SGT University, Chandu-Budhera, Gurugram Faculty of Engineering & Technology Department of Civil Engineering





M. Tech. Geotechnical Engineering

Scheme & Syllabus (2021-22)

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

### Geotechnical Engineering First Semester

S	Subject		L	Т	Р	С	<b>Examination</b>	ination	Subject
NO	Code	Course					r	narks	Total
110.	Coue	Title					Ext.	Int.	
1.		Advanced Soil Mechanics	3	0	0	3	60	40	100
2.		Ground Improvement Techniques	3	0	0	3	60	40	100
3.		Earth retaining structures	3	0	0	3	60	40	100
4.		Design of pavements	3	0	0	3	60	40	100
5.		Experimental soil Mechanics Lab	0	0	2	1	40	60	100
6.		Computer application in Engineering Lab	0	0	2	1	40	60	100
7.		Value Added Courses-I	2	0	0	2	60	40	100
8.		Seminar	0	0	2	1	00	100	100
		Total	14	0	6	17	380	420	800

### Second Semester

S.	Subject	Course Title	L	Т	Р	C	Examination marks		Subject Total
110.	Code	Course Thie					Ext.	Int.	
1		Rock Mechanics	3	0	0	3	60	40	100
2		Advanced Foundation Engineering		0	0	3	60	40	100
3		Soil Dynamics and Machine Foundations		0	0	3	60	40	100
4		Soil strength behavior	3	0	0	3	60	40	100
5		Rock Mechanics Lab		0	2	1	40	60	100
6		Advanced Geotechnical Laboratory	0	0	2	1	40	60	100
7		Seminar		0	2	1	00	100	100
		Total	12	0	6	15	320	380	700

S.NO.	Subject	Course Title	L	Т	P	С	Exam	inatio	Subject
	Code						1	1	Total
							ma	rks	
							Ext.	Int.	
1		Earth & Rock fill Dams	3	0	0	3	60	40	100
2		Research Methodology & IPR	3	0	0	3	60	40	100
3		Department Electives-XIII	3	0	0	3	60	40	100
4		Department Electives-XIV	3	0	0	3	60	40	100
5		Department Electives-XV	3	0	0	3	60	40	100
6		Research Methodology & IPR Lab	0	0	2	1	40	60	100
7		Department Electives Lab-XIII	0	0	2	1	40	60	100
8		Department Electives Lab-XIV	0	0	2	1	40	60	100
9		Department Electives Lab-XV	0	0	2	1	40	60	100
10		Value Added Courses-II	2	0	0	2	60	40	100
		Total	17	0	8	21	520	480	1000

### **Fourth Semester**

S.NO.	Subject	Course Title	L	Т	Р	С	Examination marks		Subject Total	
	Coue						Ext.	Int.	Total	
1		Dissertation	0	0	20 W	20	100	0	100	
		Total	0	0	20 W	20	100	0	100	

### **Departmental Electives**

S.	Specialization	Departmental Elective	Departmental	Departmental
No.		XIII	Elective XIV	Elective XV
5	Geotechnical Engineering	Strength and Deformation Behaviour of soil 3-0-2 (4) / Computational Methods in Geotechnical Engg 3-0-2 (4)	Construction Methods and Equipment 3-0-2 (4) / Advanced Pavement Materials 3-0-2 (4)	Advanced Surveying and Cartography 3-0-2 (4) / Offshore Foundations 3-0-2 (4)

### First Semester

1. Name of the Department: Civil Engineering Department									
2. Course Name	Advanced Soil	L	Т		Р				
	Mechanics								
3. Course Code		3	0		0				
4. Type of Course (u	ise tick mark)	Core (✓)	PE()		OE()				
5. Pre-requisite (if	Soil Mechanics	<b>6.</b> Frequency (use	Even	Odd (✔)	Either	Every			
any)		tick marks)	0		Sem ()	Sem			
						0			
7. Total Number of	Lectures, Tutorials	, Practical (assuming 1	4 weeks o	of one sem	lester)				
Lectures =42		Tutorials =0	Practica	ul =0					
8. Brief Syllabus									
Students will understa	nd the advanced co	ncept of soil mechanics	which in	cludes soil	l propertie	es,			
effective stresses actin	ng on soil, consoli	dation behavior of soil	and stren	ngth chara	cteristics	of			
different types of satur	ated and unsaturate	d soil.							
9. Learning objectiv	res:								
1-To study the advance	ed methods of deter	mination of engineering	properties	s of differe	nt soil san	nples			
2. To lay a firm theore	tical background ne	cessary in the design of	geotechnie	cal system	s	-			
3. Estimate shear stre	ngth, consolidation	and effective stress o	f saturate	d, unsatur	ated and	partially			
saturated soils.									
10. Course Outcomes	(COs):								
At the end of course, the student will be able to:									
1. Students are ab	le to calculate effec	tive stresses of soil							
2. Determine the	rate and magnitude	of soil consolidation w	hen the so	oil is restra	ined later	ally and			
loaded axially.									
3. Using shear str	ength concepts stud	ents able to design struc	tures gene	rally fail in	n shear				
4. Analyze the res	sults of shear streng	th in case of saturated so	il and uns	aturated so	oil.				
11. Unit wise detailed	content								
Unit-1	Number of	Title of the unit:							
	lectures = 10	Soil-water interaction	n						
Effective Stress: The	e principle of effec	tive stress, Inter-granu	lar pressu	re, Pore p	pressure, o	capillary			
pressure, problems									
Unit – 2	Number of	Title of the unit:							
	lectures $= 10$	Compressibility and	Consolida	tion					
Consolidation: Princi	ple of consolidation	n-compressibility, press	ure-void 1	ratio relati	onships, 7	Ferzaghi			
one dimensional cons	- olidation parameter	s, pre-consolidation pre	ssure, Est	timation of	f total Set	tlement.			
Two- and three-dimensional consolidation, Secondary compression.									
Unit – 3	Number of	Title of the unit:							
	lectures =10	Strength behaviour of	f soil						
Shear Strength: Basic concepts, Mohr-Coulomb theory; measurement of shear strength, drainage									
conditions, stress paths	s, pore pressure para	meters. Interpretation of	f triaxial to	est results.					

Unit – 4	Number of	Title of the unit: Strength of Cohesionless and saturated						
	lectures = 12	cohesive Soils						
Strength of Cohesion	n less Soils: Friction	on between solid surfaces, Frictional behaviour of minerals,						
strength of granular s	strength of granular soil, Factors affecting strength and deformation, Dilatancy, critical void ratio,							
Liquefaction.								
Strength of Saturate	ed Cohesive Soils	: Effective stress-water content relationship, stress history,						
structure, strain rate, se	ensitivity, Thixotrop	y, Hvorslev's strength parameters.						
12. Books Recommen	ded (3 Text Books	+ 2-3 Reference Books)						
i) Atkinson, J.H	. and Bransby, P.I	L, The Mechanics of Soils: An introduction to Critical soil						
mechanics, M	cGraw Hill, 1978.							
ii) R.D. Holtz &	W.D. Kovacs, "An	Introduction to Geotechnical Engineering" – Prentice – Hall						
India, 1981.								
iii) J. K. Mitchel,	, "Fundamentals of	Soil behaviour" - John Wiley & Sons, 1993.						
<i>iv)</i> T. W. Lambe	& R. V. Whitman, '	"Soil Mechanics" - Wiley Eastern Ltd.,2000						
v) Terzaghi, K.,	and Peck, R.B., Se	oil Mechanics in Engineering Practice, John Wiley & Sons,						
2013.								

1. Name of the Depa	rtment: Civil Engi	neering Department					
2. Course Name	Ground	L	Т		Р		
	Improvement						
	Techniques						
3. Course Code		3	0		0		
4. Type of Course (u	se tick mark)	Core (✓)	PE()		OE()		
5. Pre-requisite (if	Nil	<b>6.</b> Frequency (use	Even	Odd (✓)	Either	Every	
any)		tick marks)	0		Sem ()	Sem	
						0	
7. Total Number of	Lectures, Tutorials	, Practical (assuming 1	4 weeks	of one sem	lester)		
Lectures =42		Tutorials =0	Practic	al =0			
8. Brief Syllabus							
This course will cover	the various method	s of ground improvement	nt technic	ques and ap	plication	of	
methods in designing of	of road, foundation a	and earth retaining struct	tures.				
9. Learning objectiv	es:						
1) Understand the mec	hanical behavior of	weak ground					
2) To make the founda	tion strong underlyi	ng heavy structures.			an a sifind		
5) Study the various ac	imixtures to modify	the properties of weak g	ground by	adding in	specified	amount.	
10. Course Outcomes	(COs):						
At the end of course, the	he student will be ab	ble to:					
1. Identify suitable ground improvement technique for specific project and its implications.							
2. Understand the concept of bearing capacity and reduce settlement of soft ground, prevent							
earthquake liquefaction, control groundwater, stabilize excavation bottom, prevent deformation							
of surrounding	ground due to prese	ence of water.					
3. Understand the soil.	usefulness of differ	ent chemical required to	improve	engineerin	ig behavio	our of	
4. Understand the	recent trend in the	field of ground improver	nent tech	niques.			
11. Unit wise detailed	content						
Unit-1	Number of	Title of the unit: Intr	oduction	- Ground	Modifica	ntion	
	lectures =10	with mechanical mod	ification				
Need and objectives	of Ground Improve	ement, Classification of	Ground	Modificat	ion Techr	niques –	
suitability and feasibili	ty, Emerging Trend	s in ground improvemer	nt.	~~			
Methods of compactio	n, Shallow compact	ion, Deep compaction te	chniques	– Vibro-fl	oatation, I	Blasting,	
Dynamic consolidation	n, precompression ai	nd compaction piles, Fie	ld compa	action contr	ol.		
Unit – 2	Number of	Title of the unit: Hyd	raulic M	odification	l		
	lectures = 10						
Methods of dewatering	ng – open sumps	and ditches, Well-poir	nt system	n, Electro-	osmosis,	Vacuum	
dewatering wells; pre-	-loading without an	nd with sand drains, str	ip drains	and rope	drains, D	esign of	
vertical drains.							
Unit - 3 Number of Title of the unit. Thermal modification and chemical							
Umt - J	Number of	Title of the unit: Ther	mal mod	lification a	nd chemi	cal	

**Thermal modification:** Ground freezing and thawing. Stabilization with admixtures like cement, lime, calcium chloride, fly ash and bitumen; Grouting: Categories of grouting, Art of grouting, Grout materials, Grouting techniques and control.

Unit – 4	Number of	Title of the unit: Soil Reinforcement and application of
	lectures = 12	soil Reinforcement

**Reinforced Earth Technology:** Concept of soil reinforcement, Reinforcing materials, Backfill criteria, Art of reinforced earth technology, Design and construction of reinforced earth structures.

**Application of soil reinforcement:** shallow foundations on reinforced earth, design of reinforced earth retaining walls, reinforced earth embankments structures, wall with reinforced backfill, road construction with geosynthetics.

### **12. Books Recommended (3 Text Books + 2-3 Reference Books)**

- i) Xanthakos, P.P., Abramson, L.W. and Bruce, D.A., Ground Control and Improvement, John Wiley & Sons, 1994.
- Robert M. Koerner "Construction and Geotechnical methods in Foundation Engineering", Mc.Graw-Hill Pub. Co., New York, 1985.

iii) Manfred R. Haussmann, "Engineering principles of ground modification", Pearson Education Inc. New Delhi, 2008.

iv) F. G., Bell, "Engineering Treatment of Soils", E& FN Spon, New York, 2006.

v) P. Purushothama Raj, "Ground Improvement Techniques" Laxmi Publications (P) Limited, 2006.

vi) Jie Han et. al., "Advances in ground Improvement" Allied Pub., 2009.

1. Name of the Depa	1. Name of the Department: Civil Engineering Department								
2. Course Name	Earth retaining	L	Т		Р				
	Structures								
3. Course Code		3	0		0				
4. Type of Course (u	se tick mark)	Core (✓)	PE()		OE()				
5. Pre-requisite (if	Nil	<b>6.</b> Frequency (use	Even	Odd (✓)	Either	Every			
any)		tick marks)	0		Sem ()	Sem			
						0			
7. Total Number of	Lectures, Tutorials	, Practical (assuming 1	4 weeks	of one sem	ester)				
Lectures =42		Tutorials =0	Practica	al =0					
8. Brief Syllabus									
Earth retaining structu	res include the brief	f of earth pressure and t	heories, t	ypes of ear	th retainin	ng			
structures, retaining wa	all and its design, sh	eet piles and bulkheads	in granula	ar and cohe	sive soils	-			
9. Learning objectiv	es:		_						
To calculate earth pres	sure on various eart	h retaining structures su	ch as grav	vity retainir	ng walls, s	heet			
pile, bulkheads, bracin	g/struts and coffer d	lams.	-						
	-								
10. Course Outcomes (COs):									
At the end of course, the student will be able to:									
1. Design a relevant earth retaining structure for given soil condition									
2. Design of retaining wall in different soil condition									
3. Design of bulk head structure for given soil condition									
4. Design of tunne	4. Design of tunnel and conduits								
11. Unit wise detailed content									
Unit-1	Number of	Title of the unit:							
	lectures = 10	Earth Pressure							
Rankine and Coulomb	theories, active, pas	ssive and pressure at rest	; concent	rated surch	arge abov	e the			
back fill, earth pressure	e due to uniform sur	charge, earth pressure of	f stratified	d backfills,	saturated	and			
partially saturated back	xfill.								
Unit – 2	Number of	Title of the unit:							
	lectures = 10	Design of earth retain	ing struc	ctures					
Types of earth retai	ning structures –	Classifications - speci	ifications,	, Retaining	walls –	types -			
Design specifications a	and pressure distribution	tion variations, stability	of retain	ing walls.					
Unit – 3	Number of	Title of the unit: Bulk	heads						
	lectures = 12								
Bulkheads: bulkheads	with free and fixed	earth supports, equivale	ent beam	method, Ar	chorage of	of			
bulkheads and resistan	ce of anchor walls,	spacing between bulkhea	ads and a	nchor walls	, resistanc	e of			
anchor plates									
Unit – 4	Number of	Title of the unit: Tun	nel and c	onduits					
	lectures = 10								
Tunnel and Conduit	t: Stress distribution	on around tunnels, Typ	bes of co	onduits, Lo	ad on pr	ojecting			
conduits; Arching and	Open Cuts: Arching	g in soils.							

### 12. Books Recommended (3 Text Books + 2-3 Reference Books)

i) . E. Bowels, "Foundation Analysis and Design", Mc Graw Hill Companies, 1997

ii) B. M. Das, "Foundation engineering", Cengage Learning, 2007

iii) Gulhati, K. Shashi and M. Datta, "Geotechnical engineering", Mc.Graw Hill book company, 2005

iv) Earth Pressure and Earth-Retaining Structures by Chris R.I Clayton, Rick. I. Woods. ISBN 9781466552111, Published May 28, 2014

v) Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997

vi) Koerner, R.M., "Design with Geosynthetics", (3rd Edition) Prentice Hall, New Jersey, 2002

1. Name of the Department: Civil Engineering Department									
2. Course Name	Design of	L	Т		Р				
	pavements								
3. Course Code		3	0		0				
4. Type of Course (u	se tick mark)	Core (✓)	PE()		OE()				
5. Pre-requisite (if	Nil	<b>6.</b> Frequency (use	Even	$\operatorname{Odd}(\checkmark)$	Either	Every			
any)		tick marks)	0		Sem ()	Sem			
						0			
7. Total Number of	Lectures, Tutorials	s, Practical (assuming 1	4 weeks	of one sem	ester)				
Lectures =42		Tutorials =0	Practic	al =0					
8. Brief Syllabus									
Pavement design incl	ludes the pavemen	t properties and types,	, design	of flexible	e and rig	id			
pavement, pavement e	valuation and rehab	ilitation and stabilizatior	n of soil f	or road con	struction				
9. Learning objectiv	es:								
1-To develop methods	through the knowle	dge of modern science a	and the te	chnology a	nd use the	m in			
the field.									
2-To prepare a map or	plan to represent an	area on a horizontal pla	.n.						
10. Course Outcomes (COs):									
At the end of course, the student will be able to:									
1. Understand the	basic concepts of p	avement analysis							
2. Students are a	ible understand the	material characterizat	ion for a	analytical f	flexible p	avement			
design									
3. Analysis the rig	gid pavement								
4. Understand the	techniques involve	d in road stabilization pr	ojects						
11. Unit wise detailed	content	1	5						
Unit-1	Number of	Title of the unit:							
	lectures = 10	Pavements and paven	nents des	sign param	eters				
Philosophy of design of	of pavements, Paven	nent selection criteria. Se	election o	of pavement	t design in	put			
parameters – traffic loa	ading and volume.			1	e	1			
1	U								
Unit – 2	Number of	Title of the unit:							
	lectures = 11	Flexible Pavement							
Material characterizati	on for analytical pay	vement design – CBR ar	d stabilo	meter tests	– Resilier	nt			
modulus – Fatigue sub	system – failure crit	teria for bituminous pave	ements –	IRC design	guideline	es.			
	5	1		U	0				
Unit – 3	Number of	Title of the unit: Rigid	d Pavem	ent					
	lectures = 10								
Design procedures for	rigid pavement – IF	RC guidelines – Airfield	pavemen	ts. Highwa	y pavemer	nt –			
CRC pavements.		C C	•	0	~ 1				
1									
Unit – 4	Number of	Title of the unit:							
	lectures $= 11$	Stabilization of Soils 1	For Road	l Construc	tions				
The need for a stabilize	ed soil – Design crit	eria and choice of stabil	$\frac{1}{12} = 10000$	esting and f	field contr	ol –			

Stabilization in India for rural roads – Use of geofabrics in unpaved road construction. Case studies.

### **12.** Books Recommended (3 Text Books + 2-3 Reference Books)

i) Sharma and Sharma, Principles and Practice of Highway Engg., Asia Publishing House, 1980

ii) KhannaS.K and Justo C.E.G, Highway Engineering, New Chand and Brothers, Roorkee, 1998

iii) Croney, D., Design and Performance of Road Pavements, HMO Stationary Office, 1979.

*iv)* Design and Specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New Delhi, 2001

v) Yoder R.J and Witchak M.W., Principles of Pavement Design, John Wiley, 2000.

vi) Guidelines for the Design of Flexible Pavements, IRC:37 - 2001, The Indian roads Congress, New Delhi.

1.	Name of the I	Department	CIVIL ENGINEERING							
2.	Subject	Experimental	L	Т		Р				
	Name	soil Mechanics								
		Lab								
3.	Subject		0	0		2				
	Code									
4.	Type of Subje	ect	Core (✓)	<b>PE()</b>		<b>OE</b> ()				
5.	Pre-	Soil Mechanics	Frequency (use tick	Even ()	Odd	Either	Every			
	requisite (if		marks)		(✔)	Sem	Sem			
	any)					0	0			
6.	Total Number	r of Lectures, Tut	orials, Practical, Assum	ing 14 weel	ks in sen	nester				
Lectu	res = 00		Tutorials = 00	Practical =	=28					

### 7. Learning objectives:

1. To understand the properties of soil.

2. To evaluate the and determine the properties of soil used in foundation and pavement design.

### **Outcomes:**

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

- 1. Understand the properties and behavior of various soil used in construction
- 2. student able to understand Requirements of design as per their Indian standard specified value
- 3. Study and evaluate strength and consolidation behavior of various soils

8. Lab Content							
Sr. No.	Title	CO covered					
1	Water Content, specific gravity,	1,2					
2	Liquid Limit, Plastic Limit,	1,2					
3	Core cutter test for density determination	1,2					
4	Compaction test	1,2					
5	Permeability test	1,2					
6	Constant head & falling head methods	1,2					
7	Determination of density Sand replacement method	1,2					
8	Estimation of settlement	2,3					
9	Compression index parameter	2,3					
10	Rate of settlement, coefficient of consolidation, Swell Pressure	2,3					
11	Triaxial Compression Test - Unconsolidated	2,3					
12	Undrained Tests, Consolidated Undrained Tests with Pore pressure measurement,	2,3					

1.	1. Name of the Department CIVIL ENGINEERING									
2.	Subject	Computer	L	Τ		Р				
	Name	application								
		in								
		engineering								
		Lab								
3.	Subject Code		0	0		2				
4.	Type of Sul	oject (use	Core $(\checkmark)$			<b>OE</b> ()				
5.	Pre-	Nil	6. Frequency (use	Even ()	Odd (✓)	Either	Every			
	requisite		tick marks)	~		Sem	Sem			
	(if any)					0	0			
7.	Total Numb	er of Lectures	, Tutorials, Practical							
Lectur	res = 00		Tutorials =00	Practical =	=28					
0.	Civil Engine	ering	for the r marysis and Desig		, iouncution	compon				
9.	Course Out	comes: Comple	ete understanding of founda	tion systems						
10.	<b>Detailed</b> Co	ntent								
1-Anal	ysis and desig	gn of concrete f	ooting							
2-Stee	l footing									
3-Raft	foundation									
4-Pile	cap									
5-Pile	foundation									
6-Anal	ysis of footin	g when soil sof	t							
7-Anal	ysis of footin	g when soil sof	t							
8-Anal	ysis of footin	g when soil sof	t							
9 – Co	mposite footi	ng								
10- Re	inforcement I	Detailing of fou	ndations							

# Second Semester

1. Name of the Depa	rtment: Civil Engi	neering Department					
2. Course Name	Rock	L	Т		Р		
	Mechanics						
3. Course Code		3	0		4		
4. Type of Course (u	se tick mark)	Core (✓)	PE()		OE()		
5. Pre-requisite (if	Nil	<b>6.</b> Frequency (use	Even	Odd ()	Either	Every	
any)		tick marks)	(✔)		Sem ()	Sem	
						0	
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Lectures =42Tutorials =0Practical =0							
8. Brief Syllabus							
Rock mechanics inclue	des the testing meth	ods of rock ,rock mass of	classificat	tion, in-situ	i testing a	nd	
methods to improve th	e engineering prope	rties of rock mass					
9. Learning objectiv	es:						
1-To study and analyze	e the laboratory and	field testing for a given	project /	constructio	on.		
2. To analyze the app	ropriate methods to	improve stability of roc	k mass				
10. Course Outcomes	(COs):						
At the end of course, the	he student will be al	ble to:					
1. Understand the	laboratory method	required for determination	on of roc	k properties	8		
2. Concept of Dis	continuities in rock	mass		1 1			
3. Understand stre	ength and stability b	ehaviour of rocks					
4. Application and	d recent development	nt in the field of soil med	chanics				
11. Unit wise detailed	content						
Unit-1	Number of	Title of the unit:					
	lectures =10	Introduction and Lab	oratory	Testing m	ethods		
Introduction: Rock:	Formation of rocks,	Physical properties, Cla	ssificatio	n of rocks a	and rock		
masses, Elastic consta	nts of rock; In-situ s	tresses in rock.					
Laboratory Testing n	nethods study: Roc	k sampling, Determinat	ion of dei	nsity, Poros	sity and W	ater	
absorption, Uniaxial C	ompressive strength	, Determination of elast	ic parame	eters, Tensi	le strength	n, Shear	
Strength, Flexural strength	ngth, Strength criter	ion in rocks, Swelling a	nd slake c	lurability, p	permeabili	ty,	
point load strength, Dy	vnamic methods of t	esting, Factors affecting	strength	of rocks.		-	
Unit – 2	Number of	Title of the unit:					
	lectures = 10	Discontinuities in Roo	ck Masse	S			
Discontinuities in Ro	ck Masses: Discont	inuity orientation, Effect	t of disco	ntinuities o	n strength	of	
rock ;		,,,			- 8		
Unit – 3	Number of	Title of the unit: In –	Strength	and failu	re criterio	n of	
	lectures =10	Rock	0				
Strength Behaviour:	Compression, Tensi	on and Shear, Stress-Str	ain relati	onships, Rl	neological		
behavior.	÷ ′			± ′	U		
Strength/ Failure Cri	terion: Mohr-Could	omb, Griffith theory, stre	ength and	other strer	ngth criteri	a.	
5		, , , , , , , , , , , , , , , , , , , ,	0		0		

Stresses in rock near underground openings.
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Unit – 4		Num	ıber	of	Title of the unit: Rock application and recen						ent							
		lectu	res	= 12	devel	opme	nt i	n ro	ock n	nec	ha	nics	5					
	•		•	D 1	11	1	-			•	1	1.1	1 1	. •			1	

**Application of rock mechanics:** Rock tunneling, rock slope stability, bolting, blasting, grouting and rock foundation design. Modern modelling techniques & analyses in rocks.

### **12. Books Recommended (3 Text Books + 2-3 Reference Books)**

i) Central Board of Irrigation and Power - Manual on Rock Mechanics, 1988.

ii) R. E. Goodman, "Introduction to Rock Mechanics" John Wiley & Sons, New York, 1989.

iii) Wakter Wittke, "Rock Mechanics" Springer Verlag, New York, 1990.

iv) Kiyoo Mogi "Experimental Rock Mechanics" Taylor & Francis Group, UK, 2007.

v) T. Ramamurthy, "Engineerng in Rocks for slopes, foundations and tunnels", PHI Learning Pvt. Limited, 2010.

1.	1. Name of the Department: Civil Engineering Department								
2.	Course Name	Advanced	L	Т		Р			
		Foundation							
		Engineering							
3.	Course Code		3	0		0			
4.	Type of Course (u	se tick mark)	Core (✓)	PE()		OE()			
5.	Pre-requisite (if	Nil	<b>6.</b> Frequency (use	Even	Odd ()	Either	Every		
	any)		tick marks)	<b>(</b> ✓)		Sem ()	Sem		
						0			
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)									
Le	ctures =42		Tutorials =0	Practica	al =0				
8.	Brief Syllabus								
In	this course, the stud	lents will know the	importance of foundatio	n engine	ering, bear	ing capaci	ty		
of	soil and study the ch	naracteristics and de	sign of various foundation	ons.					
9.	Learning objectiv	es:							
1-	To study the differe	nt types of foundation	ons based on site conditi	ons.					
2.	To Analyze and sug	gest remedial measu	res against foundation fa	ailures.					
10	. Course Outcomes	(COs):	-						
At	the end of course, the	ne student will be ab	ble to:						
	1. Understand soi	l exploration planni	ng for different foundation	on projec	ts				
	2. Design shallow	foundation							
	3. Design pile fou	ndation and well for	undation						
	4. Identifying and	measuring the failu	re criteria of foundation	and mea	sures.				
11	. Unit wise detailed	content							
Ur	nit-1	Number of	Title of the unit:						
		lectures = 10	Soil Exploration						
Pla	anning of soil explo	ration for different	projects, methods of sub	osurface e	exploration	, and meth	ods of		
bo	rings along with var	ious penetration test	ts.						
Ur	nit - 2	Number of	Title of the unit:						
~-		lectures = 10	Shallow Foundations						
Sh	allow Foundations	: Foundation classif	ication; Choice of found	ations; Is	olated four	idations –			
inc	lividual and combine	ed foundations, Raff	t foundations - Necessity	; Types o	of rafts; Bea	aring capa	city and		
set	tlement of rafts – Be	eams on elastic foun	dations.						
Ur	nt - 3	Number of	Title of the unit: Pile	Foundati	ions and w	ell founda	ations		
		lectures = 10							
Pil	le Foundations: Cla	ssification and Uses	s, Carrying capacity of S	ingle pile	e, Pile load	tests, cycl	ic pile		
102	id test, pull out resis	tance, laterally load	ed Piles; Pile groups - G	roup effic	ciency, Sett	lement of	single		
p1l	e and pile groups, N	egative skin friction	i, sharing of loads	CI	1				
W	ell Foundations: Ca	ussons – Types, adv	antages and disadvantag	ges, Shape	es and com	ponent par	rts, Grip		
ler	igth, Bearing capacit	ty and settlement, Fo	orces acting, Sinking of	wells, Re	ectification	of Tilts an	a Shifts		

Unit - 4	Number of	Title of the unit: Foundation Failure and remedial						
	lectures = 12	measure						
Foundation Failures : Types and causes of failures, Remedial measures, Shoring and Underpinning								
12. Books Recommen	ded (3 Text Books	+ 2-3 Reference Books)						
i) J. E. Bowles, "Fou	ndation Analysis &	Design", Mc.Graw Hill Book Co.						
ii) W. C. Teng, "Foun	dation Design", Pre	entice Hall of India Ltd						
iii) Tomlinson, "Found	iii) Tomlinson, "Foundation Design and Construction", ELBS, Longman Group Ltd.							
iv) Winterkorn and F	ang, "Foundation I	Engineering Hand Book", Van Nostrand Reinhold Co, New						
York.								

v) Bowles. J.E., Foundation Analysis and Design, Tata McGraw-Hill International Edition, 5th Edn, 1997.

1. Name of the Depa	1. Name of the Department: Civil Engineering Department								
2. Course Name	Soil Dynamics	L	Т		P				
	and Machine								
	Foundations								
3. Course Code		3	0		0				
4. Type of Course (u	ise tick mark)	Core (✓)	PE() OE()						
5. Pre-requisite (if	Nil	<b>6.</b> Frequency (use	Even	Odd ()	Either	Every			
any)		tick marks)	(✔)		Sem ()	Sem			
					0				
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)									
Lectures =42		Tutorials =0	Practica	al =0					
8. Brief Syllabus									
Learning objectives:									
1-To analyse and de	esign behaviour of	a machine foundation	resting	on the su	urface, en	nbedded			
foundation and foundation	tions on piles by ela	stic half space concept.							
2. To analyse and des	ign vibration isolatio	on systems							
9. Course Outcomes	s (COs):								
At the end of course, t	he student will be ab	ole to:							
1. Apply theory of	of vibrations to solve	dynamic soil problems							
2. Understand the	e mechanism of vibra	ation isolation							
3-Understand the c	concept of shocks an	d vibration useful to de	sign macl	hine founda	ation				
4-Analysis the pub	lic works account								
10. Unit wise detailed	l content								
Unit-1	Number of	Title of the unit:							
	lectures = 10	Theory of vibrations							
Theory of vibrations	: Introduction – Sc	il behavior under dynar	nic loads,	, Vibration	of single	and two			
degree freedom syste	m, Vibration of six	and multi degree free	dom sys	tem, Mass	spring ar	nalogy -			
Barkan's Theory.									
<b>Unit</b> – 2	Number of	Title of the unit:							
	lectures = 10	Vibration Isolation							
Vibration Isolation:	Introduction, Active	and passive isolation, M	lethods of	f vibration	isolation.				
11	N	T:41							
Unit - 3	Number of	Title of the unit:							
	1 = 10	Machine Foundations	j 	T	- 6 1 '				
foundations	is: General princip	ies of machine foundation being foundation.	tion design	gn, Types	of machi	nes and			
ioundations, General r	equirements of mac	nine ioundation, Permiss	sible amp	inudes and	stresses.				
Unit – 4	Number of	Title of the unit.							
	lectures $= 12$	Public Works Account	nt						
Tender and accentance	e of tender Earnest	money, security money	retention	n money m	easureme	nt book			
cash book preparation	examination and	navment of hills first a	nd final b	ills admin	istrative e	anction			
cush book, preparation	i, chammation allu	payment of onis, first a		, aunni		anction,			

technical sanction.

### 11. Books Recommended (3 Text Books + 2-3 Reference Books)

i) Bharath Bhusan Prasad, "Soil Dynamics and Earthquake Engineering", PHI, New Delhi, 2009.

ii) 2. S. Prakash, "Soil Dynamics", McGraw Hill Book Co., New York, 1999

### iii) S. Prakash and V. K. Puri, "Analysis and Design of Machine Foundations", McGraw Hill Book Co., New York, 1993

*iv)* 2. P. Sreenivasulu and C. V. Vidyanathan, "Hand Book of Machine Foundation", Tata McGraw Hill, New Delhi, 1981

1. Name of the Depar	rtment: Civil Engi	neering Department							
2. Course Name	Soil strength	L	Т		Р				
	behavior								
3. Course Code		3	0		0				
4. Type of Course (u	se tick mark)	Core (✓)	PE()		OE()				
5. Pre-requisite (if	Nil	<b>6.</b> Frequency (use	Even	Odd ()	() Either Eve				
any)		tick marks)	(✔)	~	Sem ()	Sem			
					0				
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)									
Lectures =36	·	Tutorials =0	Practic	al =0					
8. Brief Syllabus			I						
This Course will introd	luce the knowledge	about soil formation an	d mineral	logy, soil fa	abric and i	its			
measurement, clay-wa	ter interaction, effe	ective granular and tota	al stress,	volume ch	ange, she	ar			
strength and deformation	on behavior.								
9. Learning objective	es:								
1. Define possible rea	sons for the obser	ved phenomenon under	scientif	ic investig	ations for	solving			
engineering problems.									
2. Identify soil fabric b	y direct and indirec	t measuring method.							
10. Course Outcomes	(COs):								
At the end of course, th	ne student will be ab	ble to:							
1. Understand the	soil formation pher	omenon and identify mi	inerals as	per their p	roperties				
2. Identify soil fab	pric elements and m	easure properties of fabr	ric	<u>1 1</u>	1				
3. Understand the	concept of clay -wa	ater interaction							
4. Measure and an	alysis volume char	nge, shear strength and d	leformation	on behavio	our of soil				
11. Unit wise detailed	content								
Unit-1	Number of	Title of the unit:							
	lectures = 10	Soil formation and mi	ineralogy	V					
Soil formation and m	ineralogy: Origin	of clay minerals, sedim	ent erosi	on, transpo	ort and dep	oosition;			
clay mineral types and	d their importance	in geotechnical engine	ering; gra	avel, sand	and silt p	articles;			
Determination of soil c	omposition, X-Ray	diffraction, Scanning E	lectron M	licroscope	-				
Unit - 2	Number of	Title of the unit:							
	lectures = 10	Soil fabric and its me	asureme	nt					
Soil fabric and its mea	asurement: Fabrics	and fabric elements, co	ntact for	ce character	rization, v	oids and			
their distribution, pore	size distribution and	alysis, methods of fabric	characte	rization					
Unit - 3	Number of	Title of the unit: Clay	-water ir	nteractions	5				
	lectures = 10								
Clay-water interactio	ons: Mechanisms o	f soil-water interaction	, propert	ies of adso	orbed wate	er; clay-			
water-electrolyte system	m, diffuse double la	yer theory; cation excha	nge, Soil	chemical i	nteraction	s			
Unit - 4	Number of	Title of the unit : Volu	ume chai	nge, shear	strength a	and			

**Volume change, shear strength and deformation behavior:** General volume change behaviour of soils, physical interactions, fabric, structure and volume change; General characteristics of strength and deformation, fabric, structure and strength; friction and physical interactions among soil particles

### **12.** Books Recommended (3 Text Books + 2-3 Reference Books)

i) L. D., Baver, "Soil Physics", Asia Publishing House, 1960.

ii) 2. Malcom D. Bolton, "A Guide to Soil Mechanics", University Press (India) Pvt. Ltd., 2003.

iii) J. K., Mitchell, "Fundamentals of Soil Behavior", John Wiley & Sons Inc., 1993.

iv) 2. Nyle C. Brady and Ray R. Weil, "The Nature and Properties of Soils", Pearson Education Inc., 2002

2. Subject NameRock LabMechanics MechanicsLTP3. Subject Code0024. Type of SubjectCore (✓)PE()OE()	em
Lab     □     □     □       3. Subject Code     0     0     2       4. Type of Subject     Core (✓)     PE()     OE()	em
3. Subject Code   0   0   2     4. Type of Subject   Core (✓)   PE()   OE()	Every em
<b>4. Type of Subject</b> Core ( $\checkmark$ )PE()OE()	Every em
<b>4. Type of Subject</b> Core (*) PE() OE()	em
	Every em
<b>5. Pre-requisite (if</b>   Nil   Frequency (use tick   Even   Odd ()   Either   H	em
$(\checkmark) \qquad \qquad \text{marks} \qquad (\checkmark) \qquad \qquad \text{Sem}  \text{S}$	)
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)	
Lectures = 00Tutorials = 00Practical = 28	
7. Learning objectives:	
1-To study and analyze the laboratory and field testing for a given project / construction.	
2 -To analyze the appropriate methods to improve stability of rock mass.	
8. Course Outcomes (COs):	
At the end of the lab course student able to	
1-Understand the laboratory method required for determination of rock properties	
2-Concept of Discontinuities in rock mass	
3-Understand strength and stability behaviour of rocks	
4-Application and recent development in the field of soil mechanics	
9. Unit wise detailed content( Tutorial / Extended Tutorial /presentation/Case s	study
components/laboratory)	
10. Tutorial / Extended Tutorial /Case study components/laboratory	
Sr. No Title	
1 Study phenomenon of rock formation	
2 Determination of physical properties of rocks	
3 Calculation of in-situ stresses in rocks	
4 Rock sampling methods	
5 Study about discontinuities of rock mass	
6 Laboratory study to determine strength characteristics of rocks	
7 Recent development to improve the stability of rocks	
8 Modern modelling techniques & analyses in rocks.	

1. Name o	ame of the Department CIVIL ENGINEERING							
2. Subject	Name	Advanced	L	Τ		Р		
		Geotechnical Lab						
3. Subject	Code		0	0		2		
4. Type of	Subject		Core (✓)	PE()		OE()		
5. Pre-req	uisite (if	Nil	Frequency (use tick	Even	Odd ()	Either	Every	
any)	-		marks)	(🗸)		Sem	Sem	
						0	0	
6. Total N	umber of	Lectures, Tutorials, P	ractical (assuming 14	weeks o	of one sem	ester)		
Lectures :	= 00		Tutorials = 00	Practi	cal = 28			
7. Learnin	ng objectiv	ves:						
1. To und	lerstand th	e properties of soil.						
2. To evalu	uate the an	d determine the propert	ies of soil used in found	ation an	d pavemer	nt design		
8. Course	Outcome	s (COs):						
At the end	l of the la	o course student able t	0					
Understan	d the beari	ng strength of soil						
2. student	able to und	lerstand Requirements of	of design as per their Inc	lian star	ndard			
3. Study an	nd evaluate	e bearing capacity of soi	il required for designing	founda	tion structu	ure		
9. Unit wi	se detaileo	l content						
10. Tutor	ial / Exter	nded Tutorial /Case stu	idy components/labora	atory/Fi	eld visit			
Sr. No	Title							
1	Test incl	udes determining the be	earing capacity of soil.					
2	Californ	ia bearing Ratio test (CI	BR) for soft soil, Mediu	m hard s	soil and sti	ff and ha	rd soil	
2	sample.							
3	Dynamic	c cone penetration test ()	DCPT) for different type	es of soi	l sample			
4	Static co	ne penetration test (SPT	) for different types of s	soil				
5	Plate loa	d tests for soft ,medium	and hard soil sample					
6	Pile load	test analysis						
7	Core cut	ter test						

# Third Semester

1. Name of the Depa	1 Name of the Department: Civil Engineering Department							
2. Course Name	Earth & Rock	<u>Г</u>	Т		Р			
	fill Dame	L	1		1			
3 Course Code	III Dailis	3	0		0			
J. Course Cour	ica tial mark)	$\frac{5}{Coro}$						
4. Type of Course (u			FE()	$O_{11}(f)$				
5. Pre-requisite (II	IN11	<b>6.</b> Frequency (use	Even	Udd (* )	Either	Every		
any)		tick marks)	0		Sem ()	Sem		
						()		
7. Total Number of	Lectures, Tutorials	, Practical (assuming 1	4 weeks (	of one sem	ester)			
Lectures =42		Tutorials =0	Practica	1 =0				
8. Brief Syllabus								
This Course will intro	duce the knowledge	e about dam and its sele	ection cri	teria, seepa	age throug	gh		
the foundation and da	m section, foundat	ion treatment methods	,stability	analysis a	nd study	of		
failure and remedial m	easure in dam							
9. Learning objectiv	es:							
1 To analyze seepage	through a given ea	urth/rockfill dam section	and sele	ct effectiv	e seepage	control		
measures for the preva	iling site conditions							
2. To study and analyz	ze stability of slopes	and evaluate the failure	criteria.					
10 Course Outcomes	$(\mathbf{COs})$							
At the end of course, the	e student will be a	le to:						
1 Select a suitabl	a site materials and	aquinment for construct	tion of our	th/roal/fill	dama			
1. Select a sultabl	d reals fill dama	equipment for construct	lion of ear		uams			
2. Design earth ar								
3. Understand the	concept of foundati	ion treatment						
4. Measure and ar	halysis the failure in	iside the body of dam						
11. Unit wise detailed	content							
Unit-1	Number of	Title of the unit:						
	lectures = 10	Dams and site selection	on of dam	l				
Introduction: Classifi	cation of dams- Sele	ection of Site-Basic desi	gn require	ements Pre	liminary s	ection.		
<b>Unit</b> – 2	Number of	Title of the unit:						
	lectures = 10	Seepage through dam	section a	and foundation	ation			
Seepage through dam	n section and contr	ol: fundamentals of see	page flow	, flow nets	s, seepage	through		
dam section and found	ation, seepage contr	ol filters, Impervious co	re, draina	ge.				
Control of seepage t	hrough foundation	<b>n:</b> types of foundations	s trench c	cutoff, ups	tream im	pervious		
blanket, horizontal drainage blanket, relief wells, drainage trenches, cut-off walls, downstream loading								
berm.								
Unit – 3	Number of	Title of the unit:						
	lectures $= 10$	Foundation treatment	t and Stal	bility anal	vsis			
Foundation treatmen	t. treatment of perv	ious impervious and roo	$\frac{1}{2}$ k foundat	tions core	contact tr	eatment		
arouting foundation of	very ation		. iounual			cument,		
stokility and lot	tion alignments	test conditions -to (1				at a k : 1 : +		
Stability analysis: cri	lical sup surfaces,	test conditions, strength	i paramete	ers, pore p	messures,	stability		

analysis-method of slices

Unit – 4	Number of	Title of the unit:			
	lectures = 10	Construction and failure in dams			
Construction of ear	th dams: constru	ction equipment, procedures for pervious, semi pervious,			
impervious and rock fi	ll sections, construc	tion supervision.			
Failures and damage	s of earth dams: na	ature of failures – piping, settlement cracks, slides, earthquake			
& miscellaneous dama	ges –case studies.				
	0				
12. Books Recommended (3 Text Books + 2-3 Reference Books)					
i) Sherard, et.al., "EA	ARTH AND ROCK	DAMS", john wiley inc1963.			
ii) H. D. Sharma, "En	mbankment dams", (	Oxford and IBH Publishing Co1991			
iii) Bharath Singh a	nd R. S. Varshne	y, "engineering for embankment dams" A. A. Balekema			
publications, 1995.					
$\cdots$ ) N 1 C D 1 1					

*iii*) Nyle C. Brady and Ray R. Weil, "The Nature and Properties of Soils", Pearson Education Inc., 2002

1.	I. Name of the Department CIVIL ENGINEERING						
2.	Course Name	Research	L	Т		Р	
		Methodology					
		and IPR					
3.	Course Code		3	0		0	
4.	Type of Course (u	se tick mark)	Core (✓)	PE-()		OE()	
5.	Pre-requisite (if		6. Frequency (use	Even	Odd	Either	Every
	any)		tick marks)	0	(✔)	Sem ()	Sem
							0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Le	ctures = 42		Tutorials $= 00$	Practica	l = 0		

### 8.Brief Syllabus:

The aim of the course is to make students understand the importance of Research Paper Writing. Also, it covers all the concepts which involved in writing the Research Paper.

### 9 Learning objectives:

The objectives of the course are:

- 1. The students are able to recognize the steps involved in doing research work.
- 2. The students will be able to collect data using various media and using the best possible sample available.
- 3. The students would learn to propose their Hypothesis and build models for the problem.
- 4. The students would be able to correctly document their findings in the form of a report.

### **10.Course Outcomes:**

After completion of this course, the student will be able to:

- 1. Recognize the various steps involved in research.
- 2. Collect data from samples, Examine and analyze the data.
- 3. Develop models for problems.
- 4. Explain the entire process in the form of a report.

### 11.Unit wise detailed content

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

Research - Types, Research process and steps, Hypothesis, Research Proposal and aspects. Research Design- Need, Problem Definition, Variables, Research Design concepts, Literature survey and review, Research design process, Errors in research. Research Modeling- Types of models, model building and stages, Data consideration.

Unit - 2	Number of	Title of the unit: Sampling
	lectures = 10	
Sampling and data col	lection- Techniques	s of sampling, Random, Stratified, Systematic, Multistage-

Sampling and data collection- Techniques of sampling, Random, Stratified, Systematic, Multistagesampling, Primary and secondary sources of data. Design of questionnaire.

Unit - 3	Number of	Title of the unit: Data Collection and Experiments
	lectures = 10	
Design of Experiments	s- Objectives, strateg	gies, Factorial experimental design, designing engineering
experiments, basic prin	nciples-replication, r	andomization, blocking, guidelines for design of
experiments.		
Unit - 4	Number of	Title of the unit: Models and Hypothesis & Report
	lectures = 12	writing
Single factor experime	ent- Hypothesis test	ting, analysis of Variance component (ANOVA) for fixed
effect model; Total,	treatment and erro	r of squares, Degrees of freedom, Confidence interval;
ANOVA for random e	ffect model, estimat	ion of variance components, Model adequacy checking.
Structure and compor	nents of Scientific l	Reports, Types of Report, Technical Reports and Thesis;
Different steps in the	preparation - Layo	ut, structure and Language of typical reports; Illustrations
and tables, Bibliograph	ny, Referencing and	foot notes.
12.Brief Description	of self learning / E-	learning component
https://research-me	thodology.net/resea	rch-methodology/
https://gradcoach.c	om/what-is-research	n-methodology/
13.Books Recommend	ded	
Text Book:		
1. Research Meth	odology - Methods	and Techniques – C.R. Kothari, New Age International,
New Delhi, 200	04.	
<b>Reference Book:</b>		
1. Design and Analys	is of Experiments -	Douglas C. Montgomery, Wiley India, 8th Edition,
2012.		

2. Practical Research: Planning Design – Paul D. Leddy, London, 1980.

1. Name of the DepartmentCIVIL ENGINEERING								
2.	Subject	Research	L	Т		Р		
	Name	Methodology						
		and IPR Lab						
3.	Subject		0	0		2		
	Code							
4.	Type of Subje	ect	Core (✓)	<b>PE()</b>		<b>OE</b> ()		
5.	Pre-	Research	Frequency (use tick	Even ()	Odd	Either	Every	
	requisite (if	Methodology	marks)		(✔)	Sem	Sem	
	any)	and IPR				0	0	
6.	6. Total Number of Lectures, Tutorials, Practical (Assuming 14 weeks in semester)							
Lectures = 00			Tutorials = 00	Practical	=28			

### Lectures = 00

### 1. Learning objectives:

The objectives of the course are:

- 2. The students are able to recognize the steps involved in Identifying research problem.
- 3. The students will be able to collect data using various media and using the best possible sample available.
- 4. The students would learn to propose their Hypothesis and build models for the problem.
- 5. The students would be able to correctly document their findings in the form of a report.

### **Outcomes:**

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

- 1. Choose the topic for writing research paper.
- 2. Develop models for problems.
- 3. The students would learn to write the research paper.

7. Lab C	7. Lab Content					
Sr. No.	Title	CO covered				
1	How to choose topic for research	1,2				
2	How to collect data for the particular research problem	1,2				
3	Writing Abstract	1,2				
4	Writing Literature review	1,2				
5	Explaining and writing methodology	1,2				
6	How to analyze the data collected	1,2				
7	Presentation of analysis and findings	1,2				
8	How to write result and conclusion	2,3				
9	References in research article	2,3				

## Departmental Elective

1. Name of the Depa	artment	CIVIL ENGINE	ERING			
2. Course Name	Strength and	L	ТР			
	Deformation					
	Behavior of soil					
3. Course Code		3	0		0	
4. Type of Course (u	se tick mark)	Core ()	PE (✓) OE()			
5. Pre-requisite (if	Nil	<b>6.</b> Frequency (use	Even	$\operatorname{Odd}(\checkmark)$	Either	Every
any)		tick marks)	0		Sem ()	Sem
						0
7. Total Number of	Lectures, Tutorials	, Practical (assuming 1	4 weeks	of one sem	ester)	
Lectures =38		Tutorials =0	Practica	al =0		
8. Brief Syllabus						
This subject includes	the strength charact	eristics and different type	pes of fin	e and coar	se soils an	nd
their deformation beha	vior					
9. Learning objectiv	es:					
1. To understand the st	rength behavior of s	soils.	-			
2. To know the different	nt concepts for the a	nalysis of failure behavi	or of soil			
3. To identify the failu	re pattern of soil.					
10. Course Outcomes	(COs):					
At the end of course, the	he student will be ab	le to:				
5. Identify the me	thod of shear streng	th determination.				
6. Understand the	importance of vario	ous shear parameter and	deformat	ion behavio	or of vario	us soils
7. Understand Yie	eld criterion of soil					
8. Measure and an	nalysis volume char	nge, and deformation be	haviour c	of soil		
11. Unit wise detailed	content					
Unit-1	Number of	Title of the unit:				
	lectures = 10	Shear strength of coh	esion less	s soils		
Shear strength of grant	alar soils - Direct sh	ear - Triaxial Testing- D	rained an	d undraine	d Stress st	rain
behaviour - Dilation, c	ontraction and critic	al states - Liquefaction	on saturat	ed sands. F	Factors	
influencing stress-strai	n shear strength.					
Unit - 2	Number of	Title of the unit:				
	lectures = 10	Shear strength of coh	esive soil	S		
Shear strength of clays	- Stress-strain beha	viour - Triaxial testing a	and stress	path plotti	ng - pore j	pressure
parameter of Skempton	n and Henkel - Tota	l stress and effective stre	ess approa	ach - shear	strength o	f
partially saturated clay	in terms of stress st	ate variables. Factors in	fluencing	stress strai	in shear st	rength.
Unit - 3	Number of	Title of the unit:				
	lectures = 10	Yield criterion				
Yield criterion: Conce	epts of yield and fail	lure in soils- yield criter	ia of von	Mises, Tre	sca and the	eir
extended form, their ap	oplicability to soils -	Detailed discussion of I	Mohr C	Coulomb fai	ilure criter	rion
Unit - 4	Number of	Title of the unit:				
	lectures $= 12$	Stress - strain laws for	r soils			
			~ ~>			

hyperbolic law - Linear visco-elastic and Elasto -plastic laws - yield functions, hardening law, flow rules and plastic strain computation - Rheological models of Kelvin, Maxwell and Burger and Burger as applied to soils.

