: Amazon Web Services – Google Cloud – Windows Azure. Python for MapReduce.
Federated Cloud Service Management and IoT: Cloud Service management (federated) –Cloud Life Cycle-service and management-Cloud architectures -Self organizing cloud architectures

Unit – 3	**Number of lectures = 9**	Fog and edge computing

Need for Fog computation, Fog data processing layers – Security and Identity Management – Business process integration – Big data interfaces – Wireless sensors and actuators, Fog in 5G, Architecture Harmonization Between Cloud Radio Access Networks and Fog Networks, Fog applications.
Need for edge computation-Edge computing architectures,Device registration, Remote diagnostics,SW update, Geo

distributed computing-concept of cloud orchestration, Edge Networks (Low bandwidth networks/ Security/ protcols),WAN vs Low bandwidth networks

Unit – 4	Number of lectures = 9	Overview of Edge Data Analytics tools

Thick-film and hybrid technology in sensor production. Basic materials, components, manufacturing Screen manufacturing, Screen printing, Parameters, Comparison: thick- vs. thin film technology Structure dimensions, Assembly and packaging Surface mount technology (SMT) Active and passive devices (SMD), Connection technologies, Packaging.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Text Books:

1. Thomas Erl, Zaigham Mahmood, and Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", Arcitura Education, 2013

Reference Books

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2012.

2. S.-C. Hung et al.: Architecture Harmonization Between Cloud RANs and Fog Networks, IEEE Access: The Journal for rapid open access publishing, Vol.3, pp: 3019 – 3034, 2015.

Cloud and Fog Computing Lab

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td colspan="2">Cloud and Fog ComputingLab</td><td>L</td><td>T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">3. Course Code</td><td colspan="2"></td><td>0</td><td>0</td><td colspan="2">2</td></tr>
<tr><td colspan="4">4. Type of Course (use tick mark)</td><td>Core ()</td><td>PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td colspan="3"></td><td>6. Frequency (use tick marks)</td><td>Even (√) | Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td colspan="2">Tutorials = 0</td><td colspan="3">Practical = 24</td></tr>
<tr><td colspan="8">8. Course Description: This course is aimed to Introduce cloud computing and enabling technologies</td></tr>
<tr><td colspan="8">9.Learning objectives:
1. Introduce cloud computing and enabling technologies
2. Explore the need for fog and edge computation
3. Impart the knowledge to log the sensor data and to perform further data analytics</td></tr>
<tr><td colspan="8">10.Course Outcomes (COs):
At the end of the course student will be able to
1. Deploy their data in the cloud for simple applications
2. Apply the analytics in cloud to extract information
3. Appreciate and deploy fog data processing layers
4. Integrate sensor data to cloud through fog computation layers
5. Understand and implement edge computation
6. Develop edge analytics using python and tensor flow
7. Perform data pushing and processing in commercial clouds</td></tr>
<tr><td colspan="8">11. List of Experiments</td></tr>
<tr><td colspan="8">Cloud Platforms: Microsoft Azure/IBM Bluemix
Language: Python
1. Pushing documents
2. Pushing Images and Processing
3. Mini Weather Station
4. Image analytics at cloud
5. Python Scikit learn
6. Tensor flow</td></tr>
</table>

Data Science

Information Visualization

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Information Visualization</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course is aimed to understand the various types of data, apply and evaluate the principles of data visualization.</td></tr>
<tr><td colspan="7">9. Learning Objectives:

1. Acquire skills to apply visualization techniques to a problem and its associated dataset.
2.To apply structured approach to create effective visualizations.
3.To learn how to bring valuable insight from the massive dataset using visualization.
4.To learn how to build visualization dashboard to support decision making.
5.To create interactive visualization for better insight using various visualization tools.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">At the end of the course student will be able to
1. Identify the data types and its associated visualization mechanisms.
2. Apply the various scalar and vector visualization techniques to create suitable visualization for real life applications.
3. Handle and analyse multidimensional data and hierarchical data for visualization.
4.Perform multivariate data analysis and visualization.
5. Apply the visualization guidelines for effective information visualization.
6. Demonstrate the concept of visualization through dashboard creation for various applications.
7.Choose appropriate methods for the given real world problems and produce meaningful visualization.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">Introduction to Data Visualization</td></tr>
<tr><td colspan="7">Overview of data visualization - Data Abstraction - Task Abstraction - Analysis: Four Levels for Validation, Human Visual Perception</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">Visualization Techniques</td></tr>
<tr><td colspan="7">Scalar and point techniques – vector visualization techniques – matrix visualization
Visualization Techniques for Trees, Graphs, and Networks, Multidimensional data</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5">Visual Analysis of data from various domains</td></tr>
<tr><td colspan="7">Time-oriented data visualization – Spatial data visualization and case studies
Text data visualization – Multivariate data visualization, and case studies</td></tr>
</table>

Unit – 4	**Number of lectures = 9**	Designing Effective Visualizations

Designing Effective Visualizations: Guidelines for designing successful visualizations, Data visualization dos and don'ts
Dashboard Creation and Visual Story Telling: Dashboard Design principles, Effective Dashboard Display Media, Dashboard creation using visualization tools for the use cases: Finance- marketing-insurance-healthcare etc.,

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Reference Books

1.Tamara Munzer, "Visualization Analysis and Design", CRC Press, 2014.

2.Stephen Few, "Now You See It", Analytics Press, 2009.

3. Stephen Few, "Information Dashboard Design: the effective visual communication of data", Oreilly, 2006.

4. Matthew O. Ward, Georges Grinstein, Daniel Keim "Interactive Data Visualization: Foundations, Techniques, and Applications", CRC Press, Second Edition, 2015.

5. Dr.Chun-hauh Chen, W.K.Hardle, A. Unwin, "Handbook of Data Visualization", Springer publication, 2008.

6. Ben Fry, "Visualizing Data", O'Reilly Media, 2008 7. Winston Chang, "R Graphics Cookbook", O'Reilly, 2012

Information Visualization Lab

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Information visualization Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
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<tr><td colspan="8">8. Course Description: This course is aimed to understand the various types of data, apply and evaluate the principles of data visualization.</td></tr>
<tr><td colspan="8">9. Learning objectives:
1. To Acquire skills to apply visualization techniques to a problem and its associated dataset.
2.To apply structured approach to create effective visualizations.
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At the end of the course student will be able to
1. Identify the data types and its associated visualization mechanisms.
2. Apply the various scalar and vector visualization techniques to create suitable visualization for real life applications.
3. Handle and analyse multidimensional data and hierarchical data for visualization.
4.Perform multivariate data analysis and visualization.
5. Apply the visualization guidelines for effective information visualization.
6. Demonstrate the concept of visualization through dashboard creation for various applications.
7.Choose appropriate methods for the given real world problems and produce meaningful visualization.</td></tr>
<tr><td colspan="8">11. List of Experiments</td></tr>
<tr><td colspan="8">1. Association Rule Mining and Clustering.
2. Visualization on KNN or Naïve Bayes Classification.
3. Financial analysis using Clustering, Histogram and HeatMap
4. Time-series analysis –Stockmarket
5. Visualization of various massive dataset-Finance-Healthcare- Census –Geospatial
6. Market-Basket Data analysis-visualization
7. Text visualization using web analytics
8. Hadoop and R integration in Table au using Hortonworks
9. Google API with maps
10. VisualizationusingD3.js
11. Visualization using Zeppelin</td></tr>
</table>

Web Intelligence and Big Data

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Web Intelligence and Big Data	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course is aimed to web-intelligence applications exploiting big data sources

9. Learning Objectives:

The objective of this paper is to build web-intelligence applications exploiting big data sources arising social media using new big-data platforms based on the 'map-reduce' parallel programming paradigm.

10. Course Outcomes (COs):

At the end of the course student will be able to

1. Describe the IoT and Cloud architectures
2. Determine the right sensors and communication protocols to use in a particular IoT system.
3. Deploy Cloud Services using different cloud technologies.
4. Implement cloud computing elements such virtual machines, web apps, mobile services, etc.
5. Establish data migration techniques from IoT devices to the cloud.
6. Implement security features to protect data stored in the cloud.
7. Use visualisation techniques to show data generated from the IoT device.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	**Introduction**

Introduction: Web Scale AI and Big Data, Web Intelligence, Big Data Look: Indexing- Index creation, Ranking, Page Rank Searching- Enterprise search, Searching structured data, Object Search, Locality Sensitive Hashing and Memory.

Unit – 2	**Number of lectures = 9**	**Listen, Load and Programming**

Listen: Streams, Information and Language, Analyzing Sentiment and Intent
Load: Databases and their Evolution, Big data Technology and Trends.
Programming: Map-Reduce, Map-Reduce applications and its efficiency, Big-Table and HBase

Unit – 3	**Number of lectures = 9**	**Learn and Connect**

Learn: Classification, Clustering, and Mining, Information Extraction
Connect: Reasoning: Logic and its Limits, Dealing with Uncertainty.