### **12.** Books Recommended (3 Text Books + 2-3 Reference Books)

v) Hotlz, R.D and Kovacs, W.D., Introduction Geotechnical Engineering, Prentice-Hall, 1981

vi) Braja, M, Das., Advanced soil mechanics, McGraw Hill, 1997.

vii) Lambe, T.W. and Whitman R.V. Soil Mechanics in S.I. Units John Wiley, 1979.

*viii)* Atkinson J.H. and BrandsbyP.L. Introduction to critical state soil mechanics McGraw Hill, 1978.

ix) Wood, D.M., Soil behaviour and Critical State Soil Mechanics, Cambridge University Press, New York, 1990.

x) Bazant, Z.P., Mechanics of Geo-materials, Rocks, Concrete and Soil, John Willey and Sons, Chilchester, 1985.

1. Name of th	e of the Department CIVIL ENGINEERING						
2. Subject Na	ame	Strength and	L	Т		Р	
		Deformation					
		Behaviour of soil					
3. Subject Co	ode		0	0		4	
4 Type of Su	hiect		Core ()	 	<u>´)</u>	OF()	
4. Type of Su	ibjeet			IL(	)	OL()	
5. Pre-requisi	ite (if	Nil	Frequency (use tic	k Even	Odd (✓)	Either	Every
any)			marks)	0		Sem	Sem
						0	0
6. Total Num	ber of ]	Lectures, Tutorials,	Practical (assuming 1	4 weeks o	of one seme	ster)	
Lectures = 00	0		Tutorials = 00	Pract	ical = 28		
7. Learning o	objectiv	ves:	<b>2</b> 11				
1. To underst	and the	strength behaviour of	t soils.	· .	.1		
2. To know the	the fail	ent concepts for the a	nalysis of failure behav	10ur of so	011.		
3. To identify	the fair						
8. Course Ou	itcomes	s (COs):					
At the end of	the lab	o course student able	to				
I- Identif	ty the m	hethod of shear streng	th determination.	1.1.0	. 11	• •	•
2- Unders	stand th	ne importance of vari	ious shear parameter a	na aetori	nation bena	vior of	various
3 Under	stand V	ield criterion of soil					
	tre and a	analysis volume chan	a and deformation be	haviour	of soil		
9 Unit wise d	letailed	content	ge, and deformation be		5011		
10. Tutorial	/ Exten	ded Tutorial /Case s	tudy components/lab	oratory/F	ield visit		
Sr. No Ti	itle			<i></i>			
1 Dr	rained u	indrained tests on soil					
2 Str	udy of I	liquefaction and reme	dial measure				
3 Sk	Skempton and Henkel - Total stress and effective stress analysis						
4 Co	oncepts	of yield and failure in	n soils				
5 Pla	astic str	rain computation					
6 Rh	Rheological models of Kelvin						
7 M	Mohr Coulomb failure criterion						
1. Name of the Depa	rtment: Civil Engi	neering Department					
--	------------------------	----------------------------	-------------	----------------------------------	-------------	----------	
2. Course Name	Computational	L	Т		Р		
	Methods in						
	Geotechnical						
	Engg						
3. Course Code		3	0		0		
4. Type of Course (u	ise tick mark)	Core ()	PE(✓)		OE()		
5. Pre-requisite (if	Nil	<b>6.</b> Frequency (use	Even	$\operatorname{Odd}(\checkmark)$	Either	Every	
any)		tick marks)	0		Sem ()	Sem	
						0	
7. Total Number of	Lectures, Tutorials	, Practical (assuming 1	4 weeks o	of one sem	ester)		
Lectures =42		Tutorials =0	Practica	al =0			
8. Brief Syllabus							
This course imparts th	e student's knowled	ge of solution of non-lin	ear equati	ions, soluti	on of OD	E using	
numerical techniques.							
Learning objectives:							
To develop the unders	tanding of computat	ional methods in geotec	hnical eng	gineering.			
9. Course Outcomes (COs):							
At the end of course, the student will be able to:							
1. Solve non-linear e	quations using nume	rical techniques.	· ·	1 •	11	1 1	
2. Apply the basic co	ncepts of tensor algo	ebra and calculus in con	tinuum me	echanics p	roblems a	nd solve	
linear equation using	ng numerical technic	ques.	1 1 '	6	1 • 1 4		
3. Apply finite differe	ence and finite elem	ent method for analyzing	g behavioi	r of geotec	hnical stru	ictures	
4. Apply the basic co	ncepts of critical sta	te soil mechanics for co	nstitutive	modeling	n Geomeo	chanics	
10. Unit wise detailed	content						
Unit-1	Number of	Title of the unit: Solu	tion of No	on-linear l	Equations	5	
	lectures = 10				-		
Solution of Non-linear	Equations: Bisection	n, False Position, Newto	on-Raphso	on, Success	sive		
approximation method	, Iterative methods.		-				
Unit – 2	Number of	Title of the unit: Solu	tion of set	t of Linea	r Equatio	ns	
	lectures =10						
Solution of set of Line	ear Equations: Jacob	oi's method, Gauss Seid	al method	l, Successi	ve over re	laxation	
method.							
Unit – 3	Number of	Title of the unit: Solu	tion of O	DE using	numerica		
	lectures $= 10$	techniques:				-	
Solution of ODE usin	ng numerical techni	ques: Initial value prol	blems and	l boundary	value n	oblems:	
Taylor series method.	Picard's method. Eu	ler's method. Runge-Ku	tta method	d	P-		
The continuum theory	of Soil Mechanics.	methodology of continu	um mech	nanics, intr	oduction t	o tensor	
algebra and tensor cal	culus, deformation a	nd strain, traction and st	ress	,			
	,	, .					

Unit – 4	Number of	Title of the unit:
	lectures = 12	Finite Difference Method

Finite Difference Method: Boundary value and Initial value problems – Disichlet conditions, Neumann conditions; ordinary and partial differential equations; Nonlinear problems Introduction to Finite Element Method: Formulation of weak form, interpolation functions

Constitutive modelling of soil: Critical state soil mechanics; Elastic-plastic constitutive models; Original Cam-Clay model and Modified Cam-Clay model.

#### **11.** Books Recommended (3 Text Books + 2-3 Reference Books)

 S. Chandrakant., Desai and John T. Christian, "Numerical Methods in Geotechnical Engineering", Mc. Graw Hill Book Company, 1977.

ii) 2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, "Numerical Methods for Scientific and Engineering computations", Third edition, New Age International (P) Ltd. Publishers, New Delhi. 2010.

iii) D.J. Naylor and G.N. Pande, "Finite Elements in Geotechnical Engineering", Pineridge Press Ltd., UK. 1981

*iv)* 2. Sam Helwany, "Applied Soil Mechanics with ABAQUS Applications", John Wiley & sons, Inc, USA, 2007.

v) 3. Alexander Puzrin, "Constitutive Modelling in Geomechanics: Introduction", Springer, 2012

1. Name of the Dep	1. Name of the DepartmentCIVIL ENGINEERING					
2. Subject Name	Computational	L	Т		Р	
	Methods in					
	Geotechnical Engg					
	Lab					
3. Subject Code		0	0		4	
4 Type of Subject		Core ()	PF (✓		OF()	
+ Type of Subject			12 (	)	OL()	
5. Pre-requisite (i	f Nil	Frequency (use tick	Even	Odd	Either	Every
any)		marks)	0	<b>(</b> ✓)	Sem	Sem
					0	0
6. Total Number of	Lectures, Tutorials, Pr	ractical				
Lectures = 00		Tutorials = 00	Practi	cal = 28		
7. Learning objecti	ves:					
1. To develop the u	1. To develop the understanding of computational methods in geotechnical engineering.					
8. Course Outcome	s (COs):					
At the end of the la	b course student able to	0				
1- Solve non-linear	equations using numerica	al techniques				
2-Analyse and calcu	late the set of linear equa	ations				
3-Undestand the car	n clay model and constitu	utive modeling of soil				
9. Unit wise detaile	d content					
10. Tutorial / Exte	nded Tutorial /Case stu	dy components/labora	tory			
Sr. No Tit	le					
1 Bis	ection methods for Non-	linear Equations				
2 Ite	ative methods comparison	ons				
3 So	ution of set of Linear Eq	luations by using succes	sive ove	er relaxatio	on metho	d.
4 An	alysis of Finite Difference	ce Method				
5 То	study methodology of co	ontinuum mechanics				
6 Stu	dy of Modified Cam-Cla	ay model				
7 Co	nstitutive modelling of s	oil				

1. Name of t	he Depa	rtment: Civil Engi	neering Department				
2. Course Na	ame	Construction	L	Т		Р	
		Methods and					
		Equipment					
3. Course Co	ode		3	0		0	
4. Type of C	ourse (u	ise tick mark)	Core ()	PE (✔)		OE()	
5. Pre-requi	site (if	Nil	6. Frequency (use	Even	$\operatorname{Odd}(\checkmark)$	Either	Every
any)			tick marks)	0		Sem ()	Sem
-							0
7. Total Nur	nber of	Lectures, Tutorials	, Practical (assuming 1	4 weeks	of one sem	ester)	
Lectures =42			Tutorials =0	Practic	al =0		
8. Brief Sylla	abus						
Construction I	Methods	and Equipment cou	urse includes the study o	f modern	constructi	on materia	al,
modern constr	ruction 1	nethods and equipn	nent's and advanced stu	udy of po	olymers in	the field	of
civil engineeri	ng.						
9. Learning	objectiv	es:					
1. To crea	ate an av	vareness in Engineer	rs about construction me	thods and	d equipmen	t's.	
2. To und	erstand t	he modern materials	s used in modern constru	iction.			
10. Course O	utcomes	(COs):					
At the end of o	course, t	he student will be ab	ole to:				
1. Students u	nderstan	d the technology of	uses of modern material	and equi	ipment.		
2. Understand	d the sig	nificance of constru	ction methods involve ir	n modern	constructio	on techniq	ues
3. Use of diff	ferent co	nstruction equipmer	nt's and their capabilities	8.			
4. Identify th	e proper	ties of advanced pol	ymers				
11. Unit wise	detailed	content					
Unit-1		Number of	Title of the unit:				
		lectures = 10	Modern Construction	Materia	ıls		
Study of Adva	ince Bui	lding Materials like,	Aluminium, Glass, fabr	ric, variou	is types of t	finishes &	
treatments, Co	onstructio	on chemicals – seala	ints, engineering grouts,	mortars,	admixture	s and adhe	esives,
Plastic,FRP.							
Unit – 2		Number of	Title of the unit:				
_		lectures = 10	Construction Method	S			
Precast Flat F	Panel Sys	stem, 3d Volumetric	c Construction, Tunnel I	Boring M	ethods, Pre	ecast Four	ndations.
Fabrication of	f Pre-Ca	st and Pre-Stressed	l Components, Reinford	cing Stee	el: Types,	Bending,	Placing,
Splicing and S	pacing,	Tendons- Soil Impro	ovement - Mechanical, T	Thermal.			
Unit – 3		Number of	Title of the unit: Cons	struction	Equipmen	nt	
		lectures = 10					
Equipment for	or Exca	vating, Dredging,	Trenching, Tunneling	, Drillin	g, Blastin	g-Equipm	ent for
compaction-E	rection I	Equipment- Types o	f pumps used in constru	uction-Ec	uipment fo	or Dewate	ring and
Compaction-Erection Equipment- Types of pumps used in construction-Equipment for Dewatering and Grouting-Foundation and Pile Driving Equipment							-
Equipment for Excavating, Dredging, Trenching, Tunneling, Drilling, Blasting-Equipment for compaction-Erection Equipment- Types of pumps used in construction-Equipment for Dewatering and Grouting Foundation and Pile Driving Foundation					juipment fo	or Dewater	ring and

Unit – 4	Number of	Title of the unit:
	lectures = 12	Study of advanced Polymers in Civil Engineering

Polymers in Civil Engineering-Structural Plastics and Composites- Polymer Membranes Coatings-Adhesives, Non - Weathering Materials-Flooring and Facade Materials- Glazed Brick, Photo Catalytic Cement, Acid Etched Copper and Composite Fiber Metals-Metals and Special Alloys Of Steel.

#### **12. Books Recommended (3 Text Books + 2-3 Reference Books)**

i) Shan Somayaji, "Civil Engineering Materials", 2nd Edititon, Prentice Hall Inc., 2001.

- ii) Mamlouk, M.S. and Zaniewski, J.P., " Materials for Civil and Construction Engineers ", Prentice Hall Inc., 1999.
- iii) Derucher, K.Korfiatis. G. and Ezeldin, S., " Materials for Civil and Highway Engineers ", Prentice Hall Inc., 1999. 4th Edition
- iv) Peurifoy, R.L., Ledbetter, W.B.and Schexnayder, C., "Construction Planning, Equipment and Methods ",5th Edition, McGraw Hill, Singapore, 1995. 5. Sharma S.C. "Construction Equipment and Management ", Khanna Publishers New Delhi, 1988.
- v) Dr. Mahesh Varma, "Construction Equipment and its Planning and Application ", Metro-politan Book Company, New Delhi-, 1983.

vi) Deodhar, S.V. "Construction Equipment and Job Planning ", Khanna Publishers, New Delhi, 1988.

1. Name of the DepartmentCIVIL ENGINEERING						
2. Subject Name	Construction	L	Т	Р		
	methods and					
	Equipments					
	Laboratory					
3. Subject Code		0	0	4		
4. Type of Subject		Core ()	PE (✓)	OE()		
5. Pre-requisite (if	Nil	Frequency (use tick	Even $Odd(\checkmark)$	Either	Every	
any)		marks)	0	Sem	Sem	
				0	0	
6. Total Number of I	ectures, Tutorials,	Practical				
Lectures = 00		Tutorials = 00	<b>Practical = 28</b>			
7. Learning objective	es:	1				
1. To create an av	wareness in Engineer	s about construction met	hods and equipmer	nt's.		
2. To understand	the modern materials	s used in modern constru	iction			
8. Course Outcomes (COs):						
At the end of the lab course student able to						
1-Students understand	the technology of us	es of modern material an	nd equipment.			
2-Understand the sign	ificance of construct	on methods involve in n	nodern construction	i techniqu	ues	
3-Use of different con	struction equipment'	s and their capabilities.				
4-Identify the properti	es of advanced polyr	ners				
9. Unit wise detailed	content	4 d				
Sr. No	Titlo	tudy components/labor	alory			
1						
1	Identification and det	ermination of properties	of modern building	g materia	ls	
2	Tunnel Boring Metho	ods				
3	Study about precast a	and cast in-Situ construct	tion methods of fou	ndation		
4	Understanding the pre-tensioning and post tensioning methods					
5	Field Grout methods and its effect					
6	Drilling methods					
7	Understanding of dif	ferent types of polymers	used in constructio	n		
8	Freezing and thawing	g test for materials				

1. Name of the Depar	rtment: Civil Engi	neering Department				
2. Course Name	Advanced	L	Т		Р	
	Pavement					
	Materials					
3. Course Code		3	0		0	
4. Type of Course (us	se tick mark)	Core ()	PE (✓)		OE()	
5. Pre-requisite (if	Nil	<b>6.</b> Frequency (use	Even	Odd (✓)	Either	Every
any)		tick marks)	0		Sem()	Sem
		,	~		<sup>v</sup>	0
7. Total Number of I	Lectures, Tutorials	, Practical (assuming 1	4 weeks	of one sem	ester)	~
Lectures =42	,	Tutorials =0	Practica	al =0	,	
8. Brief Syllabus						
Advance pavement mat	terials course incluc	les				
9. Learning objective	es:					
1 To understand the pro	operties of different	paving materials				
2. To study the behavio	r of bituminous bin	der and modified binder	as per th	eir use in r	avement l	aver.
, , , , , , , , , , , , , , , , , , ,			I. I.	r i i i		
<b>10. Course Outcomes</b>	10. Course Outcomes (COs):					
At the end of course, the student will be able to:						
1. Understand the characteristics and behaviour of soil subgrade and various soil deposits						
2. Understand the behavior of various material used in construction of pavement design						
3. Select appropria	ate asphalt binder fo	or construction of a flexi	ble paven	nent depen	ding upon	the
traffic and climation	atic conditions.					
4. Determine the p	proportions of ingre	dients required for the m	nix design	of both as	phalt mixt	tures
and cement con-	crete.	-	_		-	
11. Unit wise detailed	content					
Unit-1	Number of	Title of the unit: Intro	oduction-	Sub grade		
	lectures = 10			_		
Introduction -Sub grad	de functions, Impo	rtance of sub grade soil	propertie	s on paver	nent perfo	ormance.
Identification and signi	ficance of soil char	acteristics, Soil classific	ation, Eff	ect of wate	er on swel	ling and
shrinkage, Cohesion an	d Plasticity					-
	•					
Unit – 2	Number of	Title of the unit: Road	d making	aggregate	s	
	lectures = 10		0	00 0		
Road making aggreg	ates – Classificatio	on, Properties of aggre	gates, des	sign of ag	gregate gi	radation,
texture, polishing and s	kid resistance			0 00		
Unit – 3	Number of	Title of the unit: Bitu	minous re	oad binde	rs	
	lectures = 10					
Bituminous road bind	lers – Straight- run	bitumen, emulsions, Cu	tback and	modified	binders. R	heology
of bituminous binders.	U					
Unit – 4						
	Number of	Title of the unit: Mod	ified bind	lers and <b>R</b>	equireme	ents of
	Number of lectures = 12	Title of the unit: Mod paving concrete, desig	ified bind gn of mix	lers and R es	equireme	ents of

viscosity. Additives and their suitability, Fillers. Design of Bituminous mixes – Marshall method and super paves procedure.

**Requirements of paving concrete, design of mixes** – IRC, absolute volume, Vibrated Concrete mix design, design of DLC and SFRC mixes, Soil stabilization techniques. CBR Test

#### **12. Books Recommended (3 Text Books + 2-3 Reference Books)**

- i) PapagiannakisA. T., MasadEyad, "Pavement design and materials", John Wiley & Sons.
- Athanassios Nikolaides, "Highway Engineering: Pavements, Materials and Control of Quality", CRC Press
- iii) Read, J. And White oak, D., "The Shell Bitumen Handbook", Fifth edition, Shell Bitumen, Thomas Telford Publishing, London 2003

iv) Atkins, N. Harold, Highway Materials, Soils and Concretes, Fourth Edition, 2002, PrenticeHall.

v) Kerbs Robert D. and Richard D. Walker, Highway Materials, McGraw-Hill, 1971.

2. Subject Name       Advanced       L       T       P         Pavement       Material Lab       0       0       4         3. Subject Code       0       0       4         4. Type of Subject       Core ()       PE (✓)       OE()         5. Pre-requisite (if any)       Nil       Frequency (use tick marks)       Even ()       Odd ()       Either Sem Sem ()       Sem Sem ()         6. Total Number of Lectures, Tutorials, Practical       Tutorials = 00       Practical = 28       7. Learning objectives:       I. To understand the properties of different paving materials.       2. To study the behaviour of bituminous biner and modified binder as per their use in pavement layer         8. Course Outcomes (COs):       At the end of the lab course student able to       1-Understand the characteristics and behaviour of soil subgrade and various soil deposits       2-Understand the behavior of various material used in construction of pavement design	1. Name of the I	Departme	nt	CIVIL ENGINEER	ING			
3. Subject Code       0       0       4         4. Type of Subject       Core ()       PE (✓)       OE()         5. Pre-requisite (if Nil       Frequency (use tick marks)       Even Odd ()       Either       Even Sem Sem ()         any)       Imarks       Imarks       Imarks)       Imarks       Imarks       Imarks       Sem Sem Sem ()       Imarks         6. Total Number of Lectures, Tutorials, Practical       Imarks       Imark	2. Subject Name	e A Pa M	dvanced avement laterial Lab	L	T P			
4. Type of Subject       Core ()       PE (✓)       OE()         5. Pre-requisite (if Nil       Frequency (use tick marks)       Even ()       Odd ()       Either Even ()         any)       Frequency (use tick marks)       ()       (✓)       Sem ()       Sem ()         6. Total Number of Lectures, Tutorials, Practical       Itectures = 00       Tutorials = 00       Practical = 28       Sem ()       ()         7. Learning objectives:       1.       To understand the properties of different paving materials.       Per their use in pavement layer         8. Course Outcomes (COs):       At the end of the lab course student able to       1-Understand the characteristics and behaviour of soil subgrade and various soil deposits       2-Understand the behavior of various material used in construction of pavement design	3. Subject Code			0	0		4	
5. Pre-requisite (if NilFrequency (use tick marks)Even ()Odd ()Either Even Sem Sem ()any)()6. Total Number of Lectures, Tutorials, Practical()()()()6. Total Number of Lectures, Tutorials, PracticalLectures = 00Tutorials = 00Practical = 287. Learning objectives:1. To understand the properties of different paving materials.2. To study the behaviour of bituminous biner and modified binder as per their use in pavement layer8. Course Outcomes (COs):At the end of the lab course student able to1-Understand the characteristics and behaviour of soil subgrade and various soil deposits2-Understand the behavior of various material used in construction of pavement design	4. Type of Subje	ect		Core ()	PE (✓	)	OE()	
6. Total Number of Lectures, Tutorials, Practical         Lectures = 00       Tutorials = 00       Practical = 28         7. Learning objectives:         1. To understand the properties of different paving materials.         2. To study the behaviour of bituminous biner and modified binder as per their use in pavement layer         8. Course Outcomes (COs):         At the end of the lab course student able to         1-Understand the characteristics and behaviour of soil subgrade and various soil deposits         2-Understand the behavior of various material used in construction of pavement design	5. Pre-requisite any)	e (if N	il	Frequency (use tick marks)	EvenOddEitherEven() $(\checkmark)$ SemSen()()()			Every Sem ()
Lectures = 00Tutorials = 00Practical = 287. Learning objectives: 1. To understand the properties of different paving materials. 2. To study the behaviour of bituminous biner and modified binder as per their use in pavement layer8. Course Outcomes (COs):At the end of the lab course student able to 1-Understand the characteristics and behaviour of soil subgrade and various soil deposits 2-Understand the behavior of various material used in construction of pavement design	6. Total Number	r of Lectu	res, Tutorials, P	ractical	•			
<ul> <li>7. Learning objectives:</li> <li>1. To understand the properties of different paving materials.</li> <li>2. To study the behaviour of bituminous biner and modified binder as per their use in pavement layer</li> <li>8. Course Outcomes (COs):</li> <li>At the end of the lab course student able to</li> <li>1-Understand the characteristics and behaviour of soil subgrade and various soil deposits</li> <li>2-Understand the behavior of various material used in construction of pavement design</li> </ul>	Lectures = 00			Tutorials = 00	Practi	cal = 28		
At the end of the lab course student able to         1-Understand the characteristics and behaviour of soil subgrade and various soil deposits         2-Understand the behavior of various material used in construction of pavement design	<ol> <li>To understand the properties of different paving materials.</li> <li>To study the behaviour of bituminous biner and modified binder as per their use in pavement layer</li> <li>8 Course Outcomes (COs):</li> </ol>							
1-Understand the characteristics and behaviour of soil subgrade and various soil deposits 2-Understand the behavior of various material used in construction of pavement design	At the end of the	e lab cour	rse student able t	0				
2-Understand the behavior of various material used in construction of pavement design	1-Understand the	e character	ristics and behavior	our of soil subgrade and	various	soil depos	sits	
	2-Understand the	e behavior	of various materi	al used in construction c	of paven	nent desigi	n	
3-Select appropriate asphalt binder for construction of a flexible pavement depending upon the traffi	3-Select appropri	iate aspha	lt binder for cons	truction of a flexible pay	ement	depending	upon the	e traffic
and climatic conditions.	and climatic cond	ditions.						
4-Determine the proportions of ingredients required for the mix design of both asphalt mixtures an	4-Determine the	proportio	ns of ingredients	required for the mix de	sign of	both aspha	alt mixtu	res and
cement concrete.	ement concrete.	ailed cont	ont					
10. Tutorial / Extended Tutorial /Case study components/laboratory	<b>10.</b> Tutorial / E	xtended 7	cm Futorial /Case sti	idv components/labora	torv			
Sr. No Title	Sr. No Title				loij			
1         Sub grade properties and strength analysis	1 Sub g	grade prop	erties and strengt	h analysis				
2 Tests to analyze effects of water on swelling and shrinking behaviour of soil	2 Tests	to analyze	e effects of water	on swelling and shrinkir	ng behav	viour of so	oil	
3 Study Engineering properties of Road making aggregates	3 Study	/ Engineer	ring properties of	Road making aggregates	3			
4 To determine compressive strength of road aggregates by impact tests	4 To de	4 To determine compressive strength of road aggregates by impact tests						
5 To study properties and characteristics of bitumen binders	5 To str	udy prope	rties and characte	ristics of bitumen binder	`S			
6 Physical testing of bitumen	6 Physi	cal testing	g of bitumen					
7 Study engineering properties and uses of modified binders	7 Study	engineer	ing properties and	l uses of modified binder	ſS			
8 Vibrated Concrete mix design	8 Vibra	ted Concr	ete mix design					

1. Name of the Depa	rtment: Civil Engi	neering Department				
2. Course Name	Offshore	L	Т		Р	
	Foundations					
3. Course Code		3	0		0	
4. Type of Course (u	se tick mark)	Core ()	PE (✔)		OE()	
5. Pre-requisite (if	Foundation	<b>6.</b> Frequency (use	Even	$\operatorname{Odd}(\checkmark)$	Either	Every
any)	Engineering	tick marks)	0		Sem ()	Sem
						0
7. Total Number of 1	Lectures, Tutorials	, Practical (assuming 1	4 weeks	of one sem	ester)	
Lectures =42		Tutorials =0	Practic	al =0		
8. Brief Syllabus						
Student will study the	e challenges of an	offshore engineering d	esign, m	ain compo	nents of a	an
offshore site investigat	ion.					
9. Learning objectiv	es:					
1. To introduce the con	ncepts of offshore en	ngineering and types of o	offshore f	oundation.		
2. The student is expos	sed to the use the url	ban storm water models	for better	storm wate	er manage	ment.
10 Course Outcomes	10 Course Outcomes (COs):					
At the and of course, the student will be able to:						
1 Apply the basic concepts of offshore engineering in foundation construction						
Apply the basic concepts of on shore engineering in foundation construction.						
2. Analyse the main components of an offshore site investigation						
5. Identify the typ	3. Identify the types of offshore foundation					
4. Select appropri	ate design method i	or construction of an off	shore for	indation		
II. Unit wise detailed	Number of	Title of the unit.				
Umt-1	Number of	Challongos of offshor	onginog	ring docig	n	
Identify and describe k	rectures =12	Chanenges of offshore	n: describ	the aspect	u ots of the t	norino
anvironment that feed	into offshore engine	ering design	II, uesci ii	be the aspec		marme
	into orishore engine	tering design				
Unit - 2	Number of	Title of the unit.				
Omt - 2	lectures – 10	Main Component of a	n offsho	re site inve	stigation	
Describe the main co	moments of an of	fshore site investigation	· Internr	et selected	geotechn	ical site
investigation data	inponents of an of	ishore site investigation	i, interpr	er selected	geoteenn	ilear site
in vostigation auta						
Unit - 3	Number of	Title of the unit:				
	lectures $= 10$	Types of offshore four	ndation			
Identify the main typ	es of offshore four	dation systems and de	escribe th	e drivers o	during for	undation
design, Perform selected	ed foundation design	n calculations to illustrat	e the inte	rplaving m	echanism	s
				r,,,,		-
Unit - 4	Number of	Title of the unit:				
	lectures = 10	Geotechnical pipeline	design a	spects		
Identify key aspects	of geotechnical pi	peline design and perf	form sele	ected desig	n calcula	tions to
illustrate the interplavi	ng mechanisms, det	ermine the loads acting	on the off	fshore struc	tures	
	-	C				

#### **12.** Books Recommended (3 Text Books + 2-3 Reference Books)

i) Ben C. Gerwick, "Construction of Marine and Offshore Structures", CRC Press, 1999.

ii) 2. B. Gou, S. Song, J. Chacko and A. Ghalambor, "Offshore Pipelines", GPP Publishers, 2006.

iii) S. K. Hakrabarti, "Handook of Offshore Engineering", Elsevier, 2005.

iv) 2. M. J. Tomlinson, "Pile Design and Construction", E and F Spon, 1994

1. Name of the Department CIVIL ENGINEERING							
2. Subject	Name	Offshore Foundations	L	Т		Р	
		Laboratory					
3. Subject	Code		0	0		4	
	~ ~ ~ ~						
4. Type of	f Subject		Core ()	PE(✓)	)	OE()	
5. Pre-re	equisite	Foundation	Frequency (use tick	Even	Odd	Either	Every
(if any)	-	Engineering	marks)	0	(✓)	Sem	Sem
						0	0
6. Total N	umber o	of Lectures, Tutorials, Pr	ractical				
Lectures =	= 42		Tutorials = 00	Practi	cal = 00		
7. Learnir	ng object	tives:					
1. To intro	oduce the	e concepts of offshore eng	ineering and types of of	fshore	foundation.		
2. The stud	dent is ex	posed to the use the urbar	n storm water models fo	r better	storm wate	er manag	ement.
8. Course	8. Course Outcomes (COs):						
At the end	d of the l	ab course student able to	0				
1-Apply th	I-Apply the basic concepts of offshore engineering in foundation construction.						
2-Analyse	the main	n components of an offsho	re site investigation				
3-Identify	the types	s of offshore foundation					
4-Select ap	ppropriat	e design method for const	ruction of an offshore for	oundatio	on		
9. Unit wi	se detail	ed content					
10. Tutor	rial / Ext	ended Tutorial /Case stu	dy components/labora	tory			
Sr. No	Title						
1	Offshor	e engineering design Requ	uirements				
2	2 To study the main components of an offshore site investigation						
3	3 Analysis of geotechnical site investigation data						
4	To stud	y main types of offshore f	oundation systems				
5	Analysi	s of foundation design cal	culations to illustrate th	e interp	laying med	chanisms	
6	Geotecl	hnical pipeline design proc	cedures				
7	Determination of loads acting on the offshore structures						

1. Name of the Depa	rtment: Civil Engi	neering Department				
2. Course Name	Advanced	L	Т		Р	
	Surveying and					
	Cartography					
3. Course Code		3	0		0	
4. Type of Course (u	ise tick mark)	Core ()	PE(✓)		OE()	
5. Pre-requisite (if	Nil	<b>6.</b> Frequency (use	Even	Odd (✓)	Either	Every
any)		tick marks)	0		Sem ()	Sem
						0
7. Total Number of	Lectures, Tutorials	, Practical (assuming 1	4 weeks	of one sem	ester)	
Lectures =42		Tutorials =0	Practic	al =0		
8. Brief Syllabus						
Students will learn the	concept of advance	d Surveying				
9. Learning objectiv	'es:					
To teach the students a	bout the Triangulation	ion and Trilateration .				
2. To enable the studen	nts to understand the	Photogrammetry and R	emote Se	ensing.		
10. Course Outcomes	(COs):	-				
At the end of course, t	he student will be ab	ole to:				
1. Understand the	concept of triangul	ation survey and Trilater	ration			
2. Analysis the pr	oject survey					
3. Understand the	field astronomy rec	uirements and methods				
4. Role of Photog	rammetry, Remote	Sensing, GPS and GIS in	the field	of surveyin	ng	
11. Unit wise detailed	content					
Unit-1	Number of	Title of the unit:				
	lectures = 10	Triangulation, Trilate	eration a	nd Adjusti	ment	
		Computations				
Triangulation and T	Trilateration: Nece	ssity of Control Surve	ying, Pri	nciple of '	Triangulat	ion and
Trilateration classification	ation of Triangulat	ion Systems Station M	larks, To	owers and	Signals,	Satellite
station, Intersected	and Resected poi	nts, Reconnaissance,	Indivisib	oility of	stations,	Angular
Measurement, Base lir	ne measurement and	its extension				
Adjustment Comput	ations: Treatment of	of random errors, Norma	al law of	errors, Mos	st Probabl	e Value,
Weight of observation	s, Propagation of en	rrors and variances, Prin	nciple of	Least Squa	ares, Obse	rvations
and correlative Norma	l Equations, Adjustr	nent of triangulation fig	ures and I	level nets.		
Unit - 2	Number of	Title of the unit:				
	lectures = 10	Curves and project su	irvey			
Curves: Classification	n of curves, Elemen	ts of Simple Circular, T	ransition	and Vertic	al curves,	Theory
and methods of setting	out circular, transit	ion and vertical curves,	special fi	eld problen	1S.	
Project Surveys: (	eneral requiremen	ts and specifications	tor Er	igineering	project	surveys,
Reconnaissance, Prelin	ninary and Location	surveys for highways, i	ailways a	and canals.		
Unit - 3	Number of	Title of the unit: Field	Astrono	omy:		
	lectures = 10			-		
	I					

**Field Astronomy:** Astronomical terms, co-ordinate systems, Spherical trigonometry, Astronomical triangle, Relationship between coordinates.

Unit – 4	Number of	Title of the unit:
	lectures = 12	Photogrammetry ,Remote Sensing,GPS and GIS

**Photogrammetry and Remote Sensing:** Photogrammetry-Introduction, Scale of photograph, Tilt and height displacement, Stereoscopic vision and stereoscopes, Principles of remote sensing, Electro Magnetic Radiation (EMR)

**GPS and GIS:** Global Positioning System (GPS)-Introduction, principle, and applications of GPS in different fields of Surveying, Geographic Information System (GIS) – Introduction, Geographical concepts and terminology, Applications of GIS

**12. Books Recommended (3 Text Books + 2-3 Reference Books)** 

i- Agor, R., "Surveying", Vol. II & III, Khanna Publications, Delhi, 1995.

ii- Punmia, B.C., "Surveying", Vol.II & III Laxmi Publications, New Delhi

iii- Duggal S.K., Surveying Vol. I & II TMH Basak, Surveying TMH. Kanetkar, Surveying Chandra, A.M. "Plane Surveying", New Age International Publisher,.

iv. Dent, B. D., "Cartography – Thematic Map Design", 5th" Edition, W C B McGraw-Hill, Boston, 1999.

v- "Rampal .K.K, "Mapping and Compilation". Concept Publishing Co., New Delhi, 1993.

1. Name of the De	partment	CIVIL ENGINEER	RING					
2. Subject Name	Advanced Surveying	L	Т		P			
	and Cartography							
	Laboratory							
3. Subject Code		0	0		4			
1 Type of Subject		Coro ()	DE (	)	ΟΕΟ			
<b>4.</b> Type of Subject				)	OE()			
5. Pre-requisite	Nil	Frequency (use tick	Even	Odd (✓)	Either	Every		
(if any)		marks)	0		Sem	Sem		
					0	0		
6. Total Number of	of Lectures, Tutorials,	Practical (assuming 14	weeks o	of one seme	ester)			
Lectures = 00		Tutorials = 00	Practi	cal = 28				
7. Learning object	tives:							
1. To teach the stu	dents about the Triangu	lation and Trilateration	_					
2. To enable the stu	idents to understand the	Photogrammetry and Re	mote Se	ensing				
8. Course Outcom	es (COs):							
At the end of the l	ab course student able	to						
1-Understand the concept of triangulation survey and Trilateration								
2-Analysis the proj	ect survey							
3-Understand the fi	eld astronomy requirem	nents and methods						
4-Role of Photogra	mmetry ,Remote Sensir	ng,GPS and GIS in the fie	eld of su	rveying				
9. Unit wise detail	ed content							
10. Tutorial / Ext	ended Tutorial /Case s	tudy components/labor	atory/Fi	ield visit				
Sr. No	Title							
1	To study about Triang	ulation and Trilateration	methods	6				
2	Theory and methods o	f setting out circular, trar	nsition a	nd vertical	curves			
3	General requirements	and specifications for En	gineerin	g project si	urveys			
4	Photogrammetry and 7	Techniques of photo-inter	rpretatio	n				
5	GPS Technology							
6	GIS Technology							
7	Laboratory study of T	otal Station						
1	7 Laboratory study of Total Station							

# Curriculum (Scheme of Examination) & Syllabus for M.Tech Geo-informatics and Remote Sensing

# **Batch 2021 onwards**



# SGT University Gurgaon

Credit Based Scheme w.e.f. 2021-2022



## Scheme of Examination for M.Tech- Geo-informatics and Remote Sensing **Program** SEMESTER WISE COURSE STRUCTURE

#### **First Semester**

S.	Subject		L	Т	Р	C	Exami	nation	Subject
NO.	Code	Course					mai	rks	Total
		Title					Ext.	Int.	
1		Geographical Information System	3	0	0	3	60	40	100
2		Photogrammetric & Remote Sensing	3	0	0	3	60	40	100
3		Remote Sensing & GIS for Hydrology and Water Resources	3	0	0	3	60	40	100
4		Emerging Trends in Geoinformatics	3	0	0	3	60	40	100
5		Photogrammetric & Remote Sensing Lab	0	0	2	1	40	60	100
6		Computer application in Engineering Lab	0	0	2	1	40	60	100
7		Value Added Courses-I	2	0	0	2	60	40	100
8		Seminar		0	2	1	00	100	100
		Total	14	0	6	17	380	420	800

#### **Second Semester**

<b>S.</b>	Subject		L	Т	Р	С	Examination		Subject
NO.	Code	Course					ma	ırks	Total
		Title					Ext.	Int.	
1		Digital Image Processing	3	0	0	3	60	40	100
2		GPS & Electronic Surveying	3	0	0	3	60	40	100
3		attern Recognition and Machine Learning		0	0	3	60	40	100
4		Remote Sensing & GIS for Urban Planning and Management	3	0	0	3	60	40	100
5		Digital Image Processing Lab	0	0	2	1	40	60	100
6		GPS Lab		0	2	1	40	60	100
7		Seminar		0	2	1	00	100	100
		Total	12	0	6	15	320	380	700



#### Scheme of Examination for M.Tech– Geo-informatics and Remote Sensing Program

SEMESTER WISE COURSE STRUCTURE

#### **Third Semester**

S.	Subject	Course Title	L	Т	Р	С	Exami	nation	Subject
NO.	Code						mai	:ks	Total
							Ext.	Int.	
1		Basics and Digital Cartography	3	0	0	3	60	40	100
2		Research Methodology & IPR	3	0	0	3	60	40	100
3		Department Electives-XIII	3	0	0	3	60	40	100
4		Department Electives-XIV	3	0	0	3	60	40	100
5		Department Electives-XV	3	0	0	3	60	40	100
6		Research Methodology & IPR Lab	0	0	2	1	40	60	100
7		Department Electives Lab-XIII	0	0	2	1	40	60	100
8		Department Electives Lab-XIV	0	0	2	1	40	60	100
9		Department Electives Lab-XV	0	0	2	1	40	60	100
10		Value Added Courses-II	2	0	0	2	60	40	100
		Total	17	0	8	21	520	480	1000

#### **Fourth Semester**

S.	Subject Code	Course Title	L	Т	Р	C	Examination marks		Subject	
NU.							Ext.	Int.	lotai	
1		Dissertation	0	0	20	20	100	0	100	
		Total	0	0	20	20	100	0	100	

#### **Departmental Elective**

S. No.	Specialization	Departmental Elective XIII	Departmental Elective XIV	Departmental Elective XV
1	Geoinformatics & Remote Sensing	Advanced Surveying and Cartography 3-0-2(4)	Applications of Remote Sensing in Geosciences 3-0-2(4)	Non-Topographic Photogrammetry 3-0-2(4)

# **First Semester**

1.	Name of the De	CIVIL EN	GINEE	RING					
2.	Course Name	Geographical	L		Т		P		
		Information							
		System							
3.	Course Code		3		0		0	0	
4.	<b>Type of Course</b>	e	Co	ore (✓)	<b>PE(</b> )		<b>OE</b> ()		
5.	Pre-requisite		6.	Frequency (use	Even	Odd (✓)	Either	Every	
	(if any)			tick marks)	0		Sem	Sem	
							0	0	
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)									
Le	ctures = 42		Tu	itorials = 00	Practic	cal = 00			
Dw	of Syllabury D	acia Introduction	to C	IS Decia Spatial A	nalucia	to CIS Concept	of Intogra	tion and	

**Brief Syllabus:** Basic Introduction to GIS, Basic Spatial Analysis to GIS, Concept of Integration and Modeling, Web GIS and Introduction to DTM.

#### 8. Learning objectives:

- 1. To give the students an insight about Geographical Information System.
- 2. To study different concepts of Modeling and DTM.

#### 9. Course Outcomes:

- 1. Knowledge about Geographical Information System
- 2. Understanding concepts of integration and modelling.
- 3. Understanding the concepts of Web GIS.

10. Unit wise detailed content								
Unit-1	Number of	Title of the unit:	<b>Basic Introduction and Understanding</b>					
	lectures = 10							

Introduction, Definitions, Basic Concepts, history and evolution, Components, Need, Scope, interdisciplinary relations, applications areas, and overview of GIS. GIS data: spatial and non-spatial, spatial data model: raster, vector, Topology and topological models; Spatial referencing using coordinates and geographic identifiers, metadata; Spatial data acquisition; Attribute data sources; Spatial and attribute data input; Data storage, RDBMS, database operations; Spatial and non-spatial data editing functions; Quality of spatial data; GIS analysis functions: Retrieval, classification, measurement, neighborhood, topographic, interpolation, overlay, buffering, spatial join and query, connectivity, network functions, watershed analysis, view-shed analysis, spatial pattern analysis, spatial autocorrelation, trend surface analysis; GIS presentation functions: data visualization methods, exporting data; Modern trends: Internet GIS, 3DGIS.

Unit - 2	Number of	Title of the unit: Basic Spatial Analysis, Integration and
	lectures = 10	Modeling

Logic operations, general arithmetic operations, general statistical operations, geometric operations, query and report generation from attribute data, geometric data search and retrieval, complex operations of attribute data, classification reclassification, integrated geometry and attributes, overlay, buffer zones, raster data overlay, integrated data analysis.

Unit - 3	Number of	Title of the unit: Introduction to DTM
	lectures =10	

Digital surface modeling by DTM/DHM and DSM/DEM, Interpolation techniques, GRID and TIN, break lines, profiles, mass points, / random points, factors influencing choice of sampling patterns, DTM generation process, preprocessing, main processing, post processing, differential rectification, mosaicing, automatic production of digital orthophotos. Differential sampling techniques- manual, Semiautomatic, automatic sampling techniques, storage of TIN Grid and its data base structure. Data sources, / input to DTM, Direct and indirect data collection method.

Unit - 4	Number of	Title of the unit: Web GIS
	lectures = 12	

Definition, concept of Web GIS, History of web GIS, components of web

GIS, internet, web GIS v/s Internet GIS, Fundamentals of computer networking – network environment –network communication models –protocols – TCP/IP. Applications of web GIS, users and stake holders of web GIS, advantages and limitations of web GIS, Participatory GIS -Web-based GIS For Collaborative Planning And Public Participation, Digital Democracy for planning, web GIS An Aid To Local Environmental Decision making, web GIS for regional and local level planning. Community GIS, Internet GIS Applications in intelligent transportation systems, planning and resource management.

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

- 1. <u>https://www.coursera.org/specializations/gis</u>
- 2. https://www.edx.org/learn/gis-geographic-information-systems
- 3. <u>https://www.learning-gis.com/</u>

#### 12. Books Recommended TEXT BOOKS

- 1. Principal of GIS for Land Resources Assessment P.A. Vurrough
- 2. GIS Principal Vol-1 Goodchild
- 3. Zhong- Ren Peng, Ming-Hsiang Tsou, (2003) Internet GIS: Distributed Geographic
- 4. Information Services for the Internet and Wireless Networks, Wiley.

#### **REFERENCE BOOKS**

- 1. Principles of GIS for Land Resources Assessment by P.A.Burrough, Oxford: Science publications, 1986.
- 2. Geographic Information Systems An introduction by Tor Bernhardsen, John Wiley and Sons, Inc., New York, 2002.
- 3. GIS A computing Perspective by Micheal F. Worboys, Taylor & Francis, 1995.
- 4. Remote Sensing and Image Interpretation by Thomas M. Lillesand and Ralph W. Kiefer, John Wiley and Sons Inc., New York, 1994.

1.	Name of the I	Department	CIVIL EN	GINEE	RING			
2.	Course	Photogrammetry	L	Т		Р		
	Name	& Remote						
		Sensing						
3.	Course		3	0		0		
	Code							
4.	<b>Type of Cour</b>	se (use tick mark)	Core (✓)	<b>PE()</b>		<b>OE</b> ()		
5.	Pre-	Surveying	6. Frequency	Even	Odd (✓)	Either	Every	
	requisite (if		(use tick	0		Sem	Sem	
	any)		marks)			0	0	
7.	<b>Total Number</b>	r of Lectures, Tutor	ials, Practical (assu	ming 14	weeks of one sen	nester)		
Le	ctures = 42		Tutorials = 00	Practi	cal = 00			
8.	Brief Syllabu	s: Basic Introducti	on to Remote Sensin	ng, Con	cept of Photogram	nmetry,	Remote	
	Sensing: Appl	ications and Errors.						
9.	Learning obj	ectives:						
1.'	To give the stud	lents an insight abou	t Remote Sensing					
2. To study different concepts of Photogrammetry and its application areas.								
10	10. Course Outcomes:							
1.	Knowledge abo	out Remote Sensing.						
2.	Understanding	concepts of Photogra	mmetry and its applic	cation ar	eas.			
11. Unit wise detailed content								
Un	Unit-1Number ofTitle of the unit:							
		lectures = 10	<b>Basic Introduction</b>	and Un	derstanding			
De	finition and ter	ms, history of Photo	grammetry, concepts	, princip	les and types of F	Photogram	nmetry,	
typ	bes of aerial	photographs vertica	l photographs, tilted	d photo	graphs, orthopho	tographs	, aerial	
cai	neras, geometr	y and scale orienta	tion and measureme	ents, dis	tortions, displace	ments ar	nd their	
COI	rections, rectifi	cation and orthophot	tographs.					
Un	nit - 2	Number of	Title of the unit:					
		lectures = 10	<b>Basic Principles of</b>	Remote	Sensing			
Ph	ysics of remote	sensing, Characteris	stics of electro-magne	etic radi	ation; Interactions	between	n matter	
and	d electro-magn	etic radiation; energ	y interaction in the	atmosph	ere; energy intera	actions w	vith the	
ear	th's surface sp	pectral reflectance c	urves. Types of ren	note sen	sing with respect	t to way	velength	
reg	gions; active a	and passive remote	e sensing, Sensor	types c	haracteristics: im	naging s	ystems,	
ph	otographic sens	sors, characteristics	of optical sensors; F	OV, IF	OV; Sensor resol	ution - s	spectral,	
spa	atial, radiomet	ric and temporal;	Dispersing element	nt; Spe	ctroscopic filter;	Spectr	ometer;	
Ch	aracteristic of	optical detectors; im	aging sensors, Therr	nal sens	ors; Atmospheric	sensors;	Sonar;	
La	ser, radar, hype	r spectral sensors.						
Un	uit - 3	Number of	Title of the unit: R	emote S	ensing satellites a	and data		
		lectures = 10	products					

EMR characteristics and interaction in atmosphere and with ground objects; Atmospheric errors and removal; Geometric and radiometric distortions, Applications of optical remote sensing techniques in

natural resources management. Interpretation elements; Systems and techniques of extraction and analysis of information from aerial/satellite stereo data.

Unit - 4	Number of	Title of the unit: Fundamentals of Photogrammetry
	lectures = 12	

Photograph v/s image, Panchromatic, Multispectral, hyper spectral, stereo images, Optical mechanical line scanner; Push broom scanner; Imaging spectrometer.

#### **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 BOOKS

1. Remote Sensing and Image Interpretation Thomas M. Lillesand & Palph W. Kiefer

- 2. Elements of Photogrammetry with application in GIS Paul R. Wolf & Bon A. Dewitt
- 3. Remote Sensing Geology Ravi P. Gupta

#### **REFERENCE BOOKS**

- 1. Elements of Photogrammetry with applications in GIS by Paul R Wolf and Bon A. Dewitt, 3rd edition, 2004, ISBN 007-123689-9.
- 2. Aerial Photography and Image interpretation second edition by David P paine, and James D Kiser, 2003, John Wiley and Sons Inc. ISBN 0-471-20489-7

1.	1. Name of the Department			CIVIL EN	[GINEE]	RING		
2.	<b>Course Name</b>	Remote Sensing	L		Т		Р	
		and GIS for						
		Hydrology and						
		Water						
		Resources						
3.	<b>Course Code</b>		3		0		0	
4.	<b>Type of Course</b>	<u>,</u>	Co	ore (🗸)	<b>PE()</b>		<b>OE</b> ()	
5.	Pre-requisite		6.	Frequency	Even	Odd (✓)	Either	Every
	(if any)			(use tick	0		Sem	Sem
				marks)			0	0

## 7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)Lectures = 42Tutorials = 00Practical = 00

8. Brief Syllabus: Basic Introduction to Hydrology, Drainage Basins, Quality of water and Groundwater And Irrigation Management

#### 9. Learning objectives:

- 1. To give the students an insight about Remote Sensing and Hydrology.
- 2. To give the students an insight about GIS and Hydrology.
- 3. To give the students an insight about Remote Sensing and Water Resources.
- 4. To give the students an insight about GIS and Water Resources.

#### **10. Course Outcomes:**

- 1. Knowledge about Remote Sensing in Water Resources and Hydrology.
- 2. Understanding concepts of GIS in Water Resources and Hydrology.

11. Unit wise detai	iled content			
Unit-1	Number of	Title of the unit: BASICS OF HYDROLOGY		
	lectures = 10			
hydrological cycle -	- estimation of vario	bus components of hydrology cycle – clouds – rainfall – runoff		
– evaporation – tra	anspiration – evapo	-transpiration – interception – depression storage – spectral		
properties of water	- GIS application in	surface water modeling – case studies.		
Unit - 2	Number of	Title of the unit: DRAINAGE BASIN		
	lectures = 10			
Watershed divide – stream networks – Delineation and codification of watersheds morph metric				
analysis – linear – a	areal -relief aspects -	– Rainfall- runoff modeling – urban hydrology – case studies.		
Unit - 3	Number of	Title of the unit: GROUND WATER AND WATER		
	lectures =10	QUALITY		
Ground water pros	spects – surface wa	ater indicators – vegetation, geology, soil aquifer – aquifer		
parameters – well	hydraulics – estin	nation of ground water potential – hydrologic budgeting –		
mathematical mode	els – GIS application	n in ground water modeling – study on sea water intrusion –		
modeling of sea water intrusion – water quality parameters –physical, chemical, biological properties.				
Water quality mapping and monitoring –correlation model for pollution detection and suspended				
sediment concentration- case studies				
Unit - 4	Number of	Title of the unit: IRRIGATION AND WATERSHED		

 lectures = 12
 MANAGEMENT

 Project investigation, implementation, maintenance stage- location of storage/ diversion works – canal

alignment –depth-area capacity curve generation, - conjunctive use of surface and ground water – Mapping and monitoring the catchment command area – artificial recharge of groundwater – water harvesting structures – sediment yield – modeling of reservoir siltation – prioritization of watershed – modeling of sustainable development – Development of information system for Natural resource management case studies.

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

- 1. https://elearning.iirs.gov.in/
- 2. <u>https://elearning.iirs.gov.in/e-Learning.html</u>
- 3. <u>https://gis.e-education.psu.edu/remote\_sensing</u>

#### 13. Books Recommended TEXT BOOKS

1. Eric C. Barrett, Clare H.Power, Satellite Remote Sensing for Hydrology and Water Management, gordon @ Breach Science publications - new York 1990,

2. Dr. David Maidment, Dr. Dean Djokic, Hydrologic and Hydraulic Modeling Support with Geographic Information Systems, Esri Press 2000,

3. Wilfried Brutsaert, Hydrology: An Introduction Cambridge University Press, 2005,

4. Andy D. Ward and Stanley W. Trimble, Environmental Hydrology, second edition, Lewis Publishers, 2004,

5. U.M. Shamsi, GIS Applications for Water, Wastewater, and Storm water Systems, CRC; first edition 2005,

1. Name of the DepartmentCIVIL ENGINEERING					Ĵ		
2. Subject	Emerging	L		Т		Р	
Name	trends in						
	Geoinformatics						
3. Subject		3		0		0	
Code							
4. Type of Subject (use tick		Core (	<b>√</b> )	PE-III()		<b>OE</b> ()	
mark)							
5. 5 Pre-	Nil	6.	Frequency (use	Even	Odd ()	Either	Every
requisite			tick marks)	(🗸)		Sem	Sem
(if any)						0	0
Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Lectures = 42Tutorials =00Practical =00							
7. Learning ob	jectives:						

1. To study the new concepts of Geoinformatics at global level

#### 8. Subject Outcomes:

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

- 1. To understand the global scenario of Geoinformatics and the space programs
- 2. To understand the education facility, laws and the policies

9. Unit wise de		
Unit-1	Number of	Title of the unit:
	lectures = 10	Global and Indian Scenario of Geo-informatics

Current status and Recent Advances in the field of RS, GIS, Photogrammetry, GPS, products and process, software and hardware. Global Institutions- NASA, ESRI, ERDAS, Canadian Institute of Remote Sensing, International Institute of Photogrammetry and Remote Sensing, Google, India-ISRO and its subunits, NRSA, SAC, Antrix, IIRS, RRSSCs; State Remote Sensing Centers; Funding Sources for R&D projects; Global and National Spatial Data Centers, Satellite data sources and procurement procedures.

Unit - 2	Number of	Title of the unit:
	lectures = 10	World and Indian Space Programs

Satellites and sensors and their products and applications; Geoinformatics usage by Government and Private Sectors - User Departments of Central Govt. and State Govt. and their major projects: Central - SOI, MOEF, MOUD, MOD, few Case studies.

Unit - 3	Number of	Title of the unit: Education and Training facilities in
	lectures = 10	Geoinformatics
Global Geoinformat	tics Courses, scho	larships; Web Resources for e-learning; eBooks; open
sources of free softw	vare; International J	Journals, Review magazines, News Letters, e-journals.
Unit - 4	Number of	Title of the unit:

lectures = 12	Laws and Policy Perspectives and International Co-
	operations

Laws and policy matters at international and national level with respect to Space, Sea, Photogrammetry, data sharing and data security, interoperability; Global and national Geoinformatics survey reports, case-studies, show cases of best practices.

#### 10. 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.

#### 11. Text Book

1. "GIS Development".net, ESRI web site, NCGIA, UCGIA, Google Earth, Yahoo Maps, NASA web site, ISRO website.

1.	Name of the	Department	CIVIL ENGL	NEERING	
2.	Course	Photogrammetric	L	Т	Р
	Name	& Remote			
		Sensing Lab			
3.	Course		0	0	2
	Code				
4.	Type of Cou	rse	Core (✓)	<b>PE</b> ()	<b>OE</b> ()
5.	Pre-		6. Frequency	Even $Odd(\checkmark)$	Either Every
	requisite		(use tick	0	Sem Sem
	(if any)		marks)		0 0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)				
Lectures = 00			Tutorials = 00	Practical = 28	

**Brief Syllabus:** The fundamental principle used by Photogrammetry is triangulation. By taking photographs from at least two different locations, so-called "lines of sight" can be developed from each camera to points on the object.

#### 8. Learning objectives:

The fundamental principle used by Photogrammetry is triangulation. By taking photographs from at least two different locations, so-called "lines of sight" can be developed from each camera to points on the object.

#### 9. Course Outcomes:

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

- 1) Will learn about the Photogrammetry and its types.
- 2) Will learn about the stereoscopy.
- 3) Will able to learn about the analytical Photogrammetry

#### 10. Unit wise detailed content

- 1. Fundamentals of aerial photos and satellite image Interpretation
- 2. Types of imaging
- 3. Elements of interpretation
- 4. Techniques of Visual interpretation
- 5. Generations of Thematic maps
- 6. Study of satellite image annotation
- 7. Demarcation of contours & watershed
- 8. Remote sensing applications
- 9. Understanding of spectral response pattern of different landforms
  - 10. Image Interpretation and Analysis

1.	1. Name of the Department     CIVIL ENGINEERING				
2.	Course	Computer	L	Т	Р
	Name	Application in			
		Engineering			
		Lab			
3.	Course		0	0	2
	Code				
4.	Type of Cou	irse	Core (✓)	<b>PE</b> ()	<b>OE</b> ()
5.	Pre-		6. Frequency	Even $Odd(\checkmark)$	Either Every
	requisite		(use tick	0	Sem Sem
	(if any)		marks)		0 0
7.	<b>Total Numb</b>	er of Lectures, Tut	orials, Practical (assuming	ng 14 weeks of one sem	ester)
Lectur	es = 00		Tutorials = 00	Practical = 28	
Brief S	Syllabus: Ex	xplore the world o	f spatial analysis and ca	rtography with geograp	hic information
systems	s (GIS). In this	s class you will lear	n the basics of the industry	y's leading software tool,	ArcGIS, during
four we	ek-long modu	ıles.			
8.	Learning ob	jectives:			
Basics	of ArcGIS				
0	Course Out	comes:			
On c	course Out	this course the stud	ents will be able to		
1)	Spatial Analy	sis and Cartography			
2)	Will learn abo	out the stereoscopy.			
3)	Will able to le	earn about the analy	tical Photogrammetry		
10.	Unit wise de	tailed content			
1.	ArcGIS Enter	prise Deployment			
2.	ArcGIS Tools	8			
3.	ArcGIS Data				
4.	ArcGIS Custo	omization			
5.	5. ArcGIS Drawing				
6.	6. ArcGIS Base map				
7.	7. ArcGIS Levels				
8.	8. ArcGIS Layers				
9.	ArcGIS Symb	oology			
10.	ArcGIS Mapp	oing			

# Second Semester

1.	Name of the D	epartment	CIVIL ENGINEER	ING			
2.	Subject	DIGITAL	L	Т		Р	
	Name	IMAGE					
		PROCESSING					
3.	Subject		3	0		0	
	Code						
4.	Type of Subje	ct	Core (✓)	<b>PE()</b>		<b>OE</b> ()	
5.	<b>Pre-requisite</b>		Frequency (use tick marks)	Even	Odd	Either	Every
	(if any)			(🗸)	0	Sem	Sem
						()	0

### 6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)

Lectures = $42$	Tutorials = 00	<b>Practical = 00</b>

#### **Brief Syllabus:**

Digital image processing includes Introduction Image processing system, Image Analysis and Understanding and Multi temporal Data merging – Change detection procedures & Hyper-spectral Image Analysis and Radar image analysis.

#### 7. Learning objectives:

- 1 To study and analyze the image processing
- 2 To analyze the appropriate methods to improve data merging and image analysis

#### 8. Subject Outcomes:

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

- 1. Students will be able to understand use of image processing in Civil Engineering
- 2. Students will understand about GIS and image processing techniques

9. Unit wise detailed content					
Unit-1	Number of	Title of the unit:			
	lectures =10	Introduction			

Image processing system; Satellite data acquisition –Storage and retrieval – Data Formats – Compression – Satellite System – Data products – Image display system – Current Remote Sensing Systems. Preprocessing of remotely sensed data; Radiometric and Geometric distortions and corrections- Geometric correction Radiometric correction – Noise removal. Spectral Rationing – Principal and Canonical Components– Vegetative Components.

Unit - 2	Number of	Title of the unit:
	lectures =10	Image Analysis and Understanding
Image Rectification	on and Restoratio	n. Image enhancement- Contrast Manipulation – Gray-Le

Image Rectification and Restoration. Image enhancement- Contrast Manipulation – Gray-Level Thresh holding- Level Slicing Contrast Stretching. Convolution – Edge Enhancement – Spatial feature manipulation. Image transformations; Pattern recognition, Image classification, Image fusion and change detection. Pattern recognition – Shape analysis- Textural and contextual analysis.

Unit – 3	Number of	Title of the unit: Data Merging and GIS Integration

	lectures =10	
Multi temporal Da	ta merging – Chan	ge detection procedures- Multi sensor image merging – Merging
of image data with	Ancillary data Inc	orporating GIS Data in automated land cover classification.
8		······································
Unit - 4	Number of	Title of the unit: Hyper-spectral Image Analysis and
	lectures = 12	Radar image analysis
Atmospheric corre	ction – Hyper-spec	tral image analysis techniques.
10. Brief Descript	ion of self learnin	g / E-learning component
The students will b	e encouraged to le	arn using the SGT e-Learning portal and choose the relevant
lectures delivered b	by subject experts of	of SGT University.
The link to the E-L	earning portal.	
https://elearning.sg	tuniversity.ac.in/co	ourse-category/
Journal papers; Pat	ents in the respecti	ve field.
11. Books Recom	nended	
Text books		
1. John R Jenson "	Introducing Digital	Image Processing" Prantice Hall. New Jersy 1986.
2. R. A. Schowen	gergt, "Techniques	s for Image Processing and Classification in Remote Sensing';
1983		
<b>Reference Books:</b>	<b>1</b>	
1. Remote Sensing	& Image Interpret	ation Thomas M. Lillesand, Ralph W.Kiefer,

2. Image Interpretation in Geology Drury S.A.

3. Robert A Schowengergt, "Remote Sensing – Models and Methods for Image Processing Academic Press 1997 Hord R M, Academic Press, 1982

1. Name of the DepartmentCIVIL ENGINEER			ERING				
2.	Subject Name	GPS &	L	Т		Р	
		Electronic					
		Surveying					
3.	Subject Code		3	0		0	
4.	Type of Subject (	use tick mark)	Core (✓)	<b>PE</b> ()		<b>OE</b> ()	
5.	Pre-requisite (if		Frequency (use tick	Even	Odd ()	Either	Every
	any)		marks)	(🗸)		Sem ()	Sem
							0
6.	6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Le	ctures = 42		Tutorials = 00	Practic	al = 00		

#### Lectures = 42

#### **Brief Syllabus:**

In this course, the students will know the importance of GPS, Factor affecting GPS & Applications of GPS.

#### 7. Learning objectives:

- 1. To study the different types of GPS and its technical description.
- To Analyse the data collected and use the application 2.

#### 8. Subject Outcomes:

- 1. Students will learn how to take observation and collect data from GPS.
- 2. Students will be able to understand the application of GPS

## 9. Unit wise detailed content

Unit-1	Number of	of	Title of	the unit:					
	lectures =	= <b>10</b>	Introdu	uction					
	 				~	0		-	

Maps & their numbering, Map projection and co-ordinate system, Geo referencing and data, Basic concepts of GPS: History and timeline, overview. pseudo range and carrier phase measurements; Signal structure; GPS coordinate systems: WGS-84, GPS time; GPS Errors and biases; GPS orbital Geometry and Navigational solution.

Unit - 2	Number of	Title of the unit:
	lectures = 10	Technical Description and GPS Observables

System Segmentation - Space segment; control segment, user segment- types of receivers ; GPS satellite signals, GPS data, position and time from GPS, code phase tracking, pseudo range navigation, receiver position, time and velocity, carrier phase tracking, GPS positioning types absolute positioning, differential positioning; Navigation signals -GPS frequencies; Calculating positions using C/A code using P(Y) code, code phase v/s carrier phase, augmented GPS, local augmentation; Accuracy and error sources - atmospheric effects, multipath effects, ephemeris and clock errors; selective availability, relativity, sagnac distortion

Unit - 3	Number of	Title of the unit: Factor affecting GPS
	laaturaa — 10	U
	lectures = 10	
Factors that affect GPS	S - number of satell	ites, multipath, ionosphere, troposphere, satellite geometry,
satellite health signal	strength distance f	rom the reference receiver RF interference loss of radio

transmission; Other satellite based navigational systems: GLONASS, GALILEO. GPS interference and jamming – natural sources, artificial sources; Techniques to improve accuracy- augmentation, precise monitoring, GPS time and data, GPS modernization.

Unit - 4	Number of	Title of the unit: Applications of GPS
	lectures = 12	

Military – airborne, marine and land based navigation, and civilian –surveying and mapping, control surveys, cadastral surveying, navigation, RS, GIS and Photogrammetry, geodesy, location, navigation, tracking, mapping and timing, Engineering and Monitoring; Special applications of GPS, etc.,

#### 10. 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.

#### 11. Books Recommended

#### **Text Books**

1 Understanding GPS: Principles and Applications Elliott Kaplan, Christopher Hearty

2. Introduction to GPS: The Global Positioning System Ahmed El-Rabbany

#### **Reference books**

1. Tomlinson, "Foundation Design and Construction", ELBS, Longman Group Ltd.

2. Integrating GIS and the Global Positioning System Karen Steede-Terry

	epartment	CIVIL ENGL	NEERING	j		
2. Subject	Pattern	L	Т		Р	
Name	<b>Recognition and</b>					
	Machine					
	Learning					
3. Subject		3	0		0	
Code						
4. Type of Subje	ct	Core (✓)	<b>PE()</b>		<b>OE</b> ()	
5. Pre-requisite		Frequency (use tick	Even	Odd ()	Either	Every
(if any)		marks)	(🗸)		Sem ()	Sem
						0
6. Total Number	of Lectures, Tutor	ials, Practical (assuming	ng 14 wee	ks of on	e semeste	er)
Lectures = 42		Tutorials = 00	Practica	l = 00		
7. Learning obje	ctives:					
1.To analyse Kernel m	ethods and space clu	ustering				
2. To analyse basic co	oncept of machine le	arning and artificial neu	ral networ	k		
-	-	-				
Subject Outcomes: O	n completion of this	course, the students wil	l be able t	0		
1. Kernel methods for	SVM classification	and apace clustering & 1	nodel base	ed cluster	ring	
2. Apply & use basic c	concept of machine 1	earning and neural netw	ork		U	
11.5	1	8				
8. Unit wise deta	iled content					
8. Unit wise deta Unit-1	iled content Number of	Title of the unit:				
8. Unit wise deta Unit-1	iled content Number of lectures = 10	Title of the unit: Kernel Methods				
8. Unit wise deta Unit-1 Introduction to metric	iled content Number of lectures = 10 c space, vector space	Title of the unit: Kernel Methods ce, normed space, inne	r product	space;	RKHS; I	earning
8. Unit wise deta Unit-1 Introduction to metric theory; SVM for cla	iled content Number of lectures = 10 c space, vector space ssification & regres	<b>Title of the unit:</b> <b>Kernel Methods</b> ce, normed space, inne ssion; implementation (	r product echniques	space; D	RKHS; I M; kern	Learning el ridge
8. Unit wise deta Unit-1 Introduction to metric theory; SVM for cla regression; kernel deta	iled content Number of lectures = 10 c space, vector space ssification & regressing high particular for the space of	<b>Title of the unit:</b> <b>Kernel Methods</b> ce, normed space, inne ssion; implementation t ernel PCA; kernel online	r product echniques e learning	space; 1 of SVN . Randor	RKHS; I M; kern n forest,	Learning el ridge Genetic
8. Unit wise deta Unit-1 Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony	iled content Number of lectures = 10 c space, vector space ssification & regress nsity estimation; key optimization	<b>Title of the unit:</b> <b>Kernel Methods</b> ce, normed space, inne ssion; implementation t ernel PCA; kernel online	r product echniques e learning	space; 1 of SVN . Randor	RKHS; I M; kern n forest,	Learning el ridge Genetic
8. Unit wise deta Unit-1 Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony	iled content Number of lectures = 10 c space, vector space ssification & regressing nsity estimation; key optimization	<b>Title of the unit:</b> <b>Kernel Methods</b> ce, normed space, inne ssion; implementation to ernel PCA; kernel online	r product echniques e learning	space; 1 of SVN . Randor	RKHS; I M; kern n forest,	Learning el ridge Genetic
8. Unit wise deta Unit-1 Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony Unit – 2	iled content Number of lectures = 10 c space, vector spaces ssification & regress nsity estimation; key optimization Number of	Title of the unit: Kernel Methods ce, normed space, inne ssion; implementation t ernel PCA; kernel online Title of the unit:	r product echniques e learning	space; 1 of SVN . Randor	RKHS; I M; kern n forest,	Learning el ridge Genetic
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel det algorithms, ant colony</li> <li>Unit – 2</li> </ul>	iled content Number of lectures = 10 c space, vector spaces ssification & regress insity estimation; key optimization Number of lectures = 10	Title of the unit: Kernel Methods ce, normed space, inne ssion; implementation t ernel PCA; kernel online Title of the unit: Spectral Clustering	r product echniques e learning	space; 1 of SVN . Randor	RKHS; I M; kern n forest,	Learning el ridge Genetic
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m</li> </ul>	iled content Number of lectures = 10 c space, vector spaces ssification & regress insity estimation; key optimization Number of lectures = 10 odel based clustering	Title of the unit: Kernel Methods ce, normed space, inne ssion; implementation t ernel PCA; kernel online Title of the unit: Spectral Clustering g, Expectation Maximiz	r product echniques e learning ation; Inde	space; 1 of SVN . Randor	RKHS; I M; kern n forest, Compon	Learning el ridge Genetic
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel det algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m Analysis; Hidden Mar</li> </ul>	iled content Number of lectures = 10 c space, vector spaces ssification & regress insity estimation; key optimization Number of lectures = 10 odel based clustering khov models; Facto	Title of the unit: Kernel Methods ce, normed space, inne ssion; implementation t ernel PCA; kernel online Title of the unit: Spectral Clustering g, Expectation Maximiz r Analysis; introduction	r product echniques e learning ation; Inde	space; 1 of SVN . Randor	RKHS; I M; kern n forest, Compon	Learning el ridge Genetic ent ent
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m Analysis; Hidden Mari Methods.</li> </ul>	iled content Number of lectures = 10 c space, vector spaces ssification & regress insity estimation; key optimization Number of lectures = 10 odel based clustering khov models; Facto	Title of the unit: Kernel Methods ce, normed space, inne ssion; implementation t ernel PCA; kernel online Title of the unit: Spectral Clustering g, Expectation Maximiz r Analysis; introduction	r product echniques e learning ation; Inde to Graphie	space; 1 of SVN . Randor ependent cal mode	RKHS; I M; kern n forest, Compon els & San	Learning el ridge Genetic ent pling
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m Analysis; Hidden Mar Methods.</li> </ul>	iled content Number of lectures = 10 c space, vector space ssification & regrest insity estimation; key optimization Number of lectures = 10 odel based clustering khov models; Facto	Title of the unit: Kernel Methods ce, normed space, inne ssion; implementation t ernel PCA; kernel online Title of the unit: Spectral Clustering g, Expectation Maximiz r Analysis; introduction	r product echniques e learning ation; Inde to Graphi	space; 1 of SVN . Randor ependent cal mode	RKHS; I M; kern n forest, Compon els & San	Learning el ridge Genetic ent npling
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m Analysis; Hidden Mari Methods.</li> <li>Unit – 3</li> </ul>	iled content Number of lectures = 10 c space, vector spaces ssification & regress insity estimation; key optimization Number of lectures = 10 odel based clustering khov models; Facto	Title of the unit: Kernel Methods ce, normed space, inne ssion; implementation ternel PCA; kernel online Title of the unit: Spectral Clustering g, Expectation Maximiz r Analysis; introduction	r product echniques e learning ation; Inde to Graphi	space; 1 of SVN . Randor ependent cal mode	RKHS; I M; kern n forest, Compon els & San	Learning el ridge Genetic ent pling
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m Analysis; Hidden Mari Methods.</li> <li>Unit – 3</li> </ul>	iled content Number of lectures = 10 c space, vector space ssification & regrest insity estimation; key optimization Number of lectures = 10 odel based clustering khov models; Facto Number of lectures = 10	Title of the unit: Kernel Methods ce, normed space, inne ssion; implementation t ernel PCA; kernel online Title of the unit: Spectral Clustering g, Expectation Maximiz r Analysis; introduction Title of the unit: Basic concepts of mac	r product echniques e learning ation; Inde to Graphic	space; 1 of SVN . Randor ependent cal mode	RKHS; I M; kern n forest, Compon els & San	Learning el ridge Genetic ent pling
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel det algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m Analysis; Hidden Mar Methods.</li> <li>Unit – 3</li> <li>Basic concepts of m</li> </ul>	iled content Number of lectures = 10 c space, vector space ssification & regress insity estimation; key optimization Number of lectures = 10 odel based clustering khov models; Factor Number of lectures = 10 achine learning, inc	Title of the unit: Kernel Methods ce, normed space, inne ssion; implementation to ernel PCA; kernel online Title of the unit: Spectral Clustering g, Expectation Maximiz r Analysis; introduction Title of the unit: Basic concepts of mac ductive learning, decis	r product echniques e learning ation; Inde to Graphic chine lear	space; 1 of SVN . Randor ependent cal mode	RKHS; I M; kern n forest, Compon els & San	Learning el ridge Genetic ent pling
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m Analysis; Hidden Mari Methods.</li> <li>Unit – 3</li> <li>Basic concepts of m learning, ensemble lea</li> </ul>	iled content Number of lectures = 10 c space, vector space ssification & regreen insity estimation; key optimization Number of lectures = 10 odel based clustering khov models; Facto Number of lectures = 10 achine learning, inder rning, clustering	Title of the unit:         Kernel Methods         ce, normed space, inne         ssion; implementation ternel PCA; kernel online         Title of the unit:         Spectral Clustering         g, Expectation Maximiz         r Analysis; introduction         Title of the unit:         Basic concepts of mac         ductive learning, decise	r product echniques e learning ation; Inde to Graphic chine lear	space; 1 of SVN . Randor ependent cal mode	RKHS; I M; kern n forest, Compon els & San	Learning el ridge Genetic ent pling
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m Analysis; Hidden Mar Methods.</li> <li>Unit – 3</li> <li>Basic concepts of m learning, ensemble lea</li> </ul>	iled content Number of lectures = 10 c space, vector space ssification & regress insity estimation; key optimization Number of lectures = 10 odel based clustering khov models; Facto Number of lectures = 10 achine learning, incomparing	Title of the unit:         Kernel Methods         ce, normed space, inne         ssion; implementation the         ernel PCA; kernel online         Title of the unit:         Spectral Clustering         g, Expectation Maximiz         tr Analysis; introduction         Title of the unit:         Basic concepts of machine         ductive learning, decis	r product echniques e learning ation; Inde to Graphic chine lear	space; 1 of SVN . Randor ependent cal mode	RKHS; I M; kern n forest, Compon els & San	Learning el ridge Genetic ent pling
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m Analysis; Hidden Mari Methods.</li> <li>Unit – 3</li> <li>Basic concepts of m learning, ensemble lea</li> <li>Unit – 4</li> </ul>	iled content Number of lectures = 10 c space, vector space ssification & regress isity estimation; key optimization Number of lectures = 10 odel based clustering khov models; Facto Number of lectures = 10 achine learning, incr rning, clustering Number of lectures = 10	Title of the unit: Kernel Methods ce, normed space, inne ssion; implementation ( ernel PCA; kernel online Title of the unit: Spectral Clustering g, Expectation Maximiz r Analysis; introduction Title of the unit: Basic concepts of mac ductive learning, decise	r product echniques e learning ation; Inde to Graphic chine lear ion tree 1	space; 1 of SVN . Randor ependent cal mode	RKHS; I M; kern n forest, Compon els & Sam	Learning el ridge Genetic ent pling
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m Analysis; Hidden Mar Methods.</li> <li>Unit – 3</li> <li>Basic concepts of m learning, ensemble lea</li> <li>Unit – 4</li> </ul>	iled content Number of lectures = 10 c space, vector space sification & regreen insity estimation; key optimization Number of lectures = 10 odel based clustering khov models; Facto Number of lectures = 10 achine learning, inter rning, clustering Number of lectures = 12	Title of the unit: Kernel Methods ce, normed space, inne ssion; implementation to ernel PCA; kernel online Title of the unit: Spectral Clustering g, Expectation Maximiz r Analysis; introduction Title of the unit: Basic concepts of mac ductive learning, decis Title of the unit: Artificial neural netw	r product echniques e learning ation; Inde to Graphic chine lear ion tree 1	space; 1 of SVN . Randor ependent cal mode	RKHS; I M; kern n forest, Compon els & San	Learning el ridge Genetic ent pling pervised
<ul> <li>8. Unit wise deta</li> <li>Unit-1</li> <li>Introduction to metric theory; SVM for cla regression; kernel der algorithms, ant colony</li> <li>Unit – 2</li> <li>Spectral Clustering; m Analysis; Hidden Mari Methods.</li> <li>Unit – 3</li> <li>Basic concepts of m learning, ensemble lea</li> <li>Unit – 4</li> <li>Artificial neural network</li> </ul>	iled content Number of lectures = 10 c space, vector space sification & regrest isity estimation; key optimization Number of lectures = 10 odel based clustering khov models; Facto Number of lectures = 10 achine learning, incr rning, clustering Number of lectures = 12 orks, support vector	Title of the unit:         Kernel Methods         ce, normed space, inne         ssion; implementation (         ernel PCA; kernel online         Title of the unit:         Spectral Clustering         g, Expectation Maximiz         r Analysis; introduction         Title of the unit:         Basic concepts of mac         ductive learning, decise         Title of the unit:         Artificial neural netver         machines, Bavesian le	r product echniques e learning ation; Inde to Graphic chine learning corks arning. de	space; 1 of SVN . Randor ependent cal mode ning earning, earning,	RKHS; I M; kern n forest, Compon els & Sam semi-su	Learning el ridge Genetic ent pling pervised
neural network, accuracy assessment

#### 9. 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.

#### **10.** Books Recommended (3 Text Books + 2-3 Reference Books)

#### **Text Books**

1. Neural Networks and Learning Machines (3<sup>rd</sup> Ed) by Simon Haykin, McMaster University, Canada,2008

2. Deep learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press, 2016.

#### **Reference Books**

1. Pattern Recogonition and Machine learning Christopher M Bishop 2006

2. Machine Learning, Tom Mitchell, McGraw Hill, 1997

1. Name of the DepartmentCIVIL ENGINEERING						
2. Cours	e Digital Image	L	Т		Р	
Name	Processing Lab					
3. Cours	e	0	0		2	
Code						
4. Type	of Course	Core (✓)	<b>PE()</b>		<b>OE</b> ()	
5. Pre-		6. Frequency	Even	Odd ()	Either	Every
requis	ite	(use tick	(🗸)		Sem	Sem
(if any	7)	marks)			0	0
7. Total	Number of Lectures, Tu	torials, Practical (assur	ning 14 w	eeks of one seme	ester)	
Lectures = 00		Tutorials = 00	Practi	ical = 28		
Brief Syllabus	: Digital image processi	ing includes Introduction	Image pr	ocessing system,	Image A	nalysis
and Understan	ding and Multi tempora	1 Data merging – Chang	ge detecti	on procedures &	Hyper-s	spectral
Image Analysi	s and Radar image analys	is.				
0 T	• • • •					
8. Learn	ing objectives:					
1 To study and	analyze the image proce	ssing.	ndimogo	onalizaia		
	ne appropriate methods to	improve data merging a	nd mage	analysis.		
9. Cours	e Outcomes:					
On completion	of this course, the studer	ts will be able to				
1. Students will	ll be able to understand us	se of image processing in	Civil Eng	gineering.		
2. Students will	Il understand about GIS a	nd image processing tech	iniques.			
10. Unit v	vise detailed content					
1. Familia	arization with digital image	ge processing & image pr	ocessing	software		
2. Import	ing raw data					
3. Display	ving image data					
4. Image Rectification & Registration						
5. Image Enhancement & Transformation						
6. Unsupervised Classification						
7. Training site marking & Supervised Classification						
8. Accuracy Assessment						
9. Map Composition, Image Data Fusion						
10. Calcula	ation of area and Accurac	y Assessment				

1. Name of the Department     CIVIL ENGINEERING						
2. Course	GPS Lab	L	Τ		Р	
Name						
3. Course		0	0		2	
Code						
4. Type of C	ourse	Core(✓)	<b>PE</b> ()		<b>OE</b> ()	
5. Pre-		6. Frequency	Even	Odd ()	Either	Every
requisite		(use tick	(✔)		Sem	Sem
(if any)		marks)			0	0
7. Total Nun	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)					
Lectures = 00	_	Tutorials = 00	Pract	ical = 28		
Brief Syllabus: I	n this course, the stu	dents will know the impo	ortance	of GPS, Factor af	fecting	GPS &
Applications of GF	Ϋ́S.					
8. Learning	objectives:					
1. To study th	e different types of GI	PS and its technical descrip	ption.			
2. To Analyse	e the data collected an	d use the application				
9. Course O	itcomes:					
On completion of t	his course, the student	ts will be able to	CDC			
1. Students will lea	rn how to take observ	ation and collect data from	n GPS			
2. Students will be	able to understand the	e application of GPS				
10. Unit wise	detailed content					
1. Familiariza	tion with different typ	es of GPS and software				
2. Measureme	ent of location with the	e help of GPS				
3 GPS Surve	v of Natural and Man-	made features				
4 Field every of GPS data collection in standalong mode						
5. CDS & CIS data integration and output proparation						
6. DGPS setting up for observation						
7. Data collection in differential mode						
8. Ground control points, Criteria for Selecting reference station						
9. Reference s	tation equipment's, or	perational procedures, pos	t proces	sing of data		
10. Ground control for geometric correction of satellite imagery using DGPS						

# Third Semester

1. Name of the DepartmentCIVIL ENGINEERING							
2.	Course Name	Basics and	L	Т		Р	
		Digital					
		Cartography					
3.	<b>Course Code</b>		3	0		0	
4.	Type of Course	e	Core (✓)	<b>PE()</b>		<b>OE</b> ()	
5.	Pre-requisite		6. Frequency (use	Even	Odd (✓)	Either	Every
	(if any)		tick marks)	0		Sem	Sem
						0	0
7.	<b>Total Number</b>	of Lectures, Tut	orials, Practical (assu	ming 14	weeks of one sen	nester)	
Le	ctures = 42		Tutorials = 00	Practic	cal = 00		
Br	ief Syllabus: Ba	asic Introduction	to Cartography, practic	cal applie	cations in GIS in t	erms of	labeling
tec	techniques, colour choice and symbolization. Theoretical and critical views of GIS as a tool, as well						
as	maps as conveye	ors of information					
8. Learning objectives:							
1. '	1. To give the students' knowledge about Cartography.						
2. '	To study differer	t concepts of Bas	ic and Digital Cartogra	aphy.			
9. 	Course Outcor	nes:					
Kn	lowledge and und	lerstanding				~	
(1) ski	Explain how for lls	nts, coolers and sy	mbols are used in map	os to con	vey information, C	Competer	nce and
(2)	select and custo	mize labels, color	s and symbols based o	n the put	rpose and target at	idience o	of the
ma	ıp,						
(3)	utilize graphics	software for post-	processing of map cor	tent and	design,		
(4)	design map layo	outs whose appear	ance and content are w	vell suite	d to their purpose,	and Jud	gment
and	d approach						
(5)	Assess and relat	te to maps in term	s of their function as c	onveyors	s of information.		
10	. Unit wise detai	iled content					
Un	nit-1	Number of	Title of the unit: Ba	asic Intr	oduction and Un	derstand	ling
		lectures = 10					
Int	roduction to the	basic concepts an	d techniques for Carto	graphy, t	the manipulation,	analysis,	and the
graphic representation of spatial information.							
Un	nit - 2	Number of	Title of the unit: Pro	ocessing			
		lectures = 10					
Concept of Processing, compilation and symbolization of spatial data and the application of related							
statistical techniques.							
Un	nit - 3	Number of	Title of the unit: Ma	pping			
		lectures =10					

Technology of mapping, particularly the Internet, computer mapping, geographic information systems, and remote sensing.

Unit - 4	Number of	Title of the unit: Basics of Computer Cartography
	lectures = 12	

Introduction to image processing: Acquisition of digital images and image formats; Digital image processing operations: Image rectification and restoration, image enhancement, spatial feature manipulation, spectral ratioing, image data fusion, image classification; Image interpretation: elements and techniques; Air- photo interpretation, Satellite imagery interpretation.

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

- 1. <u>https://www.edx.org/learn/cartography</u>
- 2. <u>https://www.coursera.org/courses?query=cartography</u>
- 3. <u>https://www.esri.com/training/catalog/596e584bb826875993ba4ebf/cartography./</u>

### 12. Books Recommended

#### TEXT BOOKS

1. Monmonier, M.S. (1982): Computer Assisted Cartography: Principles and Prospects, Prentice Hall.

- 2. Robinson, H. et al (1995): Elements of Cartography, 6th Edition, John Wiley & Sons, New York.
- 3. Monkhouse, F.J.R. & Wilkinson H.R.(2000): Maps and Diagrams, Methuen & Co. London.
- 4. Raise, Erwin (1962): Principles of Cartography, McGraw-Hill, New York.

#### **REFERENCE BOOKS**

- 1. Rampal, K.K.(1993): Mapping and Compilation, Concept Publishing Co. New Delhi.
- 2. Slocum, T.A.et al.(2008): Thematic Cartography and Revisualization, 3rd Edition, Prentice Hall.
- 3. Mishra, R.P. (1973): Fundamentals of Cartography, Prasaranga, University of Mysore..

<b>1. Name of the Department</b> CIVIL ENGINEERING							
2.	Course Name	Research	L	Т		Р	
		Methodology					
		and IPR					
3.	Course Code		3	0		0	
4.	Type of Course (u	se tick mark)	Core (✓)	PE-()		OE()	
5.	Pre-requisite (if		6. Frequency (use	Even	Odd	Either	Every
	any)		tick marks)	0	(✔)	Sem ()	Sem
							0
_	TT 4 1 NT 1		D (1) 1 ( 1 1	4 1	e		

#### 7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)

Lectures $= 42$	Tutorials $= 00$	Practical = 0
	I atoriaib 00	i fuetieur o

#### 8.Brief Syllabus:

The aim of the course is to make students understand the importance of Research Paper Writing. Also, it covers all the concepts which involved in writing the Research Paper.

#### 9 Learning objectives:

The objectives of the course are:

- 1. The students are able to recognize the steps involved in doing research work.
- 2. The students will be able to collect data using various media and using the best possible sample available.
- 3. The students would learn to propose their Hypothesis and build models for the problem.
- 4. The students would be able to correctly document their findings in the form of a report.

#### **10.Course Outcomes:**

After completion of this course, the student will be able to:

- 1. Recognize the various steps involved in research.
- 2. Collect data from samples, Examine and analyze the data.
- 3. Develop models for problems.
- 4. Explain the entire process in the form of a report.

# 11.Unit wise detailed content Unit-1 Number of lectures = 10

Research - Types, Research process and steps, Hypothesis, Research Proposal and aspects. Research Design- Need, Problem Definition, Variables, Research Design concepts, Literature survey and review, Research design process, Errors in research. Research Modeling- Types of models, model building and stages, Data consideration.

Unit - 2	Number of lectures = 10	Title of the unit: Sampling
Sampling and data col	llection- Techniques	s of sampling, Random, Stratified, Systematic, Multistage-

sampling, Primary and secondary sources of data. Design of questionnaire.

Unit - 3	Number of	Title of the unit: Data Collection and Experiments		
	lectures = 10			
Design of Experiments	s- Objectives, strateg	gies, Factorial experimental design, designing engineering		
experiments, basic prin	nciples-replication, 1	randomization, blocking, guidelines for design of		
experiments.				
Unit - 4	Number of	Title of the unit: Models and Hypothesis & Report		
	lectures = 12	writing		
Single factor experime	ent- Hypothesis tes	ting, analysis of Variance component (ANOVA) for fixed		
effect model; Total,	treatment and erro	or of squares, Degrees of freedom, Confidence interval;		
ANOVA for random e	ffect model, estimat	ion of variance components, Model adequacy checking.		
Structure and comport	nents of Scientific	Reports, Types of Report, Technical Reports and Thesis;		
Different steps in the	preparation - Layo	out, structure and Language of typical reports; Illustrations		
and tables, Bibliograph	ny, Referencing and	foot notes.		
12.Brief Description	of self learning / E-	learning component		
https://research-me	thodology.net/resea	arch-methodology/		
https://gradcoach.c	om/what-is-researcl	h-methodology/		
13.Books Recommended				
Text Book:				
1. Research Meth	odology – Methods	and Techniques – C.R. Kothari, New Age International,		
New Delhi, 2004.				
Reference Book:				
1. Design and Analysis of Experiments – Douglas C. Montgomery, Wiley India, 8th Edition.				
2012.				
2. Practical Research: Planning Design – Paul D. Leddy, London, 1980.				
	0 0 0 0			

1. Name of the D	epartment	CIVIL ENGI	NEERING	T		
2. Subject	Research	L	Т		Р	
Name	Methodology					
	and IPR Lab					
3. Subject		0	0		2	
Code						
4. Type of Subj	ect	Core (✓)	<b>PE</b> () <b>OE</b> ()			
5. Pre-	Research	Frequency (use tick	Even ()	Odd	Either	Every
requisite (if	Methodology	marks)		(🗸)	Sem	Sem
any)	and IPR				0	0
6. Total Number of Lectures, Tutorials, Practical (Assuming 14 weeks in semester)						

#### Lectures = 00

#### 1. Learning objectives:

The objectives of the course are:

2. The students are able to recognize the steps involved in Identifying research problem.

**Tutorials = 00** 

3. The students will be able to collect data using various media and using the best possible sample available.

**Practical = 28** 

- 4. The students would learn to propose their Hypothesis and build models for the problem.
- 5. The students would be able to correctly document their findings in the form of a report.

#### **Outcomes:**

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

1. Choose the topic for writing research paper.

- 2. Develop models for problems.
- 3. The students would learn to write the research paper.

7. Lab (	7. Lab Content				
Sr. No.	Title	CO covered			
1	How to choose topic for research	1,2			
2	How to collect data for the particular research problem	1,2			
3	Writing Abstract	1,2			
4	Writing Literature review	1,2			
5	Explaining and writing methodology	1,2			
6	How to analyze the data collected	1,2			
7	Presentation of analysis and findings	1,2			
8	How to write result and conclusion	2,3			
9	References in research article	2,3			

# Departmental Electives

2. Subject Name	Advanced	L	Т		_	
Name		1	1		P	
	Surveying					
	and					
	Cartography					
3. Subject		3	0		0	
Code						
4. Type of Subje	ect (use tick	Core ()	<b>PE</b> (√)		<b>OE</b> ()	
mark)						
5. Pre-requisite	nil	Frequency (use tick	Even ()	Odd	Either	Every
(if any)		marks)		(🗸)	Sem	Sem
					0	0
6. Total Numbe	r of Lectures, Tu	itorials, Practical (assu	ming 14 we	eks of o	ne semest	er)
Lectures = 42		Tutorials = 00	Practical	=00		
Brief Syllabus:						
7. Learning obj	ectives:					
1. To teach the students	about the Triangu	ulation and Trilateration				
2. To enable the student	s to understand th	e Photogrammetry and I	Remote Sen	sing		
8. Subject Outc	omes:					
On completion of this c	ourse, the student	s will be able to				
1. Understand the conce	pt of advanced su	irveying				
2. Understanding the co	ncept of field surv	vey and field astronomy.				
9. Unit wise det	ailed content					
Unit-1	Number of	Title of the unit:				
	lectures = 10	Triangulation, Trila	ateration	and A	djustmer	it
		Computations				
Triangulation and Tr	ilateration :Nece	essity of Control Surve	ying, Princi	ple of T	riangulati	on and
Trilateration classificat	ion of Triangulat	tion Systems Station M	larks, Towe	ers and S	Signals, S	Satellite
station, Intersected an	nd Resected point	ints, Reconnaissance,	Indivisibilit	y of st	ations, A	Angular
Measurement, Base line	measurement and	d its extension				

**Adjustment Computations:** Treatment of random errors, Normal law of errors, Most Probable Value, Weight of observations, Propagation of errors and variances, Principle of Least Squares, Observations and correlative Normal Equations, Adjustment of triangulation figures and level nets.

Unit - 2	Number of	Title of the unit:		
	lectures = 10	Curves and project survey		
Curves: Classification of curves, Elements of Simple Circular, Transition and Vertical curves, Theory				
and methods of setting out circular, transition and vertical curves, special field problems.				

**Project Surveys:** General requirements and specifications for Engineering project surveys, Reconnaissance, Preliminary and Location surveys for highways, railways and canals, Correlation of surface and underground surveys in case of culverts, Bridges and Tunnels; Principles and practice of hydrographic surveys, Layout of culverts, canals, bridges and buildings.

Unit - 3	Number of	Title of the unit: Field Astronomy:
	lectures = 10	

**Field Astronomy:** Astronomical terms, co-ordinate systems, Spherical trigonometry, Astronomical triangle, Relationship between coordinates.

Unit – 4	Number of	Title of the unit:
	lectures = 12	Photogrammetry ,Remote Sensing, GPS and GIS

**Photogrammetry and Remote Sensing:** Photogrammetry-Introduction, Scale of photograph, Tilt and height displacement, Stereoscopic vision and stereoscopes, Techniques of photo-interpretation, Principles of remote sensing, Electro Magnetic Radiation (EMR), energy interaction with atmosphere and earth features, spectral signatures, Remote sensing satellites and their data products, methods of interpretation of remotely sensed data.

**GPS and GIS:** Global Positioning System (GPS)-Introduction, principle, and applications of GPS in different fields of Surveying, Geographic Information System (GIS) – Introduction, Geographical concepts and terminology, Applications of GIS

#### **10. 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.

#### 11. Books Recommended

#### Text Books

1 Agor, R., "Surveying", Vol. II & III, Khanna Publications, Delhi, 1995.

2. Arora, K.R., "Surveying", Vol. II & III, Standard Book House, Delhi. Bannister, A. And Baker, R., "Solving Problems in 3 Surveying, "Longman Scintific Technical, U.K., 1994.

5. Punmia, B.C., "Surveying", Vol.II & III Laxmi Publications, New Delhi.

#### **Reference books**

1. Duggal S.K., Surveying Vol. I & II TMH Basak, Surveying TMH. Kanetkar, Surveying Chandra, A.M. "Plane Surveying", New Age International Publisher,

2. Cromley .R. G, "Digital Cartography". Prentice-Hall of India, New Delhi, 1992.

3. Dent, B. D., "Cartography – Thematic Map Design", 5th" Edition, W C B McGraw-Hill, Boston, 1999.

4. Rampal .K.K, "Mapping and Compilation". Concept Publishing Co., New Delhi, 1993.

1. Name of the Depar	•tment	CIVIL ENGINEERING				
2. Subject Name	Advanced	L	Т	Р		
	Surveying and					
	Cartography					
	Lab					
3. Subject Code		0	0	2		
4. Type of Subject (u	se tick mark)	Core ()	<b>PE(</b> ✓)	<b>OE</b> ()		
5. Pre-requisite (if	Nil	5. Frequency	Even Odd	Either Every		
any)		(use tick	() (•)	Sem () Sem ()		
		marks)				
7 Total Number of Lectures Tutorials, Practical (assuming 14 weeks of one semester)						

Lectures = 00 Tutorials = 00 Practical = 28

**8. Brief Syllabus:** This course explores how geographic information systems and related technologies (global positioning systems, remote sensing, etc.) can be used to promote and support the construction and simulation of dynamic models of human and environmental systems.

#### 9. Learning objectives:

- 1. To teach the students about the Triangulation and Trilateration
- 2. To enable the students to understand the Photogrammetry and Remote Sensing

#### **10. Subject Outcomes:**

On completion of this course, the students will be able to perform/Understand:-

- 1. Understand the concept of advanced surveying
- 2. Understanding the concept of field survey and field astronomy.
- 3. Understanding the concept of Photogrammetry
- 4. Understanding the concept of Remote Sensing,
- 5. Understanding the concept of GPS and GIS

11. Unit wise detailed	11. Unit wise detailed content				
Sr. No.	Title				
1.	Study of Principle of Triangulation and Trilateration				
2	Study of Satellite station, Intersected and Resected points, Reconnaissance, Indivisibility of stations				
-					
3	Study of Propagation of errors and variances				
4	Study of Adjustment of triangulation figures and level nets.				
5	Theory and methods of setting out circular, transition and vertical curves,				
6	General requirements and specifications for Engineering project surveys				
7.	Study of Applications of GIS				

1.	Name of the De	epartment	CIVIL EN	JGINEERING				
2.	Course Name	Application of	L	Т	Т		Р	
		Remote						
		Sensing in						
		Geosciences						
3.	Course Code		3	0		0		
4.	<b>Type of Course</b>	e	Core ()	<b>PE(</b> ✓)		<b>OE</b> ()		
5.	Pre-requisite		6. Frequency (use	Even	Odd (✓)	Either	Every	
	(if any)		tick marks)	0		Sem	Sem	
						0	0	
_								

# 7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)Lectures = 42Tutorials = 00Practical = 00

**Brief Syllabus:** Basic Introduction to Remote Sensing, Basic Spatial Analysis and Urban Mapping, Concept of Urban Planning, Urban Disaster Management.

#### 8. Learning objectives:

1. To give the students an insight about Remote Sensing.

2. To study different concepts of Urban Planning and Urban Mapping.

#### 9. Course Outcomes:

At the end of the syllabus, students will be able to understand the

1. Knowledge about Remote Sensing.

2. Understanding concepts of Urban Planning and Urban Mapping.

#### 10. Unit wise detailed content

Unit-1	Number of	Title of the unit:	Basic Introduction and Understanding
	lectures = 10		

An overview of - origin of earth, structure of earth, geological time scale, plate tectonics and continental drift, rocks and minerals, different geomorphic processes. Applications of remote sensing and GIS in mineral targeting, geomorphologic studies, engineering geological studies, litho logical and structural mapping. Hydrological cycle, river systems and river dynamics, river morph metric analysis, wetlands mapping and monitoring, watershed concept and its management, behavior of different Remote Sensing sensors in surface water studies.

Unit - 2	Number of	Title of the unit: Urban Mapping and Spatial Analysis
	lectures = 10	

Urban process, the physical structure and composition of urban areas, Urbanization process, growth trend, problems of urbanization, information requirements for perspective planning, Scale and resolution concepts and interpretation techniques for urban and regional analysis, urban GIS, spatial analytical techniques, statistics and visualization, conceptual modeling of urban processes; Urban Sprawl: Change detection in Land Use Land Cover monitoring physical growth of urban area, trends in urban sprawl and associated problems.

Unit - 3	Number of	Title of the unit: Urban Planning
	lectures =10	

Plans – planning needs, types of plans, urban and regional planning;

LU/LC mapping Urban Planning: Zoning of Land Use, Zonal Land Use Plan, Object oriented GIS data modeling for urban design, landscape architecture, urban infrastructure, Site selection for urban development, site suitability analysis for utilities and civic amenities, interim master plan, Master Plan.

Unit - 4	Number of	Title of the unit: Urban Disaster and Emergencies
	lectures =12	Management

Mapping vulnerable zones with respect to earth quake, flood, fire, terrorist attacks, and finding optimum routes for ambulances, and emergency services, GIS modeling for Hazard risk and emergencies management

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

- 1. <u>https://elearning.iirs.gov.in/</u>
- 2. https://elearning.iirs.gov.in/e-Learning.html
- 3. https://gis.e-education.psu.edu/remote\_sensing

#### 12. Books Recommended TEXT BOOKS

- 1. Remote Sensing of Geology Prof. R.P.Gupta
- 2. Geomorphological process Savindra Singh
- 3. Remote Sensing in Geosciences Nitin K. Tripathi & Vishwanath Bajpai
- 4. Earth Surface System Richard J. Huggett

1. Name of the Depar	rtment	CIVIL ENGINEER	RING			
2. Subject Name	Application of	L	Т	Р		
	Remote Sensing					
	in Geosciences					
	Lab					
3. Subject Code		0	0	2		
4. Type of Subject (u	se tick mark)	Core ()	<b>PE(</b> ✓)	<b>OE</b> ()		
5. Pre-requisite (if	Nil	6.Frequency (use	Even Odd	Either Every		
any)		tick marks)	() (1)	Sem () Sem ()		
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 00		Tutorials = 00	Practical = 28			
7 Brief Syllabus: Basic Introduction to Remote Sensing, Basic Spatial Analysis and Urban Manning						

**7. Brief Syllabus:** Basic Introduction to Remote Sensing, Basic Spatial Analysis and Urban Mapping, Concept of Urban Planning, Urban Disaster Management

#### 8. Learning objectives:

- 1. To give the students an insight about Remote Sensing.
- 2. To study different concepts of Urban Planning and Urban Mapping.