Unit – 4	**Number of lectures = 9**	**Predict Data Analysis**

Predict: Forecasting, Neural Models, Deep Learning, and Research Topics.
Data Analysis: Regression and Feature Selection

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Text Book:

1. The Intelligent Web: Search, Smart Algorithms and Big Data published by Oxford University Press, UK, in November 2013, authored by Dr. Gautam Shroff.

References Books:

1. Mining Massive Datasets by J.D. Ullman and A. Rajaraman (Cambridge University Press, UK 2012)
2. Introduction to Information Retrieval by Christopher Manning, Prabhakar Raghavan and Hinrich Schutze (Cambridge University Press, UK 2008).

Bigdata Frameworks

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Bigdata Frameworks	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			
8. Course Description						
This course is aimed to understand the need of Big Data, challenges and different analytical architectures						
1. Learning Objectives: 2.Installation and understanding of Hadoop Architecture and its ecosystems 3.Processing of Big Data with Advanced architectures like Spark. 4.Describe graphs and streaming data in Spark						
10. Course Outcomes (COs):						
At the end of the course student will be able to 1.Discuss the challenges and their solutions in Big Data 2.Understand and work on Hadoop Framework and eco systems. 3. Explain and Analyse the Big Data using Map-reduce programming in Both Hadoop and Spark framework. 4. Demonstrate spark programming with different programming languages. 5.Demonstrate the graph algorithms and live streaming data in Spark 6. Lab: analyse and implement different frame work tools by taking sample data sets. 7.Project: illustrate and implement the concepts by taking an application problem.						
11. Unit wise detailed content						
Unit-1	**Number of lectures = 9**	Introduction To Big Data				
Data Storage and Analysis - Characteristics of Big Data – Big Data Analytics - Typical Analytical Architecture – Requirement for new analytical architecture – Challenges in Big Data Analytics – Need of big data frameworks						
Unit – 2	**Number of lectures = 9**	Hadoop Framework & Ecosystem				
Hadoop – Requirement of Hadoop Framework - Design principle of Hadoop –Comparison with other system - Hadoop Components – Hadoop 1 vs Hadoop 2 – Hadoop Daemon's – HDFS Commands – Map Reduce Programming: I/O formats, Map side join, Reduce Side Join, Secondary sorting, Pipelining MapReduce jobs Hadoop Ecosystem: Introduction to Hadoop ecosystem technologies: Serialization: AVRO, Co-ordination: Zookeeper, Databases: HBase, Hive, Scripting language: Pig, Streaming: Flink, Storm						
Unit – 3	**Number of lectures = 9**	Spark Framework				
Introduction to GPU Computing, CUDA Programming Model, CUDA API, Simple Matrix, Multiplication in CUDA, CUDA Memory Model, Shared Memory Matrix Multiplication, Additional CUDA API Features. Data Analysis with Spark Shell: Writing Spark Application - Spark Programming in Scala, Python, R, Java - Application Execution.						

Unit – 4	Number of lectures = 9	Spark SQL and GraphX
SQL Context – Importing and Saving data – Data frames – using SQL – GraphX overview – Creating Graph – Graph Algorithms. Spark Streaming: Overview – Errors and Recovery – Streaming Source – Streaming live data with spark		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.		
13. Books Recommended		

Reference Books

1. Mike Frampton, "Mastering Apache Spark", Packt Publishing, 2015.

2. TomWhite,"Hadoop:TheDefinitiveGuide",O'Reilly,4thEdition,2015.

3. NickPentreath,MachineLearningwithSpark,PacktPublishing,2015.

4. Mohammed Guller, Big Data Analytics with Spark, Apress,2015 5. Donald Miner, Adam Shook, "Map Reduce Design Pattern", O'Reilly, 2012

Bigdata Frameworks Lab

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Bigdata Frameworks Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
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<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
</table>

8. Course Description: This course is aimed to understand the need of Big Data, challenges and different analytical architectures

Learning objectives:

1.Installation and understanding of Hadoop Architecture and its ecosystems

2.Processing of Big Data with Advanced architectures like Spark.

3.Describe graphs and streaming data in Spark

9. Course Outcomes (COs):

At the end of the course student will be able to

1.Discuss the challenges and their solutions in Big Data

2.Understand and work on Hadoop Framework and eco systems.

3. Explain and Analyse the Big Data using Map-reduce programming in Both Hadoop and Spark framework.

4. Demonstrate spark programming with different programming languages.

5.Demonstrate the graph algorithms and live streaming data in Spark

6. Lab: analyse and implement different frame work tools by taking sample data sets.

7.Project: illustrate and implement the concepts by taking an application problem.

10. List of Experiments

1. HDFS Commends Map Reduce Program to show the need of Combiner
2. Map Reduce I/O Formats-Text, key-value Map ReduceI/O Formats – Nline, Multiline
3. Sequence file Input/Output Formats Secondary sorting
4. Distributed Cache & Map Side Join, Reduce side Join Building and Running a Spark Application Word count in Hadoop and Spark Manipulating RDD
5. Inverted Indexing in Spark Sequence alignment problem in Spark Implementation of Matrix algorithms in Spark Spark Sql programming, Building Spark Streaming application

IoT and Cloud Computing

1. Name of the Department- Computer Science & Engineering						
2. Course Name	IoT and Cloud Computing	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course is aimed to provides an overview of the Internet of Things (IoT) and Cloud Computing concepts, infrastructures and capabilities.

9.Learning Objectives:

This will help students gain the necessary knowledge to construct IoT systems and use cloud services for processing and storage of the data produced by the IoT devices. Emphasis will be placed on the architecture and design of IoT systems, the different technologies (wireless/mobile/sensor) governing system implementation and the migration of the data to the Cloud for processing. This module aims to develop knowledge and critical understanding of the underlying principles of Cloud Computing and IoT systems, and the commercial and business implications of technical advances in this area. Students will gain practical experience in the development of Cloud-based IoT systems and exposure to appropriate hardware and software platforms that underpin such development.

10. Course Outcomes (COs):

At the end of the course student will be able to

1. Describe the IoT and Cloud architectures
2. Determine the right sensors and communication protocols to use in a particular IoT system.
3. Deploy Cloud Services using different cloud technologies.
4. Implement cloud computing elements such virtual machines, web apps, mobile services, etc.
5. Establish data migration techniques from IoT devices to the cloud.
6. Implement security features to protect data stored in the cloud.
7. Use visualisation techniques to show data generated from the IoT device.

11. Unit wise detailed content

Unit-1	Number of lectures = 9	Introduction to IoT & Cloud
Trends of Computing, Introduction to IoT		
Unit – 2	**Number of lectures = 9**	**Internet of Things**
IoT Architectures, IoT Devices and Sensors, IoT communication and protocols.		
Unit – 3	**Number of lectures = 9**	**Cloud Computing**

Cloud Computing Fundamentals, Cloud Computing Architectures, Cloud Types and Services, Virtualization and Resource Management .		
Unit – 4	**Number of lectures = 9**	**Application of IoT & Cloud**
IoT and cloud integration, Application development and cloud processing, Security and Privacy for IoT/Cloud Computing.		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.		
13. Books Recommended		
Reference Books 1. Botta A, De Donato W, Persico V, Pescapé A, "Integration of Cloud computing and Internet of Things: A survey", 2015.		

IoT and Cloud Computing Lab

1. Name of the Department- Computer Science & Engineering						
2. Course Name	IoT and Cloud Computing Lab	**L**	**T**		**P**	
3. Course Code		**0**	**0**		**2**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 0		**Tutorials = 0**	**Practical = 24**			

8. This course is aimed to provides an overview of the Internet of Things (IoT) and Cloud Computing concepts, infrastructures and capabilities.

9.Learning Objectives:

This will help students gain the necessary knowledge to construct IoT systems and use cloud services for processing and storage of the data produced by the IoT devices. Emphasis will be placed on the architecture and design of IoT systems, the different technologies (wireless/mobile/sensor) governing system implementation and the migration of the data to the Cloud for processing. This module aims to develop knowledge and critical understanding of the underlying principles of Cloud Computing and IoT systems, and the commercial and business implications of technical advances in this area. Students will gain practical experience in the development of Cloud-based IoT systems and exposure to appropriate hardware and software platforms that underpin such development.

10. Course Outcomes (COs):

At the end of the course student will be able to

1. Describe the IoT and Cloud architectures
2. Determine the right sensors and communication protocols to use in a particular IoT system.
3. Deploy Cloud Services using different cloud technologies.
4. Implement cloud computing elements such virtual machines, web apps, mobile services, etc.
5. Establish data migration techniques from IoT devices to the cloud.
6. Implement security features to protect data stored in the cloud.
7. Use visualisation techniques to show data generated from the IoT device.

11. List of Experiments:

1. Installation of Raspbian OS or Ubuntu ARM OS on a Rasberry Pi Platform
2. Setting the networking parameters for Raspbian OS like Ethernet, WLAN, Bluetooth, etc
3. Enabling Security or SELinux in Raspbian OS or Ubuntu OS
4. Accessing IBM Bluemix from IoT Devices
5. Data dissemination from Sensor nodes (any make)
6. Data visualization using d3.js or any other tool
7. Contiki OS Installation and Simple IoT network configuration usingContiki
8. Border Router using Contiki OS

9. Implementation of CoAP protocol using Contiki OS
10. Energy, power, duty cycle calculation of IoT devices in Contiki OS
11. Simple application deployment in Google Cloud Engine or Juju Framework
12. Simple application deployment with PubNub cloud services.

NOSQL Databases

1. Name of the Department- Computer Science & Engineering						
2. Course Name	NOSQL Databases	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course is aimed to Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.

9. Learning Objectives:

1. Understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases)
2. Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases.

10. Course Outcomes (COs):

At the end of the course student will be able to

1.Explain the detailed architecture, Database properties and storage requirements

2.Differentiate and identify right database models for real time applications

3.Outline Keyvalue architecture and characteristics

4.Design Schema and implement CRUD operations, distributed data operations

5.Compare data ware housing schemas and implement various column store internals

6.Choose and implement Advanced columnar data model functions for the real time applications

7.Develop Application with Graph Data model

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	INTRODUCTION TO NOSQL CONCEPTS

Data base revolutions: First generation, second generation, third generation, Managing Trans actions and Data Integrity, ACID and BASE for reliable database transactions, Speeding performance by strategic use of RAM, SSD, and disk, Achieving horizontal scalability with database sharding, Brewers CAP theorem.

Unit – 2	**Number of lectures = 9**	NOSQL DATA ARCHITECTURE PATTERNS

NoSQL Data model: Aggregate Models- Document Data Model- Key-Value Data Model Columnar Data Model, Graph Based Data Model Graph Data Model, NoSQL system ways to handle big data problems, Moving Queries to data, not data to the query, hash rings to distribute the data on clusters, replication to scale reads, Database distributed queries to data nodes.

Unit – 3	**Number of lectures = 9**	KEY VALUE DATA STORES

From array to key value databases, Essential features of key value Databases, Properties of keys, Characteristics of Values, Key-Value Database Data Modeling Terms, Key-Value Architecture and implementation Terms, Designing Structured Values, Limitations of Key Value Databases, Design Patterns for Key-Value Databases, Case Study: Key-Value Databases for Mobile Application Configuration

Unit – 4	Number of lectures = 9	DOCUMENT ORIENTED DATABASE
Document, Collection, Naming, CRUD operation, querying, indexing, Replication, Sharding, Consistency Implementation: Distributed consistency, Eventual Consistency, Capped Collection, Case studies: document oriented database: MongoDB and/or Cassandra		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Reference Books

1. An introduction to Information Retrieval, Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze

2. TheDesignandImplementationofModernColumn-OrientedDatabaseSystems,Daniel Abadi YaleUniversity

3. Next Generation database: NoSQL and big data by GuyHarrison

NOSQL Databases Lab

2. Name of the Department- Computer Science & Engineering

3. Course Name	NOSQL Databases Lab	**L**	**T**	**P**
4. Course Code		**0**	**0**	**2**
5. Type of Course (use tick mark)		**Core ()**	**PE(√)**	**OE ()**

6. Pre-requisite (if any)		**7. Frequency (use tick marks)**	Even (√)	Odd ()	Either Sem ()	Every Sem ()

8. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)

Lectures = 0	**Tutorials = 0**	**Practical = 24**

9. Course Description: This course is aimed to Explore the origins of NoSQL databases and the characteristics that distinguish them from traditional relational database management systems.

9. Learning objectives:

1. Understand the architectures and common features of the main types of NoSQL databases (key-value stores, document databases, column-family stores, graph databases)
2. Discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases.

10. Course Outcomes (COs):

At the end of the course student will be able to

1.Explain the detailed architecture, Database properties and storage requirements

2.Differentiate and identify right database models for real time applications

3.Outline Keyvalue architecture and characteristics

4.Design Schema and implement CRUD operations, distributed data operations

5.Compare data ware housing schemas and implement various column store internals

6.Choose and implement Advanced columnar data model functions for the real time applications

7.Develop Application with Graph Data model

11. List of Experiments

ImporttheHubwaydataintoNeo4jandconfigureNeo4j.Then, answer the following questions using the Cypher Query Language:

a)List top 10 stations with most outbound trips (Show station name and number of trips)
b) Listtop10stationswithmostinboundtrips(Show station name and number of trips)
c) List top 5 routes with most trips (Show starting station name, ending station name and number of trips)
d) List the hour number(forexample13means1pm-2pm)and number of trips which end at the station ”B.U. Central”

2. Download a zip code dataset at http://media.mongodb.org/zips.json .Use mongo import to import the zip code dataset into MongoDB. After importing the data, answer the following questions by using aggregation pipelines: (1) Find all the states that have a city called ”BOSTON”.
Find all the states and cities whose names include the string ”BOST”.
Each city has several zip codes. Find the city in each state with the most number of zip codes and rank those cities along with the states using the city populations.
MongoDB can query on spatial information.

3. Create a database that stores road cars. Cars have a manufacturer ,a type. Each car has a maximum

performance and a maximum torque value. Do the following: Test Cassandras replication schema and consistency models.

4. Master Data Management using Neo4j Manage your master data more effectively The world of master data is changing. Data architects and application developers are swapping their relational databases with graph databases to store their master data. This switch enables them to use a data store optimized to discover new insights in existing data,providea360-degree view of master data and answer questions about data relationships in real time.

5. Shopping Mall case study using cassendra, where we have many customers ordering items from themal land we have suppliers who deliver them their ordered items

Cyber Security & Forensics

Cyber Attacks Detection and
Prevention Systems

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Cyber Attacks Detection and Prevention Systems</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course is aimed to understand the intrusion detection and prevention technologies, various types of network behavior analysis.</td></tr>
<tr><td colspan="7">9. Learning Objectives:

1.To understand the honeypots, multiple IDS methods, tools to analyze various types of attacks like wireless attacks and their detection.
2.To understand the the attack source and also provides practical knowledge for dealing with intrusions in real world applications</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1.To understand the intrusion detection and prevention technologies, various types of network behavior analysis.
2.To understand the honeypots, multiple IDS methods, tools to analyze various types of attacks like wireless attacks and their detection.
3.To understand the the attack source and also provides practical knowledge for dealing with intrusions in real world applications.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">Introduction to IDPS</td></tr>
<tr><td colspan="7">IDPS Technologies, Components and Architecture Implementation Uses of IDPS Technologies, Key Functions, Common Detection Methodologies Signature, Anomaly and Stateful Protocol Analysis, Types of IDPS Technologies 2 Host and Network IDPS: Application, Transport, Network and Hardware Layer attacks, Sniffing Network Traffic, Replay Attacks, Command Injection, Internet Control Message Protocol Redirect, DDoS, Dangers and defenses with Man-in the Middle, Secure Socket Layer attacks, DNS Spoofing, Defense- in-Depth Approach, Port Security, Use Encrypted Protocols</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">Network Behaviour Analysis and Honeypots</td></tr>
<tr><td colspan="7">Components and Architecture Typical, Network Architecture, Sensor Locations.
Honeypots: Honeynets- Gen I, II and III, Honeymole, Detecting the Attack - Intrusion Detection, Network Traffic Capture, Monitoring on the box, Setting up the Realistic Environment.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5">Working with SNORT IDS</td></tr>
</table>

Introduction to Snort, Snort Alert Modes and Format, Working with Snort Rules, Rule Headers, Rule Options, The Snort Configuration File etc, Plugins, Preprocessors and Output Modules, Using Snort with MySQL.		
Unit – 4	**Number of lectures = 9**	Multiple IDPS Technologies
Need for multiple IDPS Technologies, Integrating Different IDPS Technologies -Direct and Indirect, Firewalls, Routers and Honeypots, IPS using IP Trace back - Probabilistic and De- terministic Packet Marking, Marking Wireless IDPS: WLAN Standards, WLAN Components, Threats against WLANs, 802.11 Wireless Infrastruc- ture Attacks, WEP Attacks, Wireless Client Attacks, Bluetooth Attacks, Cellphones, Personal Digital Assistance and Other Hybrid Devices Attack Detection, Jailbreaking.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Text Book(s)

1.Shui Yu, Distributed Denial of Service Attack and Defense, Springer, 2014

2.Bradd Lhotsky, OOSEC Host based Intrusion detection, PACKT Publication, 2013

Reference Books

1.John Hoopes, Virtualization for Security: Including Sandboxing, Disaster Recovery, High Availability, Forensic Analysis, and Honeypotting, Syngress,2009.