#### 9. Subject Outcomes:

#### At the end of the syllabus, students will be able to understand the

- 1. Knowledge about Remote Sensing.
- 2. Understanding concepts of Urban Planning and Urban Mapping.

#### 10. Unit wise detailed content

Sr. No.	Title
1.	Study of Applications of remote sensing and GIS in mineral targeting
2	Study of wetlands mapping and monitoring, watershed concept and its management
3	Study of Scale and resolution concepts and interpretation techniques for urban and regional analysis
4	Study of Change detection in Land Use Land Cover monitoring physicalgrowth of urban area
5	LU/LC mapping Urban Planning
6	Mapping vulnerable zones with respect to earth quake
7.	GIS modeling for Hazard risk and emergencies management

1.	1. Name of the DepartmentCIVIL ENGINEERING						
2.	Course	Non –	L	Т		Р	
	Name	Topographic					
		Photogrammetry					
3.	Course		3	0		0	
	Code						
4.	Type of Cour	se	Core ()	<b>PE(</b> ✓)		<b>OE</b> ()	
5.	Pre-		6. Frequency	Even	Odd (✓)	Either	Every
	requisite (if		(use tick	0		Sem	Sem
	any)		marks)			0	0
7.	Total Number	r of Lectures, Tute	orials, Practical (ass	uming 1	4 weeks of one s	emester	)
Le	ctures = 42		Tutorials = 00	Praction	cal = 00		
Br	ief Syllabus: H	Basic Introduction to	o Non – Topographic	Photog	ammetry		
8.	Course Outco	omes:					
Th	e student will b	e able to:					
	1. Understand	d basic photogramm	netric & remote sensi	ng techn	iques		
	2. Perform ba	asic photogrammetr	ric office computation	IS			
	3. Apply Pho	togrammetry inform	nation to professional	l surveyi	ng services		
	4. Demonstra	te an appropriate n	nastery of the knowled	dge, tech	niques, skills and	d modern	tools
	of Photogr	ammetry					
	5. Apply curr	ent knowledge and	adapt to emerging ap	plication	ns of Photogramr	netry and	1
	technology	1					
	6. Identify, an	nalyze, and solve te	chnical photogramme	etric pro	blems		
	7. Communic	cate photogrammeti	ric analysis and result	s effecti	vely		
9.	Unit wise deta	ailed content					
Un	nit-1	Number of	Title of the unit: I	NTROI	DUCTION		
		lectures = 10					
Ba	sic Introduction	on, Potential of	Close Range Phot	ogramm	etry, Instrument	tation o	f Data
Ac	quisition, Photo	otheodolite, Analyti	cal Stereo plotters.				
Un	nit - 2	Number of	Title of the unit: A	rchitect	ure		
		lectures =10					
Ap	plications in A	rchitecture and Arc	haeology, Photomont	age by I	nverse Photogram	nmetry.	
Un	nit - 3	Number of	Title of the unit: In	dustry	and Engineering	g Applica	ations
		lectures =12					
Ae	rospace Indust	ry, Automobile Inc	lustry, Measurement	of Stor	age Tanks and C	Cooling 7	Γowers,
Mo	odel Studies.						
				1			
Un	uit - 4	Number of	Title of the unit: A	pplicati	ons Areas		
		lectures $= 10$					
X	– Ray Photogra	ammetry Systems, I	Reverse Projection T	echnique	es, Under water	Photogra	mmetry
and	and Case Studies.						

#### 10. Brief Description of self-learning / E-learning component

- 1. <u>https://elearning.iirs.gov.in/e-Learning.html</u>
- 2. https://gis.e-education.psu.edu/remote\_sensing

### 11. Books Recommended

#### TEXT BOOKS

1. Juliana Maantay, John Ziegler, John Pickles, GIS for the Urban Environment, Esri Press 2006.

2. Allan Brimicombe, GIS Environmental Modeling and Engineering, CRC; 1 edition 2003.

1. Name of the Depar	rtment	CIVIL ENGINEERING				
2. Subject Name	2. Subject Name Non –		Т		Р	
	Topographic					
	Photogrammetry					
	Lab					
3. Subject Code		0	0 2		2	
4. Type of Subject (use tick mark)		Core $()$	<b>PE(</b> ✓)		<b>OE</b> ()	
5. Pre-requisite (if	Nil	Frequency (use tick	Even	Odd	Either	Every
any)		marks)	0	(🗸)	Sem ()	Sem ()
6. Total Number of L	ectures, Tutorials,	Practical (assuming 14	weeks o	f one s	emester)	
Lectures = 00		Tutorials = 00	Practi	cal = 2	8	
7. Brief Syllabus: Basic Introduction to Non – Topographic Photogrammetry.						
8. Learning objectives:						
1. To teach the students about the Triangulation and Trilateration						

2. To enable the students to understand the Photogrammetry and Remote Sensing

#### 9. Subject Outcomes:

The student will be able to:

- 1. Understand basic photogrammetric & remote sensing techniques
- 2. Perform basic photogrammetric office computations
- 3. Apply Photogrammetry information to professional surveying services
- 4. Demonstrate an appropriate mastery of the knowledge, techniques, skills and modern tools of Photogrammetry
- 5. Apply current knowledge and adapt to emerging applications of Photogrammetry and technology
- 6. Identify, analyze, and solve technical photogrammetric problems
- 7. Communicate photogrammetric analysis and results effectively

10. Unit wise detailed content			
Sr. No.	Title		
1.	Study of Potential of Close Range Photogrammetry		
2	Study of Analytical Stereo plotters.		
3	Study of Photomontage by Inverse Photogrammetry		
4	Measurement of Storage Tanks and Cooling Towers		
5	Study of Underwater Photogrammetry		
6	Study of Analytical Stereo plotters		
7.	Study of X – Ray Photogrammetry Systems		

SGT University, Chandu-Budhera, Gurugram Faculty of Engineering & Technology Department of Civil Engineering





### M. Tech. Water Resource Engineering

Scheme & Syllabus (2021-22)

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

#### Water Resource Engineering First Semester

S.	Subject		L	Τ	P	C	Examination		Subject
NO.	Code	Course					mai	rks	Total
		Title					Ext.	Int.	
1		Advanced Fluid Mechanics	3	0	0	3	60	40	100
2		Surface Water Hydrology and Hydrologic Systems	3	0	0	3	60	40	100
3		Flow and Transport in Porous Media	3	0	0	3	60	40	100
4		Water Quality Modeling and Management	3	0	0	3	60	40	100
5		Flow and Transport in Porous Media Laboratory	0	0	2	1	40	60	100
6		QGIS and SAGA GIS Laboratory	0	0	2	1	40	60	100
7		Value Added Courses-I	2	0	0	2	60	40	100
8		Seminar		0	2	1	00	100	100
		Total	14	0	6	17	380	420	800

#### Second Semester

S. NO.	Subject Code	Course	L	Т	Р	C	Examin marl	ation ks	Subject Total
		Title					Ext.	Int.	1000
1		Water Resources systems analysis and design	3	0	0	3	60	40	100
2		Remote sensing applications in water resources engineering	3	0	0	3	60	40	100
3		Computational Hydraulics and Hydrology	3	0	0	3	60	40	100
4		Statistical Methods in Hydrology	3	0	0	3	60	40	100
5		Computational Hydraulics and Hydrology Laboratory	0	0	2	1	40	60	100
6		Water Resources Systems Design Lab	0	0	2	1	40	60	100
7		Seminar		0	2	1	00	100	100
		Total		0	6	15	320	380	700

#### **Third Semester**

S.NO.	Subjec	Course Title	L	Т	Р	С	Examinatio		Subject
	t Code						1	1	Total
							ma Ext	rks Int	
1		Geographical Information Systems and its Applications in Hydrology	3	0	0	3	60	40	100
2		Research Methodology & IPR	3	0	0	3	60	40	100
3		Department Electives-XIII	3	0	0	3	60	40	100
4		Department Electives-XIV	3	0	0	3	60	40	100
5		Department Electives-XV	3	0	0	3	60	40	100
6		Research Methodology & IPR Lab	0	0	2	1	40	60	100
7		Department Electives Lab-XIII	0	0	2	1	40	60	100
8		Department Electives Lab-XIV	0	0	2	1	40	60	100
9		Department Electives Lab-XV	0	0	2	1	40	60	100
10		Value Added Courses-II	2	0	0	2	60	40	100
		Total	17	0	8	21	520	480	1000

#### **Fourth Semester**

S.NO.	Subject	ubject Course Title L		Т	Р	С	Examination marks		Subject
	Code						Ext.	Int.	Total
1		Dissertation	-	-	20 W	20	100	-	100
		Total	-	-	20 W	20	100	-	100

## **Departmental Electives**

S. No.	Specialization	Departmental Elective XIII	Departmental Elective XIV	Departmental Elective XV
1	Water Resource Engineering	Hydraulic Modeling 3-0-2 (4)	Hydrogeology and Groundwater Development 3-0-2 (4)	Environmental Impact Assessment of Water 3-0-2 (4)
2		Hydropower 3-0-2 (4)	Watershed Management 3-0-2 (4)	Urban Hydrology and Drainage 3-0-2 (4)

1.	Name of the Dep	partment: Civil Eng	gine	ering Departme	ent			
2.	Course Name	Advanced Fluid Mechanics	L		Т		Р	
3.	Course Code		3		0		0	
4. Type of Course (use tick mark)		Co	ore (1)	PE()		<b>OE</b> ()		
5.	Pre-requisite (if any)	Fluid Mechanics	6.	Frequency (use tick marks)	Even ()	Odd (✓)	Either Sem ()	Every Sem ()
7.	Total Number o	f Lectures, Tutoria	ls, I	Practical (assum	ing 14 v	weeks of	one sem	ester)
Le	ectures = 42		Τι	itorials = 0	Practi	cal = 0		
8. Th dif wi of	8. Learning objectives: The course provides the elements to understand the basic tools for the analysis and solution of different types of flows, from the ideal to the viscous flow, contrasting the numerical results with the experiments. The students will be able to understand and assimilate the foundations of fluid mechanics.							

#### 9. Course Outcomes (COs):

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

1. Formulate momentum, energy and mass transport models, Analyze Potential Flows, Develop approximate solutions for small and large Reynolds number flows, Apply turbulent flow models, Boundary layer formation and stress acts at the boundary.

10. Unit wise detailed content					
Unit-1	Number of	KINEMATICS OF FLUIDS			
	lectures = 10				

Methods of describing fluid motion-Lagrangian and Eulerian methods, Translation, Rotation and rate of deformation. Streamline, Path lines and streak lines, Material Derivative-local and Convective Acceleration, Fluid rotation-Vorticity Vector.

Unit - 2	Number of	STRESSES IN FLUIDS AND RATE OF
	lectures = 10	STRAIN

Stresses at a point fluids. Stress Tensior-Normal and shear stresses, Nature of strains. Relations between stresses and rates of strains-Stokes law of viscosity. Viscous Contribution to normal stresses.

Unit - 3	Number of	FUNDAMENTAL EQUATIONS OF	
	lectures = 10	FLOW OF VISCOUS COMPRESSIBLE	
		FLUIDS:	
Reynold's transport theorem Equations of Continuity and Momentum in integral form and			

Reynold's transport theorem, Equations of Continuity and Momentum in integral form and applications, Differential form of continuity equation and Euler's equation of motion, Navier-Stoke's equations of viscous compressible fluids.

Unit - 4	Number of	TWO AND THREE DIMENSIONAL
	lectures = 12	INVISCID INCOMPRESSIBLE FLOW
		OF FLUIDS:

Circulation concept-Stoke's theorem, Kelvin's theorem, Stream function, Irrotational flow and velocity potential function, Integration of Euler's equation-along a stream line for irrotational flows, Momentum theorem and moment of momentum theorem. Laplace equation and Flow nets.

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

The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended (2 Books+ 4 References)

- 1. Fox, R.W., Pitchard, P.J., and Mcdonald, A.T., Fluid Mechanics, Wiley India Pvt. Ltd., 2009
- 2. Schlichting, H., and Gresten, K., Boundary Layer Theory, Springer Publications, 2004
- 3. White, F.M., Viscous Fluid Flow, McGraw Hill Pub. Co, New York, 2011
- 4. Yalin, M.S., Theory of Hydraulic Models, McMillan Co., 1971

1. Name of the	e Department: Civil l	Engineering Departmen	t			
2. Course	Surface Water	L	Т		Р	
Name	hydrology and					
	hydrologic					
	systems					
3. Course		3	0		0	
Code						
4. Type of Cou	urse (use tick mark)	Core (✓)	<b>PE()</b>		<b>OE</b> ()	
5. Pre-		6. Frequency	Even	Odd	Either	Every
requisite		(use tick	0	(🗸)	Sem	Sem
(if any)		marks)			0	0
7. Total Numb	per of Lectures, Tuto	rials, Practical (assumir	ng 14 w	eeks of	one sem	ester)
Lectures = 42		Tutorials = 0	Practi	cal = 0		
<ul> <li>8. Learning of To address the comprovide a balanced a</li> <li>9. Course Out</li> </ul>	<ul> <li>8. Learning objectives:</li> <li>To address the computational emphasis of advanced hydrology at a post-graduate level, and to provide a balanced approach to important applications in hydrologic engineering and science.</li> <li>9. Course Octoores (COc):</li> </ul>					
At the end of the co	urse, the student will b	be able to				
1) To addre	ess the computational	emphasis of advanced	hydrol	nov at s	a nost-o	raduate
level an	d to provide a balan	ced approach to import	ant ann	lication	s in hvd	rologic
engineer	ing and science.		me opp		,	1010810
10. Unit wise do	etailed content		<b>.</b>	<u> </u>		
Unit-1	Number of	Title of the unit: HYD	ROLO	GIC PH	RINCIPA	ALS
	lectures $= 10$					
Hydrologic cycles a	nd weather, weather, l	nydrologic losses. Philoso	ophy of	mathen	natical m	odels
of watershed hydrol	ogy.					
Unit - 2	Number of	Title of the unit: HYD	ROLO	GIC AN	NALYSI	S
	lectures = 10					
Watershed concepts	, rainfall-runoff, hvdro	l Ograph analysis, unit hydr	ograph	theory.	linear ar	nd
kinematic wave model, overland flow models						
Unit - 3	Number of	Title of the unit	: ROU	TING		
	lectures = 10					
Lumped flow distributed flow dynamic wave routing Muskingum method Saint Variant						
Faultion-Revnolds	transport theorem	continuity equation t	noment	iim ea	, Sant-	energy
equation	transport theorem,	communey equation, 1	noment	un cq	uanon,	chergy
1						

Init -	1	Number of	Title of the unit: HVDPOI OCIC STATISTICS		
- Unit -	7	1100000000000000000000000000000000000	The of the diff. IT DROLOGIC STATISTICS		
		10000000 - 12			
Statist	ical paramete	r estimation, probabil	ity distribution, goodness of fit, concepts of probability		
weight	ed moments a	and L-moments, frequ	ency analysis, Markov chain, reliability analysis.		
11	Dwief Degen	intion of colf looming	c / E looming component		
11					
	Quiz/Assign	ment/ Seminar/Writte	en Examination. The online platform, will involve the		
	NPTEL and	SWAYAM portal sy	stem. Lecture series and assignments will be beneficial		
	for the stude	ents. Seminars will b	be conducted with the students. Online means will be		
	explored for	broad outlook in the	syllabus.		
12	Books Reco	mmended (2 Books+	- 4 References)		
1.	Bras, R. L.,	and Rodriguez-Iturbe,	, 1994, "Random Functions and Hydrology", Dover		
	Publications	, New York.			
2.	Chow, V. T.	, D. R. Maidment, and	d L. W. Mays; "Applied Hydrology", McGraw Hill		
	International	Editions.			
3.	Haan, C. T.,	2002. "Statistical Me	thods in Hydrology", 2nd ed., Blackwell Publishing,		
	Ames IA				
4	Hoskings I R M and I R Wallis 1997 "Regional Frequency Analysis An Approach				
	Decad on L	Momente" Combrida	a University Drass New York		
_	Dascu Uli L-	W and C L L	e University (1688, New TOIK.		
Э.	v iessman Jr	., w., and G. L. Lewis	s, introduction to Hydrology <sup>*</sup> , 4th ed., Harper-Collins,		
	New York, 1	1996			
1					

1.	1. Name of the Department: Civil Engineering Department							
2.	Course Name	FLOW AND TRANSPORT IN POROUS MEDIA	L		T		Р	
3.	<b>Course Code</b>		3		0		0	
4.	Type of Course (use tick mark)		Co	ore (🗸)	<b>PE</b> ()		<b>OE</b> ()	
5.	Pre-requisite		6.	Frequency	Even	Odd	Either	Every
	(if any)			(use tick	0	(🗸)	Sem ()	Sem
				marks)				0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							

#### Lectures = 42 Tutorials = 0

#### 8. Learning objectives:

- 1. To study the basic principles of flow.
- 2. To study the different mapping techniques.
- 3. To control the seepage and to analyze the seepage with various theories and techniques.

Practical = 0

4. To impart the knowledge of various de-watering methods and drainage methods for stability of slope.

#### 9. Course Outcomes (COs):

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

- 1. Students should be able to analyze the seepage with various theories and techniques.
- 2. Students should be able to utilize basic principles of flow.
- 3. Students should be able to use different mapping techniques.
- 4. Students should be able to perform analysis of the seepage by application of seepage theories.

#### **10. Unit wise detailed content**

Unit-1	Number of	Title of the unit: Basic Principles:
	lectures = 10	

Darcy's Law, Permeability and its field determination, equation of continuity, velocity potential, and stream function Laplace's equation. Solution of Laplace's Equation: Solution by graphical method, flow nets in homogeneous soils, anisotropic soils and layered soils, computation of seepage quantity, seepage pressure, uplift pressure on structures, exit gradient, piping due to subsurface erosion and heave. Two and three dimensioned electrical analogy method, relaxation method.

Unit - 2	Number of	Title of the unit: Seepage through Earth Dams
	lectures = 10	

Determination of phreatic line, Dupuit's solution, Casagrande's solution, Kozeney parabola, entrance and exit corrections, flow nets for zoned earth dams and earth dams on pervious foundations under steady seepage conditions, flow nets for homogeneous sections under sudden drawn down, introduction to control of seepage, filters -type, selection and design.

Unit - 3	Number of	Title of the unit: Solution by Mapping Techniques:
	lectures = 10	

Conformal mapping of elementary function, Kozeney's basic parabola, Schwarez-Christoffel transformation, Khosla's solution, Velocity hydrograph, flow characteristics at singular points, examples of velocity hydrograph, solution by complex velocity, solution of triangular dam.

Unit - 4	Number of	Title of the unit: Seepage in Foundations:
	lectures = 12	

Construction dewatering-Methods of dewatering, Design of dewatering for foundation excavations, foundation improvement by drainage, drainage in retaining structures, influence of seepage on stability of slopes, drainage methods for stability of slopes.

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

Quiz/Assignment/ Seminar/Written Examination. The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended

1. Harr, M.E. " Ground Water & Seepage"

2. Cedergren "Seepage, Drainage & Flow nets"

1.	1. Name of the Department: Civil Engineering Department							
2.	Course Name	Water Quality	L		Т		Р	
	1 (unite	Management						
3.	Course		3		0		0	
	Code							
4.	4. Type of Course (use tick		Core (✓)		<b>PE()</b>		<b>OE</b> ()	
	mark)							
5.	Pre-		6.	Frequency	Even	Odd	Either	Every
	requisite			(use tick	0	(🗸)	Sem ()	Sem
	(if any)			marks)				0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Lectur	res = 42		Tutori	als = 0	Praction	cal = 0		

#### 8. Learning objectives:

*1.* Meaning of important parameters for measuring water quality, water quality criteria and standards, and their relation to public health, environment and urban water cycle.

2. Water quality tests and to determine how the parameters relate to each other.

#### 9. Course Outcomes (COs):

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

- 1. Principles and the practical approaches and techniques required to effectively monitor the chemical, hydrological, microbiological and aquatic elements of water quality.
- 2. Water quality tests and to determine how the parameters relate to each other.

10. Unit wise detailed content			
Unit-1	Number of	Title:- Introduction	
	lectures = 10		

Introduction: Quality parameter and classification of natural water, Physico-Chemical and biological water quality classification of aquatic systems. Sources of pollution: characteristics of point and non-point sources of pollution.

Unit - 2	Number of	Title:- Management strategies
	lectures = 10	

Eutrophication in natural water bodies: causes processes and control Toxic wastes: Sources, transportation and management strategies.

Unit - 3	Number of lectures = 10	Title:- Thermal pollution		
Thermal pollution: causes model and control. Acid rains: Occurrences, impacts and strategies for				
control.				

Unit - 4	Number of	Title:- Water quality monitoring
	lectures = 12	

Water quality monitoring: Objectives, requirements, planning and various techniques. Case studies related to water quality monitoring under various river actions plans including Ganga and Yamuna Action plans.

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

The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended (2 Books+ 4 References)

1. Reckhow and Chapra (1983) Engineering Approaches for Lake Management, Vol. 1, Butterworth, Boston.

- 2. Thomson and Mueller (1987) Principles of Surface Water Quality Modelling and Control, Harper and Row, NY.
- 3. Tchobanoglous and Schroeder (1987) Water Quality: characteristics, Modelling and modification, Addition Wesley Pub. Co., US
- 4. APHA (1998) Standard Methods for Examination of Water and Wastewater, 20th Edition, Washington, D.C
- 5. Velz, C.J.(1970) Applied Stream Sanitation, Wiley Interscience, NY

1. Name of the Department: Civil Engineering Department								
2.	Course	Flow and	L	Т		Р		
	Name	Transport in						
		Porous Media						
		Laboratory						
3.	Course		0	0		2		
	Code							
4.	Type of Cou	rse (use tick	Core (✓)	<b>PE</b> ()		<b>OE</b> ()		
	mark)							
5.	Pre-		6. Frequency	Even	Odd	Either	Every	
	requisite (if		(use tick	0	(🗸)	Sem ()	Sem	
	any)		marks)				0	
	<b></b>							
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)								
Lectures = 0			Tutorials $= 0$	Practic	Practical = 28			
8.	8. Experiments							
1.	To study the b	basic principles of	flow.					
2.	To study the c	lifferent mapping	techniques.					
3. To control the seepage and to analyze the seepage with various theories and techniques.								
4. To impart the knowledge of various de-watering methods and drainage methods for								
stability of slope								
9. Brief Description of self-learning / E-learning component								
The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and								
assignments will be beneficial for the students. Seminars will be conducted with the students.								
Online means will be explored for broad outlook in the syllabus.								

1. Name of the Department: Civil Engineering Department								
2.	Course Name	QGIS and SAGA GIS Laboratory	L	Т		Р		
3.	Course Code		0	0		2		
4.	Type of Course (use tick mark)		Core (✓)	<b>PE</b> ()		<b>OE</b> ()		
5.	Pre-		6. Frequency	Even	Odd	Either	Every	
	requisite		(use tick	0	(🗸)	Sem	Sem	
	(if any)		marks)			0	0	
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)								
Lectures = 0		Tutorials = 0	Practical = 28					
8.	Content			•				

1. QGIS is the most popular GIS tool with an impressive trajectory and a vibrant community. It also even has a particular ecosystem of complements called "plugins".

2. SAGA GIS is a GIS platform oriented to spatial analysis. SAGA GIS is a simple but powerful tool, with a big library focused on spatial analysis and characterization of basins. The interpolation options in SAGA GIS are better implemented than in other free and commercial software.

#### 9. Brief Description of self learning / E-learning component

The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### **10. Books/courses Recommended**

1. Manuals available at <u>http://www.saga-gis.org/</u> and <u>http://www.qgis.org/</u>

2. QGIS and SAGA GIS are completely open source alternative that reduces the cost barriers since it does not need a paid license and can be executed in any operative system.

# Second Semester

1. Name of the Department: Civil Engineering Department							
2. Course	Water	L	Т		Р		
Name	resources						
	system						
	analysis						
	and design						
3. Course		3	0		0		
Code							
4. Type of Cou	urse (use tick	Core (✓)	<b>PE() OE()</b>				
mark)			F	0.11	<b>T</b> '4	F	
5. Pre-		6. Frequency	Even	Odd	Either	Every	
requisite		(USE TICK	(•)	0	Sem	Sem	
(II any)		marks)			0	0	
7. Total Numb	per of Lectures	, Tutorials, Practical (a	ssuming	g 14 wee	eks of on	e	
semester)							
Lectures = 42		Tutorials = 0	Practical = 0				
8. Learning of	ojectives:						
1. Students sh	ould be able to	apply concepts of system	is analys	sis for p	lanning o	of	
water resou	irces systems ar	d minor levels					
2. Students ca	an perform basi	c economic analysis betw	veen alte	rnate w	ater resou	urces	
projects an	d to evaluate th	e economic feasibility of	water re	esources	s enginee	ring	
projects							
9. Course Out	comes (COs):	(					
At the end of the co	urse, the studen	t will be able to					
1. Students m	ust in position t	o formulate and solve det	terminis	tic optir	nization		
models for	design and oper	ration of water resources	systems		<b>C</b> 1		
2. To develop at	halytical skills t	o formulate and solve sto	chastic	problem	is for dec	1S10N	
making under	r uncertainty.						
10. Unit wise de	etailed content						
Unit-1	Number of	Title of the unit: INTE	RODUC	TION			
	lectures =						
	10						
Planning, Meaning and Significance. Need for water resources systems planning, Issues in							
planning. Planning process.							
Unit - 2	Number of	Title of the unit: PLA	NNING	FOR V	VATER		
	lectures =	<b>RESOUCES DEVELOPMENT:</b>					
	10						
Statement of objectives. Data requirements. Project formulation. Environmental							
considerations in pla	anning, Systems	s analysis. Pitfalls in proj	ect plan	ning. Co	onservatio	on and	
augmentation of wa	ter resources. N	Iultipurpose projects. Fui	nctional	require	ments in	multi-	
purpose project. Compatibility of multipurpose uses.							
Unit - 3	Number of	Title of the unit: ECONOMIC ANALYSIS:					
----------------------	------------------	--					
	lectures =						
	10						
Equivalence of kir	nd. Equivalence	e of time, Value. Cost. Benefit. Discounting factors,					
Discounting technic	ques. Measuren	nent of cost and benefit. Benefit-cost analysis. Project					
evaluation, Benefit-	cost variation.	Limitations of benefit-cost analysis. Dynamic of project					
analysis.							
Unit - 4	Number of	Title of the unit: FINANACIAL ANALYSIS:					
	lectures =						
	12						
Role of financial	analysis. Distir	nctions from economic analysis. Financial feasibility,					
Separable and nor	n-separable cos	sts. Cost allocation, allocation consequences. Water					
resources pricing.							

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

The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended

1. Water Resources Engineering by R.K. Liniley and Franzini, McGraw-Hill Book Co.

2. Water Resources Systems Engineering by Hall and Dracup, McGraw Hill Book Co.

3. Economics of Water Resources Engineering by L. Douglas James. And Robert R. Lee McGraw Hill BookCo.

4. Design of Water Resources Systems by Arther Mass et. Al, Harward Univ. Press Cambridge. 1967

5. Optimization Theory and Applications by S.S.Rao, Willy East. Ltd.

1. Name of the Department: Civil Engineering Department										
2.	Course	Remote sensing		L		Т		Р		
	Name	applications in								
		water resources								
		engineering								
3.	Course			3		0		0		
	Code		<u>`</u>	~	<u> </u>					
4.	Type of Cou	rse (use tick mark	K)	Core	(✔)	PE()		<b>OE</b> ()		
5.	Pre-			6.	Frequen	Even	Odd ()	Either	Every	
	requisite (if				cy (use	(🗸)		Sem ()	Sem ()	
	any)				tick					
					marks)					
7.	Total Numbe	er of Lectures, Tu	itoria	ls, Prac	ctical (assur	ning 14	weeks of	one seme	ester)	
Lectur	res = 42		Tut	orials =	0	Praction	cal = 0			
8.	Learning obj	jectives:								
1. The	techniques of	Remote Sensing a	nd Ge	eograph	ic Informati	on Syste	em (GIS)			
2. Diff	ferent types of	remotely sensed in	nages	5						
3. App	lication of Ren	note Sensing in wa	ater r	esources	s engineerin	g				
4. App	olication of GIS	in water resource	es eng	gineering	g.					
0	Course Oute									
At the	end of the cou	rse, the student wi	ll be a	able to						
1. To ι	understand the	interaction of elec	troma	agnetic	interaction v	with mat	ter and wo	orking of	aerial and	
satellit	e remote sensi	ng and radar								
2. To 1	earn image int	erpretation and sat	ellite	image ]	processing					
3. To	learn to make	use of aerial and	satel	lite data	for applica	tions in	hydrolog	y, water i	resources,	
agricu	lture, geology,	environment and s	snow	& glaci	er studies					
4. To 1	earn to integra	te remote sensing	and C	GIS anal	ysis.					
10.	. Unit wise det	ailed content								
Unit-1	l	Number of	Titl	e:- Prin	ciples					
		lectures = 10			_					
Princir	oles of remote	sensing, Remote se	ensin	g platfo	rms and data	a acquisi	tion syste	ms, Wave	ebands,	
Radior	metric quantitie	es, Spectral reflect	ance	and spe	ctral signatu	re. Inter	action of e	electroma	gnetic	
radiati	on with land su	urface features, hyd	drosp	here and	d atmospher	e, Data	capture fo	r simulati	on of	
land su	urface processe	es.	-		-					
I Init	2	Number of	T;41	o. Dha	tographia a	nd imag	n intorn-	otation		
Unit -	4	lectures — 10	1111	c I 110	logi apilit a	nu miag	se merpr	ciatioli		
		1000000 - 10								
5. Pre- requisite (if any)       6. Frequen cy (use (v)       Even (v)       Odd () Either       Every Sem ()         7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)         Lectures = 42       Tutorials = 0       Practical = 0         8. Learning objectives:       1. The techniques of Remote Sensing and Geographic Information System (GIS)       2. Different types of remotely sensed images         3. Application of Remote Sensing in water resources engineering       4. Application of GIS in water resources engineering.         9. Course Outcomes (COS):										

Photographic and image interpretation, Satellite image processing, Earth surface features inventory, Geomorphology, Land use classification, Land use planning and land cover mapping, Flood plain mapping and flood plain zoning.

Unit - 3	Number of	Title:- Remote sensing applications
	lectures = 10	

Remote sensing applications in water resources, agriculture, geology and environmental monitoring, Applications in snow and glacier studies, Snow line, Ice cover, Snow-pack properties, Integrated use of remote sensing and GIS, Database preparation and Decision support analysis.

Unit - 4	Number of	Title:- Estimation of damages
	lectures = 12	

Estimation of damages due to hydrologic extremes and preparation of contingency plans, Case studies.

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

The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended (2 Books+ 4 References)

(1) Lillesand, T., Kiefer, R. W., Chipman, J., Remote Sensing and Image Interpretation, 6th Ed., Wiley, 2007.

(2) Curran, P.J., Principles of Remote Sensing, ELBS, 1988

(3) Rees, W.G., Physical Principles of Remote Sensing, 2nd Edition, Cambridge University Press, 2001

(4) Keshari, A.K., Satellite Remote Sensing, Ane Books, 2015

(5) Keshari, A.K. and Singh, R.P., Use of microwave radiometry for monitoring the alpine environment. Snow, Hydrology and Forests in High Alpine Areas, IAHS Publ. No. 205, 81-89, International Association of Hydrological Sciences, 1991.

(6) Ambast, S.K., Keshari, A.K. and Gosain, A.K., An operational model for estimating regional evapotranspiration through surface energy partitioning (RESEP). International Journal of Remote Sensing, 23(22): 4917-4930, 2002

1. Name of the Department: Civil Engineering Department									
2.	Course	Computational	L	T P					
	Name	Hydraulics							
		and Hydrology							
3.	Course		3	0		0			
	Code								
4.	Type of Cou	rse (use tick	Core (✓)	<b>PE()</b>		<b>OE</b> ()			
	mark)				-				
5.	Pre-		6. Frequency	Even	Odd	Either	Every		
	requisite		(use tick	(🗸)	0	Sem	Sem		
	(if any)		marks)			0	0		
7.	Total Numb semester)	er of Lectures, Tu	utorials, Practical (assu	ming 14	weeks	of one			
Lectur	res = 42		Tutorials = 0	Practi	cal = 0				
<b>9.</b> At the	The purpose widely used Course Out end of the cou	of this course is to in water resources comes (COs): urse, the student w	o obtain knowledge on va engineering. ill be able to	arious so	oft comp	uting tecl	nniques		
1. To	forecast the	complex systems	in water resources eng	gineerin	g using	soft con	nputing		
technic	ques.								
10.	. Unit wise de	tailed content							
Unit-1	l	Number of lectures = 10	Title:- Introduction						
Introdu	uction, need for	or soft computing t	echniques, components of	of soft c	omputing	g. Artifici	al		
Neural	l Networks (A	NN), types of ANI	N and learning algorithm	s, tasks	performe	ed by AN	N.		
Unit -	2	Number of lectures = 10	Title:- Basic concepts						
Basic concepts of feed forward neural networks, perception learning rule, back propagation learning algorithm, application of feed forward ANN for function approximation and prediction. Hebbian learning and hopified networks, pattern association, radial basis function networks, Kohonen networks and self-organization maps, applications of ANN in pattern classification.									
Unit -	3	Number of lectures = 10	Title:- Information an	d uncer	tainty				

Information and uncertainty, chance versus ambiguity, classical sets and fuzzy sets, logic and reasoning. Fuzzy set operations and fuzzy relations, Membership Functions, fuzzy numbers and fuzzy arithmetic. Fuzzy Systems, fuzzy relations, fuzzy interface systems, Decision making with fuzzy information, Fuzzy classification and pattern recognition, Neuro-Fuzzy Systems.

Unit - 4	Number of	Title:- Evolutionary computing
	lectures = 12	

Evolutionary computing, concepts of genetic algorithm, components of genetic algorithm, Hybrid soft computing techniques, Applications in Hydrology and Water Resources Engineering.

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

The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended (2 Books+ 4 References)

- 1. Neural Networks, A Comprehensive Foundation- Haykin, Prentice Hall India.
- 2. Neuro-Fuzzy and Soft Computing, A Computational Approach to learning-Jang, J.R., Sun Chuen-tsaiandMizutaniEiji, Prentice Hall.

1. Name of the Department: Civil Engineering Department									
2. C	ourse	Statistical	L	T P					
N	ame	Methods in							
		Hydrology							
3. Co	ourse Code		3	0		0			
4. Ty	ype of Cours	se (use tick	Core (✓)	<b>PE(</b> )		<b>OE</b> ()			
m	ark)								
5. Pı	re-requisite		6. Frequency	Even	Odd	Either	Every		
(if	f any)		(use tick	<b>(</b> ✓)	0	Sem	Sem		
			marks)			0	0		
7. Te	otal Number	of Lectures, Tu	itorials, Practical (assu	ning 14	weeks	of one	1		
se	mester)								
Lectures	= 42		Tutorials = 0	Practi	cal = 0				
8. Le	earning obje	ctives:							
Тс	o make the s	tudent investigat	ting the causes, consequ	ences a	nd poss	ible solut	tions to		
pr	oblems asso	ciated with deg	radation of environmen	tal resc	ources a	nd analy	ses the		
po	otential non-s	sustainability of	certain types of econo	omic ac	tivities	using ec	onomic		
an	alysis as a to	ol.							
<u>9</u> C	ourse Outco	mes(COs)							
At the end	d of the cours	se, the student wi	ll be able to						
• Stude	nts would be	able to apply f	inite difference and finit	e eleme	nt metho	od for an	alvzing		
behav	ior of geotec	hnical structures		• • • • • • • • • • • • • • • • • • • •		, <b>a</b> 101 <b>a</b>			
• Stude:	nts would be	able to solve line	ear and non-linear equati	ons usin	g numer	rical tech	nique		
<b>10.</b> Ui	nit wise deta	iled content							
Unit-1		Number of	<b>Title:- Numerical Solu</b>	tion					
		lectures = 10							
Numerica	l Solution of	Ordinary Differ	ential Equations: Solutio	n by Ta	ylor's Se	eries- Eul	ler's		
Method -	Runge-Kutta	a Methods – Sim	ultaneous and Higher Or	der Equ	ations- I	Boundary	Value		
Problems – Applications									
Unit - 2		Number of	Title:- Economic signi	ficance					
		lectures = 10							
Economic	c significance	and causes of e	hvironmental degradation	n - The a	concepts	of policy	7		
failure, ex	sternality and	market failure -	Economic analysis of en	vironme	ental deg	radation	– Equi.		
Marginal	principle.		<b>j</b>			~	1		
Ũ									

Unit - 3	Number of	Title:- Probability Distribution
	lectures = 10	

Economics of Pollution - Economics of optimal pollution, regulation, monitoring and enforcement - Managing pollution using existing markets: Bargaining solutions - Managing pollution through market intervention: Taxes, subsidies and permits.

Unit - 4	Number of	Title:- Numerical Solution
	lectures = 12	

Probability Distribution: Discrete and Continuous probability Distribution Functions – Binomial, Poisson, Normal, Lognormal, Exponential, Gamma Distribution, Extreme Value Distribution - Transformations to Normal Distributions, Selecting a Probability Distribution, Parameter Estimation – Method of Moments, Method of Maximum Likelihood, Probability Weighted Moments and Least Square Method, Joint Probability Distributions. Regression Analysis: Simple Linear Regression, Evaluation of Regression – Confidence Intervals and Tests of Hypotheses – Multiple Linear Regressions – Correlation and Regression Analysis.

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

The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended

- 1. Applied Numerical Methods for Engineers by Akai
- 2. Statistical Methods in Hydrology by Haan
- 3. Computational Methods in Subsurface Flow by Huyorkon, Pinder
- 4. Numerical Recipes The Art of Scientific Computing by Press, Flannery, Tenklsky, Vetterling

1.	Name of the	e Department: Civ	vil Engineering Departm	nent				
2.	Course Name	Computational Hydraulics and Hydrology Laboratory	L	Т		Р		
3.	Course Code		0	0		2		
4.	Type of Cou mark)	ırse (use tick	Core (✓)	PE()		<b>OE</b> ()		
5.	Pre-		6. Frequency	Even	Odd	Either	Every	
	requisite		(use tick	<b>(</b> ✓)	0	Sem	Sem	
	(if any)		marks)			0	0	
7.	Total Numb	er of Lectures, T	utorials, Practical (assu	ming 1	4 week	s of one	I	
	semester)							
Lectur	res = 0		Tutorials = 0	Practi	cal = 2	8		
8.	Content			L				
	1. Kohone classifie	en networks and se cation.	lf-organization maps, app	plicatio	ns of Al	NN in pa	ttern	
	2. Fuzzy S fuzzy ir System	Systems, fuzzy rela nformation, Fuzzy s.	ations, fuzzy interface systemation classification and pattern	stems, E i recogn	Decisior ition, N	n making Jeuro-Fu	with zzy	
	3. Applica	tions in Hydrolog	y and Water Resources E	ngineer	ing.			
<b>9. Brief Description of self learning / E-learning component</b> The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.								
10.	Books Reco	mmended						
2. 3.	<ol> <li>Books Recommended</li> <li>Neural Networks, A Comprehensive Foundation- Haykin, Prentice Hall India.</li> <li>Neuro-Fuzzy and Soft Computing, A Computational Approach to learning-Jang, J.R., Sun Chuen-tsaiandMizutaniEiji, Prentice Hall.</li> </ol>							

1.	Name of the	e Department: (	Civil En	gineering Depa	artment				
2.	Course Name	Water Resources Systems Design Lab	L		T	Τ		P	
3.	Course Code		0		0	0		2	
4.	4. Type of Course (use tick mark)		Core (🗸)		<b>PE()</b>	<b>PE</b> ()		<b>OE</b> ()	
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)									
Lectur	res = 0		Tutor	ials = 0	Practi	cal = 28			
8.	Content								
	<ol> <li>Using software and analyzing open channel flow over different paths condition.</li> <li>Design of flow system by software like HEC-RAS Systems.</li> </ol>								

3. Applications in Hydrology and Water Resources Engineering.

#### 9. Brief Description of self learning / E-learning component

The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### **10. Books Recommended**

1. HEC-RAS Manual.

2. E-Learning courses by different portal.

# Third Semester

1. Name of the Department: Civil Engineering Department									
2.	2. CourseGeographicalLTP								
	Name	Information							
		Systems and							
		its							
		Applications							
		in Hydrology							
3.	Course		3	0		0			
	Code								
4.	Type of Cou	ırse (use tick	Core (✓)	<b>PE()</b>		<b>OE</b> ()			
	mark)			-	0.11		-		
5.	Pre-		6. Frequency	Even	Odd	Either	Every		
	requisite		(use tick	()	(•)	Sem	Sem		
	(if any)		marks)			()	0		
7.	Total Numb	per of Lectures, T	utorials, Practical (assu	ming I	4 week	s of one			
Lootu	$\frac{\text{semester}}{100}$		Tutoriala — 0	Draati	$\frac{1}{1}$				
Lectur	$\frac{100}{100} = 40$	•	1 utorials = 0	Fracu	cal = 0				
<b>8.</b>	Learning of	ojectives:		. 1 1	4				
1.	Conduct nyd	rologically related	streams and riverse	aigebra	on rast	er grids;			
2. 2	A nolyzo o di	aital alayation mo	del of land surface torreit	a to dom	vo wot	orchoda a	nd		
J.	notworks	gital elevation mo	uer of failu sufface terrai		ve wat	ersneus a	ma		
stream	networks.								
9.	Course Out	comes (COs):							
At the	end of the co	urse, the student w	vill be able to						
1.	Principles of	Satellite-based Ro	emote Sensing						
2.	Derivation o	f surface reflectan	ce, and biophysical varia	bles inc	luding	vegetatic	n		
	indices				U	U			
3.	Land use Ma	ups, and surface ter	mperature maps.						
10	. Unit wise de	etailed content							
Unit-1		Number of	Title :- Course Overvi	ew					
		lectures = 10							
Course	e Overview. In	ntroduction to GIS	in Water Resources. Intr	oductio	n to Ai	cGIS sof	tware,		
Geodesy, Map projections, Reprojection, and Coordinate systems.									
Unit -	2	Number of	Title :- Data source						
		lectures = 10							
Data s	ources for GI	S in water resource	es, Building a Base Map,	Spatial	analys	is using g	grids		
Spatia	l analysis (Mo	del Builder geo p	rocessing capability to pr	ogram a	seque:	nce of A	cGIS		
functio	ons/Raster Ca	culator to calculat	e watershed attributes/Sp	atial In	terpola	tion).			

Unit - 3	Number of	Title :- Concept of Reference
	lectures = 10	

The Concept of Reference Evapotranspiration/ASCE-Standardized Reference Evapotranspiration Equation, Weather data and Quality Assessment and Control of Automated Weather Data.

Unit - 4	Number of	Title :- Watershed and Stream Net
	lectures = 12	

Watershed and Stream Network Delineation, Remote Sensing: Principles of Electromagnetic Radiation/ Spectral Characteristics of Vegetation & Water bodies/Creating Color Composites from individual bands

Working with Landsat Imagery, NLCD, and DEM, Estimation of Evapotranspiration from Landsat NDVI. Evapotranspiration- Energy Balance Algorithms/EEFLUX (Earth Engine Flux)

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

The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended (2 Books+ 4 References)

(1) Lillesand, T., Kiefer, R. W., Chipman, J., Remote Sensing and Image Interpretation, 6th Ed., Wiley, 2007.

(2) Curran, P.J., Principles of Remote Sensing, ELBS, 1988

(3) Rees, W.G., Physical Principles of Remote Sensing, 2nd Edition, Cambridge University Press, 2001

(4) Keshari, A.K., Satellite Remote Sensing, Ane Books, 2015

(5) Keshari, A.K. and Singh, R.P., Use of microwave radiometry for monitoring the alpine environment. Snow, Hydrology and Forests in High Alpine Areas, IAHS Publ. No. 205, 81-89, International Association of Hydrological Sciences, 1991.

(6) Ambast, S.K., Keshari, A.K. and Gosain, A.K., An operational model for estimating regional evapotranspiration through surface energy partitioning (RESEP). International Journal of Remote Sensing, 23(22): 4917-4930, 2002

1.	1. Name of the DepartmentCIVIL ENGINEERING						
2.	Course Name	Research	L	Т		Р	
		Methodology					
		and IPR					
3.	Course Code		3	0		0	
4.	Type of Course (u	ise tick mark)	Core (✓)	PE-()		OE()	
5.	Pre-requisite (if		6. Frequency (use	Even	Odd	Either	Every
	any)		tick marks)	0	(✔)	Sem ()	Sem
							0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Le	ctures = 42		Tutorials $= 00$	Practica	al = 0		

Lectures = 42

Tutorials = 00

#### 8.Brief Syllabus:

The aim of the course is to make students understand the importance of Research Paper Writing. Also, it covers all the concepts which involved in writing the Research Paper.

#### 9 Learning objectives:

The objectives of the course are:

- 1. The students are able to recognize the steps involved in doing research work.
- 2. The students will be able to collect data using various media and using the best possible sample available.
- 3. The students would learn to propose their Hypothesis and build models for the problem.
- 4. The students would be able to correctly document their findings in the form of a report.

#### **10.Course Outcomes:**

After completion of this course, the student will be able to:

- 1. Recognize the various steps involved in research.
- 2. Collect data from samples, Examine and analyze the data.
- 3. Develop models for problems.
- 4. Explain the entire process in the form of a report.

#### **11.Unit wise detailed content**

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

Research - Types, Research process and steps, Hypothesis, Research Proposal and aspects. Research Design- Need, Problem Definition, Variables, Research Design concepts, Literature survey and review, Research design process, Errors in research. Research Modeling- Types of models, model building and stages, Data consideration.

Unit - 2	Number of	Title of the unit: Sampling
	lectures = 10	
Sampling and data col	llection- Techniques	s of sampling Random Stratified Systematic Multistage-

sampling, Primary and secondary sources of data. Design of questionnaire.

Unit - 3	Number of	Title of the unit: Data Collection and Experiments
	lectures = 10	

Design of Experiments- Objectives, strategies, Factorial experimental design, designing engineering experiments, basic principles-replication, randomization, blocking, guidelines for design of experiments.

Unit - 4	Number of	Title of the unit: Models and Hypothesis & Report
	lectures = 12	writing

Single factor experiment- Hypothesis testing, analysis of Variance component (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effect model, estimation of variance components, Model adequacy checking. Structure and components of Scientific Reports, Types of Report, Technical Reports and Thesis; Different steps in the preparation – Layout, structure and Language of typical reports; Illustrations and tables, Bibliography, Referencing and foot notes.

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

https://research-methodology.net/research-methodology/ https://gradcoach.com/what-is-research-methodology/

#### **13.Books Recommended**

**Text Book:** 

1. Research Methodology – Methods and Techniques – C.R. Kothari, New Age International, New Delhi, 2004.

#### **Reference Book:**

1. Design and Analysis of Experiments – Douglas C. Montgomery, Wiley India, 8th Edition, 2012.

2. Practical Research: Planning Design - Paul D. Leddy, London, 1980.

1.	Name of the Do	epartment	CIVIL ENGI	NEERING	r		
1.	Subject	Research	L	Т		Р	
	Name	Methodology					
		and IPR Lab					
2.	Subject		0	0		2	
	Code						
3.	Type of Subje	ect	Core (✓)	<b>PE()</b>		<b>OE</b> ()	
4.	Pre-	Research	Frequency (use tick	Even ()	Odd	Either	Every
	requisite (if	Methodology	marks)		<b>(</b> ✓)	Sem	Sem
	any)	and IPR				0	0
5.	5. Total Number of Lectures, Tutorials, Practical (Assuming 14 weeks in semester)						
Lectures = 00			Tutorials = 00	Practical	=28		

#### Lectures = 00

#### 1. Learning objectives:

The objectives of the course are:

- 2. The students are able to recognize the steps involved in Identifying research problem.
- 3. The students will be able to collect data using various media and using the best possible sample available.
- 4. The students would learn to propose their Hypothesis and build models for the problem.
- 5. The students would be able to correctly document their findings in the form of a report.

#### **Outcomes:**

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

- 1. Choose the topic for writing research paper.
- 2. Develop models for problems.
- 3. The students would learn to write the research paper.

6. Lab C	6. Lab Content					
Sr. No.	Title	CO covered				
1	How to choose topic for research	1,2				
2	How to collect data for the particular research problem	1,2				
3	Writing Abstract	1,2				
4	Writing Literature review	1,2				
5	Explaining and writing methodology	1,2				
6	How to analyze the data collected	1,2				
7	Presentation of analysis and findings	1,2				
8	How to write result and conclusion	2,3				
9	References in research article	2,3				

# Departmental Electives

1. Name of the Department: Civil Engineering Department						
2. Course Name	HYDRAULIC	L	Т		Р	
	MODELLING					
3. Course Code		3	0		0	
4. Type of Course (	use tick mark)	Core ()	<b>PE(</b> ✓)		<b>OE</b> ()	
5. Pre-requisite (if		6. Frequency	Even	Odd	Either	Every
any)		(use tick	0	(🗸)	Sem	Sem
		marks)			0	0
7. Total Number of	Lectures, Tutori	als, Practical (assum	ing 14 v	weeks of o	one seme	ster)
Lectures = 42		Tutorials = 0	Practi	cal = 0		
8. Learning objectiv	ves:	1	1			
1. To able the stu	idents to model the	e domain.				
2. To impart the	knowledge of es	tablishing the relation	nship be	etween the	e model	and the
constraints.						
3. To impart the	knowledge to mod	lel the dynamic struct	ures.			
9. Course Outcome	s (COs):					
At the end of the cour	se, the student wil	l be able to				
1. Students a	re able to model th	e domain.				
2. Students	are able to estab	blish the relationshi	p betw	een the	model a	and the
constraints	5.		-			
3. Students a	re able to model th	e dynamic structures				
10. Unit wise detaile	d content					
Unit-1	Number of	Title of the unit: M	ODEL	LING PR	OCESS	AND
	lectures = 10	PRIMITIVE MOD	ELS			
Taxonomy of model t	ypes, Steps in mod	lel building; Simulati	on, Algo	orithms an	d Heuris	tics,
Simulation languages	. Establishing relat	ionships via physical	laws, E	stablishin	g relation	ships
via curve fitting, Para	meter estimation p	roblems, Elementary	state tra	insition m	odels.	
Unit - 2	Number of	Title of the unit: F	ORE CA	ASTING	AND	
	lectures = 10	PATTERN RECO	GNITIO	DN		
Nature of data, Statist	ical attributes of d	ata, Probability distril	butions a	and their r	nechanis	ms,
Generation of random numbers, Time series. Neighborhood and distances, Cluster analysis,						
Individual and group preference patterns						
	T					
Unit - 3	Number of	Title of the unit: S	<b>FATIC</b>	EQULLI	BRIUM	
	lectures = 10	MODELS AND LI	NEAR ]	DYNAM	ICAL	
		STRUCTURE				

Graphical models and matrix models, Input-output type models, Decomposition of large systems, Routing problems.