2.Karen Scarfone and Peter Mell, Guide to Intrusion Detection and Prevention Systems (IDPS), NIST Special Publication 800-94, 2007

Cyber Attacks Detection and Prevention Systems Lab

1. Name of the Department- Computer Science & Engineering							
2. Course Name	Cyber Attacks Detection and Prevention Lab		**L**	**T**		**P**	
3. Course Code			**0**	**0**		**2**	
4. Type of Course (use tick mark)			**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)			**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)							
Lectures = 0		**Tutorials = 0**		**Practical = 24**			

8. Course Description: This course os aimed to understand the intrusion detection and prevention technologies, various types of network behavior analysis.

9. Learning objectives:

1.To 2.To understand the honeypots, multiple IDS methods, tools to analyze various types of attacks like wireless attacks and their detection.

3.To understand the the attack source and also provides practical knowledge for dealing with intrusions in real world applications

10. Course Outcomes (COs):

The students will be able to:-

1.To understand the intrusion detection and prevention technologies, various types of network behavior analysis.

2.To understand the honeypots, multiple IDS methods, tools to analyze various types of attacks like wireless attacks and their detection.

3.To understand the the attack source and also provides practical knowledge for dealing with intrusions in real world applications.

11. List of Experiments

Extract the features based on various color models and apply on image and video retrieval.

2. Network monitoring, packet sniffing with Wire shark and Deep Packet inspection.
3. Protocol and traffic analysis with MRTG and Performance measurement using PRTG for different sensors.
4. Real time environment setup with honeynet and capturing intrusions and Analyzing the benchmark dataset to categorize the various kind of intrusion types.
5. Analysis of SNORT IDS with ACID and Design custom rules for intrusion detection based on attack signatures with SNORT IDS.
6. Comparative study of various IP traceback schemes and Tools available for wireless attack detection and prevention

Cryptosystem

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Cryptosystem</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course is aimed to provide an in-depth understanding of cryptography theories, algorithms and systems.</td></tr>
<tr><td colspan="7">9. Learning Objectives:
1. To provide necessary approaches and techniques to develop protection mechanisms in order to secure computer networks</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Analyze and model the Symmetric cryptographic algorithms for information security.
2. Model the Public Key cryptosystems.
3. Apply the Integrity standards for information systems.
4. Identify the authentication schemes for membership authorization.
5. Understand how to apply access control techniques to authenticate the data.
6. Analyze the Cryptanalysis techniques.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">Introduction to Wireless Sensor Networks</td></tr>
<tr><td colspan="7">Introduction, Applications of Wireless Sensor Networks, WSN Standards, IEEE 802.15.4, Zigbee. Network Architectures and Protocol Stack – Network architectures for WSN, classification of WSN, protocol stack for WSN Wireless Transmission Technology and Systems: Wireless Transmission Technology and Systems – Radio Technology, Available Wireless Technologies. Wireless Sensor Technology - Sensor Node Technology, Hardware and Software, Sensor Taxonomy, WN Operating Environment</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">Medium Access Control Protocols for Wireless Sensor Networks</td></tr>
<tr><td colspan="7">Fundamentals of MAC Protocols, MAC Protocols for WSNs, Contention-Based protocols: Power Aware Multi-Access with Signaling - Data-Gathering MAC, Contention-Free Protocols: Low Energy Adaptive Clustering Hierarchy, B-MAC, S-MAC. Dissemination Protocol for Large Sensor Network.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5">Deployment and Configuration</td></tr>
<tr><td colspan="7">Target tracking, Localization and Positioning, Coverage and Connectivity, Single-hop and Multi hop Localization, Self-Configuring Localization Systems. Routing Protocols and Data Management for Wireless Sensor Networks - Routing Challenges and Design Issues in Wireless Sensor Networks, Routing Strategies in Wireless Sensor Networks, Routing protocols: data centric, hierarchical, location based energy efficient routing etc. Querying, Data Dissemination and Gathering.</td></tr>
<tr><td>Unit – 4</td><td>Number of lectures = 9</td><td colspan="5">Operating Systems For Wireless Sensor Networks</td></tr>
</table>

Operating System Design Issues, TinyOS, Contiki – Task management, Protothreads, Memory and IO management Sensor Network Platforms And Tools: Sensor Node Hardware – Tmote, Micaz, Programming Challenges, Node-level Software Platforms, Node-level Simulators, State-centric Programming.

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

1. Kazem Sohraby, Daniel Minoli, Taieb Znati, "Wireless Sensor Networks, Technology, Protocols and Applications", Wiley, 2007

2. Holger Karl, Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.

3. Jun Zheng, Abbas Jamalipour, "Wireless Sensor Networks: A Networking Perspective", Wiley, 2009.

4. Ian F. Akyildiz, Mehmet Can Vuran, "Wireless Sensor Networks", Wiley, 2010

5. Ibrahiem M. M. El Emary, S. Ramakrishnan, "Wireless Sensor Networks: From Theory to Applications", CRC Press Taylor & Francis Group, 2013

Digital Forensics

<table>
<tr><td colspan="6">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Digital Forensics</td><td>L</td><td colspan="2">T</td><td>P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td>0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td>OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem () | Every Sem ()</td></tr>
<tr><td colspan="6">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="3">Practical = 0</td></tr>
<tr><td colspan="6">8. Course Description</td></tr>
<tr><td colspan="6">This course is aimed to learn about the different digital forensic systems and services</td></tr>
<tr><td colspan="6">9.Learning Objectives:

1. To learn the basics of digital forensics
2. To learn about file recovery using various tools
3. To learn about processing the crime scene and preserving digital evidence</td></tr>
<tr><td colspan="6">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="6">The students will be able to:-
1. Describe what a digital investigation is, the sources of digital evidence, and the limitations of forensics
2. Describe the legal requirements for use of seized data
3. Conduct data collection on backup drives
4. Recover data based on a given search term from an imaged system
5. Capture and interpret network traffic
6. Handle the challenges associated with mobile device forensics
7.Handling forensics challenges in social and cloud computing</td></tr>
<tr><td colspan="6">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="4">Overview of Computer Forensics Technology</td></tr>
<tr><td colspan="6">Computer Forensics Fundamental- Types of Computer Forensics Technology
Computer Forensics system and Services: Types of Computer Forensics system Computer Forensics Services</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="4">Computer Forensics: Evidence Capture - Data Recovery and Data Seizure</td></tr>
<tr><td colspan="6">Data Backup and Recovery Test Disk Suite, Data-Recovery Solution, Hiding and Recovering Hidden Data, Evidence Collection and Data Seizure.
Preserving the Digital Crime scene, Computer Evidence Processing steps, Legal aspects of Collecting and Preserving Computer Forensic Evidence.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="4">Digital Forensics Tools and Platform</td></tr>
<tr><td colspan="6">Tools (Encase)- Building software, Installing Interpreters, Working with images and File Sys- tems Forensics</td></tr>
<tr><td>Unit – 4</td><td>Number of lectures = 9</td><td colspan="4">Network Forensics and Operating System Artifacts</td></tr>
</table>

Network Forensic Scenario: Destruction of email, damaging computer evidence and System Testing. Operating System Artifacts: Windows System Artifacts, Linux System Artifacts.
Mobile Forensics: Introduction to mobile forensics, understanding Android, Android forensic setup and predata extraction techniques, data recovery techniques

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Text Books:

1. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, Second Edition, Charles River Media,2005

2. Cory Altheide, Harlan Carvey, Digital Forensics with Open Source Tools, British Library Cataloguing-in-Publication Data,2011.

3. Sathish Bommisetty, Rohit Tamma, Heather Mahalik, Practical Mobile Forensics, Kindle Edition, 2014

4. Greg Gogolin,Digital Forensics Explained,CRC Press,2013.

Reference Books

1. David Lilburn Watson, Andrew Jones, Digital Forensics Processing and Procedures, Syngress,2013.

2 Bill Nelson, Amelia Philips, Christopher Steuart, Guide to Computer Forensics and Investigations, Fifth Edition, Cengage Learning,2016

Digital Forensics Lab

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Digital Forensics Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
</table>

8. Course Description: This course is aimed to learn about the different digital forensic systems and services

9. Learning objectives:

1. To learn the basics of digital forensics
2. To learn about file recovery using various tools
3. To learn about processing the crime scene and preserving digital evidence

10. Course Outcomes (COs):

The students will be able to:-

1. Describe what a digital investigation is, the sources of digital evidence, and the limitations of forensics
2. Describe the legal requirements for use of seized data
3. Conduct data collection on backup drives
4. Recover data based on a given search term from an imaged system
5. Capture and interpret network traffic
6. Handle the challenges associated with mobile device forensics
7. Handling forensics challenges in social and cloud computing

11. List of Experiments

1. File Recovery (Deleted, fragmented, hidden)
2. Network Forensics (Determining the type attacks, extracting files from network logs, encrypted files) 8 hours .
3. OS Forensics (Windows and Linux artifacts, memory, registry).
4. OS Forensics (Windows and Linux artifacts, memory, registry).
5. Mobile Forensics(Tools for Android and iOS).
6. Data backup and preservation and password recovery

Mobile and Wireless Security

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Mobile and Wireless Security</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course is aimed to Identify and analyze various the security issues in wireless mobile communication.</td></tr>
<tr><td colspan="7">9. Learning Objectives:

1.To learn about securing wireless networks.
2.To learn various issues of application level security in wireless environment and its related solution.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The students will be able to:-
1. Identify the requirement of security and various issues at wireless and mobile network.
2. Analyze the threats in wireless environment including device, networks and servers.
3.Distinguish the attacks at various protocols in wireless network and differentiate the solution required for them.
4.Assess the security requirement for mobile adhoc environment, ubiquitous environment
5.Recognize the attacks in various environment and Report consequences of them.
6.Select an appropriate solution for security and Justify and demonstrate the usage of preventive measures and countermeasures.
7.Implement the security solution for various environment in wireless network</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">Security Issues in Mobile Communication</td></tr>
<tr><td colspan="7">Mobile Communication History, Security Wired Vs Wireless, Security Issues in Wireless and Mobile Communications Security of Device, Network, and Server Levels:s Mobile Devices Security Requirements, Mobile Wireless network level Security, Server Level Security. Application Level Security in Wireless Networks - Application of WLANs, Wireless Threats, Security for 2G Wi-Fi Applications,Recent Security Schemes for Wi-Fi Applications</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">Application Level Security in Cellular Networks</td></tr>
<tr><td colspan="7">Generations of Cellular Networks, Security Issues and attacks in cellular networks, GSM,GPRS and UMTS security for applications, 3G security for applications.</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td colspan="5">Application Level Security in MANETs</td></tr>
<tr><td colspan="7">MANETs, applications of MANETs, MANET Features, Security Challenges in MANETs, Security Attacks on MANETs.
Application Level Security in Ubiquitous Networks: Ubiquitous Computing, Need for Novel Security Schemes for UC, Security Challenges for UC</td></tr>
</table>

Unit – 4	Number of lectures = 9	Application Level Security in Heterogeneous Wireless Networks
Heterogeneous Wireless network architecture, Heterogeneous network application in disaster management, Security problems and solutions in heterogeneous wireless networks. Wireless Sensor Network Security: Attacks on wireless sensor networks and counter measures Prevention mechanisms: authenti- cation and traffic protection centralized and passive intruder detection decentralized intrusion detection		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

1. Pallapa Venkataram, Satish Babu, Wireless and Mobile Network Security, First Edition, Tata McGraw Hill, 2010.

2 Hakima Chaouchi, Maryline Laurent-Maknavicius, Wireless and Mobile Network Security Security Basics, Security in On-the-shelf and Emerging Technologies, Wiley, 2009

3 Tara M. Swaminathan and Charles R. Eldon, Wireless Security and Privacy- Best Practices and Design Techniques, Addison Wesley, 2002.

Mobile and Wireless Security Lab

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="2">Mobile and Wireless Security Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="2"></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="8">8. Course Description: This course is aimed to Identify and analyze various the security issues in wireless mobile communication.</td></tr>
<tr><td colspan="8">9. Learning objectives:
1.To learn about securing wireless networks.
2.Identify and analyze various the security issues in wireless mobile communication.
3.To learn various issues of application level security in wireless environment and its related solution.</td></tr>
<tr><td colspan="8">10. Course Outcomes (COs):
The students will be able to:-
1. Identify the requirement of security and various issues at wireless and mobile network.
2. Analyze the threats in wireless environment including device, networks and servers.
3.Distinguish the attacks at various protocols in wireless network and differentiate the solution required for them. 4.Assess the security requirement for mobile adhoc environment, ubiquitous environment
5.Recognize the attacks in various environment and Report consequences of them.
6.Select an appropriate solution for security and Justify and demonstrate the usage of preventive measures and countermeasures.
7.Implement the security solution for various environment in wireless network</td></tr>
<tr><td colspan="8">11. List of Experiments</td></tr>
<tr><td colspan="8">1. Design and Implementation of Security algorithm for Wireless networks.
2. Implementation of security protocol for mobile network.</td></tr>
</table>

Malware Analysis

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Malware Analysis	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course is aimed to recognize the types of malware through analysis methods

9. Learning Objectives:

1.To learn basic and advanced malware analysis techniques 3.To practice the android malware analysis techniques for real world applications

10. Course Outcomes (COs):

The students will be able to:-

1.Identify various malwares and understand the behavior of malwares in real world applications.
2.Implement different malware analysis techniques.
3.Analyze the malware behavior in windows and android.
4.Understand the purpose of malware analysis.
5.Identify the various tools for malware analysis.

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	Introduction

Malware Analysis Goals of Malware Analysis, Techniques Static and Dynamic Analysis, Types of Malware Backdoor, Botnet, Downloader, Information Stealing malware, Launcher, Rootkit, Scareware, Worm or Virus.
Data Collection Methods: Volatile Data Collection Methodology-Preservation of Volatile Data, Physical Memory Acqui sition on a Live Windows System, Identifying Users Logged into the System, Non-Volatile Data Collection Inspect Prefetch Files, Examine the File System, Remote Registry Analysis, Examine Web Browsing Activities, Examine Cookie Files.

Unit – 2	**Number of lectures = 9**	Windows Basics

Introduction to Windows Malware - Windows Basics Relevant to Malware Behavior-File System and Directory structure, Registry, Boot Sequence, Malware payloads.

Unit – 3	**Number of lectures = 9**	Dynamic Malware Analysis

Malware activities, Self-Start techniques, Essential setup for executing malware, Executing DLL files, Classifying Malware Based on their Behavior.
Basic Static Analysis: Number System Static Analysis with File Attributes and PE Header Packet Identification

Unit – 4	**Number of lectures = 9**	Advanced Static Analysis Reverse Engineering

Advanced Static Analysis Reverse Engineering Assembly level computing Standard x86 in structions, Introduction to IDA, OllyDbg, Advanced Malware Analysis Virus, Trojan. Parsing Basic Analysis of an APK.

Android Malware Analysis: APK File Structure Security Model Android Root Brief Description of Spreading and Dis- tribution Introduction to Android Debugging Tools and Their Usage Dex Structure Parsing Basic Analysis of an APK. Exploits MasterKey VulnerabilityFileNameLength Vulnerability Introduction to Obfuscation DEX code obfuscation
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.
13. Books Recommended
1.Cameron H. Malin, Eoghan Casey, James M. Aquilina and Curtis W. Rose, Malware Forensics Field Guide for Windows Systems, Syngress, Elsevier, 2012 2 Christopher C. Elisan , Advanced Malware Analysis, Tata McGraw Hill, 2015 3.Cameron H. Malin, Eoghan Casey, James M. Aquilina and Curtis W. Rose, Malware 3 Cameron H. Malin, Eoghan Casey, James M. Aquilina and Curtis W. Rose, Malware Forensics Field Guide for Linux Systems, Syngress, Elsevier, 2014. 4.Ken Dunham, Saeed Abu-Nimeh, Michael Becher and Seth Fogie, Mobile Malware Attacks and Defense, Syngress, Elsevier, 2009 5 John Aycock, Computer Viruses and Malware, Springer, 2006. 6 ErciFiliol, Computer Viruses: from theory to applications, Springer, 2005

Malware Analysis Lab

<table>
<tr><td colspan="9">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="3">Malware Analysis Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="3"></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="4">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td colspan="2"></td><td>6. Frequency (use tick marks)</td><td>Even (√)</td><td>Odd ()</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td colspan="2">Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="9">8. Course Description: This course is aimed to recognize the types of malware through analysis methods</td></tr>
<tr><td colspan="9">Learning objectives:
1.To learn basic and advanced malware analysis techniques
2.To practice the android malware analysis techniques for real world applications</td></tr>
<tr><td colspan="9">9. Course Outcomes (COs):
The students will be able to:-
1.Identify various malwares and understand the behavior of malwares in real world applications.
2.Implement different malware analysis techniques.
3.Analyze the malware behavior in windows and android.
4.Understand the purpose of malware analysis.
5.Identify the various tools for malware analysis.</td></tr>
<tr><td colspan="9">10. List of Experiments</td></tr>
<tr><td colspan="9">1.Packet sniffing with Wire shark.
2. Capturing intruders through packet inspection.
3. Analysis of various Malware types and behavior.
4. Basic Static Analysis.
5. Basic Dynamic Analysis.
6. Analyzing windows programs.
7. Android malware analysis .
8. Data encoding and malware countermeasures.
9. Comparative study of various malware analysis tools.
10. Tools available in Antivirus Application</td></tr>
</table>

AIML

Soft Computing Techniques

1. Name of the Department- Computer Science & Engineering

2. Course Name	Soft Computing Techniques	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (✓)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)

Lectures = 36	**Tutorials = 0**	**Practical = 0**

8. Course Description

The concepts of Fuzzy logic (FL) will be covered first, followed by Artificial Neural Networks (ANNs) and optimization techniques using Genetic Algorithm (GA). Applications of Soft Computing techniques to solve a number of real life problems will be covered to have hands on practices.