Block diagram, Representation of model structure, Transfer function representation, State space models, Stability, System control.

Unit - 4	Number of	Title of the unit: GROWTH AND DECAY
	lectures = 12	PROCESSES

Discrete and continuous growths, Limits to growth, Competition among species, Growth process and integral equations, Discrete event approach, Population planning.

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

Quiz/Assignment/ Seminar/Written Examination. The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended

- 1. I. R. Haberman, Mathematical Models. Prentice Hall.
- 2. D.P. Maki and M. Thompson, Mathematical Models and Applications. Prentice Hall.
- 3. R.E. Shannon, System Simulation: Art and Science Prentice Hall

1. Name of the D	1. Name of the Department CIVIL ENGINEERING					
7. Subject	Hydraulic	L	ТР			
Name	Modelling Lab					
8. Subject		0	0		2	
Code						
9. Type of Subje	ect	Core (✓)	<b>PE()</b>		<b>OE</b> ()	
10. Pre-		Frequency (use tick	Even ()	Odd	Either	Every
requisite (if		marks)		(✔)	Sem	Sem
any)					0	0
11. Total Number	r of Lectures, Tut	orials, Practical (Assun	ning 14 we	eks in se	mester)	
Lectures = 00		Tutorials = 00	Practica	l =28		
6. Learning obj	ectives:	·	-			
The objectives of the	course are:					
1. Students are able to model the domain.						
2. Students are able to establish the relationship between the model and the constraints.						

3. Students are able to model the dynamic structures

#### **Outcomes:**

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

- 1. Students are able to model the domain.
- 2. Students are able to establish the relationship between the model and the constraints.
- 3. Students are able to model the dynamic structures

120 234				
Sr. No.	Title	CO covered		
1	Steps in model building; Simulation	1,2		
2	Elementary state transition models.	1,2		
3	Probability distributions and their mechanisms	1,2		
4	Individual and group preference patterns	1,2		
5	Graphical models and matrix models	1,2		
6	Representation of model structure	1,2		
7	Discrete and continuous growths	1,2		
8	Growth process and integral equations	2,3		

1. Name of the	Department: Civ	vil Engineering Departr	nent			
2. Course	2. Course Hydropower		Т		Р	
Name	ilyuropower					
3. Course		3	0		0	
Code						
4. Type of Cou	rse (use tick	Core ()	<b>PE(</b> ✓)		<b>OE</b> ()	
mark)				-		
5. Pre-		6. Frequency	Even	Odd	Either	Every
requisite		(use tick	0	(🗸)	Sem ()	Sem
(if any)		marks)				0
7. Total Numb	er of Lectures, T	utorials, Practical (assu	ming 14	weeks o	f one sen	nester)
Lectures = 40		Tutorials = 0	Practi	cal = 0		
8. Learning ob	jectives:					
1. The objectiv	e of this course	is to understand the	concept	of hvdr	opower 1	orojects
including inv	estigation. planni	ng and design aspects.	r·	j		j
	<i>с</i> , г	С — — — — — — — — — — — — — — — — — — —				
9. Course Oute	comes (COs):					
At the end of the cou	irse, the student w	ill be able to				
1. To learn the e	lements of hydror	ower scheme.				
2. To study the $\epsilon$	stimation of hvdr	opower potential				
3. To gain know	vledge on water	convevance system by s	tudving	intake s	tructures.	power
canals, surge tan	ks and penstocks.		<i>,                                    </i>		· · · · · · · · · · · · · · · · · · ·	L
4. To understand	l the force exerted	by a jet on a fixed target	, moving	g target, a	ind by a jo	et on a
series of curved	vanes.	<b>J J</b>	/ C		5 5	
5. To gain knowl	edge on Francis tu	urbine and Miscellaneous	hvdrau	lic machi	nes.	
8			<b>)</b>			
10. Unit wise de	tailed content					
Unit-1	Number of	Title of the unit: HYD	ROPOV	WER PL	ANT	
	lectures = 10	DEVELOPMENT				
Sources and forms o	f energy Hydropo	wer plants classification	avout «	and comp	onents	
Development of hyd	ronower schemes	Comparison of Hydro an	d Thern	na comp nal nower	Survey	and
Investigation	ropower senemes				, our vey i	
mvestigation.						
Unit - 2	Number of	Title of the unit: POW	ER PO	TENTIA	L	
	lectures = 10					
Estimation of Hydropower potential Flow duration curve. Firm power Secondary power Load						
and Load duration curves, Load factor, Firm capacity Reservoir capacity, Capacity factor.						
Unit - 3	Number of	Title of the unit: WAT	ER CO	NVEYAN	NCE SYS	TEM
	lectures = 10					

Intake structures: Location function and types of intakes, Energy losses at intake trash rock Power canals, Alignment, Design of power canals Penstocks, Alignment, types of penstock, Economic diameter of penstocks and Anchor blocks Water hammer pressure. Behavior of surge tanks, Types of surge tanks. Hydraulic design of simple surge tank.

Unit - 4	Number of	Title of the unit: IMPACT OF JET ON VANES
	lectures = 12	

Introduction to Impulse Momentum equation and its applications Force exerted by a Jet on a fixed, Force exerted by a Jet on a moving target, Force exerted by a Jet on a serious of curved vane.

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

The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended (2 Books+ 4 References)

- 1. Modi .P.N. and Seth .S.M, "Hydraulics and Fluid Mechanics", Standard Book House, 2005.
- Rajput .R.K, "Fluid Mechanics and Hydraulic Machines", S.Chand and Company Ltd., 2013.
- 3. Bansal .R.K, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications 2010
- 4. M.M.Dandekar and K.N.Sharma, "Water Power Engineering", Vikas Publications.

1.	. Name of the Department: Civil Engineering Department						
2.	Course Name	Hydropower	L	Т		Р	
		Laboratory					
3.	Course Code		0	0		4	
4.	1. Type of Course (use tick mark)		Core ()	<b>PE(</b> ✓)		<b>OE</b> ()	
5.	Pre-requisite (if		Odd ()	Either	$\operatorname{Odd}(\checkmark)$	Either	Every
	any)			Sem ()		Sem ()	Sem
							0
6.	6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
ΙA	ctures - 28		Tutorials —0	Practice	al –0		

#### 7. Learning objectives:

The objective of this course is to understand the concept of hydropower projects including investigation, planning and design aspects.

#### 8. Course Outcomes (COs):

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

- 1. To learn the elements of hydropower scheme.
- 2. To study the estimation of hydropower potential

3. To gain knowledge on water conveyance system by studying intake structures, power canals, surge tanks and penstocks.

4. To understand the force exerted by a jet on a fixed target, moving target, and by a jet on a series of curved vanes.

5. To gain knowledge on Francis turbine and Miscellaneous hydraulic machines.

#### 9. Unit wise detailed content

- 1. To study the behaviour of centrifugal and axial rotating pump.
- 2. To study the estimation of hydropower potential
- 3. To explore intake structures, power canals, surge tanks and penstocks.
- 4. To study a jet on a series of curved vanes.
- 5. To work on a Francis turbine and others hydraulic machines.
- 6. Explore the options of hydro-power plants in the local and nearby cities areas.

1.	1. Name of the Department: Civil Engineering Department						
2.	Course	HYDROGEOLOGY	L	Т		P	
	Name	AND					
		GROUNDWATER					
		DEVELOPEMENT					
3.	Course		3	0		0	
	Code						
4.	Type of Cour	se (use tick mark)	Core ()	<b>PE(</b> ✓)		<b>OE</b> ()	
5.	Pre-		6. Frequency	Even	Odd	Either	Every
	requisite (if		(use tick	0	(🗸)	Sem	Sem
	any)		marks)			0	0
7	Total Number	n of Lootunog Tutoriola	Due etient (aggressi	~ 14			(
/. I.c	$\frac{101a1 \text{ Number}}{64}$	r of Lectures, 1 utorials	, rracucal (assumir	1g 14 W6	eeks of 0	ne semes	ier)
Le	ctures = 40		1 utorials = 0	Fracu	cal = 0		
8.	Learning obj	ectives:					
	• To	create a simple conceptu	ual model of an area	's hydro	geology	that can	be used
	to	guide a site investigation	or engineering desig	n projec	et.		
	• To	compare methods for so	olving groundwater f	low equ	ations ur	nder a va	riety of
	situ	ations, selecting the m	nost appropriate mo	deling	technique	es based	on an
	eng	gineering project's goals	and evaluating how	their we	aknesses	may imp	pact the
	fina	al conclusions.					
	• To	develop a preliminary of	consulting report for	r a grou	ndwater	developr	ment or
	ren	nediation project.	0	C			
9.	Course Outco	omes (COs):					
At	the end of the c	course, the student will b	e able to				
	1. Model reg	ional groundwater flow a	and design water wel	ls			
	2. Formulate	and solve conjunctive	e use of surface w	ater an	d ground	dwater r	esource
	utilization	problems					
	3. Identify si	tes for artificial recharge	e of groundwater and	d detern	nine the o	conseque	nces of
	artificial re	echarge.					
	4. Conduct C	eophysical exploration s	tudies for groundwar	ter sourc	ce identif	ication.	
10	<b>T</b> T <b>1</b> / <b>1</b> /						
10. T	Unit wise det	ailed content			DENCE		
Un	111-1	number of lectures	I lue of the unit: (	JUCUK	KENCE	AND	
		= 10	MOVEMENT OF	GKUU	IND WA	TEK:	
Gr	oundwatar in h	udrological avala Dropar	ties of rooks and was	tor hoor	na forma	tions off	octing
Gr	ound water in h	yurological cycle, Proper	Lortical distribution	of group	ng iorina	Cround -	votor
gro	ground water flow, Ground water basins, Vertical distribution of ground water, Ground water						
po	iential and its e	xpionation in India. Darc	ys law, Permeability	y and its	uetermir	iation, Fl	UW
rat	es and direction	is of flow of ground wate	er, Dispersion of trac	ers in gr	ound wa	ter, Unsa	urated
tlo	ws, General equ	lations governing steady	unsteady flow throu	igh conf	ined and	unconfin	ed
aqı	aquifers.						

Unit - 2	Number of lectures	Title of the unit: HYDRAULICS OF WATER
	= 10	WELLS:

Flow in confined aquifers towards wells in steady and unsteady state. Flow through leaky or semi confined aquifers into wells, Dupuits assumption for unconfined aquifers, Steady and unsteady flows into wells, Theis, Jacob's and Chow's methods of solution of unsteady flows, Method of superposition in groundwater flow-method of images, Solutions of flow towards wells near a recharge boundary or impermeable boundary, Use of observation wells, Multiple well systems, Partially penetrating wells.

Unit - 3	Number of lectures	Title of the unit: DESIGN AND
	= 10	<b>CONSTRUCTION OF WELLS:</b>

Selection of Aquifer, well depth and well diameter, selection of screen-type and design of well screen, Provision of artificial gravel pack and shrouded wells, Test holes and well logs, Method of construction of shallow and deep wells including drilling, Completion and development of wells, Pumping equipment, resting the wells for yield, Maintenance and protection of wells, Rehabilitation of old and abandoned wells.

Unit - 4	Number of lectures	Title of the unit: SURFACE AND
	= 12	SUBSURFACE INVENSTIGATIONS OF
		GROUNDWATER

SURFACE: - Geological methods, remote sensing, Geophysical exploration, electrical Resistivity method, Seismic Refraction method, Gravity and magnetic methods, Water Witching.

SUBSURFACE:- Test drilling measurement of water levels, Geophysical logging, Resistivity logging, Spontaneous potential logging, Radiation logging, Temperature logging, Caliper logging, Fluid conductivity logging, Fluid Velocity logging, miscellaneous logging and other subsurface techniques.

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

Quiz/Assignment/ Seminar/Written Examination, The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended (2 Books+ 2 References)

- 1. Karamouz, M, Ahmadi, A, and Akhbari, M, Groundwater Hydrology: Engineering Planning and Management, CRC Press, 2011.
- Todd, D.K., and Mays, L. W., Groundwater Hydrology, John Wiley & Sons, Singapore, 2011
- 3. Davis, S.N., and De Weist, R.J.M., Hydrogeology, John Wiley & Sons, New York, 1966.
- 4. Domenico, Concepts and Models in Groundwater Hydrology, McGraw Hill Inc. New York, 1972.

1. Name of the Department: Civil Engineering Department						
2. Course Name	HYDROGEOLOGY	L	Т		Р	
	AND					
	<b>GROUNDWATER</b>					
	DEVELOPEMEN I Laboratory					
3. Course Code		0	0		4	
		·	Ŭ		•	
4. Type of Course	(use tick mark)	Core ()	<b>PE(</b> ✓)		<b>OE</b> ()	
5. Pre-requisite		Odd ()	Either	Odd	Either	Every
(if any)			Sem	(🗸)	Sem ()	Sem
			0			0
6. Total Number o	f Lectures, Tutorials, P	ractical (assuming 14	weeks o	of one sem	ester)	L
Lectures = 28		Tutorials =0	Practic	al =0		
7. Learning object	ives:	1	<u> </u>			
The objective of this	course is to understand	the concept of hydropo	ower proj	ects incluc	ling invest	tigation,
planning and design	aspects.					
8 Course Outcom						
At the end of the cou	rse, the student will be a	ble to				
1. To learn the el	ements of hydropower s	cheme.				
2. To study the e	stimation of hydropower	potential				
3. To gain know	ledge on water convey	ance system by study	ing intak	ke structur	es, power	canals,
surge tanks and p	enstocks.					
4. To understand	the force exerted by a je	et on a fixed target, mo	ving targ	et, and by	a jet on a	series
of curved vanes.						
5. To gain knowle	edge on Francis turbine a	and Miscellaneous hyd	raulic ma	achines.		
9. Unit wise detailed	l content					
1. Properties of rock	ks and water bearing form	nations affecting group	nd water	flow.		
2. General equation	2. General equations governing steady/unsteady flow through confined and unconfined aquifers.					
3. Flow in confined aquifers towards wells in steady and unsteady state.						
4. Jacob's and Chow's methods of solution of unsteady flows.						
5. Type and design of well screen.						
6. Maintenance and protection of wells.						
7. Electrical Resistiv	7. Electrical Resistivity method.					
8. Fluid conductivity	logging					

1. Name of the Depa	rtment	<b>CIVIL ENGINEER</b>	ING			
2. Subject Name	Watershed	L	Т		Р	
-	management					
3. Subject Code		3	0		0	
4. Type of Subject		Core ()	<b>PE(</b> ✓)		<b>OE</b> ()	
5. Pre-requisite (if	Nil	Frequency (use tick	Even	Odd	Either	Every
any)		marks)	0	(✔)	Sem	Sem
					0	0
6. Total Number of 1	Lectures, Tutorials, I	Practical (assuming 14 v	veeks of	one sem	ester)	
Lectures =42		Tutorials = 00	Practic	al = 00		
7. Learning objectiv	es:					
1. Proper use of all av	vailable resources of a	watershed for optimum	productio	on with n	ninimum	hazards
to natural resources						
2. Discuss various asp	bects of water resource	es development and mana	agement	on water	shed basi	s.
9. Subject Outcomes:						
On completion of this	course, the students v	will be able to				
1. Apply their know	vledge of Watershed	management practices	in varie	ous regi	ons; Sus	tainable
watershed approach;	Integrated watershe	ed management; Waters	shed mo	deling;	Use of	modern
techniques in watersh	ed management;					
2. Apply social aspec	ets of watershed man	agement; Management c	f water	quality;	Storm wa	ater and
flood management; D	rought management;	Water conservation and r	ecycling			
9. Unit wise detailed	content					
Unit-1	Number of	Title of the unit: Intro	duction	and Bas	ic Conce	pts:
~ ~ ~ ~	lectures = 10					
Concept of watershe	ed, introduction to v	vatershed management,	differen	t stakeh	olders ar	nd their
relative importance, v	vatershed managemen	t policies and decision m	aking.			
<b>TT T</b>				<b>X</b> 7 4 <b>X</b>		1.0
Unit - 2	Number of	Title of the unit: Sust	ainable	Watersh	ed Appr	oach &
lectures = 10 Watershed Management Practices						
Sustainable integrated watershed management, natural resources management, agricultural practices,						
Integrated farming, Soli erosion and conservation; Watershed Management Practices in Arid and						
Semiaria Regions, Ca	Semiarid Regions, Case studies, short term and long term strategic planning.					
TI:4 2	N P		4 - 1 337	- 4 1	1 1/1-	
Unit - 3	number of	1 the of the unit: Integ	rated W	atershee	i Manage	ement:

 lectures = 10

 Introduction to integrated approach, Integrated water resources management, conjunctive use of water resources, rainwater harvesting; roof catchment system.

Unit – 4	Number	of	Title of the unit: Watershed Modeling:		
	lectures = 10				
Standard modeling approaches and classifications, system concept for watershed modeling, overall					
description of different hydrologic processes, modeling of rainfall-runoff process, subsurface flows					
and groundwater flow.					

#### **10. 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.

#### 11. Books Recommended

#### **Text Books**

1.Murty, J.V.S. "Watershed Management", New Age Intl., New Delhi 1998

2. Purandare, A.P., Jaiswal A.K., Waterhed Development in India, NIRD, Hyderabad, 1995.

1.	1. Name of the Department: Civil Engineering Department									
2.	Course Name	Watershed	L	Т		Р				
		management								
		Laboratory								
3.	Course Code		0	0		4				
4.	4. Type of Course (use tick mark)		Core ()	PE(✓)		<b>OE</b> ()				
5.	Pre-requisite (if		Odd ()	Either	$\operatorname{Odd}(\checkmark)$	Either	Every			
	any)			Sem ()		Sem ()	Sem			
							0			
6.	Total Number of	Lectures, Tutorials	, Practical (assuming 1	4 weeks	of one sem	ester)	1			
Le	ctures = 00		Tutorials =0	Practica	al =28					

#### 7. Learning objectives:

1. Proper use of all available resources of a watershed for optimum production with minimum hazards to natural resources

2. Discuss various aspects of water resources development and management on watershed basis.

#### 7. Subject Outcomes:

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

1. Apply their knowledge of Watershed management practices in various regions; Sustainable watershed approach; Integrated watershed management; Watershed modeling; Use of modern techniques in watershed management;

2. Apply social aspects of watershed management; Management of water quality; Storm water and flood management; Drought management; Water conservation and recycling.

#### 9. Unit wise detailed content

- 1. Examine various stakeholders in watershed management.
- 2. Explore nearby natural resources for their effects in watershed.
- 3. Study the nearby arid and semi-arid areas for watershed management.
- 4. Explore the possibility of building a rainwater harvesting plants in nearby areas.
- 5. Examine the role of integrated watershed management.
- 6. Study various steps in watershed modelling.

1. Name of the Depa	ING				
2. Subject Name	Environmental	L	Т	Р	
	Impact				
	Assessment of				
	water				
3. Subject Code		3	0	0	
4. Type of Subject		Core ()	PE(✓)	<b>OE</b> ()	
5. Pre-requisite (if	Nil	Frequency (use tick	Even Odd	Either Every	
any)		marks)	() (1)	Sem Sem	
				0 0	
6 Total Number of 1	actures Tutorials I	Practical			

#### 1 otal Number of Lectures, 1 utorials, Practical

Lectures =42	Tutorials = 00	Practical = 00

#### 7. Learning objectives:

- 1. Identify the need to assess and evaluate the impact on environment.
- 2. Major principles of environmental impact assessment
- 3. Understand the different steps within environmental impact assessment
- 8. Subject Outcomes: On completion of this course, the students will be able to
- 1) Overview of assessing risks posing threats to the environment
- 2) Be able to access different case studies/examples of EIA in practice
- 3) Able to liaise with and the importance of stakeholders in the EIA process

#### 9. Unit wise detailed content

Unit-1	Number	of	<b>Title:- Initial environmental Examination</b>
	lectures = 10		

Initial environmental Examination, Elements of EIA, - factors affecting E-I-A Impact evaluation and analysis, preparation of Environmental Base map, Classification of environmental parameters. E I A Methodologies: introduction, Criteria for the selection of EIA Methodology, E I A methods, Ad-hoc methods, matrix methods, Network method Environmental Media Quality Index method, overlay methods, cost/benefit Analysis.

Unit – 2	Number	of	Title:- Assessment of Impact
	lectures = 10		

Assessment of Impact of development Activities on Vegetation and wildlife, environmental Impact of Deforestation - Causes and effects of deforestation.

Unit – 3	Number	er of Title:- Procurement of relevant							
	lectures =	<b>: 10</b>							
Procurement of rele	vant soil	quality, 1	mpact	prediction,	Assessment	of	Impact	significance,	
Identification and Incorporation of mitigation measures.									

Unit - 4Number lectures = 10ofTitle:- Environmental Audit	
--	--

Environmental Audit & Environmental legislation objectives of Environmental Audit, Types of environmental Audit, Audit protocol, stages of Environmental Audit, onsite activities, evaluation of Audit data and preparation of Audit report, Post Audit activities.

#### 10. 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.

#### 11. Books Recommended Text Books

1. Larry Canter – Environmental Impact Assessment, McGraw-Hill Publications.

2. Environmental Impact Assessment, Barthwal, R. R. New Age International Publications.

1. Name of the Department: Civil Engineering Department								
2. Course Na	me	Environmental	L	Т		Р		
		Impact						
		Assessment of						
		water						
		laboratory						
3. Course Co	de		0	0		4		
4. Type of Co	ourse (us	se tick mark)	Core ()	<b>PE(</b> ✓)	1 .	<b>OE</b> ()		
5. Pre-requis	ite (if		Odd ()	Either	$\operatorname{Odd}(\checkmark)$	Either	Every	
any)				Sem ()		Sem ()	Sem	
6. Total Num	6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Lectures = 00			Tutorials =0	Practic	al =28			
7. Learning of	ojectives	:						
1. Identify	the need	d to assess and eval	luate the impact on envir	ronment.				
2. Major j	brinciples	s of environmental	impact assessment	4				
5. Unders	tand the o	uniferent steps with	ini environmentai impac	t assessii	lent.			
8 Subject Ou	tcomes	On completion of	this course the students	will be a	hle to			
1) Overview of	f assessin	on completion of	ats to the environment	will be u				
2) Be able to a	ccess diff	ferent case studies/	examples of EIA in prac	tice				
3) Able to liais	e with an	nd the importance of	of stakeholders in the EL	A process	5			
9. Unit wise d	etailed co	ontent		<b>I</b>	-			
1. Stu	dv the ini	itial environment e	xamination before imple	ementatio	n of EIA.			
2 Exr	olore the	method of matrix a	nd ad-hoc for the purpo	se of FIA	methodolo	ov selecti	ion	
	ouloto the	a cost requirements	for the nurness of here	fite on all		by selection	on.	
5. Cal	culate the	e cost requirements	s for the purpose of bene	ins analy	/818.			
4. Exp	olore near	rby wildlife and ve	getation that are in verge	e of extin	ction.			
5. Coi	nduct a so	ocial awareness for	stopping deforestation a	and enhai	nce the plan	tation driv	ve.	
6. Stu	dy nearby	y water resources f	or the purpose of Polluti	on contro	ol.			

1. Name of the Department: Civil Engineering Department							
2. Course	Urban	L	T P				
Name	Hydrology						
	and Drainage						
3. Course		3	0				
Code							
4. Type of Cou	rse (use tick	Core ()	<b>PE(</b> ✓)		<b>OE</b> ()		
mark)				1			
5. Pre-		6. Frequency	Even	Odd	Either	Every	
requisite		(use tick	0	Sem			
(if any)		marks)			0	0	
7. Total Numb semester)	er of Lectures, T	<b>Sutorials, Practical (ass</b>	uming 1	4 weeks	of one		
Lectures = 42		Tutorials = 0	Practi	cal = 0			
8. Learning ob	iectives:						
1. To learn ur	ban water manage	ement practices and its e	effect on	urban wa	ter		
infrastructu	are, hydrology and	d groundwater regime.					
		6 6					
9. Course Outo	comes (COs):						
At the end of the cou	irse, the student w	vill be able to					
1. To understa	nd urban water	cycle and its role	in the o	designs	of urban	water	
infrastructure	es water supply, s	torm water drainage, sa	nitation,	sewerage	e and was	stewater	
conveyance i	nfrastructures and	d its rehabilitation and au	ıgmentat	ion			
2. To understan	d sustainability co	oncepts and how to carry	y out sust	tainable u	ırban desi	gns.	
3. To learn abo	ut emerging susta	ainable materials and its	hydraul	ic, struct	ural stren	gth and	
resilience pro	operties, and desig	gn procedures for water	supply ar	nd sewer	pipelines.		
10. Unit wise de	tailed content		_				
Unit-1	Number of	Title:- Urban water c	ycle				
	lectures $= 10$						
Urban water cycle, U	Jrban water infras	structures - water supply	, storm w	vater drai	nage, san	itation,	
sewerage and waster	water conveyance	infrastructures.					
Unit - 2	Number of	Title:- Water supply a	and sewe	erage net	work		
	lectures = 10						
Water supply and se	werage network h	ydraulics, SCADA syste	ems, Sus	tainable 1	urban desi	igns,	
Methodologies for a	ssessing sustainab	oility of urban water infra	astructur	es, Emer	ging susta	inable	
materials and design	procedures for w	vater supply and sewerag	e pipelin	es.			
Unit - 3	Number of	Title:- Hydraulic perf	ormanc	e			
	lectures = 10	,					

Hydraulic performance and structural strength, chemical resistance and resilience characteristics of emerging materials based water and sewer pipelines, Rehabilitation and augmentation technologies for water supply and sewerage networks, Analytic hierarchy process and optimization techniques for arriving at the best appropriate rehabilitation/ augmentation technology.

Unit - 4	Number of	Title:- Urban water management
	lectures = 12	

Urban water management, Rain water harvesting, Managed aquifer recharge, Constructed/engineered wetlands, Sprinkler and drip irrigation, Water use efficiencies, Effect of water management practices on urban water infrastructure, hydrology and groundwater regime, Surface and subsurface mapping of water supply and sewerage networks, Structural safety and mitigating plans against natural and human caused threats.

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

The online platform, will involve the NPTEL and SWAYAM portal system. Lecture series and assignments will be beneficial for the students. Seminars will be conducted with the students. Online means will be explored for broad outlook in the syllabus.

#### 12. Books Recommended (2 Books+ 4 References)

(1) Grigg, N.S., Water, Wastewater, and Storm water Infrastructure Management, Second Edition, CRC Press, 2012

(2) Lazaro, T.R., Urban Hydrology, CRC Press, 1990

(3) WEF and ASCE, Existing Sewer Evaluation and Rehabilitation, McGraw-Hill, 2009

(4) Keshari, A.K., Rainwater Harvesting. Water Digest, 1(2): 46-50, 2006.

(5) Smith, S.W., Landscape Irrigation: Design and Management, 1st Edition, Wiley, 1996

(6) Mays, L.W., Hydraulic Design Handbook, McGraw-Hill, 1999

1.	1. Name of the Department: Civil Engineering Department								
2.	Course Name	Urban	L	Т		Р			
		Hydrology and							
		Drainage							
		Laboratory							
3.	Course Code		0	0		4			
4.	Type of Course (u	ise tick mark)	Core ()	PE(✓		<b>OE</b> ()			
5.	Pre-requisite (if		Odd ()	Either	$\operatorname{Odd}(\checkmark)$	Either	Every		
	any)			Sem ()		Sem ()	Sem		
							0		
6.	Total Number of	Lectures, Tutorials	s, Practical (assuming 1	4 weeks	of one sem	ester)			
Le	ctures = 28		Tutorials =0	Practic	al =0				
7.	7. Learning objectives:								
	1. To learn	urban water manag	gement practices and its	s effect o	n urban wa	ater infras	tructure,		
	hydrology and groundwater regime.								

#### 8. Course Outcomes (COs):

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

- 1. To understand urban water cycle and its role in the designs of urban water infrastructures water supply, storm water drainage, sanitation, sewerage and wastewater conveyance infrastructures and its rehabilitation and augmentation
- 2. To understand sustainability concepts and how to carry out sustainable urban designs.
- 3. To learn about emerging sustainable materials and its hydraulic, structural strength and resilience properties, and design procedures for water supply and sewer pipelines.

#### **10. Unit wise detailed content**

- 1. To determine mean rainfall of an area by isohyetal method.
- 2. The determine mannings rogosity coefficient.
- 3. To determine the velocity of a running of a stream in a canal by current meter and Calculate the approximate discharge of the canal.
- 4. To design a regime channel by Lacey's theory for a given .pattern of crops and area to be Irrigated.
- 5. To determine the yield of an open well by recuperation test.
- 6. To determine the yield of an open well by constant level pumping test.
- 7. To visit a Multipurpose River valley, project and to prepare a report of the solid project.

## Curriculum (Scheme of Examination) & Syllabus for M.Tech Environmental Engineering

### **Batch 2021 onwards**



# SGT University Gurgaon

Credit Based Scheme w.e.f. 2021-2022



### Scheme of Examination for M.Tech– Environmental Engineering **Program** SEMESTER WISE COURSE STRUCTURE

#### **First Semester**

S.	Subject		L	Т	P	C	Examination		Subject
NO.	Code	Course					ma	rks	Total
		Title					Ext.	Int.	
1		Atmospheric Processes & Climate Change	3	0	0	3	60	40	100
2		Physico-chemical, Biological Principles and Processes	3	0	0	3	60	40	100
3		Environmental Quality Modeling	3	0	0	3	60	40	100
4		Solid Waste Management	3	0	0	3	60	40	100
5		Environmental system design lab	0	0	2	1	40	60	100
6		Environmental Quality Modeling Lab	0	0	2	1	40	60	100
7		Value Added Courses-I	2	0	0	2	60	40	100
8		Seminar	0	0	2	1	00	100	100
		Total	14		6	17	380	420	800

#### **Second Semester**

<b>S.</b>	Subject		L	Т	Р	С	Examination		Subject
NO.	Code	Course					marks		Total
		Title					Ext.	Int.	
1		Energy, Instrumentation, Measurement &Control	3	0	0	3	60	40	100
2		Environmental Audit & Impact Assessment	3	0	0	3	60	40	100
3		Design of Water & Wastewater Treatment Systems	3	0	0	3	60	40	100
4		Air Pollution & Its Control	3	0	0	3	60	40	100
5		Design of Water & Wastewater Treatment Systems Lab	0	0	2	1	40	60	100
6		Environmental Engineering Lab	0	0	2	1	40	60	100
7		Seminar	0	0	2	1	00	100	100
		Total	12	0	6	15	320	380	700


# Scheme of Examination for M.Tech– Environmental Engineering Program SEMESTER WISE COURSE STRUCTURE

# **Third Semester**

S.	Subject	Course Title	L	Т	Р	С	Exami	nation	Subject
NO.	Code						mai	rks	Total
							Ext.	Int.	
1		Energy Auditing, Conservation & Management	3	0	0	3	60	40	100
2		Research Methodology & IPR	3	0	0	3	60	40	100
3		Department Electives-XIII	3	0	0	3	60	40	100
4		Department Electives-XIV	3	0	0	3	60	40	100
5		Department Electives-XV	3	0	0	3	60	40	100
6		Research Methodology & IPR Lab	0	0	2	1	40	60	100
7		Department Electives Lab-XIII	0	0	2	1	40	60	100
8		Department Electives Lab-XIV	0	0	2	1	40	60	100
9		Department Electives Lab-XV	0	0	2	1	40	60	100
10		Value Added Courses-II	2	0	0	2	60	40	100
		Total	17	-	8	21	520	480	1000

# **Fourth Semester**

S.	Subject	Course Title	L T		Р	С	Exami ma	nation rks	Subject	
NU.	Code						Ext.	Int.	lotal	
1		Dissertation	0	0	20	20	100	0	100	
		Total	0	0	20	20	100	0	100	

# **Departmental Elective**

S.	Specialization	Departmental Elective	Departmental	Departmental	
No.		XIII	Elective XIV	Elective XV	
2	Environmental Engineering	Emerging Trends in Waste Treatment 3-0-2 (4)	Urban Environmental Quality Management 3-0-2 (4)	Environmental Quality Monitoring 3-0-2 (4)	

# First Semester

1.	Name of t	he Department: Civil Eng	ginee	ering					
2.	Course	Atmospheric Processes	L		Т		Р		
	Name	and Climate Change							
3.	Course		3		0		4		
	Code								
4.	4. Type of Course (use tick mark)			Core (✓)			<b>OE</b> ()		
5.	Pre-		6.	Frequency	Even	Odd	Either	Every Sem ()	
	requisite			(use tick	0	(🗸)	Sem ()		
	(if any)			marks)					
7.	Total Nur	nber of Lectures, Tutorial	ls, P	ractical (assu	iming 1	4 week	s of one sen	nester)	
_									

### Lectures = 42 Tutorials = 0 Practical =0

### 8. Brief Syllabus

This course will help learners to understand the key characteristics of natural and anthropogenic perturbations to the climate system (such as greenhouse gases, aerosols, land use, volcanoes and solar radiation), and to elucidate the mechanisms through which these perturbations influence global and regional climate. Since atmospheric processes play important roles in shaping the Earth's energy and water cycles.

### 9. Learning objectives:

- 1. The evolution of the earth's atmosphere
- 2. Characteristics of the terrestrial atmosphere
- 3. Homogeneous and heterogeneous processes in the atmosphere
- 4. A basic understanding of the recent advances made in the understanding of the atmospheric processes leading to climate change

### **10.** Course Outcomes (COs):

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

- 1. First acquire a basic understanding of the evolution of the earth's atmosphere.
- 2. Thereafter, learn about the structure and composition of the various atmospheric layers.
- 3. Gain a basic grounding on atmospheric chemical cycles.
- 4. Understand how atmospheric chemical processes are linked to the dynamics.
- 5. Finally, gain an insightful understanding of the Physico-chemical processes leading to climate change.

### 11. Unit wise detailed content

Unit-1	Number of lectures = 10	Title of the unit: Introduction to Atmosphere & Radiation					
Origins of the	Earth's Atmosphere. Laye	ers of the Atmosphere. Earth-Atmosphere System. Solar and					
Terrestrial Radiation. Absorption of Radiation by gases. Solar variability and the Earth's Energy							
Balance. A sin	nple model to estimate Gree	en House Effect.					

Unit - 2	Number of lectures =	Title of the unit: Conceptual Models
		<b>▲</b>

		10										
	7	1		2				1		0	1	

The ideal Gas law, Atmospheric Composition, Hydrostatic balance, Derivation of the Potential Temperature, States of stability of the Atmosphere, Parcel Concepts. General Circulation and Geotropic flows. Quantification of dry and moist adiabatic Lapse Rates. Cloud Formation.

Unit - 3	Number of lectures =	Title of the unit: Environmental Phenomenon & Global
	10	Activities

Atmospheric Chemical Reactions, Chemical Kinetics, Bimolecular Reactions, Photo-dissociation. Stratospheric Ozone, Chapman Chemistry, Pathways for Ozone destruction. The Antarctic Ozone Hole. Global Climate Change: Global Temperature Record and Solar Variability. Possible Effects of Global Warming. Aerosol direct, in-direct and semi-direct effects. Climate Response to Anthropogenic Aerosols.

Unit - 4	Number of lectures =	Title of the unit: Analytics of Pollutants-Aerosols
	12	

Atmospheric Aerosol: Aerosol size distributions. Continental and Maritime Aerosol. Homogeneous and heterogeneous nucleation. Condensation, Coagulation, Evaporation. Sedimentation and dry deposition. Formation of Cloud droplets. Auto-conversion and Precipitation. Exposure to applications based on current industrial trends.

#### **12. Books Recommended (1 Books+ 2 References)**

1. Introduction to Environmental Engineering and Science. Gilbert M. Masters. Prentice-Hall of India. 2005.

2. Inter-governmental Panel on Climate Change: The Third Assessment Report (2007). Cambridge University Press.

3. A Treatise on Atmospheric Phenomena, by Edward Joseph Lowe, Nabu Press (24 July 2011).

4. The World Axis as an Atmospheric Phenomenon, by Marinus Anthony Van Der Sluijs, All-Round Publications (28 September 2007)

5. Atmospheric Phenomena: Readings from "Scientific American", by David K. Lynch, W. H. Freeman & Co Ltd; Illustrated edition (1 July 1980).

1.	Name of the Depa	rtment: Civil Engi	nee	ring				
2.	Course Name	Physico-	L		Т		Р	
		chemical,						
		Biological						
		Principles and						
		Processes						
3.	Course Code		3		0		4	
4.	Type of Course (u	ise tick mark)	Co	ore (1)	<b>PE()</b>		<b>OE</b> ()	
5.	Pre-requisite (if	Basic of physics,	6.	Frequency (use	Even	$\operatorname{Odd}(\checkmark)$	Either	Every
	any)	chemistry and		tick marks)	0		Sem ()	Sem
		biology						0
7.	Total Number of	Lectures, Tutorials	s, Pr	ractical (assuming 1	4 weeks	of one sem	lester)	
Lectures = 42			Tutorials = 0Practical = 0					

This course touches on some of the fundamentals of Physico-chemical, Biological Principles and Processes field. Starting from basic elements in biochemistry, the course covers other aspects like commonly used to study structure and properties of water, ecosystems & applications of microbiological principles to environmental engineering. Hence this subject aims to give knowledge to the students regarding advanced Physico-chemical, Biological Principles and Processes at large.

# 9. Learning objectives:

- 1. To study about the solid- liquid- gas interactions
- 2. To understand about process kinetics.
- 3. To deal with the microbial applications in environmental engineering.
- 4. To let aware students about the Ecosystem at large.
- 5. To gain insight into the basics of Biochemistry for application in day-to-day activities.

### **10.** Course Outcomes (COs):

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

- 1. Apply the concepts of different Equilibrium
- 2. Apply the basic of mass transfer and transport of impurities in current system
- 3. Able to function as a member of an interdisciplinary problem-solving team.
- 4. Study and applying practically about microbial kinetics
- 5. Able to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments.

# 10. Unit wise detailed content

Unit-1	Number of	Title of the unit: Structure and Properties of Water						
	lectures = 10							
Chemical Structure and Properties of Water- their significance in environmental engineering, Sources of								
Water impurities, Abio	otic reactions, biolog	gical metabolism. Solid-Liquid-Gas interactions, Mass transfer						
and transport of impurities in water, diffusion, dispersion. Physical and Chemical interactions due to								
various forces, suspensions and dispersions.								

Unit - 2	Number of	Title of the unit: Chemical reactions					
	lectures = 10						
Chemical Reactions,	Chemical Equilibri	ium and Laws of thermodynamics, Acid-base Equilibrium,					
Solubility equilibria, Oxidation-reduction equilibria. Process kinetics, reaction rates and catalysis,							
Surface and colloidal chemistry, Adsorption Phenomenon and Characteristics.							
Unit - 3	Number of	Title of the unit: Ecosystems & Applications of					
	lectures = 10	Microbiological Principles to Environmental Engineering					
Introduction to Ecosy	stems: biotic and a	biotic components, biogeochemical cycles, Ecological niche,					
Mortality and Survivor	rship, Natural and a	rtificial ecosystems.					
Applications of micr	obiological princip	les to environmental engineering; Assimilation of wastes,					
Concepts and Principle	es of Carbon Oxidat	ion, Nitrification, Denitrification, Methanogenesis, etc.					
Unit - 4	Number of	Title of the unit: Biochemistry					
	lectures = 12						
Introduction to Bioc	chemistry; Biologic	cal compounds- enzymes, coenzymes and amino acids,					
Microbiological conce	epts; Cells, Classific	cation and Characteristics of living organisms, Reproduction,					
Metabolism, Microbia	l Growth Kinetics. H	Exposure to applications based on current industrial trends.					
11. Books Recommen	ded (3 Text Books	+ 2-3 Reference Books)					
1. Benefield, L.D. Jud	kins J.F. and Wean	ed B.L. (1982). Process Chemistry for Water and Wastewater					
Treatment, End ed.,	Prentice-Hall, Inc,	New Jersey, USA					
2. Metcalf and Eddy, 1	M.C., "Wastewater	Engineering: Treatment, Disposal and Reuse", Tata McGraw-					
Hill Publications, New Delhi, 2003							
3. Pelczar, M.J., Chan	ECS and Krieg NR	, Microbiology, Tata McGraw Hill Edition, New Delhi, India					
4. Talaro K., Talaro A Cassida Pelzar and Reid, (1993) Foundations in Microbiology, W.C. Brown							
Publishers							
5. Sawyer, McCarty, and Parkin, 2003. Chemistry for Environmental Engineers, 5th" McGraw Hill							

1. Name of the Department: Civil Engineering								
2. Subject	Water Quality	L	Т		Р			
Name	Modeling							
3. Subject Code		3	0		4			
4. Type of Subject (use tick mark)		Core (✓)	<b>PE</b> ()		<b>OE</b> ()			
5. Pre-requisite	Nil	Frequency (use	Even ()	Odd (✔)	Either	Every		
(if any)		tick marks)			Sem	Sem		
					0	0		
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)								
Lectures = 42		Tutorials = 0	Practical = 00					

This course will discuss a wide variety of waters and factors and processes affecting the microbial water quality. We will also discuss the approaches that may be taken to improve the quality of water. At the end of this course, students will learn how intentional, incidental or unintentional misuse of water resources can have a detrimental consequence on human health. The course will also cover water remediation and safeguard techniques for the improvement of water quality.

#### 8. Learning objectives:

1. Sources of microbial water contamination and its impact of human health globally.

2. Understand the relationship between human behavior and water quality.

3. Develop remediation strategies for several types of microbial water quality contamination.

4. Understand epidemiological studies related to water quality and public health.

5. Understand various water sources and transmission mechanisms of infectious agents.

### 9. Course Outcomes:

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

1. Apply the basics of water quality in day-to-day life.

2. Understand the significance of Management practices for maintaining water quality.

3. Apply the understanding of water treatment methods in water conservation.

4. Apply the skills in developing proper waste disposal for water quality maintenance.

5. Apply the dynamics of water in conservation strategies.

#### **10. Unit wise detailed content**

Unit-1	Number of lectures =	Title of the unit: Overview of Water Quality
	10	

Water quality: sources and impacts of impurities, classification of water quality parameter Standards: drinking water quality standards, effluent disposal standards, Surface water, And pollution: sources, Effects of Surface water pollution: physico-chemical, biological, toxic and pathological, Ground water pollution: sources & effects, Consequences of overusing of surface water & ground water.

Unit - 2		Number of lectures =	Title of the unit: Water Management Prac			nt Practice	es	
		12						
Non-point so	urce	pollution-Agricultural	runoff,	TMDLs,	Best	management	practices	(BMPs),
Numeric vs narrative standards, Water quality dynamics and human impacts on water quality. Human								

population growth-Modern lifestyle effects on the water and human health.

Unit - 3	Number of lectures =	Title of the unit: Water Treatment Methods
	12	

Water treatment in developed and developing countries -Primary, secondary, and tertiary treatments, Land application of sewage, Improving the quality of drinking water at the source: Education and proper hygiene, Proper waste disposal, Water chlorination, Improving surveillance.

Unit - 4	Number of lectures =	Title of the unit: Dynamics of Water Quality
	8	

Water quality and health linkage; Understanding the significance of the environment for human health, Human population pressures and pollution dynamics, Common terms and definitions in water quality, Aquatic resources of the world & Sources of drinking water, Common contaminants of drinking, water and linkages to disease. Exposure to applications based on current industrial trends.

# **11.** Books Recommended (3 Text Books + 2-3 Reference Books)

1. Hall, W.A. and Dracup, J.A., Water resources systems engineering, Mc Graw Hill, 1970.

2. Hexem, R.W. and Heady E.O., Water production functions for irrigated agriculture, Iowa State University Press, 1978.

3. James, L.D. & Robert, R. L., Economics of Water Resources Planning, 1970, 5th edition.

4. Lee, S.M., Linear optimization for management, Petrocelli/ Charter, New York, 1976. Isobel W Heathcote. 1998. Integrated Watershed Management: Principles and Practice. Wiley Publ.

5. Kenneth N Brooks, Peter F Folliott, Hans M Gregersen, Leonard F DeBano. 1991. Hydrology and the Management of Watersheds. Wiley-Blackwell.

1. Name of the Dep	partment: Civil Engine	ering				
2. Course Name	Solid Waste	L	Т		Р	
	Management					
3. Course Code		3	0		4	
4. Type of Course	(use tick mark)	Core (✓)	<b>PE()</b>		<b>OE</b> ()	
5. Pre-requisite		6. Frequency	Even ()	Odd	Either	Every
(if any)		(use tick		(🗸)	Sem ()	Sem
		marks)				0
7. Total Number o	f Lectures, Tutorials, P	ractical (assuming 1	4 weeks o	of one sen	nester)	
Lectures = 42		Tutorials = 0	Practica	$\mathbf{l} = 00$		
8. Brief Syllabus						
This course is base	d on Solid-waste mana	gement techniques,	the collec	ting, treat	ing, and di	sposing
of solid material that	t is discarded because i	t has served its purp	oose or is	no longer	r useful. In	nproper
disposal of municipa	l solid waste can create u	insanitary conditions	, and these	e conditio	ns in turn c	an lead
to pollution of the e	nvironment and to outbr	eaks of vector-borne	e disease–	–that is, c	liseases spi	read by
rodents and insects.	The tasks of solid-waste	management presen	t complex	technica	l challenge	s. They
also pose a wide var	riety of administrative, e	economic, and social	problems	that mus	t be manag	ged and
solved.						
9. Learning Object	tives:					
1. To gain insight in	to collection, transfer and	l transport of municip	pal solid w	vaste.		
2. Understand the de	esign and operation of mu	inicipal solid waste la	andfill.			
3. Understand the de	esign and operation of res	source recovery facili	ty.			
4. Understand the de	esign and operation of wa	ste to energy facility.				
10.0						
10. Course Outcom	es (COs):					
At the end of the cou	rse, the student will be a	ble to				
1. Understand solid	waste and its composition	n				
2. Understand variou	us processes involved in	solid waste collection	i, segregat	ion and tr	ansportatio	n.
3. Design solid wast	e disposal facility					
4. Able to handle lea	chate in preventing grou	nd water pollution.				
5. Apply the understa	anding in disposal of Soli	id Wastes.				
11. Unit wise detaile	ed content					
Unit-1	Number of lectures	Title of the unit: M	Iunicipal	Solid Wa	ste Manaa	ement
	= 10				ste manag	
Definition of solid w	= 10	naior legislation mon	nitoring re	sponsibili		s and
Definition of solid waste	= 10 aste-waste generation, n sampling and character	najor legislation, mon	nitoring re	sponsibili	ties, source	s and

Unit - 2	Number of lectures = 12	Title of the unit: Collection and Transportation of Solid Waste

Waste collection systems, analysis of collection system–alternative techniques for collection system. Need for transfer operation, transport means and methods, transfer station types and design requirements.

Unit - 3	Number of lectures	Title of the unit: Process of Solid Waste and Energy
	= 12	recovery

Unit Operations for separation and processing, Materials Recovery facilities, Waste transformation through combustion and aerobic composting, anaerobic methods for materials recovery and treatment, Energy Recovery-Incinerators

Unit - 4	Number of lectures	Title of the unit: Landfills & Disposal of Solid Wastes
	= 8	

Landfills: Site selection, Engineered Sites, liners and covers, leachate control and treatment, gas recovery and control, including utilization of recovered gas (energy). Landfill monitoring and reclamation.

Definition and identification of hazardous wastes-sources and characteristics, hazardous wastes in Municipal Waste, Hazardous waste regulations – minimization of Hazardous Waste-compatibility, handling, storage and disposal of hazardous waste-collection and transport. Exposure to applications based on current industrial trends.

**11. Books Recommended (3 Text Books + 2-3 Reference Books)** 

1. Hand book of Solid Waste Management by Frank Kreith, McGraw Hill Publication.

2. Bagchi, A., Design, Construction, and Monitoring of Landfills, (2ndEd). Wiley Interscience, 1994.

3. Sharma, H. D., and Lewis, S. P., Waste Containment Systems, Waste Stabilization and Landfill. Design and Evaluation. Wiley Interscience, 1994. ISBN: 0471575364.

4. George Techobanoglous et al," Integrated Solid Waste Management ", McGraw-Hill Publication, 1993.

5. Charles A. Wentz; "Hazardous Waste Management ", McGraw-Hill Publication, 1995

1.	1. Name of the Department: Civil Engineering								
2.	Course Name	Environmental	L	Т	Р				
		system Design							
		Lab							
3.	Course Code		0	0	4				
4.	Type of Course (u	ise tick mark)	Core (✓)	<b>PE()</b>	<b>OE</b> ()				
5.	Pre-requisite (if		Odd ()	Either Odd	Either Every				
	any)			Sem () (✓)	Sem () Sem ()				
6.	6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)								
Lectures = 0			Tutorials = 0	<b>Practical = 28</b>					

This laboratory course work emphasis on development of basic knowledge of the learner toward environment system. In addition to that, this course will inculcate the understanding about parameters involved in the environment monitoring.

### 8. Learning objectives:

1. Understand the processes for determination of environment system.

2. To gain insight into basic concept of environment quality management.

3. Understand the parameter involved in determination of environment quality management variables.

#### 7. Course Outcomes (COs):

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

1. Apply the methodologies involved in the determination of environment quality monitoring.

2. Apply the understanding of analytical techniques toward parameters that influences environment monitoring.

### 8. Unit wise detailed content

- 1. Environmental Engineering includes specialized software.
- 2. Determination of land remediation.
- 3. To determine the air quality management.
- 4. To determine the pollution control of noise.
- 5. To determine the air and water Pollution.
- 6. Determination of environmental and pollution management.