12. Learning Objectives:

1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for real-world problems.
2.To provide adequate knowledge of non-traditional technologies and fundamentals of artificial neural networks, backpropagation networks, fuzzy sets, fuzzy logic, genetic algorithms in solving social and engineering problems.
3. o provide comprehensive knowledge of associative memory networks and adaptive resonance theory

10. Course Outcomes (COs):

The student will be able
1.Apply neural networks, bidirectional associative memories and adaptive resonance theory for solving different engineering problems.
2.Identify and describe soft computing techniques and build supervised learning and unsupervised learning networks.
3.Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
4.Apply genetic algorithms to combinatorial optimization problems.
5.Evaluate and compare solutions by various soft computing approaches for a given problem

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	Introduction to Soft Computing & Neural Networks

Soft computing vs. hard computing, evolution of soft computing, features and types of soft computing, applications of soft computing, basics of machine learning.
Basic concepts of Neural Networks, Model of Artificial Neuron, Neural Network Architectures, Characteristics of neural networks, Learning Methods, Early neural network architectures, Application domains. Backpropagation network (BPN), Backpropagation Learning, Applications of BPN, Parameter selection, Variations of Backpropagation Algorithms

Unit – 2	**Number of lectures = 9**	Associative Memory Network & Unsupervised learning

Autocorrelators, hetero-correlators: Kosko's discrete Bi-direction associative memory (BAM), Exponential BAM, Application of Character Recognition.

Adaptive Resonance Theory (ART), Classical ART Networks, Simplifies ART Architecture, Features, algorithms and

<table>
<tr><td colspan="3">Illustration of ART1 and ART2 model, Related Applications</td></tr>
<tr><td>Unit – 3</td><td>Number of lectures = 9</td><td>Fuzzy Sets and Fuzzy Relation</td></tr>
<tr><td colspan="3">Fuzzy versus Crisp, Crisp Sets, Fuzzy sets, Membership functions, fuzzy set operations, properties of Fuzzy sets, Crisp Relations, Fuzzy relations –Fuzzy Cartesian product, Operations of Fuzzy Relations.
Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Quantifiers, Fuzzy Inference, Fuzzy knowledge and rule-based system, fuzzy decision making, Defuzzification, Application of fuzzy logic.</td></tr>
<tr><td>Unit – 4</td><td>Number of lectures = 9</td><td>Genetic Algorithms</td></tr>
<tr><td colspan="3">History of Genetic Algorithm, Basic concepts, Creation of offspring, working principles, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, crossover, inversion & deletion, mutation operator, Bitwise operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional method, Hybrid systems, evolutionary computing, Genetic Algorithm based on Backpropagation networks-Implementation and comparison on performance of traditional algorithms with Genetic Algorithms.</td></tr>
<tr><td colspan="3">12. Brief Description of self-learning / E-learning component
The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.</td></tr>
<tr><td colspan="3">13. Books Recommended</td></tr>
<tr><td colspan="3">S, Rajasekaran & G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy systems and evolutionary algorithms: Synthesis and Applications”, PHI Publication, 2ndEd.2017.

Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, John Wiley and Sons, 3rded, 2011.

S.N. Sivanandam & S.N. Deepa, “Principles of Soft Computing”, Wiley Publications, 3rded, 2018</td></tr>
</table>

Soft Computing Techniques Lab

<table>
<tr><td colspan="9">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td colspan="3">Soft Computing Techniques Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td colspan="3"></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="4">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td colspan="2">5. Pre-requisite (if any)</td><td colspan="2"></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="9">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td colspan="2">Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="9">8. Course Description</td></tr>
<tr><td colspan="9">Learning objectives:
1. To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for real-world problems.
2.To provide adequate knowledge of non-traditional technologies and fundamentals of artificial neural networks, backpropagation networks, fuzzy sets, fuzzy logic, genetic algorithms in solving social and engineering problems.
3. To provide comprehensive knowledge of associative memory networks and adaptive resonance theory</td></tr>
<tr><td colspan="9">9. Course Outcomes (COs):
The student will be able
1.Apply neural networks, bidirectional associative memories and adaptive resonance theory for solving different engineering problems.
2.Identify and describe soft computing techniques and build supervised learning and unsupervised learning networks.
3.Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
4.Apply genetic algorithms to combinatorial optimization problems.
5.Evaluate and compare solutions by various soft computing approaches for a given problem</td></tr>
<tr><td colspan="9">10. List of Experiments</td></tr>
<tr><td colspan="9">1. Create a perceptron with appropriate number of inputs and outputs. Train it using fixed increment learning algorithm until no change in weights is required. Output the final weights
2. Write a program to implement artificial neural network without back propagation
3. Write a program to implement artificial neural network with back propagation.
4. Implement Union, Intersection, Complement and Difference operations on fuzzy sets. Also create fuzzy relation by Cartesian product of any two fuzzy sets and perform max-min composition on any two fuzzy relations.
5. Implement travelling sales person problem (tsp) using genetic algorithms
6. Implement linear regression and multi-regression for a set of data points.
7. Implement crisp partitions for real-life iris dataset</td></tr>
</table>

Knowledge Engineering and Intelligent Systems

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Knowledge Engineering and Intelligent Systems</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">This course presents Artificial Intelligence methods, techniques and technologies which are applied already in the engineering of distributed systems in order to make them more flexible, adaptable and reconfigurable. It presents first a new paradigm of agent-based software design methodologies, where the analysis and design of distributed systems uses concepts from human societies and organizations (actor, role, responsibility, delegation of tasks) to model, in a flexible way, the interactions within the system and ways to recover from failures. Also we see how smart technologies are being implemented (logical reasoning, planners automatic mechanisms of negotiation and argumentation) to extend the semantic web services technologies towards their fullest potential, to make them more flexible and adaptive.</td></tr>
<tr><td colspan="7">11. Learning Objectives:

1. To introduce the fundamentals of Knowledge Engineering and Intelligent Systems.
2.To provide deep understanding of Knowledge Engineering and Intelligent Systems .
3.To educate about all aspect of advanced models of KE and its application.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">The student will be able
1. Demonstrate the knowledge of fundamental elements and concepts related to Intelligent Systems.
2.Demonstrate the fundamental and advanced modules of KE especially with Searching methods, Representation of knowledge and different reasoning techniques.
3.Ability to work with Predicate logic, back propagation with respect to the CNNs model parameters and implementing the models successfully.
4.Apply the higher order logics for handling uncertainty5.Implement an expert system to solve critical problems of medical domain, application of business intelligence and robotics in real life problems.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">Knowledge Engineering Concepts</td></tr>
<tr><td colspan="7">Definition of Knowledge Engineering –Knowledge base Systems –Knowledge base systems Vs Database systems –Rules Vs Triggers –Domain Expert –Expert Systems –Heuristic Search –A*, AO* and Mini-max algorithms -Knowledge representation –Semantic Networks –Frames-Conceptual Dependency –Scripts –Ontology –Semantic Web–Reasoning Methods</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">First Order Logic</td></tr>
</table>

Role of Logic –Propositional logic –Predicate logic –Syntax –Semantics –Interpretations –Denotation –Satisfaction and models –Pragmatics –Explicit and Implicit Beliefs -Logical Consequence –Expressing Knowledge -Basic and Complex Facts –Terminological facts –Entailment –Abstract Individuals -Other Sorts of Facts –Resolution –The Propositional Case –Predicate Logic –Handling Variables and Quantifiers –First Order Resolution-Answer Extraction –Skolemization –Clause Form –Equality -Dealing with Computational Intractability -The First-Order Case -Herbrand Theorem -The Propositional Case -The Implications -SAT Solvers -Most General Unifiers -Other Refinement

Unit – 3	**Number of lectures = 9**	Knowledge Representation –Using Rules

Procedural Versus Declarative Knowledge -Logic Programming -Forward versus Backward Reasoning –Rule Matching –Rules in Production Systems-Working Memory-Conflict Resolution-Rete's Algorithm –Discriminant Networks -Control Knowledge –Reasoning with Horn Clauses –Computing Selective Linear Definite clause resolution Derivatives –Rule Formation and Search Strategy –Algorithm Design –Specifying Goal order –Committing to Proof methods –Controlling Back Tracking –Negation as Failure –Dynamic Databases.

Unit – 4	**Number of lectures = 9**	Object Oriented Representation using Logic

Object oriented Representation –Objects and Frames –Frame Formalism –Object Driven Programming with Frames –Generic and Individual Frames –Inheritance –Reasoning with Frames –Structured Descriptions –Descriptions –Description Language –Meaning and Entailment –Interpretations –Truth in an Interpretation –Computing Entailments –Simplifying the Knowledge base –Normalization –Structure Matching –Subsumption Computation –Taxonomies and Classification –Inheritance Networks –Handling Defeasible Inheritance

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

1. Ronald Brachman, Hector Levesque, Knowledge Representation and Reasoning, 1st Edition, Morgan Kaufmann, 2004
2.Richard A Frost, "Introduction to Knowledge Based Systems", Macmillan Publishing Co, 1986.
3.John F. Sowa, Knowledge Representation: Logical, Philosophical and Computational Foundations, Brooks Cole Publishing Co., Pacific Grove, CA, 20004.
4. Building Intelligent Systems A Guide to Machine Learning Engineering, Authors: Hulten, Geoff, Apress; 1st ed. edition (2018

Deep Learning and its Applications

Stochastic Models and Applications

1. Name of the Department- Computer Science & Engineering

2. Course Name	Deep Learning and its Applications	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)

Lectures = 36	**Tutorials = 0**	**Practical = 0**

8. Course Description

The course is aimed to understand the theoretical foundations, algorithms and methodologies of Neural Network

9.Learning Objectives:

1.To design and develop an application using specific deep learning models.
2. To provide the practical knowledge in handling and analysing real world applications.

10. Course Outcomes (COs):

Upon completion of the course, the students will be able to

1. Recognize the characteristics of deep learning models that are useful to solve real-world problems.
2. Understand different methodologies to create application using deep nets.
3. Identify and apply appropriate deep learning algorithms for analyzing the data for variety of problems.
4. Implement different deep learning algorithms
5. Design the test procedures to assess the efficacy of the developed model.
6. Combine several models in to gain better result

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	MACHINE LEARNING BASICS

Learning algorithms, Maximum likelihood estimation, Building machine learning algorithm, Neural Networks Multilayer Perceptron, Back-propagation algorithm and its variants Stochastic gradient decent, Curse of Dimensionality

Machine Learning and Deep Learning, Representation Learning, Width and Depth of Neural Networks, Activation Functions: RELU, LRELU, ERELU, Unsupervised Training of Neural Networks, Restricted Boltzmann Machines, Auto Encoders, Deep Learning Applications

Unit – 2	**Number of lectures = 9**	CONVOLUTIONAL NEURAL NETWORKS

Architectural Overview,Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet, AlexNet - Applications
Transfer learning Techniques, Variants of CNN: DenseNet, PixelNet.

Unit – 3	**Number of lectures = 9**	SEQUENCE MODELLING – RECURRENT AND RECURSIVE NETS

Recurrent Neural Networks, Bidirectional RNNs, Encoder-decoder sequence to sequence architectures - BPTT for training RNN, Long Short Term Memory Networks.		
Unit – 4	**Number of lectures = 9**	AUTO ENCODERS & DEEP GENERATIVE MODELS
Under complete Auto encoder, Regularized Auto encoder, stochastic Encoders and Decoders, Contractive Encoders. DEEP GENERATIVE MODELS: Deep Belief networks, Boltzmann Machines,Deep Boltzmann Machine, Generative Adversial Networks.		

12. Brief Description of self-learning / E-learning component

The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.

13. Books Recommended

Text books:

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, " Deep Learning", MIT Press, 2017. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2.Umberto Michelucci "Applied Deep Learning. A Case-based Approach to Understanding Deep Neural Networks" Apress, 2018.

Reference Books :

1. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012.
2. EthemAlpaydin,"Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.
3.Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
4.Antonio Gulli, Sujit Pal "Deep Learning with Keras", Packt Publishers, 2017. Francois Chollet "Deep Learning with Python", Manning Publications, 2017.

Deep Learning and its Applications Lab

<table>
<tr><td colspan="8">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td colspan="2">2. Course Name</td><td>Deep Learning and its Applications Lab</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td colspan="2">3. Course Code</td><td></td><td>0</td><td colspan="2">0</td><td colspan="2">2</td></tr>
<tr><td colspan="3">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(√)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td colspan="2"></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (√)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="8">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="3">Lectures = 0</td><td>Tutorials = 0</td><td colspan="4">Practical = 24</td></tr>
<tr><td colspan="8">8. Course Description: The course is aimed to understand the theoretical foundations, algorithms and methodologies of Neural Network</td></tr>
<tr><td colspan="8">9. Learning objectives:
1.To design and develop an application using specific deep learning models.
2. To provide the practical knowledge in handling and analysing real world applications</td></tr>
<tr><td colspan="8">10.Course Outcomes (Cos):
Upon completion of the course, the students will be able to

1. Recognize the characteristics of deep learning models that are useful to solve real-world problems.
2. Understand different methodologies to create application using deep nets.
3. Identify and apply appropriate deep learning algorithms for analyzing the data for variety of problems.
4. Implement different deep learning algorithms
5. Design the test procedures to assess the efficacy of the developed model.
6. Combine several models in to gain better result</td></tr>
<tr><td colspan="8">11.List of Experiments</td></tr>
<tr><td colspan="8">1.Train a Deep learning model to classify a given image using pre trained model
2. Object detection using Convolution Neural Network
3. Recommendation system from sales data using Deep Learning
4. Improve the Deep learning model by tuning hyper parameters
5. Perform Sentiment Analysis in network graph using RNN
6. Image generation using GAN</td></tr>
</table>

Bio-Inspired Computing

<table>
<tr><td colspan="7">1. Name of the Department- Computer Science & Engineering</td></tr>
<tr><td>2. Course Name</td><td>Bio-Inspired Computing</td><td>L</td><td colspan="2">T</td><td colspan="2">P</td></tr>
<tr><td>3. Course Code</td><td></td><td>3</td><td colspan="2">0</td><td colspan="2">0</td></tr>
<tr><td colspan="2">4. Type of Course (use tick mark)</td><td>Core ()</td><td colspan="2">PE(✓)</td><td colspan="2">OE ()</td></tr>
<tr><td>5. Pre-requisite (if any)</td><td></td><td>6. Frequency (use tick marks)</td><td>Even ()</td><td>Odd (✓)</td><td>Either Sem ()</td><td>Every Sem ()</td></tr>
<tr><td colspan="7">7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)</td></tr>
<tr><td colspan="2">Lectures = 36</td><td>Tutorials = 0</td><td colspan="4">Practical = 0</td></tr>
<tr><td colspan="7">8. Course Description</td></tr>
<tr><td colspan="7">An introduction to self-adapting methods also called artificial intelligence or machine learning. Schemes for classification, search and optimization based on bio-inspired mechanisms are introduced. This includes evolutionary computation, artificial neural networks and more specialized approaches like e.g. swarm intelligence and artificial immune systems. Further, an overview of alternative traditional methods will also be included.</td></tr>
<tr><td colspan="7">9.Learning Objectives:

1.To understand the fundamentals of evolutionary theory and cellular automata.
2.To learn the artificial neural systems and swarm optimization for feature selection.
3.To learn the genetic algorithm and hybridization with memetic algorithms.</td></tr>
<tr><td colspan="7">10. Course Outcomes (COs):</td></tr>
<tr><td colspan="7">Upon completion of the course, the students will be able to