1.	. Name of the Department: Civil Engineering								
2.	Course Name	Water Quality	L	Т		Р			
		Modeling Lab							
3.	Course Code		0	0 4					
4.	. Type of Course (use tick mark)		Core (✓)	<b>PE</b> ()		<b>OE</b> ()			
5.	Pre-requisite (if		Odd ()	Either	Odd	Either	Every		
	any)			Sem ()	<b>(</b> ✓)	Sem ()	Sem ()		
6.	6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)								
Le	ctures = 0		Tutorials = 0	Practica	al = 28				

This laboratory course work emphasis on development of basic knowledge of the learner toward water system. In addition to that, this course will inculcate the understanding about parameters involved in the water modeling.

#### 8. Learning objectives:

- 1. Understand the processes for determination of water modeling.
- 2. To gain insight into basic concept of water modeling.
- 3. Understand the parameter involved in determination of water modeling variables.

#### 7. Course Outcomes (COs):

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

1. Apply the methodologies involved in the determination of water modeling.

2. Apply the understanding of analytical techniques toward parameters that influences water modeling.

#### 8. Unit wise detailed content

- 1. Determination of Optimum Coagulant dosage
- 2. Determination of residual chlorine in bleaching powder
- 3. Determination of available chlorine in bleaching powder
- 4. Determination of Oil and Grease
- 5. Determination of suspended, settleable, volatile and fixed solids.
- 6. Determination of pH, Turbidity and conductivity
- 7. Determination of Hardness
- 8. Determination of Alkalinity and Acidity
- 9. Determination of Chlorides
- 10. Determination of Phosphates and Sulphates

# Second Semester

1.	. Name of the Department: Civil Engineering									
2.	Course	Energy Instrumentation,	L	Т	Т					
	Name	Measurement and								
		Control								
3.	Course		3	0	0		0			
	Code									
4.	Type of Co	urse (use tick mark)	Core (🗸)	<b>PE</b> ()		<b>OE</b> ()				
5.	Pre-		6. Frequency (use	Even	Odd ()	Either	Every			
	requisite		tick marks)	(••)		Sem	Sem			
	(if any)					(••)	0			
7.	<b>Total Num</b>	ber of Lectures, Tutorials,	Practical (assuming 1	4 weeks	of one sen	nester)				
Le	ctures = 42		Tutorials = 0	Practic	al = 00					

Provides an introduction to the field of instrumentation and covers process variables and the various instruments used to determine the energy and fluid flow. The course concludes with a study of instrumentation drawings and diagram. The process variables used in determination fluid flow are expressed in details to enhance learner knowledge in this field.

### 9. Learning objectives:

1. To understand the basics of instrumentation involved in energy metering.

- 2. To understand the flow detection devices employed in the fluid metering.
- 3. To understand the working principles of different flow meters.

#### **10.** Course Outcomes (COs):

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

- 1. Apply the basic understanding of metering devices in the field of energy analysis.
- 2. Apply the understanding of flow meters in controlling of the fluid/ gas flow at different fields.
- 3. Apply the understanding of Energy Metering Device in daily life.

4. Apply the understanding of Thermal Energy Meter at various sites.

5. Apply the understanding of Air & Fluid Flow meters in different sites.

#### 11. Unit wise detailed content

Unit-1Number of lectures = 10Title of the unit: Electrical Energy Metering

Electrical energy meter, One Phase energy meters, Three Phase Energy meters, Working principle, Automatic meter reading systems

Unit - 2 N	Number of lectures = 12	Title of the unit: Thermal Energy Metering

Combustion Analyser, Fuel Efficiency Monitor, Flue Gas Analyzer, Thermocouples & RTDs, Potentiometric & Paperless Recorders, I/P Converters, Temperature Transmitters, Optical Pyrometer, Digital Indicators, PID Controllers, Loop Powered Indicators & Isolators, BTU meters, Thermistors, Heat Flux sensor.

Unit - 3	Number of lectures = 12	Title of the unit: Air Flow Metering & Velocity	
		Metering	
Air flow meters: vane (flap) type air flow meters and "hot wire" and "hot film" air mass meters.			
Anemometer, types and its classification, working principle. Types and its basic working principle,			
Odometer			

Unit - 4	Number of lectures = 8	Title of the unit: Fluid Flow Metering

Classification of fluid flow meters based on the operating principle- Differential Pressure Flow meters, Velocity Flow meters, Positive Displacement Flow meters, Mass Flow meters, Open Channel Flow meters, Types: Orifices, Venturies, Nozzles, Rota meters, Pitot Tubes, Calorimetric, Turbine, Vortex, Electromagnetic, Doppler, Ultrasonic, Thermal, and Coriolis. Exposure to applications based on current industrial trends.

#### **12.** Books Recommended (3 Text Books + 2 Reference Books)

1. Measurement and Control Basics, ISA; 4th edition (30 June 2007), by Thomas A. Hughes

- Electrical Measurements and Measuring Instruments, I K International Publishing House Pvt. Ltd (30 December 2013) by S. Kamakshaiah, J. Amarnath, Pannala Krishna Murthy.
- 3. Flow Measurement, CRC Press; 1st edition (15 September 1993), by Bela G. Liptak.
- 4. A Course in Electronic Measurements and Instrumentation, Dhanpat Rai & Co. (P) Limited (1 January 2015), by A.K. Sawhney
- 5. Flow Measurement Handbook: Industrial Designs, Operating Principles, Performance, and Applications, Cambridge University Press; 1st edition (29 May 2000), by Roger C. Baker

1.	1. Name of the Department: Civil Engineering						
2.	Course Name	Environmental	L	Т		Р	
		Audit and Impact					
		Assessment					
3.	Course Code		3	0		0	
4. Type of Course (use tick mark)		Core (✓)	<b>PE</b> ()	<b>PE</b> () <b>O</b>			
5.	Pre-requisite (if		6. Frequency (use	Even	Odd ()	Either	Every
	any)		tick marks)	(✔)		Sem ()	Sem ()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Le	ctures = 42		Tutorials = 0	Practic	al =00		

This subject provides an introduction to environmental impact assessment (EIA) and environmental auditing. This includes the environmental impact assessment process, State based environmental planning as well as methodologies associated with impact prediction, environmental assessment, and environmental auditing. On completion, students are able to develop the appropriate documentation for an environmental impact statement and respond appropriately to an environment audit or environmental management system.

### 9. Learning objectives:

1. To develop relationship between EIA content and the preparation of environmental impact Statements

2. Familiarize with environmental auditing and Environmental management systems responsibilities.

3. Decipher the benefits of environmental auditing and impacts for the EIS.

### **10.** Course Outcomes (COs):

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

1. Have an in-depth understanding of the processes associated with EIA, environmental auditing, and environmental management systems

2. Have an in-depth understanding of the current legislative requirements of environmental impact assessment and environmental auditing.

3. Have an ability to develop the appropriate documentation for an environmental impact statement.

4. Have an ability to develop an appropriate response to an environmental audit.

5. Have an ability to develop an appropriate environmental management system.

11. Unit wise detailed	11. Unit wise detailed content					
Unit-1	Number of	Title of the unit: General Aspects				
	lectures = 10					
Introduction to EIA	& Audit, Enviro	nment & Industries, Input information, Plant operation,				
Environmental Management planning, Waste Streams impact on water bodies.						
Unit - 2	Number of	Title of the unit: Procedures and Regulations				
	lectures = 12					

Environmental Impact Assessment planning. Activities, Methodology for Environmental Impact Assessment, Role of Environmental Engineering firm, Role of Regulatory agencies & control boards, Role of the Public.

Unit - 3	Number of	Title of the unit: Approach to Environmental Audit &
	lectures = 12	Reports

Environmental Audit: Introduction, Environmental information Purpose & advantage of studies, General approach of environmental Auditing Environmental Audit, Audit programs in India, Auditing program in major polluting Industries.

Unit - 4	Number of	Title of the unit: Environmental Laws & Acts
	lectures = 8	

Pollution prevention and control laws & acts: Constitution of India & environment, Constitution protection to Environment laws, Administrative & legislative arrangement for Environmental production, Indian Standards, Pollution control acts in India, critical appraisal, fiscal incentives for environmental protection. Exposure to applications based on current industrial trends.

#### **11.** Books Recommended (3 Text Books + 2-3 Reference Books)

1. O P Gupta, "Elements of Environmental pollution & Control Khanna Publishing house.

2. Environmental Impact Assessment by Canter, McGraw Hills.

3. Environmental Chemistry by Stanley E. Manahan, VIth Ed. Lewis Publishers, London

4. Dying Wisdom: Rise, Fall, and potential of India's Traditional rain water harvesting systems by Anil Agarwal & Sunita Narayan, CSE Publication. New Delhi.

5. Environmental Impact Assessment (Theory and Practice) by Peter Wathern, Routledge (Taylor and Frances Group), London and New York.

1.	. Name of the Department: Civil Engineering					
2.	Course Name	Design of	L	Т	Р	
		Wastewater				
		Treatment &				
		Disposal System				
3.	Course Code		3	0	0	
4.	Type of Course (us	e tick mark)	Core (🗸)	<b>PE()</b>	<b>OE</b> ()	
5.	Pre-requisite (if	Environmental	6. Frequency (use	Even () Odd (	Either Every	
	any)	Quality	tick marks)		Sem Sem ()	
		Monitoring			(•)	
7.	. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)					

	,	· ·	•	0	
Lectures = 42			Tutorials = 0		Practical = 28

The objective of wastewater treatment course is familiarizing the learner with the water quality parameters. Beside this learner will be able to understand the conventional methods used in water treatment. Moreover, different levels of water treatments will be elaborated in this syllabus and also decipher the characteristics of the waste water.

### 9. Learning objectives:

- 1. To expose the student to various technologies in waste water treatment in order to make water safe to drink.
- 2. To familiarize the learner to various treatment options available in treatment of waste water for recycle and safe disposal.
- 3. To inculcate the basic understanding about treatment plants and its methodologies.
- 4. To develop knowledge about disinfections methods followed in treatment plants at municipal levels.

### **10.** Course Outcomes (COs):

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

1. Able to evaluate the water quality standards and apply in day-to-day activities.

2. Able to work in water treatment operations at municipal levels.

3. Able to characterize the waste water in various prospects.

4. Able to develop mechanism for disposal of waste water.

5. Able to design various water treatment units required

### 11. Unit wise detailed content

Unit-1	Number of	Title of the unit: Municipal Water Supply, Sources
	lectures = 10	Quantity and Quality

Objectives of water treatment, Raw water sources and quality, Drinking Water Quality Standards, Regulations, Per capita water demand, Population Estimates-Guide to Selection of Water Treatment Processes, Water distribution networks.

Unit - 2	Number of lectures = 12	Title of the unit: Conventional Unit Operations used in Water Treatment		
Aeration, Types of settling, Principal of Sedimentation, Design of Sedimentation Tanks, Coagulation,				

Flocculation, Filtration, Rapid gravity sand filter, disinfection methods, mechanism of disinfection, chlorine, other disinfectants.

Unit - 3	Number of	Title of the unit: Wastewater Characterization and
	lectures = 12	Disposal

Philosophy of wastewater treatment, characteristics of wastewater, discharge standards for aquatic and land disposal, Wastewater Disposal; disposal to inland waters such as lakes reservoirs, rivers and streams, disposal to sea, disposal on Land.

Unit - 4	Number of	Title of the unit: Pre, Primary and Secondary
	lectures = 8	Wastewater Treatment

Sources of Wastewater Generation, Collection of waste-water, Flow variation, Design of stabilization plant, Preliminary treatment methods.

Design of trickling filters and, activated sludge process (ASP). Variations of ASP, Wastewater treatment pond, Requirements of Tertiary treatment, Different types of advanced wastewater treatments. Exposure to applications based on current industrial trends.

# **12. Books Recommended (3 Text Books + 2-3 Reference Books)**

- 1. Water and Wastewater Engineering: Design Principles and Practice' authored by Mackenzie L. Davis, McGraw-Hill Education (India) Private Ltd., 2015.
- Water Treatment: Principles and Design authored by John C. Crittenden, R. Rhodes Trussell, David W. Hand, Kerry J. Howe and George. T, 3rd Edition, John Willey and Sons, 2012
- Handbook of Water and Wastewater Treatment Plants Operations, authored by Frank R. Spellman, 3rd Edition, CRC Press, 2014
- 4. Water Works Engineering: Planning, Design and Operation' authored by Syed R. Qasim, Edward M. Motley and Guang Zhu, Pearson Prentice Hall, 2011.
- 5. Design Manual Onsite Wastewater Treatment and Disposal Systems, by U S Environmental Protection Agency, Scholar's Choice (16 February 2015)

1.	Name of the Department: Civil Engineering							
2.	Course Name	Air Pollution and	L		Т		Р	
		its Control						
3.	3. Course Code		3		0		0	
4.	4. Type of Course (use tick mark)		Co	ore (🗸 )	<b>PE</b> ()		<b>OE</b> ()	
5.	Pre-requisite (if	Basics of	6.	Frequency (use	Even	Odd ()	Either	Every
	any)	Environment		tick marks)	(•)		Sem ()	Sem ()
		Quality						
		Measures						
7.	Total Number of	Lectures, Tutorials	s, Pr	actical (assuming 1	4 weeks	of one sem	ester)	
Le	ctures = 42		Tu	torials = 0	Practic	al = 00		

This will enhance the learner basics about Air Pollution, its prevention methods, the techniques employed to reduce or eliminate the emission into the atmosphere of substances that can harm the environment or human health. These include adverse effects on human health, property, and atmospheric visibility.

# 9. Learning objectives:

The course is intended

1. To understand the basics of Air Pollution.

- 2. To enhance learner skills for control and remedial measures against Air Pollution.
- 3. To teach measures and technologies required to prevent air pollution.

### **10. Course Outcomes (COs):**

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

- 1. Identify the type the source of pollutant.
- 2. Monitor the Air pollution and analyse the samples.
- 3. Control air pollution using different ECS.
- 4. To apply methods to control Air Pollution
- 5. To disseminate knowledge in society to prevent Air Pollution.

# 11. Unit wise detailed content

Unit-1	Number of	Title of the unit: Air Pollution & its Classification
	lectures = 10	

Definition of Air Pollution, Causes, Air Quality Monitoring Methods, Classification of Air Pollutants.

Unit - 2	Number of	Title of the unit: Effects & Prevention of Air pollution
	lectures = 12	

Effects of Air pollution on human, plant and animal. Preventive measures against Air Pollution. Air Pollution Hazardous level causing -Factors and control measures.

Unit - 3	Number of lectures = 12	Title of the unit: Air Pollution Monitoring & Emission Control Systems
Collection of Gaseous	s Air Pollutants, Co	llection of Particulate Pollutants, Measurement of SO <sub>2</sub> , NO <sub>x</sub> ,

CO. Basics of Ozone and its applications.

Air pollution control technologies for particulates and gaseous contaminants. Introduction to Gravity settlers, Electrostatic precipitators, Bag Filters, Scrubbers and Cyclone Control Systems.

Unit - 4	Number of	Title of the unit: Meteorology & Dispersion of pollutants
	lectures = 8	

Introduction to Wind Circulation phenomenon, Lapse Rate, Stability Conditions, Maximum Mixing Depths, Plume Rise & dispersion. Exposure to applications based on current industrial trends.

#### 12. Books Recommended (3 Text Books + 2-3 Reference Books)

i) M. N. Rao& H V N Rao (2000), Air pollution, Tata McGraw Hill Publishing Ltd

ii) 'Fundamentals of Air Pollution' authored by Daniel Vallero, 4th Edition, Elsevier's Science & Technology, 2008 (ISBN: 978-0-12-373615-4).

iii) 'Air Pollution Control Technology Handbook' authored by Karl B. Schnelle, Jr. and Charles A. Brown, CRC Press, 2002 (ISBN 0-8493-9588-7).

iv) 'Air Pollution Control Engineering' Edited by Lawrence K. Wang, Norman C. Pereira and Yung Tse Hung, Humana Press Inc, 2004 (ISBN: 1-58829-161-8).

v) 'Advanced Air and Noise Pollution Control' Edited by Lawrence K. Wang, Norman C. Pereira and Yung-Tse Hung, Humana Press Inc, 2005 (ISBN: 1-58829-359-9).

1.	. Name of the Department: Civil Engineering						
2.	Course Name	Design of waste	L	Т	Р		
		Water treatment					
		and Disposal					
		System Lab					
3.	Course Code		0	0	4		
4.	4. Type of Course (use tick mark)		Core (✓)	<b>PE</b> ()	<b>OE</b> ()		
5.	Pre-requisite (if		Even (✓)	Either Odd ()	Either Every		
	any)			Sem ()	Sem () Sem ()		
6.	5. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Le	ctures = 0		Tutorials = 0	<b>Practical = 28</b>			

This laboratory course work emphasis on development of basic knowledge of the learner toward waste water system. In addition to that, this course will inculcate the understanding about parameters involved in the determination of water quality.

### 8. Learning objectives:

1. Understand the analytical processes for determination of waste water variables.

- 2. To gain insight into basic concept of waste water properties.
- 3. Understand the parameter involved in determination of waste water quality.

### 7. Course Outcomes (COs):

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

1. Apply the methodologies involved in the determination of variables of waste water.

2. Apply the understanding of analytical techniques toward parameters that control the water quality.

### 8. Unit wise detailed content

1. To determine the BOD of a sample.

- 2. To determine the pH and Turbidity of waste water sample.
- 3. To determine the suspended, settle able, volatile and fixed solids in a sample.
- 4. To determine the COD of a sample.
- 5. To determine the Dissolved Oxygen by Winkler Titration Method.
- 6. Determination of Iron and Manganese in Water
- 7. Determination of Sulphate and Sulphide in Water
- 8. Jar Test for Determining Optimum Coagulant Dosage
- 9. Determination of Available Chlorine in Bleaching Powder
- 10. Test for Residual Chlorine

1.	1. Name of the Department: Civil Engineering						
2.	Course Name	Environmental	L	Т		Р	
		Engineering					
		Laboratory					
3.	Course Code		0	0		2	
4.	4. Type of Course (use tick mark)		Core $(\checkmark)$	<b>PE</b> ()		<b>OE</b> ()	
5.	Pre-requisite (if	Environmental	6. Frequency (use	Even	Odd ()	Either	Every
	any)	Engineering	tick marks)	(•)		Sem ()	Sem
							0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Le	Lectures =00		Tutorials =0	Practic	al =28		

Environmental engineering uses the principles of engineering, soil science, biology, and chemistry to develop solutions to environmental problems. They are involved in efforts to improve recycling, waste disposal, public health, and water and air pollution control.

### 2. Learning objectives:

i) To Ability to identify air pollution problems and interpret air quality data on chemical characteristic.b. Ability to recognize various biotic and abiotic environmental transformation processes of pollutants.

### 3. Course Outcomes (COs):

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

1. Ability to identify air pollution problems and interpret air quality data on chemical characteristic.

2. Ability to recognize various biotic and biotic environmental transformation processes of pollutant.

Sr. No.	Title	CO covered
1	To determine the chlorine demand and residual chlorine in water.	1
2	To determine the sludge volume index (SVI) of the given sludge sample	1
3	2. To estimate the hardness of the given water sample.	2
4	3. To estimate the total solids, total dissolved solids and volatile solids of the given water sample.	2
5	4. To determine cations (Na, K, Li) and anions (sulfate, nitrate, fluoride).	1
6	5. To determine MPN count - total and fecal.	1
7	6. To estimate the chloride concentration of the given water sample	2

# Third Semester

1.	1. Name of the Department: Civil Engineering							
2.	Course Name	Energy Auditing	L		Т		Р	
		Conservation						
		and Management						
3.	Course Code		3		0		4	
4.	4. Type of Course (use tick mark)		Co	ore (✓)	<b>PE</b> ()		<b>OE</b> ()	
5.	Pre-requisite (if		6.	Frequency (use	Even	$\operatorname{Odd}(\checkmark)$	Either	Every
	any)			tick marks)	0		Sem ()	Sem
								0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Le	ctures = 42		Tu	itorials = 0	Practica	al = 00		

To institute the correct energy efficiency programs, we have to know first which areas in our installation unnecessarily consume too much energy, which is the most cost-effective load. To enable the students to acquire the knowledge of energy conservation measures in thermal and electrical energy systems. To familiarize the students about energy conservation and energy audit. To familiarize the students with the concept of energy conservation and management.

### 9. Learning objectives:

- 1. To teach the basic concepts of energy audit and management.
- 2. The energy auditing procedures, techniques, policy planning, implementation and energy audit instrument.
- 3. To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of energy conservation and energy auditing.
- 4. To enable the students to develop managerial skills to assess feasibility of alternative approaches and drive strategies regarding energy conservation and energy auditing.

#### **10.** Course Outcomes (COs):

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

6. Understand the general aspect of energy auditing and management

- 7. Understand the energy auditing procedures, techniques, policy planning and implementation.
- 8. Conceptual knowledge of the technology, economics and regulation related issues associated with energy conservation and energy auditing

9. Ability to analyze the viability of energy conservation projects

10. Capability to integrate various options and assess the business and policy environment regarding energy conservation and energy auditing

### 11. Unit wise detailed content

Unit-1	Number of	Title of the unit: General Aspects
	lectures = 10	

General Philosophy and Need of Energy Audit and Management. Definition, Principle and Objectives of Energy Management, Energy Management Approach, Strategy & Skills, Energy Audit: Need, Types, Methodology and Approach. Understanding Energy Costs, Matching energy usage to requirements, Maximizing System Efficiency, Optimizing the Input energy requirements.

Unit - 2	Number of	Title of the unit: Procedures and Techniques		
	lectures = 12			
Data gathering: Level of responsibilities, Energy Sources, Control of energy and uses of energy, Past				
and Present Operating data, Questionnaire for data gathering.				
A				

Analytical Techniques: Incremental cost concept, mass and energy balancing techniques, Inventory of

Energy inputs and rejections, Heat transfer calculations, Evaluation of Electric load characteristics, process and energy system simulation.

Unit - 3	Number of	Title	of	the	unit:	Energy	Policy	Planning	and
	lectures = 12	Imple	men	tation	l				

Role and responsibilities of Energy Manager, Top Management Support, Managerial Functions, Accountability. Motivating-Motivation of Employees, Requirements for Energy Action Planning. Information Systems: Design and Barriers, Marketing Strategies, Training and Planning.

Unit - 4	Number of	Title of the unit: Energy Balance, MIS & Energy Audit
	lectures = 8	Instruments

First and Second law of Efficiency, Methods for Preparing Process flow, Energy Balance Diagram, Identification of Losses in Energy System. Energy Balance sheet and Management Information System (MIS), Energy Modeling and Optimization.

Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy. Exposure to applications based on current industrial trends.

12. Books Recommended (3 Text Books + 2-3 Reference 1
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1. Energy Management: W. R. Murphy, G. McKay (Butterworths).

2. Energy Management Principles: C.B. Smith (Pergamon Press).

3. Efficient Use of Energy: I. G. C. Dryden (Butterworth Scientific)

4. Energy Economics -A.V. Desai (Wiley Eastern)

5. Industrial Energy Conservation: D.A. Reay (Pergamon Press)

1.	Name of the Department		CIVIL ENGINEE				
2.	Course Name	Research	L	Т		Р	
		Methodology					
		and IPR					
3.	Course Code		3	0		0	
4.	Type of Course (u	se tick mark)	Core (✓)	PE-()		OE()	
5.	Pre-requisite (if		6. Frequency (use	Even	Odd	Either	Every
	any)		tick marks)	0	<b>(</b> ✓)	Sem ()	Sem
							0
7.	Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						

7. Total Number of Lectures, Tu	toriais, r ractical (assuming	g 14 weeks of one sem
Lectures $= 42$	Tutorials $= 00$	Practical = 0

The aim of the course is to make students understand the importance of Research Paper Writing. Also, it covers all the concepts which involved in writing the Research Paper.

### 9 Learning objectives:

The objectives of the course are:

- 1. The students are able to recognize the steps involved in doing research work.
- 2. The students will be able to collect data using various media and using the best possible sample available.
- 3. The students would learn to propose their Hypothesis and build models for the problem.
- 4. The students would be able to correctly document their findings in the form of a report.

### **10.Course Outcomes:**

After completion of this course, the student will be able to:

- 1. Recognize the various steps involved in research.
- 2. Collect data from samples, Examine and analyze the data.
- 3. Develop models for problems.
- 4. Explain the entire process in the form of a report.

11.Unit wise detailed content				
Unit-1	Number of lectures = 10	Title of the unit: Introduction		

Research - Types, Research process and steps, Hypothesis, Research Proposal and aspects. Research Design- Need, Problem Definition, Variables, Research Design concepts, Literature survey and review, Research design process, Errors in research. Research Modeling- Types of models, model building and stages, Data consideration.

Unit - 2	Number of	Title of the unit: Sampling
	lectures = 10	
Sampling and data col	llection- Technique	s of sampling, Random, Stratified, Systematic, Multistage-

sampling, Primary and secondary sources of data. Design of questionnaire.

11 14 0					
Unit - 3	Number of	Title of the unit: Data Collection and Experiments			
	lectures = 10				
Design of Experiments- Objectives, strategies, Factorial experimental design, designing engineering					
experiments, basic prir	ciples-replication,	randomization, blocking, guidelines for design of			
experiments.					
Unit - 4 Number of Title of the unit: Models and Hypothesis & Report					
	lectures = 12	writing			
Single factor experime	ent- Hypothesis tes	ting, analysis of Variance component (ANOVA) for fixed			
effect model; Total,	treatment and error	or of squares, Degrees of freedom, Confidence interval;			
ANOVA for random e	ffect model, estimat	tion of variance components, Model adequacy checking.			
Structure and compon	ents of Scientific	Reports, Types of Report, Technical Reports and Thesis;			
Different steps in the	preparation – Layo	out, structure and Language of typical reports; Illustrations			
and tables. Bibliograph	v. Referencing and	foot notes.			
,	<i>,</i> ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				
12.Brief Description	of self learning / E-	learning component			
https://research-me	thodology.net/resea	arch-methodology/			
https://gradcoach.c	om/what-is-researcl	h-methodology/			
13 Books Recommend	led				
Text Book.					
1 Research Meth	odology – Methods	and Techniques $-CR$ Kothari New Age International			
New Delbi 200	M	and reeningues – e.k. Kothan, New Age international,			
New Denn, 200	<i>)</i> +.				
<b>Reference Book:</b>					
1. Design and Analysi	s of Experiments -	- Douglas C. Montgomery, Wiley India, 8th Edition,			
2012.	-				
2. Practical Research: I	Planning Design – H	Paul D. Leddy, London, 1980.			

1. Name of the Department			CIVIL ENGI	NEERING	T T		
2.	Subject	Research	L	Т		Р	
	Name	Methodology					
		and IPR Lab					
3.	Subject		0	0		2	
	Code						
4.	Type of Subje	ect	Core (✓)	<b>PE()</b>		<b>OE</b> ()	
5.	Pre-	Research	Frequency (use tick	Even ()	Odd	Either	Every
	requisite (if	Methodology	marks)		(🗸)	Sem	Sem
	any)	and IPR				0	0
6.	6. Total Number of Lectures, Tutorials, Practical (Assuming 14 weeks in semester)						
Lectures = 00			Tutorials = 00	Practical	l =28		

#### Lectures = 00

#### 1. Learning objectives:

The objectives of the course are:

- 2. The students are able to recognize the steps involved in Identifying research problem.
- 3. The students will be able to collect data using various media and using the best possible sample available.
- 4. The students would learn to propose their Hypothesis and build models for the problem.
- 5. The students would be able to correctly document their findings in the form of a report.

#### **Outcomes:**

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

1. Choose the topic for writing research paper.

- 2. Develop models for problems.
- 3. The students would learn to write the research paper.

7. Lab (	7. Lab Content					
Sr. No.	Title	CO covered				
1	How to choose topic for research	1,2				
2	How to collect data for the particular research problem	1,2				
3	Writing Abstract	1,2				
4	Writing Literature review	1,2				
5	Explaining and writing methodology	1,2				
6	How to analyze the data collected	1,2				
7	Presentation of analysis and findings	1,2				
8	How to write result and conclusion	2,3				
9	References in research article	2,3				

# Departmental Electives

1.	Name of the Department: Civil Engineering						
2.	Course Name	Emerging Trends	L	Т		Р	
		in Waste					
		Treatment					
3.	Course Code		3	0		4	
4.	. Type of Course (use tick mark)		Core (🗸)	<b>PE()</b>		<b>OE</b> ()	
5.	Pre-requisite (if		6. Frequency (use	Even ()	Odd (🗸)	Either	Every
	any)		tick marks)			Sem	Sem ()
						(🗸)	
7.	Total Number of L	ectures, Tutorials, P	ractical (assuming 14 we	eks of one	semester)		
Le	tures = 42		Tutorials $= 0$	Practica	1 = 00		

This course deals in the latest techniques involved in the treatment of hazardous waste. Also, deals in the disposal ways of waste. Waste Characterization and Source Reduction, Storage, Collection and Transport of Wastes are the part of it to gain insight the waste treatment. This will aware the learner about the remedial measures and waste processing technologies as well.

#### 9. Learning objectives:

- 1. To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipment's.
- 2. To impart understanding about the landfills and leachates, at dumping sites.
- 3. To decipher the storage and transport mechanisms involve in solid wastes management.
- 4. To aware the learner about the waste processing technologies.
- 5. To aware the student about the Regulatory frame works for solid waste handling.

#### **10. Course Outcomes (COs):**

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

- 1. Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation.
- 2. Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste.
- 3. Understand the role legislation and policy drivers play in stakeholders' response to the waste and apply the basic scientific principles for solving practical waste management challenges.
- 4. Able to apply the basics of solid waste management strategies in everyday life.
- 5. Able to work at municipal waste processing sites and provide input for efficient management of solid wastes.

11. Unit wise detailed content					
Unit-1	Number of Title of the unit: Sources, Classification and Regula				
	lectures = 10	Framework			
Introduction to Sourc	es of Solid and ha	azardous wastes, with types as, biomedical wastes, nuclear			
wastes, lead acid batte	ries, electronic was	stes, plastics and fly ash. Need for solid and hazardous waste			
management, Salient f	features of Indian le	egislations on management and handling of municipal waste.			
Elements of integrated	waste management	Public Private Participation for waste management.			
6					
Unit - 2	Number of	Title of the unit: Waste Characterization, Source			
	lectures = 12	Reduction and Waste Disposal			

Waste composition: physical, chemical and biological properties of solid wastes, Hazardous waste characteristics, TCLP tests, Waste sampling and characterization, Reduction of wastes, Recycling and reuse. Waste disposal options: Disposal in landfills, Landfill Classification and types, Aspects of sanitary landfills, secure landfills and landfill bioreactors, Leachate and landfill gas management. Landfill remediation.

Unit - 3	Number of	Title of the unit: Storage, Collection and Transport of Wastes
	lectures = 12	

Handling and Segregation of wastes at source, Storage and collection of municipal solid wastes, Analysis of Collection systems, Need for transfer and transport, Transfer stations, Optimizing waste allocation: compatibility, storage, labeling and handling of hazardous wastes, hazardous waste transportation methods.

Unit - 4	Number of	Title of the unit: Waste Processing Technologies
	lectures = 8	

Objectives of Waste processing, Processing technologies: biological and chemical conversion technologies, Methods and controls of Composting, Thermal conversion technologies and energy recovery incineration, Solidification and stabilization of hazardous wastes, Treatment of biomedical wastes. Exposure to applications based on current industrial trends.

#### **11.** Books Recommended (5 References)

1. George T., Hilary Theisen and Samuel A, Vigil, "Integrated Solid Waste Management, Mc-Graw Hill International edition, New York, 1993.

2. Michael D. La Grega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management", Mc-Graw Hill International edition, New York, 2001.

3. CPHEEO, "Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.

4. Vesilind P. A., Worrell W and Reinhart, "Solid waste Engineering", Thomson Learning Inc., Singapore, 2002.

5. Paul T Williams, "Waste Treatment and Disposal", Wiley, 2005

1.	1. Name of the Department: Civil Engineering				
2.	Course Name	Emerging Trend	L	Т	Р
		in Waste			
		Treatment Lab			
3.	Course Code		0	0	4
4.	4. Type of Course (use tick mark)		Core ()	<b>PE(</b> √ <b>)</b>	<b>OE</b> ()
5.	Pre-requisite (if		Odd ()	Either Odd	Either Every
	any)			Sem () $()$	Sem () Sem ()
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)					
Lectures = 0		Tutorials = 0	Practical = 28		

This laboratory course work emphasis on development of basic knowledge of the learner toward waste management system. In addition to that, this course will inculcate the understanding about parameters involved in the waste management.

#### 8. Learning objectives:

- 1. Understand the processes for determination of waste management variables.
- 2. To gain insight into basic concept of waste management.
- 3. Understand the parameter involved in determination of waste management variables.

#### 7. Course Outcomes (COs):

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

1. Apply the methodologies involved in the determination of waste management.

2. Apply the understanding of analytical techniques toward parameters that a waste management processes.

#### 8. Unit wise detailed content

- 1. To demonstrate the waste management practices.
- 2. To demonstrate the chemical properties of solid waste.
- 3. To demonstrate the methods for treatment of biomedical wastes.
- 4. To demonstrate the recycling and reuse methodologies of solid waste.
- 5. To demonstrate the methods and controls for Composting.
- 6. Determination of suspended, settleable, volatile and fixed solids
- 7. To demonstrate the solid waste sources at different sites.
- 8. To demonstrate the solid waste at river sites.
- 9. To demonstrate the solid waste at land sites.
- 10. To demonstrate the solid waste at mountain sites.

1.	Name of the Department: Civil Engineering						
2.	Course Name	Urban	L	Т		Р	
		Environmental					
		Quality					
		Management					
3.	<b>Course Code</b>		3	0		4	
4.	4. Type of Course (use tick mark)		Core (✔)	<b>PE()</b>		<b>OE</b> ()	
5.	Pre-requisite (if		6. Frequency (use	Even	Odd	Either	Every
	any)		tick marks)	0	(✔)	Sem	Sem
					. ,	(•	0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42			Tutorials = 0	Practic	$cal = \overline{28}$		

Students learn procedures to establish environmental quality monitoring. They are able to choose the appropriate type of environmental monitoring, both in terms of choice of sampling locations and measured parameters, as well as in terms of choice of medium. Based on practical examples, they realize the importance of proper sampling, data quality assurance and learn about the basic equipment for monitoring. Also, students are able to explain differences in the planning and implementation of environmental monitoring at local, national and international level.

#### 9. Learning objectives:

- 1. To teach students the general procedure for collection and preservation of samples of water and wastewater.
- 2. To provide standard methodologies for sampling and analysis of environment at whole and its constituents like water, wastewater, air and soil.
- 3. To teach advance analytical methods for environmental quality monitoring

#### **10.** Course Outcomes (COs):

At the end of the course, the student will be able to undergo

- 1. Schedule field studies and other data acquisition activities to be considered for compliance
- 2. Use a monitoring approach consisting of rapid assessment or screening studies at site.
- 3. Supervise monitoring techniques of various environmental parameters.
- 4. Generate monitoring data relevant to decision making process.
- 5. Manage and report environmental quality data in a way that is meaningful and understandable to intended audience.

# 11. Unit wise detailed content

Unit-1	Number of	Title of the unit: THEORY OF ENVIRONMENTAL	
	lectures = 10	PLANNING	

Concepts of Environmental Planning, History of Environmental Planning, Development of habitat patterns, settlement structure and form in response to environmental challenges, Concepts of Ecology and Ecosystem, Resource analysis for various ecosystems and development imperatives (land, geology, soil, climate, water, vegetation) characteristics, exploitation, causative factors for degradation, analytical techniques, Urban Ecosystem.

Unit - 2	Number of lectures = 12	Title of the unit: ENVIRONMENTAL DESIGN
Design as a determinant	of Environmental a	vality Evolution of Environmental design theories and practice of

Design as a determinant of Environmental quality, Evolution of Environmental design, theories and practice of design, Criteria of Urban Environmental design issues-pedestrian-vehicular conflict, City Centre Environment, Housing areas, dereliction, environmental upgradation programmes, Urban climatology, effects of thermal pollution, factors causing heat sink effects, direct radiation, climatic effects on Urban areas, control techniques, Climate Change and City Planning.

Unit - 3	<b>Number of Title of the unit:</b> ENVIRONMENTAL MONITORING AN					
	lectures = 12	ASSESSMENT				
Air Pollution-sources, c	auses/pollutants and	their effects, emission sources, vehicular emissions, techniques of				
monitoring of emission	monitoring of emissions, emission standards, and ambient air quality. Concepts of relevant meteorological					
parameters, and interpolation of data, wind system measurement, turbulence; mixing height, plume use,						
dispersion and dispersio	n models, Water Poll	ution – sources, water quality tests, minimum standards of disposal				
(for different uses), perfe	ormance criteria					
Unit - 4	Number of     Title of the unit: Advanced Analytical Methods					
	lectures = 8					
Working principles of	Spectrophotometric	methods, Nephelometric methods; Basics & Applications of				
Atomic Absorption Spectroscopy, Ion Chromatography, High performance liquid chromatography,						
CHNO/S Analyzer, TOC analyzer, Flame Photometer. Exposure to applications based on current						
industrial trends.						
12. Books Recommended (3 Text Books + 2-3 Reference Books)						
i) Metcalf and Eddy, (2003), Wastewater Engineering Treatment and Reuse, 4 <sup>th</sup> edition, Tata McGraw						
Hill Education Private Limited, ISBN:978						
ii) S. K. Garg (2010), Sewage Disposal and Air Pollution Engineering, Khanna Publishers, ISBN:978						
iii) M. N. Rao, H. V. N. Rao, (2007), Air Pollution, Tata McGraw Hill Publishing Company Limited.						
ISBN:978						
iv) Stanley E. Manahan (2005). Environmental Chemistry, 8th Edition, CRC Press, ISBN: 978						
y) Clair N Sawyer Perry L. McCarty and Gene F. Parkin (2002). Chemistry for Environmental						
Engineering and Science McGraw						
1.	Name of the Department: Civil Engineering					
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2.	Course Name	Urban	L	Т	Р	
		Environmental				
		Quality				
		Management				
		Lab				
3.	<b>Course Code</b>		0	0	4	
4.	Type of Course (u	ise tick mark)	Core ()	PE()	<b>OE</b> ()	
5.	Pre-requisite (if		Odd ()	Either Odd	Either Every	
	any)			Sem () $()$	Sem () Sem ()	
6.	6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)					
Le	ctures = 0		Tutorials = 0	<b>Practical = 28</b>		

#### 7. Brief Syllabus:

This laboratory course work emphasis on development of basic knowledge of the learner toward environment system. In addition to that, this course will inculcate the understanding about parameters involved in the environment monitoring.

#### 8. Learning objectives:

1. Understand the processes for determination of environment system.

2. To gain insight into basic concept of environment quality management.

3. Understand the parameter involved in determination of environment quality management variables.

#### 7. Course Outcomes (COs):

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

1. Apply the methodologies involved in the determination of environment quality monitoring.

2. Apply the understanding of analytical techniques toward parameters that influences environment monitoring.

#### 8. Unit wise detailed content

1. Familiarization with relevant instruments/equipments and procedures (High Volume Sampler, Handy

Sampler, Noise Meter, Spectrophotometer etc)

2. TSPM, RSPM, SO2, NOX, Stack Monitoring, Noise Level Measurements etc.

3. Familiarization with relevant instruments/equipments and procedures (Flame Photometer, Water Testing Kit,

Digital pH meter, BOD Incubator, Dissolved Oxygen Meter)

4. Alkalinity, Amonical Nitrogen, BOD, COD, DO, Coliform, Fluoride, Nitrate-Nitrogen, pH, SAR, etc

5. Familiarization with relevant instruments/equipments and procedures (Soil Testing Kit) pH, EC, Soil

Moisture, Phosphate, Potassium, Sodium, etc.

7. Familiarization with relevant instruments/equipments and procedures (Electronic Weather Station )

8. Temperature, Relative Humidity, Rainfall, Wind Direction and Speed, etc.

	~ ~ ~ ~ ~					
<b>11. Name of the Depa</b>	rtment: Civil Engi	neering	-		-	
12. Course Name	Environmental	L	Т		Р	
	Quality					
12 Course Code	Monitoring	2	0		4	
13. Course Coue	(so tick mork)				4 <b>OF</b> ()	
14. Type of Course (t	ise tiek mark)	$\frac{\text{Core}(\mathbf{\vee})}{1(\mathbf{E}_{\text{resonance}}(\mathbf{u}_{\text{resonance}}))}$	TE()	044		Essent
15. Pre-requisite (II		16. Frequency (use	Even		Either	Every
any)		uck marks)	0	(•)		
17 Total Number of	Lastung Tutoniak	Dractical (accuming 1		of one con	( <b>V</b> )	0
17. Total Number of $I$	Lectures, Tutorials	5, Practical (assuming ) Tutorials – 0	Proctic	$\frac{01}{01} = 28$	lester)	
18 Brief Syllabus		1 utor rais $-0$	Tach	ai – 20		
Students learn proced	ures to establish en	vironmental quality mo	nitoring	They are a	able to ch	oose the
appropriate type of e	nvironmental moni	toring both in terms	of choice	e of sampl	ing locati	ons and
measured parameters.	as well as in term	is of choice of medium	n. Based	on practic	al exampl	es. they
realize the importance	of proper sampling	z, data quality assurance	e and lear	rn about th	e basic eq	uipment
for monitoring. Also,	students are able t	o explain differences in	n the plai	nning and i	implement	ation of
environmental monitor	ring at local, nationa	al and international level		U	•	
19. Learning objectives:						
4. To teach students the	ne general procedure	e for collection and prese	ervation of	of samples	of water a	nd
wastewater.						
5. To provide standard	d methodologies for	sampling and analysis c	of enviror	ment at wh	ole and its	8
constituents like wa	ater, wastewater, air	and soil.				
6. To teach advance a	nalytical methods for	or environmental quality	monitori	ng		
20. Course Outcomes	(COs):					
At the end of the cours	se, the student will b	e able to undergo				
6. Schedule field stud	lies and other data a	cquisition activities to b	e conside	ered for con	npliance	
7. Use a monitoring a	pproach consisting	of rapid assessment or s	creening	studies at s	ite.	
8. Supervise monitor	ing techniques of va	rious environmental par	ameters.			
9. Generate monitorii	ng data relevant to d	ecision making process.	•		1 (	1.1.1
10. Manage and repor	t environmental qu	ality data in a way that	is mean	ingful and	understan	dable to
11 Unit wise detailed	aantant					
II. Unit wise detailed	Number of	Title of the unit: Con	oral Sam	nling and	Analytica	1
Umt-1	lectures – 10	Techniques	erai Sam	iping and	Anarytica	1
General principles for	r collection of r	epresentative samples	frequenc	ev of sam	pling va	lidation
interpretation and an	alvsis of data, var	ious statistical technique	ues. qual	lity control	assessm	ent and
management technique	management techniques.					
Unit - 2	Number of	Title of the unit: Met	hods for	Physicoch	emical An	alysis
	lectures = 12	of Water/ Wastewate	r	v		·
Gravimetric methods	for solids analysis	in water and wastewate	r, Detern	nination of	acidity, a	lkalinity
and turbidity of sample	les and nitrogen, ph	osphorus content. Analy	ysis of co	ommon cati	ions and a	nions in
water/wastewater thro	ough various chem	nical techniques, Deter	mination	of Basics	s of Prec	ipitation
titrations, Complexor	titrations, Complexometric titrations. Working principles of Electrodes and Different types of					

electrodes.				
Unit - 3	Number of	Title of the unit: Biological Methods, Microbiology & Air		
	lectures = 12	Pollution Measurements		
Sampling techniques f	for air pollution mea	asurements; analysis of particulates and common chemical air		
pollutants, Analysis m	nethods of oxides of	introgen, Sulphur, carbon monoxide, hydrocarbon and poly-		
aromatic hydro carbon	S.			
BOD & COD, MPN	N test for microbi	al pollution, plate counts; confirmatory tests for various		
microbiological agents	5.			
Unit - 4	Number of	Title of the unit: Advanced Analytical Methods		
	lectures = 8			
Working principles of	Spectrophotometric	methods, Nephelometric methods; Basics & Applications of		
Atomic Absorption Sp	ectroscopy, Ion Chr	omatography, High performance liquid chromatography,		
CHNO/S Analyzer, TO	OC analyzer, Flame	Photometer. Exposure to applications based on current		
industrial trends.				
12. Books Recommen	ded (3 Text Books	+ 2-3 Reference Books)		
i) Metcalf and Eddy, (	(2003), Wastewater	Engineering Treatment and Reuse, 4 <sup>th</sup> edition, Tata McGraw		
Hill Education Private	Limited, ISBN:978			
ii) S. K. Garg (2010), S.	Sewage Disposal and	d Air Pollution Engineering, Khanna Publishers, ISBN:978		
iii) M. N. Rao, H. V. N	N. Rao, (2007), Air I	Pollution, Tata McGraw Hill Publishing Company Limited,		
ISBN:978				
iv) Stanley E. Manahan (2005), Environmental Chemistry, 8th Edition, CRC Press, ISBN: 978				
v) Clair N Sawyer, Per	rry L. McCarty and	Gene F. Parkin (2002), Chemistry for Environmental		
Engineering and Scien	ce, McGraw	-		

9. Name of the Depa	. Name of the Department: Civil Engineering						
10. Course Name	Environment	L	Т	Р			
	Quality						
	Monitoring Lab						
11. Course Code		0	0	4			
12. Type of Course (u	se tick mark)	Core ()	<b>PE(</b> √ <b>)</b>	<b>OE</b> ()			
13. Pre-requisite (if		Odd ()	Either Odd	Either Every			
any)			Sem () $()$	Sem () Sem ()			
14. Total Number of	Lectures, Tutorials	, Practical (assuming 1	4 weeks of one set	mester)			
Lectures = 0		Tutorials $= 0$	Practical = 28				

#### 7. Brief Syllabus:

This laboratory course work emphasis on development of basic knowledge of the learner toward environment system. In addition to that, this course will inculcate the understanding about parameters involved in the environment monitoring.

#### 8. Learning objectives:

- 1. Understand the processes for determination of environment system.
- 2. To gain insight into basic concept of environment quality management.

3. Understand the parameter involved in determination of environment quality management variables.

#### **15.** Course Outcomes (COs):

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

1. Apply the methodologies involved in the determination of environment quality monitoring.

2. Apply the understanding of analytical techniques toward parameters that influences environment monitoring.

#### 16. Unit wise detailed content

1. Determination of pH & Alkalinity.

2. Determination of Hardness of water.

- 3. To determine the phosphate level in water sample.
- 4. To determine the Sulphates level in water sample.
- 5. To determine the Chloride Content in Water
- 6. Determination of Phosphates and Sulphates
- 7. Determination of Iron and Fluoride
- 8. Determination of Optimum Coagulant dosage
- 9. Determination of residual chlorine and available chlorine in bleaching powder
- 10. Determination of Oil and Grease

SGT University, Chandu-Budhera, Gurugram Faculty of Engineering & Technology Department of Civil Engineering





M. Tech. Structural Engineering

Scheme & Syllabus (2021-22)

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

#### Structural Engineering First Semester

S.	Subject		L	Τ	Р	С	Examination		Subject
NO.	Code	Course					marks		Total
		Title					Ext.	Int.	
1		Advance Pre-Stressed Concrete Design	3	0	0	3	60	40	100
2		Structural Dynamics	3	0	0	3	60	40	100
3		Matrix Methods of Structural Analysis	3	0	0	3	60	40	100
4		Design of Concrete Structural Systems	3	0	0	3	60	40	100
5		Matrix methods of Structural Analysis Lab (STAAD PRO)	0	0	2	1	40	60	100
6		Design of Concrete and Structural Systems Lab (STAAD PRO)	0	0	2	1	40	60	100
7		Value Added Courses-I	2	0	0	2	60	40	100
8		Seminar	0	0	2	1	00	100	100
		Total	14	0	6	17	380	420	800

#### Second Semester

S. NO.	Subject Code	Course	L	Т	Р	C	Examin marl	ation ks	Subject Total
		Title					Ext.	Int.	
1		Finite Element Analysis	3	0	0	3	60	40	100
2		Theory of Elasticity and Plasticity	3	0	0	3	60	40	100
3		Limit State Design of Steel Structures	3	0	0	3	60	40	100
4		Earthquake Resistant Design	3	0	0	3	60	40	100
5		Structural Engineering lab (CASTING)	0	0	2	1	40	60	100
6		Finite Element Analysis Lab (STAAD PRO)	0	0	2	1	40	60	100
7		Seminar	0	0	2	1	00	100	100
		Total	12	0	6	15	320	380	700

#### **Third Semester**

S.NO.	Subjec	Course Title	L	Т	Р	С	Exam	inatio	Subject
	t Code						1	1 	Total
							ma Fyt	rks Int	
1		Theory & Design of Plate and Shell	3	0	0	3	60	40	100
2		Research Methodology & IPR	3	0	0	3	60	40	100
3		Department Electives-XIII	3	0	0	3	60	40	100
4		Department Electives-XIV	3	0	0	3	60	40	100
5		Department Electives-XV	3	0	0	3	60	40	100
6		Research Methodology & IPR Lab	0	0	2	1	40	60	100
7		Department Electives Lab-XIII	0	0	2	1	40	60	100
8		Department Electives Lab-XIV	0	0	2	1	40	60	100
9		Department Electives Lab-XV	0	0	2	1	40	60	100
10		Value Added Courses-II	2	0	0	2	60	40	100
		Total	17	0	8	21	520	480	1000

#### **Fourth Semester**

S.NO.	Subject	Course Title	L	LT	Р	С	Examin marl	ation ks	Subject
	Code						Ext.	Int.	Total
1		Dissertation	-	-	20 W	20	100	-	100
		Total	-	-	20 W	20	100	-	100

## **Departmental Electives**

S.	Specialization	Departmental Elective	Departmental	Departmental
No.		XIII	Elective XIV	Elective XV
1	Structural Engineering	Pre-Fabricated Structures 3-0-2 (4) / Design of Industrial Structures 3-0-2 (4)	Maintenance & Rehabilitation of Structures 3-0-2 (4) / Design of Bridges 3-0-2 (4)	Composite Structures 3-0-2 (4) / Design of Tall Buildings 3-0-2 (4)

1.Name of the Depart	ment	CIVIL ENGINEERI	NG			
2.Course Name	Advanced Pre-	L	Т		Р	
	stressed Concrete					
	Structures					
3.Course Code		3	0		0	
4.Type of Course (use	e tick mark)	Core (✓)	PE-()		OE()	
5.Pre-requisite (if	RCC, PSC	6.Frequency (use	Even	Odd	Either	Every
any)		tick marks)	0	(•)	Sem ()	Sem()
7.Total Number of Le	ectures, Tutorials, l	Practical (assuming 14	weeks of	one sem	ester)	
Lectures $= 42$		Tutorials = 00	Practica	1=00		

#### 8.Brief Syllabus:

In this course, student will learn about Pre-stressed concrete. Its advantages, different methods and its application. Different types of losses in pre-stressed concrete structure and design.

#### 9.Learning objectives:

- **1.** This subject is taught to give the concepts of pre-stress.
- 2. This subject is taught to give the concepts of design the pre-stressed concrete members.

#### **10.Course Outcomes**

- On completion of this course, the students will be able to
- 1. Know the concepts, methods and materials of pre-stressing systems.
- 2. Design the pre-stressed concrete members.
- 3. Calculate the deflections in pre-stressed concrete members.
- 4. Design anchorage zones and composite pre-stressed concrete members.

#### 11.Unit wise detailed content

ine me wise actuirea	content	
Unit-1	Number of	Materials and losses in pre stress
	lectures = 12	

Difference between reinforced and pre-stressed concrete – Principles of pre-stressing – Methods and systems of pre-stressing – Principles of pre-stressing – Classification of pre-stressed concrete structures – Materials – High strength concrete and High strength steel – Stress-strain diagram - Losses in pre-stress.

Unit - 2	Number of	Design of pre-stressed concrete beams
	lectures = 11	

Design of prismatic pre-stressed concrete members for bending at service load.

Unit - 3	Number of	Deflections					
	1 / 11						
	lectures $= 11$						
Simple cable profiles -	Simple cable profiles – Calculation of deflections – Design of beams for shear and torsion at working						
and ultimate loads.	and ultimate loads.						
Unit - 4	Number of	Anchorage design					
	lectures = 08						

Design of Anchorage zone by Guyon's method – Concept of Magnel's method – IS: 1343 recommendations.

#### 13.Books Recommended TEXT BOOKS

1. Krishna Raju.N, (2010), Problems & Solutions Pre-stressed Concrete, Second Edition, CBS Publishers, ISBN-13: 9788123907154.

- 1. Dayarathnam P, (1996), Pre-stressed Concrete Structures, Fifth Edition, Oxford & IBH Pubs Company, ISBN-13: 9788120400450.
- Sinha N. C and Roy S. K., Fundamentals of Pre-stressed Concrete, Third Edition, S.Chand & Company, ISBN-13: 9788121924276.

1.	. Name of the Department		CIVIL EN				
2.	Course Name	Structural	L	Т		Р	
		Dynamics					
3.	Course Code		3	0		0	
4.	Type of Course		Core (✓)	<b>PE()</b>		<b>OE</b> ()	
5.	Pre-requisite		6. Frequency (use	Even	Odd (✓)	Either	Every
	(if any)		tick marks)	0		Sem	Sem
						0	0
7	Total Number	of Lectures Tut	orials Practical (assu	ming 14	weeks of one sen	iester)	

## 7. Total Number of Lectures, Tutorials, Practical(assuming 14 weeks of one semesterLectures = 42Tutorials = 00Practical = 00

**Brief Syllabus:** Study of Single degree of freedom system (SDOF Systems), Study of structure under Harmonic and Impulse Loading, Vibration Analysis, Study of multi degree of freedom system (MDOF Continuous Systems).

#### 8. Learning objectives:

- 1. To find the behaviour of structures subjected to dynamic loads such as wind, earthquake And blast loads.
- 2. To study different dynamic analysis procedures for calculating response of structures.
- 3. To study different mode shapes of structures.

#### 9. Course Outcomes:

- 1. Solve the problems on single degree of freedom system.
- 2. Understanding concepts of harmonic loading and impulse loading and related analysis.
- 3. Understanding the concepts of multi degree of freedom system.
- 4. Evaluate the mode shapes for different structures.

#### 10. Unit wise detailed content

To. One wise dediced content							
Unit-1	Number of	Title of the unit:	SDOF Systems				
	lectures = 10						

Single Degree of Freedom System - Introduction - Alembert's principle - Mathematical models for SDOF systems - Free vibration - Damped and undamped - Critical damping - Logarithmic decrement.

Unit - 2	Number of	Title of the unit: Harmonic and Impulse Loading
	lectures = 10	

Response to Harmonic Loading and Impulse Loading - Analysis of undamped system - damped system - general dynamic loading.

Unit - 3	Number of	Title of the unit: Vibration Analysis					
	lectures =10						
Vibration Analysis	Vibration Analysis - Rayleigh's method - Approximate Analysis - Improved Rayleigh method.						
Unit - 4	Unit - 4Number ofTitle of the unit: MDOF Systems						
	lectures = 12						
Multi degree of Freedom System - Evaluation of structural property matrices - Mode shape -							
Orthogonality cond	itions - Undampe	d and damped system - Mode superposition method.					

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

- 1. https://swayam.gov.in/course/3697-structural-dynamics
- $2.\ https://online courses.nptel.ac.in/noc16\_ce08/course$
- 3. https://www.iitk.ac.in/nicee/wcee/article/WCEE2012\_3202.pdf

#### 12. Books Recommended

#### TEXT BOOKS

1. Mario Paz, (2004), Structural Dynamics - Theory and Computation, Second Edition, CBS Publishers, ISBN-13: 9788123909783.

- 1. J. Humar, (2012), Dynamics of Structures, Third Edition, CRC Press, ISBN-13: 9780415620864.
- 2. Anil K. Chopra, (2003), Dynamics of Structures Theory and Applications to Earthquake Engineering, Third Edition, Pearson India, ISBN-13: 9788131713297.

1.	1. Name of the Department			CIVIL ENGINEERING				
2.	. Course Matrix		L		Т		Р	
	Name	Methods of						
		Structural						
		Analysis						
3.	3. Course Code		3		0		2	
4.	4. Type of Course (use tick		Cor	re (✓)	<b>PE()</b>		<b>OE</b> ()	
	mark)							
5.	Pre-requisite	Structural	6.	Frequency (use	Even	Odd (✓)	Either	Every
	(if any)	Analysis	1	tick marks)	0		Sem	Sem
							0	0
7.	<b>Total Number</b>	of Lectures, Tut	orials	s, Practical (assu	ming 14	weeks of one ser	nester)	
Le	ctures =42		Tut	corials = 00	Practic	cal =		

#### **Brief Syllabus:**

This course mainly deals with matrix analysis of structures. It begins with a review of the basic concepts of structural analysis and matrix algebra, and shows how the latter provides an excellent mathematical framework for the former. This is followed by detailed descriptions, and demonstrations through many examples, of how matrix methods can be applied to linear static analysis of skeletal structures (plane and space trusses; beams and grids; plane and space frames) by the stiffness method, and also the flexibility method.

#### 8. Learning objectives:

1. The course is intended to teach the basic concepts of indeterminate structures, static indeterminacy and kinematic indeterminacy.

2. Different matrix methods will be taught and their uses will be explained in the class.

#### 9. Course Outcomes:

1. Solve different structures by flexibility matrix method and stiffness matrix method.

- 2. Visualize and analyze space trusses and space frames.
- 3. Understand the effect of settlement of supports.

10. Unit wise detailed content							
Unit-1	Number of	Title of the unit:					

	lectures = 10	Introduction to flexibility matrix and stiffness matrix
111-1	Number of	The of the unit:

Concept of static indeterminacy and kinematic indeterminacy - concept of flexibility matrix and stiffness matrix - properties of matrices - coordinate system - solution of simple problems - derivation of stiffness matrix of beam element from strain energy.

Unit - 2	Number of	Title of the unit:
	lectures = 10	Analysis of plane structures by flexibility matrix method
Analysis of continu	uous beam, plane	e truss and plane frame by flexibility matrix method - Internal

forces due to thermal expansion and lack of fit – effect of settlement of supports.

Unit - 3	Number of	Title of the unit: Analysis of plane structures by stiffness
	lectures = 10	matrix method
Analysis of continu	uous beam, plane	russ and plane frame by stiffness matrix method - Internal forces
due to thermal expa	ansion and lack of	fit – effect of settlement of supports.
Unit - 4	Number of	Title of the unit: Space truss
	lectures	
	= 12	
Analysis of space t	russ by flexibility	matrix method and stiffness matrix method.
r marysis or space i	ituss og nektonikg	matrix motioa and stimless matrix motioa.
11 D. I. D.		
11. BOOKS Recom	mended	
<u>TEXT BOOKS</u>		
1. Pundit G.S. & G	hupta S.P., (2008),	Structural Analysis (A matrix approach), Second Edition,
Tata McGraw H	ill Education, ISB	N-13: 9780070667358 <u>.</u>
<b>REFERENCE BO</b>	OOKS	
1. J. S. Przemienie	cki. (1985). Theor	v of Matrix Structural Analysis. New Edition. Dover
Publication ISB	N_13· 978048664	9 <i>1</i>
2 Distant D Nata	$\mathbf{D} = \mathbf{D} = \mathbf{D} = \mathbf{D} = \mathbf{D}$	$\mathbf{y} = (1007) \mathbf{M}_{1} \mathbf{y}_{1}^{1} \mathbf{y}_{2}^{1} \mathbf{y}_{3}^{1} \mathbf{y}_{$
2. Kichard B. Nelso	on, Lewis P. Felto	n, (1997), Mairix Structural Analysis, John Wiley &
Sons, Imported l	Edition, ISBN-13:	9780471123248.

1. Nam	e of the Department	Civil Engine	ering			
2. Course	Design of	L	Т		Р	
Name	Concrete					
	Structural					
	Systems					
3. Course		3	0		0	
Code						
4. Type of	Course (use tick	<b>Core</b> (✓ )	<b>PE()</b>		<b>OE</b> ()	
mark)						
5. Pre-		6. Frequency	Even ()	$Odd(\checkmark)$	Either	Every
requisite		(use tick			Sem	Sem
(if any)		marks)			0	0
7. Total Nu	umber of Lectures, Tu	itorials, Practical	(assuming 1	4 weeks of	one semester	•)
Lecture	s = 42	Tutorials = 0	Practi	cal = 00		
8. Brief Sy	llabus : Student will st	udy about limit stat	te design me	thod, Deep	Beams, Flat S	Slab,
Columns	and shear walls and fr	amed buildings				
	1					
9. Learnin	g objectives:	.1	1	. 1 .		
1. This subje	ect is intended to teach	the concept of adva		ete design.	1	
2. The pract	cal aspects of various of	lesigns of structure	will be exp	lained in the	e classes	
10. Course	Outcomes (COs): On a	completion of this c	course, the s	tudents will	be able to	
On completion	on of this course, the stu	udents will be able	to			
1. Analyse a	nd design the deep bea	ms.				
2. Design sh	ears wall buildings and	flat slabs.				
3. Design slo	ender columns.					
11. Unit wis	e detailed content					
Unit-1	Number of	Title of the u	unit: Limit	state desig	n of beams	
	lectures =11					
Limit state a	nalysis and design of l	beams in flexure -	Behaviour	of reinforce	ed concrete m	embers in
bending - Pla	stic hinge – Rotation c	apacity – Factors a	affecting rot	ation capac	ity of a sectior	n – Plastic
moment – M	oment curvature relatio	nship – Redistribut	tion of mom	ents.		
Unit – 2	Number of	Title of the u	ınit: Deep I	Beams		
	lectures = 10		Ŧ			
Limit state de	esign of deep beams	I				
Unit – 3	Number of	Title of the r	ınit: Flat Sl	ab		
•	lectures $= 11$					
Design of Fla	t Slabs using BIS 456	1				
Unit – 4	Number of	Title of the r	unit. Colum	ns and sho	ar wall huildi	ngs
	Jectures – 10			115 and 5110	ar wan yunun	1123
Design of sle	nder column subjected	to combined bendi	no moment	& axial for	re using SD- 1	6
Design of stender columni subjected to combined bending moment & axial lorce using SP. 10						

#### 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 BOOKS

 Krishnaraju N., (2013), Advanced Reinforced Concrete Design, Second Edition, CBS Publisher, ISBN-13: 9788123912257.

- 1. P. C. Varghese, (2009), Advanced Reinforced Concrete Design, Second Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120327870.
- M. L. Gambhir, (2009), Design of Reinforced Concrete Structures, First Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120331938.
- P. Dayaratnam, (2011), Design of Reinforced Concrete Structures, Fourth Edition, Oxford & IBH – Pubs Company, ISBN-13: 9788120414198.
- 4. B. C. Punmia, Ashok Kr. Jain, Arun Kr. Jain, (2006), R. C. C. Designs, Laxmi Publication (P) Ltd., ISBN-13: 9788131809426.

1.	Name of the Depar	rtment		CIVIL EN	GINEE	RING		
2.	Course Name	Matrix methods	L T		Р			
		of Structural						
		Analysis Lab						
		(STAAD PRO)						
3.	Course Code		0		0		2	
4.	Type of Course (u	se tick mark)	Core (🗸)		<b>PE</b> ()		<b>OE</b> ()	
5.	Pre-requisite (if	Structural	6.	Frequency	Even	Odd (✓)	Either	Every
	any)	Analysis		(use tick	0		Sem	Sem
				marks)			0	0
7.	Total Number of I	Lectures, Tutorials	s, Pr	ractical (assu	ming 14	weeks of one ser	nester)	
Le	ctures =00		Tu	torials = 00	Practic	ral = 28		

#### **Brief Syllabus:**

This course mainly deals with matrix analysis of structures. It begins with a review of the basic concepts of structural analysis and matrix algebra, and shows how the latter provides an excellent mathematical framework for the former. This is followed by detailed descriptions, and demonstrations through many examples, of how matrix methods can be applied to linear static analysis of skeletal structures (plane and space trusses; beams and grids; plane and space frames) by the stiffness method, and also the flexibility method.

#### 8. Learning objectives:

1. The course is intended to teach the basic concepts of indeterminate structures, static Indeterminacy and kinematic indeterminacy.

2. Different matrix methods will be taught and their uses will be explained in the class.

#### 9. Course Outcomes:

- 1. Solve different structures by flexibility matrix method and stiffness matrix method.
- 2. Visualize and analyze space trusses and space frames.
- 3. Understand the effect of settlement of supports.

#### 10. Unit wise detailed content

- 1. Analysis of propped cantilever beam
- 2. Analysis of two span continuous beams
- 3. Analysis of statically determinate plane truss
- 4. Analysis of statically indeterminate plane truss
- 5. Analysis of kinematically indeterminate plane truss
- 6. Analysis of one bay one storey plane frame
- 7. Analysis of multi bay multi storied plane frame
- 8. Analysis of space truss
- 9. Analysis of space frame

1. Name of the Depa	CIVIL ENGI	CIVIL ENGINEERING				
2. Subject Name	Design of	L	Т		Р	
	Concrete and					
	Structural					
	Systems Lab					
	(STAAD PRO)					
3. Subject Code		0	0		2	
4. Type of Subject		Core (✓)	<b>PE(</b> )		<b>OE</b> ()	
Pre-requisite (if any)	Design of	Frequency (use	Even ()	Odd	Either	Every
	Concrete	tick marks)		(🗸)	Sem	Sem
	Structural				0	0
	Systems					
6 Total Number of Lectures Tutorials Practical Assuming 14 weeks in semester						

6. Total Number of Lectures, Tutorials, Practical, Assuming 14 weeks in semesterLectures = 00Tutorials = 00Practical =28

#### 7. Brief Syllabus :

Student will study about limit state design method, Beams, Slab, Columns and framed buildings & design of these by using STAAD Pro.

#### 8. Learning objectives:

- 1. This subject is intended to teach the concept of advanced concrete design.
- 2. The practical aspects of various designs of structure will be explained in the classes.

#### 9. Outcomes:

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

- 1. Analyse and design the beams.
- 2. Design shears wall buildings and slabs.
- 3. Design of slender columns.

#### 10. Lab Content

10. Lab Cont	
Sr. No.	Title
1	Design of propped cantilever RCC beam
2	Design of two span continuous RCC beams
3	Analysis and design one bay – one storey plane frame
4	Analysis and design of multi bay – multi storied plane frame
5	Analysis and design of space frame
6	Case study

# Second Semester

1. Name of the Department – Civil Engineering								
2. C	Course Name	Finite Element	L		Т		Р	
		Analysis						
3. C	Course Code		3		0 0		0	
4. Type of Course (use tick mark)		Co	ore (🗸 )	<b>PE()</b>		<b>OE</b> ()		
<b>5. P</b>	re-requisite (if		6.	Frequency (use	Even	Odd ()	Either	Every
aı	ny)			tick marks)	(✔)		Sem ()	Sem
								0
7. T	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Lectures = 42			Tu	torials = 00	Practical = 00			
8. Brief Syllabus								
Basics of finite element analysis, study of different methods linear equations and matrix method,								
study by displacement models, analysis of structure such as frame and truss by finite element analysis,								

9. Learning objectives:

Basic study of Iso-parametric elements.

- 1. The course is intended to teach the basic concepts of finite element analysis.
- 2. The practical application of finite element method and their advantages and disadvantages Will be explained in the class.

#### **10.** Course Outcomes (COs):

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

- 1. Calculate strain-displacement matrix and stress-strain matrix.
- 2. Know the analysis procedure and the matrix operations.
- 3. Know the concepts of isoperimetric elements.

#### 11. Unit wise detailed content

III ente «ne actunea	content	
Unit-1	Number of	Introduction to FEM
	lectures =10	

Introduction - Background - General description of the method – Analysis procedure - Stress and strain vectors – Stain displacement equations – Linear constitutive equations – Overall stiffness matrix – Overall load matrix - Analysis of beams.

Unit – 2	Number of	Displacement models
	lectures = 10	

Theory of Finite Element - Concept of an element - Various elements shapes - Displacement polynomials - Convergence requirements - Shape functions - Element strains and stresses - Direct formulation of element stiffness matrix for beam element and plane truss element

Unit – 3	Number of	Analysis of structures by FEM
	lectures = 10	

Overall Problems - Discretization of a body or structure - Minimization of band width - Construction of stiffness matrix and loads for the assemblage - Boundary conditions - Analysis of plane truss, space truss, plane frame.

Unit – 4 Number of		Plane stress and plane strain
	lectures = 12	

Plane stress - Plane strain - CST, LST & QST elements - Rectangular element - solutions of problems

#### 12. Books Recommended

#### **TEXT BOOKS**

1. C. S. Krishnamoorthy, (2008), Finite Element Analysis, Second Edition, Tata McGraw Hill Education Pvt. Ltd., ISBN-13: 978007462100.

- 1. Cook R. D., Malkas D. S. & Plesha M. E, (2008), Concepts and applications of Finite Element analysis, Fourth Edition, Wiley India Pvt. Ltd., ISBN-13: 9788126513369.
- 2. Reddy, (2005), An Intro. To The Finite Element Methods, Third Edition, Tata McGraw Hill Education Pvt. Ltd., ISBN-13: 9780070607415.
- 3. Singiresu S. Rao, (2010), The Finite Element Method in Engineering, Fifth Edition, Elsevier Science, ISBN-13: 9780080952048.

1.	1. Name of the Department CIVII				EERIN	G		
2.	Course	Theory of	L		Т		Р	
	Name	Elasticity and						
		Plasticity						
3.	<b>Course Code</b>		3		0		0	
4. Type of Course		Core (✓)		<b>PE()</b>		<b>OE</b> ()		
5.	Pre-requisite	Strength of	6.	Frequency	Even	Odd ()	Either	Every
	(if any)	Materials, Engg.		(use tick	<b>(</b> ✓)		Sem ()	Sem
		Mechanics		marks)				0
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						er)		
Lectures = 42			Tutori	als = 00	Practic	al =00		

8. Brief Syllabus: Structural analysis is the determination of the effects of loads on physical structures and their components. Structures subject to this type of analysis include all that must withstand loads, such as buildings, bridges, vehicles, machinery, furniture, attire, soil strata, prostheses and biological tissue.

#### Learning objectives:

1. This subject is taught to impart knowledge on theory of elasticity and plasticity.

2. To impart knowledge on Equilibrium equations.

3. To impart knowledge on Plasticity.

#### **Course Outcomes:**

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

- 1. Analyse the stresses and strains for two dimensional and three dimensional elements.
- 2. Understand the equilibrium and compatibility conditions.
- 3. Solve the problems on Torsion for different shaped bars.
- 4. Understand the concept of plasticity.

9. Unit wise detailed content						
Unit-1	Number of	Stresses and strains				
	lectures – 11					

Analysis of Stress and Strain - Elasticity approach – Definition and notation of stress – Components of stress and strain – Generalized Hooke's law -Two dimensional Problems in Cartesian Coordinates - Plane stress and plain strain problems with practical examples - Equations of equilibrium and compatibility conditions in Cartesian coordinates – Airy's stress function - Bending of simply supported beams.

Unit - 2	Number of	Axi-symmetric problems				
	lectures = 11					
Two dimensional Problems in Polar Coordinates - Equations of equilibrium and compatibility						
conditions in polar coordinates - Axi-symmetrical problems - Thick cylinder under uniform pressure -						
Circular arc beams subjected to pure bending.						

Unit - 3	Number of	Prandle's membrane analogy

lectures :	= 10
------------	------

Torsion of circular shafts, St. Venant's Approach , torsion of non-circular sections, membrane analogy, narrow rectangular cross-section

Unit - 4	Number of	Introduction to plasticity
	lectures = 10	

Introduction to plasticity – Stress – Strain diagram – Plastic analysis – Yield criteria – St. Venant's theory – Von Mises criterion – Plastic work – Strain hardening.

#### 10. Books Recommended

#### TEXT BOOKS

1. Timoshenko and Goodier, (1970), Theory of Elasticity, Third Edition, McGraw Hill Professional, ISBN-13: 9780070858053.

- 1. Srinath, (2002), Advanced Mechanics of Solids, Third Edition, Tata McGraw Hill Pvt. Ltd., ISBN-13: 9780070139886.
- 2. D. Peric, E. A. de Souza Neto & D. R. J. Owen, (2011), Computational Methods for Plasticity, Wiley, ISBN-13: 9781119964544.

Name of the Depa	C	IVIL ENGINE	RING				
1. Course	Limit State	L		Т		Р	
Name	Design of Steel						
	Structures						
2. Course Code		3		0		0	
3. Type of Cours	se	Core (✓)		<b>PE()</b>		<b>OE</b> ()	
4. Pre-requisite	Design of Steel	5.	Frequency	Even	Odd ()	Either	Every
(if any)	Structure		(use tick	(🗸 )		Sem ()	Sem
			marks)				0
6. Total Number	6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		Tutor	ials = 00	Practic	al = 00		

#### 7. Brief Syllabus:

Many civil engineering structures are made up of steel. Knowledge of designing and detailing of steel structures is very important for civil engineers in order to make structures safe and serviceable during its life span. Limit State design philosophy is currently used worldwide for design of steel structures and its various components. Also precise and correct detailing of structural drawing is necessary in order to get the correct behavior of structures and leads to smooth construction of structures. This course will provide detailed knowledge of design and detailing of steel structures as per Indian standards.

#### 8. Learning objectives:

- 1. To know how to design and use the different types of steel structural elements.
- 2. To know about the plastic analysis of structures.
- 3. To know about design of light gauge steel structures.

#### **Course Outcomes:**

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

- 1. Design compression members.
- 2. Design light gauge steel structures.
- 3. Analyse the beams and portal frames.
- 4. Design joints and connections using riveted and welded connections.

9. Unit wise deta	9. Unit wise detailed content								
Unit – 1	Number of	Compression members							
	lectures = 10								
Design of compression members – Axially – Uniaxial and biaxial bending - Design of base slab.									
<b>Unit</b> – 2	Number of	Plastic Analysis							
	lectures = 12								
Plastic Analysis of Str	uctures – Introducti	on - Shape factors – Mechanisms - Plastic hinge - Analysis							
of beams and portal fra	ames - Design of co	ntinuous beams.							
Unit – 3	Number of	Light gauge sections							
	lectures = 10								
Design of Light Gauge	Steel Structures - 7	Types of cross sections - Local buckling and lateral buckling							

- Design of compression and tension members – Beams - Deflection of beams.

Unit – 4	Number of	Chimney
	lectures = 10	
Design of Chimney D	asian of foundation	of chimmer

Design of Chimney, Design of foundation of chimney.

#### **10. Books Recommended**

#### TEXT BOOKS

1. Dayarathnam. P., (1996), Design of Steel Structures, Second Edition, S. Chand and Publishers, ISBN-13: 0788121923200.

- 1. Duggal S. K., (2014), Limit State Design of Steel Structures, Second Edition, McGraw Hill, ISBN-13: 9789351343509.
- 2. Ramchandra, Virendra Gehlot, (2010), Limit State Design of Steel Structures: Based on IS: 800-2007 IN S. I. Units, Scientific Publishers, ISBN-13: 9788172336141.

1.	Name of the Depa	rtment	CIVIL ENGINEERING				
2.	Course Name	Earthquake	L	Т		Р	
		Resistant Design					
3.	Course Code		3	0		0	
4.	4. Type of Course (use tick mark)		Core (✓)	PE-()		OE()	
5.	Pre-requisite (if	RCC	6. Frequency (use	Even	Odd ()	Either	Every
	any)		tick marks)	(🗸)		Sem ()	Sem
							0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Le	ctures = 42		Tutorials $= 00$	Practical = 10			
<b>8.</b> I	Brief Syllabus:						

The aim of the course is to present to the students fundamental concepts of current seismic codes and technical seismology as well as the technical skills for the seismic design of structures and the evaluation of their seismic response.

#### 9Learning objectives:

1. To impart the knowledge about the earthquake and its occurrence.

2. To know about the mathematical modeling of structures subjected to earthquakes and their behavior.

#### **10.Course Outcomes:**

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

- 1. Evaluate the behaviour of structures under dynamic loadings.
- 2. Know methodology for earthquake resistant design.
- 3. Design the buildings using capacity design concept.
- 4. Design the multi storied building using computer.

## 11.Unit wise detailed content Unit-1 Number of lectures = 10 Basic of Seismology

Elements of Seismology - Definitions of magnitude – Intensity - Epicenter etc - General features of tectonics of seismic regions - Seismographs.

Unit - 2	Number of	Title of the unit:
	lectures = 10	Design Philosophy

Philosophy of earthquake resistant design, earthquake proof v/s earthquake resistant design, four virtues of earthquake resistant structures (strength, stiffness, ductility and configuration), seismic structural configuration, Introduction to IS: 1893 (Part I), IS: 875 (Part V). Seismic load: Seismic Coefficient Method – base shear and its distribution along height. Introduction to Response spectrum, IS code provisions.

Unit - 3	Number of lectures = 10	Title of the unit: Ductile Detailing
Concepts of Ductile D	etailing of various st	ructural components as per IS: 13920 provisions, Strong

Column weak beam concept.

Unit - 4	Number of	Title of the unit: Capacity Based Design
	lectures = 12	
Capacity Based de	sign-an approach for	earthquake resistant design of soft storey RC Building,
Earthquake resistant	t design of shear wall.	
12.Brief Descriptio	n of self learning / E	-learning component
http://retrofit.teipi	r.gr/?course=earthqu	uakeresistant-design-of-structures⟨=en
13.Books Recomme	ended	
TEXT BOOKS		
1. Anil K. Chopra, (	2011), Dynamics of S	tructures - Theory and Applications to Earthquake
Engineerin	ng, Second Edition, Ir	ngram International Inc., ISBN-13: 9780132858038.
REFERENCE BOO	KS	
1 Dankai A garwal a	nd Manich Shrikhanda	(2007) Forthqueke Pesistent Design of
1. 1 alikajAgai wal al	Einst Edition Dranti	2, (2007), Baimquake Kesistan Design of
Structures	O) Dringinlag of East	ce-mail mula r vi Liu, ISDN-15, 9/00120520921.
2. Gupta B. L., (201	U), Principles of Earth	iquake Resistant Design of Structures & Isunami,
Standard I	Publishers & Distribut	tors, ISBN-13: 9788180141485.

1.	1. Name of the Department			<b>CIVIL ENGINEERING</b>				
2.	Course	Structural	L		Т		Р	
	Name	Engineering						
		Laboratory						
3.	<b>Course Code</b>		0		0		2	
4.	4. Type of Course		Core (✓)		<b>PE</b> ()		<b>OE</b> ()	
5.	Pre-requisite	None	6.	Frequency	Even	Odd ()	Either	Every
	(if any)			(use tick	(✔)		Sem ()	Sem
				marks)				0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						er)	
Lectures = 00			Tutori	als = 00	Practic	al = 28		

**Brief Syllabus:** The aim of the course is to present to the students fundamental concepts of current seismic codes and technical seismology as well as the technical skills for the seismic design of structures and the evaluation of their seismic response.

#### Learning objectives:

- 1. To teach students different types of testing of concrete structures.
- 2. To enable the students to know the behaviour of RCC structures.

#### **Course Outcomes:**

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

- 1. Design concrete mix for particular grade of concrete
- 2. Test concrete beams for various loading conditions
- 3. Perform non-destructive testing.

#### 8. Books Recommended (3 Text Books + 2-3 Reference Books)

#### TEXT BOOKS

1. Krishnaraju N., (2013), Advanced Reinforced Concrete Design, Second Edition, CBS Publisher, ISBN-13: 9788123912257.

#### **REFERENCE BOOKS**

- 1. P. C. Varghese, (2009), Advanced Reinforced Concrete Design, Second Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120327870.
- 2. M. L. Gambhir, (2009), Design of Reinforced Concrete Structures, First Edition, Phi Learning Pvt. Ltd., ISBN-13: 9788120331938.
- 3. P. Dayaratnam, (2011), Design of Reinforced Concrete Structures, Fourth Edition, Oxford & IBH Pubs Company, ISBN-13: 9788120414198.
- B. C. Punmia, Ashok Kr. Jain, Arun Kr. Jain, (2006), R. C. C. Designs, Laxmi Publication (P) Ltd., ISBN-13: 9788131809426.

#### Lab component components

Sr. No.	Title	CO covered
1	To determine the compressive strength of fibre reinforced concrete by	1,2,3
	testing cubes specimen.	
2	Casting and testing of simply supported RCC beams for flexural failure.	2

3	Casting and testing of simply supported RCC beams for shear failure.	2
4	To determine tensile strength on a steel reinforcement bar.	2
5	To determine shear strength of steel bar under double shear.	2,
6	To conduct bending test of I-section steel beam.	3
7	To conduct bending test of steel channel section.	3
8	To study rebound hammer test on concrete blocks.	2,
9	To study ultra sonic pulse velocity test	2

1.	1. Name of the Department – Civil Engineering								
2.	Course Name	Finite Element	L	Т		Р			
		Analysis Lab							
		(STAAD PRO)							
3.	Course Code	Course Code		00		2			
4.	Type of Course (use tick mark)		Core (✓)	<b>PE()</b>		<b>OE</b> ()			
5.	Pre-requisite (if		6. Frequency (use	Even	Odd ()	Either	Every		
	any)		tick marks)	(🗸)		Sem ()	Sem		
							0		
7.	Total Number of	Lectures, Tutorials	, Practical (assuming 1	4 weeks o	of one ser	mester)			
Le	ctures = 00		Tutorials = 00	Practical = 28					
8.	Brief Syllabus								
-									

Basics of finite element analysis, study of different methods linear equations and matrix method, study by displacement models, analysis of structure such as frame and truss by finite element analysis, Basic study of Iso-parametric elements.

#### 9. Learning objectives:

- 1. The course is intended to teach the basic concepts of finite element analysis.
- 2. The practical application of finite element method and their advantages and disadvantages Will be explained in the class.

#### **10. Course Outcomes (COs):**

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

- 1. Calculate strain-displacement matrix and stress-strain matrix.
- 2. Know the analysis procedure and the matrix operations.
- 3. Know the concepts of isoperimetric elements.
- 4. Know the analysis procedure by Staad Pro

#### 11. Unit wise detailed content

- 1. Analysis of three span continuous beams.
- 2. Analysis of propped cantilever beam.
- 3. Analysis of statically determinate plane truss.
- 4. Analysis of statically indeterminate plane truss.
- 5. Analysis of one bay one storey plane frame.

# Third Semester

<b>1.Name of the Department</b> CIVIL ENGINEERING						
2.Course Name	Theory and	L	Т		Р	
	Design of Plates					
	& Shells					
3.Course Code		3	0		0	
4.Type of Course (use tick mark)		Core (✓)	PE-()		OE()	
5.Pre-requisite (if	Fluid Mechanics	6.Frequency (use	Even	Odd	Either	Every
any)		tick marks)	0	(•)	Sem ()	Sem()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures $= 42$		Tutorials =	Practica	.1		

#### 8.Brief Syllabus:

In this course, student will learn about Thin plates its equation and boundary condition, Plate bending and design of shells, curve shell etc. design and detailing of folded plate structure.

#### 9.Learning objectives:

1. This subject is taught to impart knowledge about the behavior of plates and shells.

#### **10.Course Outcomes**

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

- 1. Analyze the plates using Navier's and Levy's method.
- 2. Analyze the circular, rectangular and square plates by finite difference method.
- 3. Design the curved shells and roofs.
- 4. Design the various folded plate structures

11.Unit wise detailed content					
Unit-1	Number of	Title of the unit:			
	lectures = 10	Thin plates			
Laterally loaded thin p	lates – Differential e	equation – Boundary conditions.			
Unit - 2	Number of	Title of the unit:			
	lectures = 11	Plate bending			
Bending of plates – Sir	mply supported recta	angular plates – Navier's solution and Levy's method –			
Rectangular plates with	h various edge cond	itions - Symmetrical bending of circular plates – Finite			
difference method for a	analysis of square ar	nd rectangular plates.			
Unit - 3	Number of	Title of the unit: Design of shells			
	lectures = 10				
Types of shells - Str	ructural action – M	lembrane theory – Limitations – Beam method of			
analysis.					
Unit - 4	Number of	Title of the unit:			
	lectures = 05	Curved shell			
Analysis and design of doubly curved shells – Elliptic parabolic - Conoid and hyperbolic paraboloid					
roofs.					

### 13.Books Recommended

- TEXT BOOKS
- 1. G. S. Ramaswamy, (1996), Design and Construction of Concrete Shell Roofs, First Edition, CBS Publishers and distributors. ISBN-13: 9780812390995.

- 1. Timoshenko and Krieger, (2010), Theory of Plates and Shells, Second Edition, Tata McGraw Hill Education Pvt. Ltd., ISBN-13: 9780070701250.
- 2. K. Bhaskar, (2013), Plates: Theories and Applications, First Edition, Ane Books Pvt. Ltd., ISBN-13: 9789382127024.

1.	1. Name of the Department CIVIL ENGINEERING						
2.	Course Name	Research	L	Т		Р	
		Methodology					
		and IPR					
3.	Course Code		3	0		0	
4.	4. Type of Course (use tick mark)		Core (✓)	PE-()		OE()	
5.	Pre-requisite (if		6. Frequency (use	Even	Odd	Either	Every
	any)		tick marks)	0	(•	Sem ()	Sem
							0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Le	ctures = 42		Tutorials $= 00$	Practica	al = 0		

Lectures = 42

### 8.Brief Syllabus:

The aim of the course is to make students understand the importance of Research Paper Writing. Also, it covers all the concepts which involved in writing the Research Paper.

#### 9 Learning objectives:

The objectives of the course are:

- 1. The students are able to recognize the steps involved in doing research work.
- 2. The students will be able to collect data using various media and using the best possible sample available.
- 3. The students would learn to propose their Hypothesis and build models for the problem.
- 4. The students would be able to correctly document their findings in the form of a report.

#### **10.Course Outcomes:**

After completion of this course, the student will be able to:

- 1. Recognize the various steps involved in research.
- 2. Collect data from samples, Examine and analyze the data.
- 3. Develop models for problems.
- 4. Explain the entire process in the form of a report.

#### **11.Unit wise detailed content**

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

Research - Types, Research process and steps, Hypothesis, Research Proposal and aspects. Research Design- Need, Problem Definition, Variables, Research Design concepts, Literature survey and review, Research design process, Errors in research. Research Modeling- Types of models, model building and stages, Data consideration.

Unit - 2	Number of	Title of the unit: Sampling
	lectures = 10	
Sampling and data col	llection- Techniques	s of sampling, Random, Stratified, Systematic, Multistage-

sampling, Primary and secondary sources of data. Design of questionnaire.

		1
Unit - 3	Number of	Title of the unit: Data Collection and Experiments
	lectures = 10	

Design of Experiments- Objectives, strategies, Factorial experimental design, designing engineering experiments, basic principles-replication, randomization, blocking, guidelines for design of experiments.

Unit - 4	Number of	Title of the unit: Models and Hypothesis & Report
	lectures = 12	writing

Single factor experiment- Hypothesis testing, analysis of Variance component (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effect model, estimation of variance components, Model adequacy checking. Structure and components of Scientific Reports, Types of Report, Technical Reports and Thesis; Different steps in the preparation – Layout, structure and Language of typical reports; Illustrations and tables, Bibliography, Referencing and foot notes.

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

https://research-methodology.net/research-methodology/ https://gradcoach.com/what-is-research-methodology/

#### **13.Books Recommended**

**Text Book:** 

1. Research Methodology – Methods and Techniques – C.R. Kothari, New Age International, New Delhi, 2004.

#### **Reference Book:**

1. Design and Analysis of Experiments – Douglas C. Montgomery, Wiley India, 8th Edition, 2012.

2. Practical Research: Planning Design - Paul D. Leddy, London, 1980.

1.	1. Name of the Department CIVIL ENGINEERING						
1.	Subject	Research	L	Т		Р	
	Name	Methodology					
		and IPR Lab					
2.	Subject		0	0		2	
	Code						
3.	Type of Subje	ect	Core (✓)	<b>PE() OE()</b>			
4.	Pre-	Research	Frequency (use tick	Even ()	Odd	Either	Every
	requisite (if	Methodology	marks)		<b>(</b> ✓)	Sem	Sem
	any)	and IPR				0	0
5. Total Number of Lectures, Tutorials, Practical (Assuming 14 weeks in semester)							
Lectures = 00			Tutorials = 00	Practical	=28		

#### Lectures = 00

#### 1. Learning objectives:

The objectives of the course are:

- 2. The students are able to recognize the steps involved in Identifying research problem.
- 3. The students will be able to collect data using various media and using the best possible sample available.
- 4. The students would learn to propose their Hypothesis and build models for the problem.
- 5. The students would be able to correctly document their findings in the form of a report.

#### **Outcomes:**

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

- 1. Choose the topic for writing research paper.
- 2. Develop models for problems.
- 3. The students would learn to write the research paper.

6. Lab Content				
Sr. No.	Title	CO covered		
1	How to choose topic for research	1,2		
2	How to collect data for the particular research problem	1,2		
3	Writing Abstract	1,2		
4	Writing Literature review	1,2		
5	Explaining and writing methodology	1,2		
6	How to analyze the data collected	1,2		
7	Presentation of analysis and findings	1,2		
8	How to write result and conclusion	2,3		
9	References in research article	2,3		
# Departmental Electives

1.Name of the Depart	ment	CIVIL ENGINEERI	NG				
2.Course Name	Prefabricated	L	Т		Р		
	Structures						
3.Course Code		3	0		0		
4.Type of Course (use	e tick mark)	Core ()	PE (✓)		OE()		
5.Pre-requisite (if		6.Frequency (use	Even	Odd	Either	Every	
any)		tick marks)	0	<b>(</b> ✓)	Sem ()	Sem()	
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Lectures = 42		Tutorials =	Practica	1			

# 8.Brief Syllabus:

In this course, student will learn about types of foundation, Prefabrication systems and structural schemes, Handling and erection stresses, Dimensioning and detailing of joints, Design of pre fabricated Modules.

# 9.Learning objectives:

1. This subject is taught to impart the knowledge in the area of prefabricated structures.

# **10.Course Outcomes**

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

- 1. Know the types of prefabrication systems.
- 2. Understand the behaviour of shell structures.
- 3. Design pre fabricated Modules.
- 4. Do the detailing of pre fabricated Modules.

11.Unit wise detailed content				
Unit-1	Number of	Introduction		
	lectures = 10			
Types of foundation -	Modular co-ordinat	tion – Components - Prefabrication systems and structural		
schemes - Design co	nsiderations - Ecor	nomy of prefabrication - Prefabrication of load-carrying		
members - DisModuleing of structures - Structural behaviour of pre cast structure.				
Unit - 2	Number of	Handling and erection stresses		
	lectures = 12			
Handling and erection	stresses - Applicati	on of pre stressing of roof members - Floor systems - Two		
way load bearing slabs	- Wall panels.			
Unit - 3	Number of	Dimensioning and detailing of joints		
	lectures = 10			
Dimensioning and deta	ailing of joints for di	fferent structural connections - Construction and expansion		
joints.				
Unit - 4	Number of	Erection of structures		
	lectures = 10			

Production - Transportation and Erection - Organizing of production - Storing and erection equipment - Shuttering and mould design - Dimensional tolerances, Erection of R.C. structures, Total prefabricated buildings.

# 13.Books Recommended TEXT BOOKS

1. Hass, A. M., Precast Concrete Design and Applications, Taylor & Francis Publishers, ISBN-13: 9780853341970.

# **REFERENCE BOOKS**

 A. S. G. Bruggeling & G. F. Huyghe, (1991), Prefabrications with Concrete, CRC Press, ISBN-13: 9789061911838.
 Second Edition, Applied Science Publishers Ltd., ISBN-13: 9780415268462.

1. Name o	1. Name of the DepartmentCIVIL ENGINEERING							
2. Subje	ct	Prefabricated	L	Т		Р		
Name		Structures Lab						
3. Subje	ct		0	0 2				
Code								
<b>4.</b> Type	of Subje	ect	Core ()	<b>PE(</b> ✓) <b>OE</b> ()			1	
5. Pre-			Frequency (use tick	Even ()	Odd	Either	Every	
requis	site (if		marks)		(•)	Sem	Sem	
any)				• 14	<u> </u>		0	
6. Total	Number	r of Lectures, Tut	orials, Practical (Assum	ning 14 we	$\frac{1}{1}$ 29	mester)		
Lectures $= 00$	) ing chi		i utoriais = 00	Practica	1 =28			
<b>o.</b> Learn	ing obje	cuves:	ladaa in tha area of a f	abmiacted -	tan at			
This subject is	staught	to impart the know	ledge in the area of pref	abricated s	tructures.			
7 Outee	mos							
On comple	tion of t	his course. the stud	lents will be able to					
1. Know the t	vpes of 1	orefabrication syste	ems.					
2. Understand	the beh	aviour of shell stru	ctures.					
3. Design pre	fabricate	ed Modules.						
4. Do the deta	iling of	pre fabricated Mod	lules.					
7. Lab C	Content							
Sr. No.	Title					COo	overed	
1	Prefab	rication systems an	d structural schemes			1,2		
2	Prefab	rication of load-car	rying members			1,2,4		
3	Structu	aral behaviour of p	re cast structure			1,2		
4	Applic	ation of pre stressi	ng of roof members			1,2,4		
5	Two w	vay load bearing sla	ıbs			1,2		
6	Dimen	sioning and detaili	ng of joints for different	structural		1,2		
	connec	ctions						
7	Organi	zing of production	- Storing and erection e	quipment		1,2		
8	Total p	prefabricated buildi	ngs.			2,3		

1.	Name of the D	epartment	CIVIL ENGINEER	ING			
2.	Course	Design of	L	Т		Р	
	Name	Industrial					
		Structures					
3.	<b>Course Code</b>		3	0		0	
4.	Type of Cours	ie :	Core ()	PE(✓)			OE()
5.	Pre-requisite	Construction	6. Frequency (use tick	Even	Odd	Either	Every
	(if any)	Technology	marks)	0	(🗸)	Sem	Sem
						0	0
7.	<b>Total Number</b>	of Lectures, Tu	torials, Practical				
т			<b>T</b> 1 00	D	1 00		

Lectures = $42$	Tutorials = 00	Practical = 00

# 8.Brief Syllabus

The purpose of this course is to develop an in-depth knowledge in the area of design of industrial structure with the latest code of practice as per the Indian Standard. On completion of this course student gain good confidence in designing major industrial structures like bridge plate girders, industrial structures like gantry girders, water tanks, support structures, high rise chimneys and pre-engineered thin walled structures.

# 9. Learning objectives:

1. This subject is taught to impart a broad knowledge in the area of industrial structures.

# 10. Course Outcomes:

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

- 1. Know the requirements of various industries.
- 2. Get an idea about the materials used and planning.
- 3. Know the construction techniques.
- 4. Understand the functional requirements

11. Unit wise d	letailed content	
Unit-1	Number of	Title of the unit: Industrial requirements & Planning
	lectures =10	

General - Specific requirements for industries like textile, sugar, cement, chemical, etc - Site layout and external facilities. Planning of Building Work – Standards - Structural materials including plastics – Polymers - Fiber glass - Pressed card boards, etc - Multi-storey buildings - Steel skeletal structures -Reinforced concrete frames – Workshops - Ware houses - Single storey buildings - Sheds in steel and reinforced concrete - North-lights - Single span spherical and other special constructions - Cooling towers and chimneys - Bunkers and silos' prefabrication - Construction.

Unit – 2	Number of	Title of the unit: Construction techniques			
	lectures = 10				
Construction Tech	niques - Expansio	n joints - Machine foundations - Other foundations - Water			
proofing - Roofs and roofing - Roof drainage - Floors and flooring joists - Curtain walling - Outer					
wall facing - Sound and shock proof mountings - Use of modern hoisting and other construction					

equipments.		
Unit – 3	Number of	Title of the unit: Circulation
	lectures = 10	
Circulation - Co	ommunication and T	Fransport - Fixed points ( central cores) – Staircases - Grid floor
sections - Lifts	refuse disposals - U	tilization of waste materials - Cranes - Continuous conveyors -
Mobile cranes -	- Transporters – Doc	ors - Sliding gates.
Unit – 4	Number of	Title of the unit: Functional Requirements
	lectures =12	
Functional Req	uirements – Lighting	g: Natural lighting - Protection from the sun - sly lights - window
cleaning install	ations -Services: Lay	yout – wiring – fixtures - cable and pipe bridges - electrical
installations - li	ghting substation - H	Effluent. Ventilation and fire protection: Ventilation - Air-
conditioning - I	Fire escapes and chu	tes - Fire alarms - Hydrants.
12. Brief D	escription of self lea	arning / E-learning component:
https://	nptel.ac.in/courses/	/105106113/3
	<b>I</b>	
13. Books I	Recommended	
TEXT BOOKS		
1. El Reedy, (2	2010), Construction	Management and Design of Industrial Concrete and Steel
Structures, Tay	lor & Francis Group	o, ISBN-13: 9781439815991.
		·

1. Nelson G. L., (1988), Light Agricultural and Industrial Structures: Analysis and Design Kluwer Academic Publisher, ISBN-13: 9780442267773.

2. Dr. Raja Rizwan Hussain, (2011), Pre-Cast Concrete for Multi-Storey Structures,

Createspace Publisher, ISBN: 9781467918220.