1.Understand basic concepts of evolutionary algorithm .
2.Understand the basic features of neural and immune systems and able to build the neural model.
3. Explain how complex and functional high-level phenomena can emerge from low-level interactions.
4.Explain the computational processes derived from neural models.
5.Implement simple bio-inspired algorithms like genetic and Particle Swarm Optimization.</td></tr>
<tr><td colspan="7">11. Unit wise detailed content</td></tr>
<tr><td>Unit-1</td><td>Number of lectures = 9</td><td colspan="5">INTRODUCTION TO EVOLUTIONARY ALGORITHM</td></tr>
<tr><td colspan="7">Evolutionary algorithm, components of evolutionary algorithm representation (definition of individuals), Evaluation function (Fitness function), Population, parent selection Mechanism, Variation Operators, Survivor Selection Mechanism (Replacement), Initialization, Termination Condition, evolutionary algorithm case study Cellular systems, cellular automata, modeling with cellular systems, other cellular systems, computation with cellular systems, artificial life: analysis and synthesis of cellular systems.</td></tr>
<tr><td>Unit – 2</td><td>Number of lectures = 9</td><td colspan="5">NEURAL SYSTEMS</td></tr>
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Biological nervous systems, artificial neural networks, neuron models, architecture, signal encoding ,synaptic plasticity, unsupervised learning, supervised learning, reinforcement learning, evolution of neural networks, hybrid neural systems, case study Rewriting system, synthesis of developmental system, evolutionary rewriting systems, evolutionary developmental programs, biological immune systems, lessons for artificial immune systems, algorithms and applications, shape space, negative selection algorithm		
Unit – 3	**Number of lectures = 9**	BEHAVIORAL SYSTEMS
Behavior is cognitive science, behavior in AI, behavior based robotics, biological inspiration for robots, robots as biological models, robot learning, evolution of behavioral systems, learning in behavioral systems, co-evolution of body and control, towards self-reproduction, simulation and Reality. Representation of Individuals, Mutation, Recombination, Population Models, Parent Selection, Survivor Selection, Example Application: Solving a Job Shop Scheduling Problem		
Unit – 4	**Number of lectures = 9**	COLLECTIVE SYSTEMS
Biological self-organization, Particle Swarm Optimization (PSO),ant colony optimization (ACO), swarm robotics, co-evolutionary dynamics, artificial evolution of competing systems, artificial evolution of cooperation, case study Introduction to Local Search, Lamarckianism and the Baldwin Effect, Structure of a Memetic Algorithm, Heuristic or Intelligent Initialization, Hybridization within Variation Operators: Intelligent Crossover and Mutation, Local Search Acting on the output from Variation Operators , Hybridization During the Genotype to Phenotype Mapping, Design Issues for Memetic Algorithms		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.		
13. Books Recommended		
1. D. Floreanoand C. Mattiussi, "Bio-Inspired Artificial Intelligence", MIT Press, 2008. 2. Tao Song, Pan Zheng, Mou Ling Dennis Wong, Xun Wang, “Bio-Inspired Computing Models and Algorithms”, ISBN: 978-981-3143-19-7, world scientific, 2019F. 3. Neumann and C. Witt, “Bioinspired Computation in combinatorial optimization: Algorithms and their computational complexity”, Springer, 2010		

Bio-Inspired Computing Lab

1. Name of the Department- Computer Science & Engineering

2. Course Name	Bio-Inspired Computing Lab	**L**	**T**	**P**
3. Course Code		**0**	**0**	**2**
4. Type of Course (use tick mark)		**Core ()**	**PE(√)**	**OE ()**

5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even ()	Odd (√)	Either Sem ()	Every Sem ()

7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)

Lectures = 0	**Tutorials = 0**	**Practical = 24**

8. Course Description: An introduction to self-adapting methods also called artificial intelligence or machine learning. Schemes for classification, search and optimization based on bio-inspired mechanisms are introduced. This includes evolutionary computation, artificial neural networks and more specialized approaches like e.g. swarm intelligence and artificial immune systems. Further, an overview of alternative traditional methods will also be included.

Learning objectives:

1.To understand the fundamentals of evolutionary theory and cellular automata.
2.To learn the artificial neural systems and swarm optimization for feature selection.
3.To learn the genetic algorithm and hybridization with memetic algorithms.

9. Course Outcomes (Cos):

Upon completion of the course, the students will be able to

1.Understand basic concepts of evolutionary algorithm .
2.Understand the basic features of neural and immune systems and able to build the neural model.
3. Explain how complex and functional high-level phenomena can emerge from low-level interactions.
4.Explain the computational processes derived from neural models.
5.Implement simple bio-inspired algorithms like genetic and Particle Swarm Optimization.

10. List of Experiments

1. Python Review
2. Measuring (uncertainty based) information
3. L-System
4. Cellular Automata & Boolean Networks
5. Evolutionary Algorithms
6. Ant Clustering Algorithm

Machine Learning for Signal Processing

1. Name of the Department- Computer Science & Engineering						
2. Course Name	Machine learning for signal processing	**L**	**T**		**P**	
3. Course Code		**3**	**0**		**0**	
4. Type of Course (use tick mark)		**Core ()**	**PE(✓)**		**OE ()**	
5. Pre-requisite (if any)		**6. Frequency (use tick marks)**	Even (✓)	Odd ()	Either Sem ()	Every Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 12 weeks of one semester)						
Lectures = 36		**Tutorials = 0**	**Practical = 0**			

8. Course Description

This course aims at introducing the students to the fundamentals of machine learning (ML) techniques useful for various signal processing applications. It will discuss various mathematical methods involved in ML, thereby enabling the students to design their own models and optimize them efficiently. The lectures will focus on mathematical principles, and there will be coding based assignments for implementation. Prior exposure to ML is not required. The course will be focused on applications in signal processing and communication, and the theory will be tailored towards that end.

9.Learning Objectives:

1. To introduce the students with machine learning fundamentals for solving signal processing based applications.
2. To implement various mathematical methods involved in Machine Learning
3. To design their own models for the specific applications and optimize them efficiently

10. Course Outcomes (COs):

After successful completion of the course student will be able to:

1. Understand the mathematical methods for implementing signal processing and machine learning techniques
2. Perform the optimization techniques for various Machine Learning models
3. Develop methods of data representations for signal processing in machine learning environment
4. Apply Machine Learning models for linear systems
5. Classify Machine Learning models for Non-linear systems
6. Apply basic machine learning models and prediction techniques on signals
7. Apply machine learning models in speech and image processing applications

11. Unit wise detailed content

Unit-1	**Number of lectures = 9**	Mathematical Foundations
Introduction -Notion of a signal-Basic digital representation of data (text, speech, image, video)-Complex Exponential functions-Shannon Information Theory, Convolution, Correlation and Covariance Functions-Wavelets-Fourier Transform -DCT and Wavelets, Gaussian Processes		
Unit – 2	**Number of lectures = 9**	Optimization Techniques

Gradient ascent/descent-Basics of convex optimization-Constrained optimization, Convex sets, Hyperplanes/ Half-spaces, Lagrange multipliers, projected gradients-Bio-Inspired Algorithms, Dictionary based representations -Eigen representations –Karhunen Loeve Theorem -Principal Component Analysis-Properties-Independent Component Analysis (ICA)-ICA for representations and Denoising -Non-negative matrix factorization		
Unit – 3	**Number of lectures = 9**	Linear Gaussian Systems and Signal Processing
Delta and Related Functions-Linear Time Invariant Systems –LTI Signal Processing –Exploiting Statistical Stability for linear-Gaussian DSP-Kalman Filters. Running Window filters-Recursive filters-Global Non-linear Filter –Hidden Markov Modelling –Homomorphic Signal Processing		
Unit – 4	**Number of lectures = 9**	Statistical Machine Learning
Statistical Machine Learning techniques -implementation for signal processing applications: Binary Classification -Linear classifiers –Perceptron's-–SVM-Linear, Kernel SVM -Multiclass Problem -K-means -Nearest Neighbors -Linear regression -Regularization, Machine Learning for Audio Classification -Time Series Analysis, LSTMs and CNNs. Machine Learning for Image Processing -Transfer Learning, Attention models, Attribute-based learning		
12. Brief Description of self-learning / E-learning component The students will be encouraged to learn using the SGT E-Learning portal and choose the relevant lectures delivered by subject experts of SGT University.		
13. Books Recommended		
1. Max A. Little, Machine Learning for Signal Processing: Data Science, Algorithms, and Computational Statistics, Oxford Publisher, 2019. 2. Paolo Prandoni,Martin Vetterli, Signal Processing for Communications (Communication and Information Sciences), CRC Press, 2008. 3. Stephen Boyd, LievenVandenberghe, Convex Optimization,Cambridge University Press, 2004		

Machine Learning for Signal Processing Lab

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<tr><td colspan="8">10. List of Experiments</td></tr>
<tr><td colspan="8">1.Implement Decision Tree learning
2. Implement Logistic Regression
3. Implement classification using Multilayer perceptron
4. Implement classification using SVM
5. Implement Adaboost
6. Implement Bagging using Random Forests
7. Implement k-nearest Neighbors algorithm
8. Implement K-means, K-Modes Clustering to Find Natural Patterns in Data
9. Implement Hierarchical clustering</td></tr>
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10. Implement Gaussian Mixture Model Using the Expectation Maximization
11. Implement Principle Component Analysis for Dimensionality Reduction
12. Evaluating ML algorithm with balanced and unbalanced datasets Comparison of Machine Learning algorithms