1. Name of the DepartmentCIVIL ENGINEERING							
2. Subje	ct	Design of	L	Т		Р	
Name		Industrial					
		Structures Lab					
3. Subje	ct		0	0		2	
Code							
<b>4. Туре</b>	of Subje	ect	Core ()	<b>PE(</b> ✓)	1	<b>OE</b> ()	
5. Pre-			Frequency (use tick	Even ()	Odd	Either	Every
requis	site (if		marks)		(•	Sem	Sem
any)						0	0
6. Total	Numbe	r of Lectures, Tut	orials, Practical (Assum	ning 14 we	eks in ser	nester)	
Lectures $= 0$	)		Tutorials = 00	Practica	l =28		
8. Learn	ing obj	ectives:	1 11 11 14	C · 1			
	ubject is	taught to impart a	broad knowledge in the a	area of ind	ustrial stru	ictures	
9. Outco	mes:	course the studen	ta will be able to				
1 Know the r	n or this	course, the studen	ustrios				
2 Get an idea	about th	he materials used a	nd planning				
3. Know the c	construct	tion techniques.	na planning.				
4. Understand	the fun	ctional requirement	ts				
7. Lab (	Content						
Sr. No.	Title					CO c	overed
1	Site la	yout and external fa	acilities			1,2	
2	Planni	ng of Building Wo	rk			1,2,4	
3	Constr	ruction Techniques	- Expansion joints			1,2	
4	Use of	modern hoisting a	nd other construction equ	uipments.		1,2,4	
5	Comm	unication and Tran	sport - Fixed points			1,2	
6	Functi	onal Requirements	– Lighting: Natural light	ting		1,2	
7	Organ	izing of production	- Storing and erection ec	quipment		1,2	
8	Ventil	ation and fire prote	ction			2,3	

1.Name of the Depart	ment	CIVIL ENGINEER	RING						
2.Course Name	Maintenance &	L	Т		Р				
	Rehabilitation								
	Kenabilitation								
	of Structures								
3.Course Code		3	0		0				
4.Type of Course (use	e tick mark)	Core ()	PE-(✓)		OE()				
5.Pre-requisite (if		6.Frequency (use	Even	Odd	Either	Every			
any)		tick marks)	0	<b>(</b> ✓)	Sem ()	Sem()			
7.Total Number of Le	ctures, Tutorials,	Practical (assuming 14	weeks of	one sem	ester)				
Lectures $= 42$		Tutorials = 0	Practica	1 = 0					
8.Brief Syllabus:						11.00			
In this course, student	will learn Mainter	nance & Rehabilitation	of Struct	ures by I	earning of	different			
properties of concrete, repairing materials and different repairing techniques.									
9.Learning objectives		in the area of marsin and		tion of a					
1. This subject imparts a broad knowledge in the area of repair and renabilitation of structures.									
10 Course Outcomes									
On completion of this course, the students will be able to									
1 Understand the properties of fresh and bardened concrete									
2 Know the strategies of maintenance and renairing									
2. Get an idea of repairing techniques									
A Understand the prop	ang teeninques.	naterials							
4. Onderstand the prop	crues of repairing in	later lais.							
11.Unit wise detailed	content		11 Unit wise detailed content						
Unit-1	Number of	<b>Properties of concrete</b>	2						
Unit-1	Number of lectures = 10	Properties of concrete	<b>)</b>						
Unit-1 Serviceability and Du	<b>Number of</b> <b>lectures = 10</b> rability of Structur	<b>Properties of concrete</b> es - Quality Assurance	for conc	rete con	struction	- Fresh			
Unit-1 Serviceability and Du concrete properties –	Number of lectures = 10 rability of Structur Strength – Permeat	<b>Properties of concrete</b> es - Quality Assurance bility - Cracking - Effec	for conc ts due to	rrete con climate	struction – Tempe	- Fresh erature –			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and	<b>Number of</b> <b>lectures = 10</b> rability of Structur Strength – Permeab erosion - Design a	<b>Properties of concrete</b> es - Quality Assurance bility - Cracking - Effec nd construction errors -	for conc ts due to Corrosio	rete con climate n mecha	struction – Tempe nism - E	- Fresh erature – ffects of			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c	Number of lectures = 10 rability of Structur Strength – Permeab erosion - Design a gracking - Methods	Properties of concrete es - Quality Assurance bility - Cracking - Effec nd construction errors - of corrosion protection	for conc ts due to Corrosio n – Inhib	crete con climate n mecha bitors - F	struction – Tempe nism - E Resistant	- Fresh erature – ffects of steels –			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro	Number of lectures = 10 rability of Structur Strength – Permeab erosion - Design a gracking - Methods otection	<b>Properties of concrete</b> es - Quality Assurance bility - Cracking - Effect nd construction errors - of corrosion protection	for conc ts due to Corrosio n – Inhib	erete con climate n mecha bitors - F	struction – Tempe nism - E Resistant	- Fresh erature – ffects of steels –			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro	Number of lectures = 10 rability of Structur Strength – Permeat erosion - Design a cracking - Methods otection	Properties of concrete es - Quality Assurance bility - Cracking - Effec nd construction errors - of corrosion protection	for conc ts due to Corrosio n – Inhib	crete con climate n mecha bitors - F	struction – Tempe nism - E Resistant	- Fresh erature – ffects of steels –			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2	Number of lectures = 10 rability of Structur Strength – Permeab erosion - Design a cracking - Methods otection	Properties of concrete es - Quality Assurance bility - Cracking - Effec nd construction errors - of corrosion protection Repairing materials	for conc ts due to Corrosio n – Inhib	erete con climate n mecha bitors - F	struction – Tempe nism - E Resistant	- Fresh erature – ffects of steels –			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a eracking - Methods otectionNumber of lectures = 10ment of Distance	Properties of concrete es - Quality Assurance bility - Cracking - Effec nd construction errors - of corrosion protection Repairing materials	for conc ts due to Corrosio n – Inhib	erete con climate n mecha: bitors - F	struction – Tempe nism - E Resistant	- Fresh erature – ffects of steels –			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assessivelocity method Pab	Number of lectures = 10 rability of Structur Strength – Permeab erosion - Design a eracking - Methods otection Number of lectures = 10 ment of Distress - Vound hammer techn	Properties of concrete es - Quality Assurance bility - Cracking - Effect nd construction errors - of corrosion protection Repairing materials Visual inspection – Non	for conc ts due to Corrosio n – Inhib destructi	erete con climate n mecha bitors - F ve tests -	struction – Tempe nism - E Resistant –Ultrasor	- Fresh erature – ffects of steels – nic pulse			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assessivelocity method – Reb	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a eracking - Methods otectionNumber of lectures = 10nent of Distress - Vound hammer techn	Properties of concrete es - Quality Assurance bility - Cracking - Effec nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat	for conc ts due to Corrosio n – Inhib destructi ions – Pu	erete con climate n mecha: bitors - F ve tests - llout test	struction – Tempe nism - E Resistant –Ultrasor s – Core	- Fresh erature – ffects of steels – nic pulse test			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assess velocity method – Reb	Number of lectures = 10 rability of Structur Strength – Permeab erosion - Design a cracking - Methods otection Number of lectures = 10 ment of Distress - V ound hammer techn	Properties of concrete es - Quality Assurance bility - Cracking - Effect nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat	for conc ts due to Corrosio n – Inhib destructi ions – Pu	ve tests - llout test	struction – Tempe nism - E Resistant –Ultrasor s – Core	- Fresh erature – ffects of steels – nic pulse test			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assessivelocity method – Reb Unit - 3	Number of lectures = 10 rability of Structur Strength – Permeab erosion - Design a cracking - Methods otection Number of lectures = 10 nent of Distress - V ound hammer techn Number of lectures = 10	Properties of concrete es - Quality Assurance bility - Cracking - Effec nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat Repairing techniques	for conc ts due to Corrosio n – Inhib destructi ions – Pu	erete con climate n mecha: bitors - F ve tests - llout test	struction – Tempe nism - E Resistant –Ultrasor s – Core	- Fresh erature – ffects of steels – nic pulse test			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assess velocity method – Reb Unit - 3 Materials for Repairin	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a eracking - Methods otectionNumber of lectures = 10nent of Distress - V ound hammer technNumber of lectures = 10Special concrete	Properties of concrete es - Quality Assurance bility - Cracking - Effec nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat Repairing techniques es and mortar - Concret	for conc ts due to Corrosio n – Inhib destructi ions – Pu e chemic	ve tests - llout test	struction – Tempe nism - E Resistant –Ultrasor s – Core	- Fresh erature – ffects of steels – nic pulse test			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assessive velocity method – Reb Unit - 3 Materials for Repairin accelerated strength or	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a gracking - Methods otectionNumber of lectures = 10nent of Distress - V ound hammer technNumber of lectures = 10g - Special concrete ain - Expansive cent	Properties of concrete es - Quality Assurance bility - Cracking - Effect nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat Repairing techniques es and mortar - Concrete nent - Polymer concrete	for conc ts due to Corrosio n – Inhib destructi ions – Pu e chemica e – Ferro	erete con climate n mecha: bitors - F ve tests - llout test als - Spe cement	struction – Tempe nism - E Resistant –Ultrasor s – Core f cial elem Fibre re	- Fresh erature – ffects of steels – nic pulse test nents for inforced			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assessive velocity method – Reb Unit - 3 Materials for Repairin accelerated strength g concrete - Fibre reinfor	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a eracking - Methods otectionNumber of lectures = 10nent of Distress - Vound hammer technNumber of lectures = 10g - Special concrete ain - Expansive cent rced plastics.	Properties of concrete es - Quality Assurance bility - Cracking - Effect nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat Repairing techniques es and mortar - Concrete nent - Polymer concrete	for conc ts due to Corrosio n – Inhib destructi ions – Pu e chemica e – Ferro	ve tests - llout test	struction – Tempe nism - E Resistant –Ultrasor s – Core cial elem Fibre re	- Fresh erature – ffects of steels – nic pulse test			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assess velocity method – Reb Unit - 3 Materials for Repairin accelerated strength g concrete - Fibre reinfor	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a eracking - Methods otectionNumber of lectures = 10nent of Distress - Vound hammer technNumber of lectures = 10g - Special concrete ain - Expansive cent rced plastics.	Properties of concrete es - Quality Assurance bility - Cracking - Effect nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat Repairing techniques es and mortar - Concrete ment - Polymer concrete	for conc ts due to Corrosio n – Inhib destructi ions – Pu e chemic e – Ferro	ve tests - llout test	struction – Tempe nism - E Resistant –Ultrasor s – Core s – Core	- Fresh erature – ffects of steels – nic pulse test			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assessivelocity method – Reb Unit - 3 Materials for Repairin accelerated strength g concrete - Fibre reinfor	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a eracking - Methods otectionNumber of lectures = 10nent of Distress - No ound hammer technNumber of lectures = 10g - Special concrete ain - Expansive cent rced plastics.Number of	Properties of concrete es - Quality Assurance bility - Cracking - Effect nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat Repairing techniques es and mortar - Concrete ment - Polymer concrete Repairs to structures	for conc ts due to Corrosio n – Inhib destructi ions – Pu e chemica e – Ferro	ve tests - llout test als - Spe cement,	struction – Tempe nism - E Resistant –Ultrason s – Core cial elem Fibre re	- Fresh erature – ffects of steels – nic pulse test			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assess velocity method – Reb Unit - 3 Materials for Repairin accelerated strength g concrete - Fibre reinfor	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a stracking - Methods otectionNumber of lectures = 10nent of Distress - Vound hammer technNumber of lectures = 10g - Special concrete ain - Expansive cent rced plastics.Number of lectures = 12	Properties of concrete es - Quality Assurance bility - Cracking - Effec nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat Repairing techniques es and mortar - Concrete ment - Polymer concrete Repairs to structures	for conc ts due to Corrosio n – Inhib destructi ions – Pu e chemica e – Ferro	ve tests - llout test als - Spe cement,	struction – Tempe nism - E Resistant –Ultrasor s – Core f cial elem Fibre re	- Fresh erature – ffects of steels – nic pulse test			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assess velocity method – Reb Unit - 3 Materials for Repairin accelerated strength g concrete - Fibre reinfor Unit - 4 Techniques for Repair	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a gracking - Methods otectionNumber of lectures = 10nent of Distress - V ound hammer technNumber of lectures = 10g - Special concrete ain - Expansive cent rced plastics.Number of lectures = 12r - Rust eliminators	Properties of concrete es - Quality Assurance bility - Cracking - Effect nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat Repairing techniques es and mortar - Concrete ment - Polymer concrete Repairs to structures and polymers coatings	for conc ts due to Corrosio n – Inhib destructi ions – Pu e chemica e – Ferro	ve tests - llout test als - Spe cement,	struction – Tempe nism - E Resistant –Ultrasor s – Core cial elem Fibre re repair -	- Fresh erature – ffects of steels – nic pulse test nents for inforced			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assessive velocity method – Reb Unit - 3 Materials for Repairin accelerated strength g concrete - Fibre reinfor Unit - 4 Techniques for Repair concrete - Mortar and	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a eracking - Methods otectionNumber of lectures = 10nent of Distress - No ound hammer technNumber of lectures = 10 g - Special concrete ain - Expansive cent rced plastics.Number of lectures = 12- Rust eliminators dry pack - Vacuus	Properties of concrete es - Quality Assurance bility - Cracking - Effect nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat Repairing techniques es and mortar - Concrete ment - Polymer concrete Repairs to structures and polymers coatings m concrete - GModulee	for conc ts due to Corrosio n – Inhib destructi ions – Pu e chemica e – Ferro	erete con climate n mecha: bitors - F ve tests - llout test als - Spe cement,	struction – Tempe nism - E Resistant –Ultrasor s – Core repair e repair - Epoxy ini	- Fresh erature – ffects of steels – nic pulse test nents for inforced Foamed jection –			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assessivelocity method – Reb Unit - 3 Materials for Repairin accelerated strength g concrete - Fibre reinfor Unit - 4 Techniques for Repair concrete - Mortar and Mortar repair for crack	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a eracking - Methods otectionNumber of lectures = 10nent of Distress - Vound hammer technNumber of lectures = 10g - Special concrete ain - Expansive cent rced plastics.Number of lectures = 12· - Rust eliminators dry pack - Vacuus s - Shoring and und	Properties of concrete es - Quality Assurance bility - Cracking - Effect nd construction errors - of corrosion protection Repairing materials Visual inspection – Non ique – ASTM classificat Repairing techniques es and mortar - Concrete ment - Polymer concrete Repairs to structures and polymers coatings m concrete - GModulee erpinning.	for conc ts due to Corrosio n – Inhib destructi ions – Pu e chemica e – Ferro	erete con climate n mecha: bitors - F ve tests - llout test als - Spe cement,	struction – Tempe nism - E Resistant –Ultrasor s – Core cial elem Fibre re repair - Epoxy inj	- Fresh erature – ffects of steels – nic pulse test nents for inforced Foamed jection -			
Unit-1 Serviceability and Du concrete properties – chemicals - Wear and cover thickness and c Coatings - Catholic pro Unit - 2 Diagnosis and Assess velocity method – Reb Unit - 3 Materials for Repairin accelerated strength g concrete - Fibre reinfor Unit - 4 Techniques for Repair concrete - Mortar and Mortar repair for crack	Number of lectures = 10rability of StructurStrength – Permeab erosion - Design a gracking - Methods otectionNumber of lectures = 10nent of Distress - Vound hammer technNumber of lectures = 10g - Special concrete ain - Expansive centred plastics.Number of lectures = 12· - Rust eliminators dry pack - Vacuut ss - Shoring and und	Properties of concrete es - Quality Assurance bility - Cracking - Effect nd construction errors - of corrosion protection <b>Repairing materials</b> Visual inspection – Non ique – ASTM classificat <b>Repairing techniques</b> es and mortar - Concrete ment - Polymer concrete <b>Repairs to structures</b> and polymers coatings m concrete - GModulee erpinning.	for conc ts due to Corrosio n – Inhib destructi ions – Pu e chemic e – Ferro for rebar and shot	erete con climate n mecha: bitors - F ve tests - llout test als - Spe cement,	struction – Tempe nism - E Resistant –Ultrasor s – Core s – Core repair - Epoxy inj	- Fresh erature – ffects of steels – nic pulse test nents for inforced Foamed jection -			

# 13.Books Recommended

1. Shetty M. S., (2008), Concrete Technology, Seventh Edition, S. Chand & Company Ltd. ISBN-13: 9788121900034.

# **REFERENCE BOOKS**

- 1. Ravindra K. Dhir, M. Roderick Jones & Li Zheng, (2005), Repair and Renovation of Concrete Structures, American Society of Civil Engineers, ISBN-13: 9780727734051.
- 2. A. R. Santha Kumar, (2006), Concrete Technology, First Edition, Oxford University Press, ISBN-13: 9780195671537.

1.	Name of the I	Department CIVIL ENGINEERING				
2.	Subject	Maintenance	L	Т	Р	
	Name	&				
		Rehabilitation				
		of Structures				
		Lab				
3.	Subject		0	0	2	
	Code					
4.	Type of Subje	ect	Core ()	<b>PE</b> (✓)	<b>OE</b> ()	
5.	Pre-		Frequency (use tick	Even () Odd	Either	Every
	requisite (if		marks)	(✔)	Sem	Sem
	any)				0	0
6.	<b>Total Numbe</b>	r of Lectures, Tut	orials, Practical (Assum	ning 14 weeks in se	mester)	
Lectu	res = 00		Tutorials = 00	Practical =28		

# 7. Learning objectives:

This subject imparts a broad knowledge in the area of repair and rehabilitation of structures.

# 8. Outcomes:

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

- 1. Understand the properties of fresh and hardened concrete.
- 2. Know the strategies of maintenance and repairing.
- 3. Get an idea of repairing techniques.

4. Understand the properties of repairing materials.

7. Lab Content						
Sr. No.	Title	CO covered				
1	Quality Assurance for concrete construction	1,2				
2	Methods of corrosion protection	1,2,4				
3	Diagnosis and Assessment of Distress	1,2				
4	Non destructive tests –Ultrasonic pulse velocity method – Rebound hammer technique.	1,2,4				
5	Techniques for Repair - Rust eliminators and polymers coatings for rebars	1,2				
6	Polymer concrete – Ferro cement, Fibre reinforced concrete - Fibre reinforced plastics.	1,2				
7	Materials for Repairing - Special concretes and mortar	1,2				
8	Epoxy injection - Mortar repair for cracks - Shoring and underpinning.	2,3				

	Department	CIVIL ENGIN	VEERING	ŕ		
2. Course	Design of	L	Т		Р	
Name	Bridges					
3. Course Code		3	0		0	
4. Type of Cours	se	Core ()	PE(✓)		OE()	
5. Pre-requisite	Reinforced	6. Frequency	Even	Odd	Either	Every
(if any)	Concrete	(use tick	0	(✔)	Sem ()	Sem
	Structures	marks)				0
7. Total Number	of Lectures, Tuto	rials, Practical (assumi	ng 14 wee	eks of on	e semeste	er)
Lectures $= 42$		Tutorials =00	Practica	l = 00		
9. Learning object	ed concrete bridges lysis is to find a dist	is normally done on the tribution of sectional for	basis of a ces which	fulfils eq	l analysis juilibrium	and is
<b>10.Course Outcomes</b> On completion of this 1. Understand the load 2. Design the slab brid	: course, the students distribution and IR ges	s will be able to C standards				
<ol> <li>Design the Arch bri</li> <li>Design the bridge b</li> </ol>	dges earings, hinges and	expansion joints.				
<ul><li>3. Design the Arch bri</li><li>4. Design the bridge b</li><li>11.Unit wise detailed</li></ul>	dges earings, hinges and content	expansion joints.				
<ol> <li>Design the Arch bri</li> <li>Design the bridge b</li> <li>11.Unit wise detailed</li> <li>Unit-1</li> </ol>	dges earings, hinges and content Number of	expansion joints. Title of the unit:				
<ul> <li>3. Design the Arch bri</li> <li>4. Design the bridge b</li> </ul> <b>11.Unit wise detailed Unit-1</b>	dges earings, hinges and content Number of lectures = 10	expansion joints. Title of the unit: IRC loading and othe	r method	S		
<ul> <li>3. Design the Arch bri</li> <li>4. Design the bridge b</li> <li>11.Unit wise detailed</li> <li>Unit-1</li> <li>Load Distribution The</li> <li>I.R.C. – Pigeaud's mathematical bridge floor –</li> <li>method (principles on</li> </ul>	dges earings, hinges and content Number of lectures = 10 eory - I.R.C. loading ethod – Bridge girc - Hendry-Jaeger m ly) .	expansion joints. Title of the unit: IRC loading and other g standards – Bridge slad lers – Courbon's methor ethod – Morice – Little	<b>r method</b> bs – Effe d – Assu e version	s ctive wid mptions of Guyo	th metho and analy on and N	d as per vsis of a fassonet
<ul> <li>3. Design the Arch bri</li> <li>4. Design the bridge b</li> <li>11.Unit wise detailed</li> <li>Unit-1</li> <li>Load Distribution The</li> <li>I.R.C. – Pigeaud's method (principles on</li> <li>Unit – 2</li> </ul>	dges earings, hinges and content Number of lectures = 10 eory - I.R.C. loading ethod – Bridge girc - Hendry-Jaeger m ly) .	expansion joints. Title of the unit: IRC loading and other g standards – Bridge slanders – Courbon's methor ethod – Morice – Little Title of the unit:	<b>r method</b> bs – Effe d – Assu e version	s ctive wid mptions of Guyo	th metho and analy on and M	d as per /sis of a lassonet
<ul> <li>3. Design the Arch bri</li> <li>4. Design the bridge b</li> <li>11.Unit wise detailed</li> <li>Unit-1</li> <li>Load Distribution The</li> <li>I.R.C. – Pigeaud's method (principles on the second se</li></ul>	dges earings, hinges and content Number of lectures = 10 eory - I.R.C. loading ethod – Bridge gird - Hendry-Jaeger m ly) . Number of lectures = 10	expansion joints. Title of the unit: IRC loading and other g standards – Bridge sladers – Courbon's methor ethod – Morice – Little Title of the unit: Slab bridges	<b>r method</b> bs – Effe d – Assu e version	s ctive wid mptions of Guyo	th metho and analy on and N	d as per vsis of a fassonet
<ul> <li>3. Design the Arch bri</li> <li>4. Design the bridge b</li> <li>11.Unit wise detailed</li> <li>Unit-1</li> <li>Load Distribution The</li> <li>I.R.C. – Pigeaud's method (principles on</li> <li>Unit – 2</li> <li>Slab Bridges - Straig</li> <li>Design of articulation</li> </ul>	dges earings, hinges and content Number of lectures = 10 eory - I.R.C. loading ethod – Bridge girc - Hendry-Jaeger m ly) . Number of lectures = 10 ht and skew slab t – Continuous girden	expansion joints. Title of the unit: IRC loading and other g standards – Bridge sla lers – Courbon's methor ethod – Morice – Little Title of the unit: Slab bridges pridges – T beam bridger r bridges.	r method bs – Effe d – Assu e version es – Bala	s ctive wid mptions of Guyo	th metho and analy on and M	d as per /sis of a fassonet ridges –
<ul> <li>3. Design the Arch bri</li> <li>4. Design the bridge b</li> <li>11.Unit wise detailed</li> <li>Unit-1</li> <li>Load Distribution The</li> <li>I.R.C. – Pigeaud's method (principles on</li> <li>Unit – 2</li> <li>Slab Bridges - Straig</li> <li>Design of articulation</li> <li>Unit – 3</li> </ul>	dges earings, hinges and content Number of lectures = 10 eory - I.R.C. loading ethod – Bridge gird - Hendry-Jaeger m ly) . Number of lectures = 10 ht and skew slab b – Continuous girden	expansion joints. Title of the unit: IRC loading and othe g standards – Bridge sla lers – Courbon's metho ethod – Morice – Little Title of the unit: Slab bridges pridges – T beam bridger bridges. Title of the unit:	r method bs – Effe d – Assu e version es – Bala	s ctive wid mptions of Guyo	th metho and analy on and M	d as per vsis of a fassonet
<ul> <li>3. Design the Arch bri</li> <li>4. Design the bridge b</li> <li>11.Unit wise detailed</li> <li>Unit-1</li> <li>Load Distribution The</li> <li>I.R.C. – Pigeaud's method (principles on</li> <li>Unit – 2</li> <li>Slab Bridges - Straig</li> <li>Design of articulation</li> <li>Unit – 3</li> </ul>	dges earings, hinges and content Number of lectures = 10 eory - I.R.C. loading ethod – Bridge girc - Hendry-Jaeger m ly) . Number of lectures = 10 ht and skew slab b – Continuous girden Number of lectures = 12	expansion joints. Title of the unit: IRC loading and othe g standards – Bridge sla lers – Courbon's metho ethod – Morice – Little Title of the unit: Slab bridges oridges – T beam bridg r bridges. Title of the unit: Arch bridges	r method bs – Effe d – Assu e version es – Bala	s ctive wid mptions of Guyo	th metho and analy on and M	d as per ysis of a fassonet
<ul> <li>3. Design the Arch bri</li> <li>4. Design the bridge b</li> <li>11.Unit wise detailed</li> <li>Unit-1</li> <li>Load Distribution The</li> <li>I.R.C. – Pigeaud's matypical bridge floor –</li> <li>method (principles on</li> <li>Unit – 2</li> <li>Slab Bridges - Straig</li> <li>Design of articulation</li> <li>Unit – 3</li> <li>Arch Bridges - Single</li> <li>functions only) – Design</li> </ul>	dges earings, hinges and content Number of lectures = 10 eory - I.R.C. loading ethod – Bridge girc - Hendry-Jaeger m ly) . Number of lectures = 10 ht and skew slab t – Continuous girden Number of lectures = 12 span closed and op gn of bow string gir	expansion joints.          Title of the unit:         IRC loading and other         g standards – Bridge slaters – Courbon's methor         ethod – Morice – Little         Title of the unit:         Slab bridges         oridges – T beam bridger         bridges.         Title of the unit:         Arch bridges         pen spandrel symmetrication	r method bs – Effe d – Assu e version es – Bala al type (st	s ctive wid mptions of Guyo	th metho and analy on and M ntilever ba	d as per ysis of a fassonet ridges – ents and
<ul> <li>3. Design the Arch bri</li> <li>4. Design the bridge b</li> <li>11.Unit wise detailed</li> <li>Unit-1</li> <li>Load Distribution The</li> <li>I.R.C. – Pigeaud's method (principles on the second se</li></ul>	dges earings, hinges and content Number of lectures = 10 cory - I.R.C. loading ethod – Bridge gird - Hendry-Jaeger m ly) . Number of lectures = 10 ht and skew slab b – Continuous girden Number of lectures = 12 span closed and op gn of bow string gir	expansion joints. Title of the unit: IRC loading and othe g standards – Bridge sla ders – Courbon's metho ethod – Morice – Little Title of the unit: Slab bridges oridges – T beam bridg r bridges. Title of the unit: Arch bridges pen spandrel symmetrica der bridges. Title of the unit:	r method bs – Effe d – Assu e version es – Bala ll type (st	s ctive wid mptions of Guyo nced car	th metho and analy on and M atilever ba	d as per /sis of a fassonet ridges – ents and

Other Bridges - Box culvert (Single vent only) – Single span rigid frame bridges (Barrel of solid slab type only) – Pre-stressed composite T beam bridges (structural arrangements only) Design of slab base and gusset base and grillage foundation along with its connection with column. Substructures -Design principles of Piers and abutments – Bridge bearings - Hinges and expansion joints.

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

https://onlinecourses.nptel.ac.in/noc17\_ce24/preview

# **13.Books Recommended**

## TEXT BOOKS

1. Johnson Victor, (2007), Essentials of Bridge Engineering, Sixth Edition, Oxford & IBH Publishing Co. Ltd., ISBN-13: 9788120417175.

# **REFERENCE BOOKS**

- 1. Wilbur Jay Watson, (2910), General Specifications for Concrete Bridges, Nabu Press, ISBN-13: 9781177206587.
- 2. Portland Cement Association, (2010), Continuous Concrete Bridges, Cambridge Scholars Publishing, ISBN-13: 978115337241.

1.	. Name of the Department CIVIL ENGINEERING						
2.	Subject	Design of	L	Т		Р	
	Name	<b>Bridges Lab</b>					
3.	Subject		0	0		2	
	Code						
4.	Type of Su	bject	Core ()	<b>PE(</b> ✓)	1	OE()	I
5.	Pre-		Frequency (use tick	Even ()	Odd	Either	Every
	requisite (i	f	marks)		(•)	Sem	Sem
	any)					()	0
6.	6. Total Number of Lectures, Tutorials, Practical (Assuming 14 weeks in semester)						
Lectur	$\frac{1}{1} \frac{1}{1} \frac{1}$		Tutorials = 00	Practica	I =28		
7.	7. Learning objectives:						
0	This subjec	t is taught to impart th	he knowledge in the analy	ysis and de	sign of con	crete br	lages
8. On con	Outcomes:	his course the studen	to will be able to				
1 Und	erstand the l	oad distribution and I	RC standards				
2 Desi	on the slab	oridges	KC standards				
3. Desi	gn the Arch	bridges					
4. Desi	gn the bridg	e bearings, hinges and	d expansion joints.				
	0 0		1 5				
7.	Lab Conte	nt					
Sr. No.	. Tit	e				CO c	overed
1	I.R.	C. loading standards				1,2	
2	Litt	le version of Guyon a	nd Massonet method.			1,2,4	
3	3 Straight and skew slab bridges 1,2						
4	4Balanced cantilever bridges1,2,4						
5	Single span closed and open spandrel symmetrical type         1,2						
6	Des	Design of bow string girder bridges.			1,2		
7	Pre	Pre-stressed composite T beam bridges			1,2		
8	Des	ign of slab base and g	gusset base and grillage f	foundation	along with	2,3	
	its c	connection with colum	ın.				

1.Name of the Depart	ment	CIVIL ENGINEERI	NG			
2.Course Name	Composite	L	Т		Р	
	Structures					
3.Course Code		3	0		0	
4.Type of Course (use	e tick mark)	Core ()	PE-(✓)		OE()	
5.Pre-requisite (if		6.Frequency (use	Even	Odd	Either	Every
any)		tick marks)	0	<b>(</b> ✓)	Sem ()	Sem()
7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures $= 42$		Tutorials $= 0$	Practica	1=0		

# 8.Brief Syllabus:

In this course, student will learn about open channel hydraulics: Pipe Flow and Free Surface Flow, Continuity Equation, Energy in Free Surface Flow, Basic Momentum Equation, Velocity Distribution, Occurrence, Critical Depth in Trapezoidal & Circular Channels, Hydraulic Exponent for Critical Flow, Critical Flow Depth Computations, Derivation of Uniform Flow Equations, Resistance in Open Channel Hydraulics, History of Uniform Flow Velocity and Resistance Factor, Integration of Differential Equation, Improved Euler Method.

# 9.Learning objectives:

- 1. To know the types of composites
- 2. To understand the need for stress strain relation
- 3. To understand the fabrication methods
- 4. To understand the laminated plates
- 5. To study and understand the different methods & analysis of composite materials.

# **10.Course Outcomes**

- On completion of this course, the students will be able to
- 1. Analyze composite structures
- 2. Do microscopic and macroscopic analysis
- 3. Analyze sandwich and laminated plates
- 4. Understand the failure criteria for composites.
- 5. Know the fabrication techniques

# 11.Unit wise detailed content

Unit-1	Number of	Stress Strain Relationship
	lectures = 10	

Introduction - advantages and application of composite materials, reinforcements and matrices - Generalized Hooke's Law - Elastic constants for anisotropic, orthotropic and isotropic materials.

Unit - 2	Number	r of	Finite Elemen	t Analysis of Plates	
	lectures	= 12			
Inter du stien	assure of most	Dianlas	mant frantian	Chunga Chunin Matuin	Chifferana masteria of

Introduction - concept of mesh - Displacement function - Stress-Strain Matrix – Stiffness matrix of plate element – Solution of problem.

Unit - 3	Number of	Methods of Analysis			
	lectures = 10				
Micro mechanics - M	lechanics of mater	rials approach, elasticity approach to determine material			
properties - Macro Me	echanics - Stress-st	train relations with respect to natural axis, arbitrary axis -			
Determination of mater	rial properties - Exp	perimental characterization of lamina.			
Unit - 4	Number of	Laminated Plates			
	lectures = 10				
Governing differential	equation for a ger	neral laminate, angle ply and cross ply laminates - Failure			
criteria for composites.					
13.Books Recommend	led				
TEXT BOOKS					
1. Madhujit Mukhopad	hyay, (2010), Mech	nanics of Composite Materials and Structures, First			
Edition, Orient Blac	kswan Pvt. Ltd., IS	BN-13: 9788173714771.			
REFERENCE BOOKS					
1. Jones, R.M., (1998), Mechanics of Composite Materials, Second Edition, Taylor and					
Francis Publisher, Is	Francis Publisher, Isbn-13: 9781560327127.				
2. Atul K. Kaw, (2005)	), Mechanics of Cor	nposite Materials, Second Edition, CRC Press,			
ISBN-13: 97808493	13431.				

1. Name	Name of the DepartmentCIVIL ENGINEERING						
2. Subje	et	Composite	L	Т		Р	
Name		Structures Lab					
3. Subje	et		0	0		2	
Code							
4. <b>Type</b> o	of Subje	ect	Core ()	$\mathbf{PE}(\checkmark)$		<b>OE</b> ()	1_
5. <b>Pre-</b>			Frequency (use tick	Even ()	Odd	Either	Every
requis	ite (if		marks)		(*)	Sem	Sem
any)	Numbor	of Lactures Tut	orials Practical (Assum	ning 14 wa	oks in son	() hostor)	0
$\frac{0.1000}{1.000}$		of Lectures, rut	Tutorials = 00	Practica	1 = 28	lester)	
7. Learning objectives:							
To know the t	ypes of c	composites					
2. To understa	and the n	eed for stress strai	n relation				
3. To understa	and the fa	abrication methods	6				
4. To understa	and the la	aminated plates					
5. To study an	d unders	stand the different	methods & analysis of c	omposite n	naterials.		
8. Outco	mes:						
On complet	tion of th	his course, the stud	ents will be able to				
1. Analyze col	mposite	structures					
2. Do iniciose 3. Analyze sat	opic and	i macroscopic anal	ysis				
4. Understand	the failu	re criteria for com	nosites				
5. Know the fa	abricatio	on techniques					
7. Lab C	ontent						
Sr. No.	Title					CO c	overed
1	Reinfo	rcements and matr	ices			1,2	
2	2 Elastic constants for anisotropic 1,2,4						
3	Displacement function 1,2						
4	Stiffness matrix of plate element         1,2,4						
5	5 Mechanics of materials approach 1,2						
6	Determination of material properties 1,2						
7	Govern	ning differential eq	uation for a general lami	inate		1,2	
8	Failure	criteria for compo	osites.			2,3	

1. Name of the Depa	Department CIVIL ENGINEERING						
2. Course Name	Design of	L		Т		Р	
	Tall						
	Buildings						
3. Course Code		3		0		0	
4. Type of Course		Core ()		PE(✓)		OE()	
5. Pre-requisite (if	Design of	6. Fr	requency	Even	Odd	Either	Every
any)	Steel	(u	se tick	0	<b>(</b> ✓)	Sem	Sem
	Structures,	m	arks)			0	0
	Structural						
	analysis						
7. Total Number of	Lectures, Tutor	ials, Practi	ical (assuming	g 14 weel	ks of one	semeste	<b>r</b> )

Tutorials = 00 Practical =00

# 8. Brief Syllabus:

Lectures = 42

Classification of buildings, Three dimensional analysis, Shear wall system ,In-filled frame system, Plane frame system.

# 9.Learning objectives:

- 1. This course is intended to teach the concept of tall structures.
- 2. Various methods to analyze the tall structure will be explained in the classes.

# **10.Course Outcomes:**

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

- 1. Know the types of tall buildings.
- 2. Analyze the plane frame systems by different methods.
- 3. Design the shear wall systems and in filled frame systems.

11.Unit wise detailed content			
Unit-1	Number of	Title of the unit: Classification of buildings	
	lectures = 10		

Introduction - Classification of buildings according to NBC – Types of loads – wind load – Seismic load – Quasi static approach.

Unit – 2	Number of	Title of the unit: Plane frame systems
	lectures = 10	

Plane Frame System - Calculation of wind load – Approximate method – Portal - Cantilever and factor methods – Kani's method – Substitute frame method for dead load and live loads.

Unit – 3	Number of	Title of the unit:
	lectures = 10	Shear wall system
61 <b>XXX 11 6</b> D		

Shear Wall System - Rosman's analysis – Design aspect – RC frame and shear wall interaction – Equivalent frame method.

Unit - 4	Number of	Title of the unit:
	lectures = 12	In-filled frame system

In-filled Frame Systems - Importance – Methods of analysis – Equivalent truss and frame method – Force-displacement method – Effect of perforation in the in-filled frame.

# **12.Books Recommended**

TEXT BOOKS

1. Bryan Stafford Smith and Alex Coull, (2011), Tall Building Structures: Analysis and Design, Wiley India, ISBN-13: 9788126529896.

# **REFERENCE BOOKS**

1. SarwarAlamRaz, (2002), Structural Design in Steel, Second Edition, New Age International, ISBN-13: 9788122432282.

2. Name of the I	Department	CIVIL ENG	INEERING			
8. Subject	Design of Tall	L	Т	Р		
Name	<b>Buildings</b> Lab					
9. Subject		0	0	2		
Code						
10. Type of Subje	ect	Core ()	<b>PE</b> (✓)	<b>OE</b> ()		
11. <b>Pre-</b>		Frequency (use tick	Even () Odd	Either Every		
requisite (if		marks)	(✔)	Sem Sem		
any)				0 0		
12. Total Number	12. Total Number of Lectures, Tutorials, Practical (Assuming 14 weeks in semester)					
Lectures = 00		Tutorials = 00	Practical =28			

# 9. Learning objectives:

Classification of buildings, Three dimensional analysis, Shear wall system ,In-filled frame system, Plane frame system.

# 10. Outcomes:

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

- 1. Know the types of tall buildings.
- 2. Analyze the plane frame systems by different methods.
- 3. Design the shear wall systems and in filled frame systems.

13. <b>Lab</b> C	13. Lab Content						
Sr. No.	Title	CO covered					
1	Classification of buildings according to N	1,2					
2	Seismic load – Quasi static approach.	1,2,					
3	Calculation of wind load	1,2					
4	Substitute frame method for dead load and live loads.	1,2,					
5	RC frame and shear wall interaction.	1,2					
6	Equivalent frame method.	1,2					
7	Methods of analysis	1,2					
8	Effect of perforation in the in-filled frame	2,3					

SGT University, Chandu-Budhera, Gurugram Faculty of Engineering & Technology Department of Civil Engineering





# M. Tech. Transportation Engineering

Scheme & Syllabus (2021-22)

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

# Transportation Engineering First Semester

S	Subject			Т	P C		Exam	ination	Subject
NO.	Code	Course				marks		Total	
110.	coue	Title					Ext.	Int.	
1.		Pavement Materials	3	0	0	3	60	40	100
2.	2. Urban Transportation System Planning		3	0	0	3	60	40	100
3.		Geometric Design of Transportation Facilities		0	0	3	60	40	100
4.		Ground Improvement	3	0	0	3	60	40	100
5.	5. Pavement Materials Lab		0	0	2	1	40	60	100
6.		Geometric design Lab	0	0	2	1	40	60	100
7.		Value Added Courses-I	2	0	0	2	60	40	100
8.	Seminar		0	0	2	1	00	100	100
		Total	14	0	6	17	380	420	800

# Second Semester

S.	Subject						Examination marks		Subject Total	
NO.	Code	Course Title					Ext.	Int.	Totai	
1		Analysis and Design of Pavement	3	0	0	3	60	40	100	
2	2 Transport Economics		3	0	0	3	60	40	100	
3	Traffic Engineering and Management		3	0	0	3	60	40	100	
4		Airport Infrastructure, Planning and Design		0	0	3	60	40	100	
5		Pavement Design Lab	0	0	2	1	40	60	100	
6		Traffic Lab		0	2	1	40	60	100	
7	Seminar		0	0	2	1	00	100	100	
		Total	12	0	6	15	320	380	700	

S.NO.	Subject	Course Title	L	Т	Р	С	Exam	inatio	Subject
	Code						n manka		Total
							ma Fyt	rks Int	
1				0	0	-	EXI.	1111.	
1		Sustainable Built Environment	3	0	0	3	60	40	100
2		Research Methodology & IPR	3	0	0	3	60	40	100
3		Department Electives-XIII	3	0	0	3	3 60 40		100
4		Department Electives-XIV	3	0	) 0 3 60 40		40	100	
5		Department Electives-XV	3	0	0	3	60	40	100
6	Research Methodology & IPR Lab		0	0	2	1	40	60	100
7		Department Electives Lab-XIII	0	0	2	1	40	60	100
8		Department Electives Lab-XIV	0	0	2	1	40 60 100		100
9	9 Department Electives Lab-XV		0	0	2	1	40	60	100
10		Value Added Courses-II	2	0	0	2	60	40	100
		Total	17	0	8	21	520	480	1000

# **Fourth Semester**

S.NO.	Subject Code	Course Title	L	Т	Р	С	Examir mar	nation 'ks	Subject Total
	Coue						Ext.	Int.	10141
1		Dissertation	0	0	20 W	20	100	0	100
		Total	0	0	20 W	20	100	0	100

# **Departmental Electives**

S. No.	Specialization	Departmental Elective XIII	Departmental Elective XIV	Departmental Elective XV
1	Trongnostation Engineering	Construction Project Management & BOT 3-0-2 (4)		Environment Impact Assessment 3-0-2 (4)
2	I ransportation Engineering	Intelligent Transportation Systems 3-0-2 (4)	Highway Traffic Analysis and Design 3-0-2 (4)	Bridge Engineering 3-0-2 (4)

1. Name of the Dep	artment	<b>CIVIL ENGINEERING</b>				
2. Subject Name	Pavement	L	Т	Р		
	Materials					
3. Subject Code		3	0	0		
4. Type of Subject (use tick		Core (✓)	<b>PE</b> ()		<b>OE</b> ()	
mark)						
5. Pre-requisite	Soil	Frequency (use	Even ()	Odd (✓)	Either	Every
(if any)	Mechanics	tick marks)			Sem	Sem
					0	0

### 6.Total Number of Lectures, Tutorials, Practical (assuming 14weeks of one semester) Lectures = 42Tutorials = 0 **Practical =0**

# 7. Brief Syllabus:

Soil composition and structure, Properties and test on road aggregate, Bitumen materials.

# 8. Learning objectives:

- 1. Understanding the strength characteristics of various road materials.
- 2. Understanding the temperature dependency of bitumen.
- 3. Understand the rheological properties of bitumen.

# 9. Subject Outcomes:

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

- 1. Strength characteristics of various road materials,
- 2. Behaviour of road binding materials.
- 3. Scope for the new road materials

10. Unit wise detailed content						
Unit-1	Number of	Title of the unit: Sub grade soil				
	lectures					
	=10					
Soil composition and structure - Soil classification for engineering purposes - Origin,						
Classification, requi	rements.					

Unit - 2	Number of	Title of the unit: Aggregates
	lectures =	
	10	

Properties and tests on road aggregates, Aggregate classification, Volumetric analysis of aggregate.

Unit - 3	Number of lectures = 10	Title of the unit: Bituminous materials			
Origin, preparation, properties and tests, constituent of bituminous (road binders), Bituminous					
Emulsions and Cutb	acks: Preparat	ion, characteristics, uses and tests.			

Unit - 4	Number of	Title of the unit: Bituminous Mix
	lectures =	
	12	
Mechanical propert	ies - Resilient	modulus, dynamic modulus and fatigue characteristics of
bituminous mixes.	Weathering	and Durability of Bituminous Materials and Mixes -
Performance based	Bitumen Speci	fications – Super pave mix design method.
11. Books Recomm	nended	
Text Books		
(i) S.K. Kha	anna & C.E.G.	Justo, Highway Engineering, Namechand & Bros. publication.
(ii) S.K. Kha	anna & C.E.G.	Justo, Highway Materials and Pavement Testing, Namechand
& Bros.	publication	
<b><u>Reference Books</u></b>	_	
(i) Martin R	Rogers and Ber	nard Enright, Highway Engineering, Wiley publication
	- I File on Deim	formed Compareto for Devices outs" IDC: SD 46 1007 Indian

- (ii) IRC, "Steel Fiber Reinforced Concrete for Pavements", IRC: SP 46, 1997, Indian Road Congress.
- (iii) Westergaard, H.M. "Stress in Concrete Pavements Computed by Theoretical Analysis"

1. Name of the Department			ENGINEERIN	G		
2. Subject	Urban	L	Т		Р	
Name	Transportation					
	System					
	Planning					
3. Subject		3	0		0	
Code						
4. Type of Subject (use tick		Core (✓)	<b>PE</b> ()		<b>OE</b> ()	
mark)						
5. Pre-	Nil	Frequency (use	Even ()	Odd (✓)	Either	Every
requisite (if		tick marks)			Sem	Sem
any)					0	0
6 .Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures $= 42$		Tutorials = 00	Practical =00			

# 7. Brief Syllabus:

Understanding the travel pattern of urban users, learn to forecast the various traffic and to understand the necessity of mass transit system in urban areas, learn to calculate the efficiency of various mass transit system.

# 8. Learning objectives:

- 1. Understanding the travel behavior of road users.
- 2. Planning proper Origin- Destination survey
- 3. Evaluation of transit mode and its efficiency.
- 4. Analysis of survey data.

# 9. Subject Outcomes:

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

- 1. Understand how to perform O-D survey.
- 2. Evaluate the efficiency of various routes
- 3. Evaluate the capacity of various transit system

10. Unit wise detailed content			
Unit-1	Number of	Title of the unit: Introduction	
	lectures = 10		

Mass transit systems, Elements / components of transit systems; Urban Mass Transit systemstypes, characteristics, suitability and adaptability of these systems; Evolution of urban transportation.

Unit - 2	Number of	Title of the unit: Transit System Planning
	lectures = 10	

Planning needs; Short-range and long-range planning; Planning procedures and methodology, Data collection; Medium performance transit systems and high performance transit systems; trends in transit planning.

Unit - 3	Number of	Title of the unit: Transit Demand Estimation and Evaluation
	lectures = 10	

Transit demand forecasting; transit mode evaluation; comparison and selection of most suitable transit mode.

Unit - 4	Number of	Title of the unit: Transit System Operations
	lectures = 12	

Basic operational elements; transit travel characteristics; transit scheduling; transit line analysis – planning objectives, geometry, types and their characteristics, capacity of transit lines, system procedures for improving transit line capacity.

# 11. Books Recommended Text Books

(i) C A O'Flaherty, 'Transport Planning and Traffic Engineering', Butter worth Heinemann, Burlington

(ii) John W. Dickey and others, "Metropolitan Transportation Planning", Tata McGraw-Hill Book Company Ltd., New Delhi

# **References**

1. C Jotin Khisty and B Kent Lall, "Transportation Engineering" Prentice Hall of India Pvt. Ltd., New Delhi

1. Name of the Department CI		CIVI	L ENGINEERING			
2. Subject	Geometric	L	Т		Р	
Name	Design of					
	Transportation					
	Facilities					
3. Subject		3	0		3	
Code						
4. Type of Subject (use tick		Core (✓)	<b>PE</b> ()		<b>OE</b> ()	
mark)						
5. Pre-	Nil	Frequency (use	Even ()	$Odd(\checkmark)$	Either	Every
requisite (if		tick marks)			Sem	Sem
any)					0	0
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		Tutorials = 0	Practical=0			

# 7. Brief Syllabus:

Understanding the various government guidelines for the geometric design, importance of crosssectional elements and sight distances and curve, learn about the intersection design.

# 8. Learning objectives:

- 1. Learn about the various road design elements.
- 2. Students will be able to understand the importance of sight distances.
- 3. Curves and the various intersection design.

# 9. Subject Outcomes:

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

- 1. Understanding the basic road design elements
- 2. Importance of sight distance and curves
- 3. Various intersection design

# 10. Unit wise detailed content

Unit-1	Number of	Title of the unit: Cross sectional elements of highway	
	lectures = 10		
Pavements sur	face characterist	tics, camber, carriageway width, median, kerbs, road	
margins, guard	rail		
Unit - 2	Number of	Title of the unit: Sight distances	
	lectures = 10		
Stopping sight	distance, Passing	signt distance, overtaking sight distance, headlight sight	
distance, sight t	riangle		
	-		
Unit - 3	Init - 3         Number of         Title of the unit: Curve design		
	lectures = 10		
Horizontal curv	e, super elevation	n, transition curve, vertical curves (summit & valley curve)	
	-		
Unit - 4	Number of	Title of the unit: Un-signalized intersection at grade	
	lectures = 12		
Sight distance consideration and principles of design, channelization, mini roundabouts,			
layout of roundabouts, Inter-changes: major and minor interchanges, entrance and exit			
ramps, acceleration	tion and decelera	tion lanes	

# 11. Books Recommended Text Books

- i) Relevant IS and IRC codes
- ii) Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Materials and Pavement

# **Reference Books**

- i) AASHTO Green Book, 2001
- ii) AASHO, A policy on Geometric Design of Rural Highway, American Association of State highway Officials; Washington.
- iii) Matson, T.M., Smith, W.S., Hurd, H.W. Traffic Engineering, McGraw Hill Book Co. Inc., New York.

1. Name of the Department		CIVIL	ENGINEERIN	G		
2. Subject	Ground	L	Т		Р	
Name	Improvement					
3. Subject		3	0		0	
Code						
4. Type of Subject (use tick		Core (✓)	<b>PE</b> ()		<b>OE</b> ()	
mark)						
5. Pre-	Soil	Frequency (use	Even ()	Odd (✓)	Either	Every
requisite (if	Mechanics,	tick marks)			Sem	Sem
any)	Rock				0	0
	Mechanics					

6 .Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)Lectures = 42Tutorials = 0Practical = 0

# 7. Brief Syllabus:

Understanding the mechanical behavior of various soils, soil stabilization techniques and deep exploration.

# 8. Learning objectives:

- 1. Properties of various soil deposit.
- 2. Students will be able to understand that how these stabilization techniques work.
- 3. Understand about the deep exploration.

# 9. Subject Outcomes:

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

- 1. Understanding the sub grade soil behavior by using various test like CBR, Tri-axial test etc.
- 2. Various techniques for the soil stabilization/improvement like mechanical, hydraulic etc.
- 3. Deep exploration.

# 10. Unit wise detailed content

Unit-1	Number of	Title of the unit: Properties of various soil deposit		
	lectures=10			

Engineering properties of soft – weak and compressible deposits – problems associated with weak deposit – Requirements of ground improvements – introduction to engineering ground modification, need and objectives.

Unit - 2	Number of lectures =10	Title of the unit: Soil Stabilization
G ! 0 !!	1 111 .1	

Science of soil stabilization – Mechanical modification – Hydraulic modification – Dewatering systems – Chemical modification – Modification by admixtures like lime, Cement, Bitumen etc. – Grouting – Deep jet mixing methods.

Number of	Title of the unit: Ground improvements techniques		
lectures = 10			
Recent Ground improvement techniques: stabilization using industrial waste – modification by			
inclusion and confinement – soil nailing – stone column – compaction piles – dynamic compaction –			
prefabricated vertical drains – preloading – electro – osmosis – soil freezing vacuum consolidation –			
deep explosion – dry powdered polymers – enzymes.			
	Number of lectures = 10 mprovement tech nfinement – soil f rtical drains – pre dry powdered p		

Unit - 4	Number of	Title of the unit: Soil reinforcement
	lectures $= 12$	

Historical background, RCC – concept of reinforced earth – Mechanisms – Types of reinforcements – Soil – Reinforcement – Interaction studies – Internal & External stability criteria – Design Principles of steep reinforced soil slops – pavements – Embankments on soft soils.

# 11. Books Recommended

# <u>Text Books</u>

- 2. Hausmann, M.R., Engineering Principles of Ground Modification, McGraw Hill International Editions, 1990.
- 3. Purushotham Raj, Ground Improvement Techniques, Laxmi Publications, New Delhi. **Reference Books** 
  - 1. Jones C. J. F. P, Earth Reinforcement and Soil Structures, Butterworths, London.
  - 2. PCA, Soil-cement Laboratory Hand Book, Portland cement association, Chicago.
  - 3. Moreland, H. and Mitchell, H. "Lime Soil Mixture" Highway Research Board Bulletin 304, 1961.

1. Name of the Department: Civil Engineering Department							
2. Course Name		Pavement Materials lab	L	Т		P	
3. Course Code			0	0		2	
4. Type of Course (use tick mark)		Core (✓)	PE()		OE()		
5. Pre-	-requisite (if	Highway	Frequency (use tick	Even () Odd		Either	Every
any)		Engineering lab	marks)		(✔)	Sem ()	Sem
							0
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Lectur	res = 0		Tutorials =0	Practical = 28			
7. Brie	ef Syllabus:						
Tests of	on aggregate to	determine the mech	nanical properties, Test	on bitumen	material a	nd test on	soil.
8. Lea	rning objectiv	es:					
1.	Students will	learn about the varie	ous material used in roa	ad construct	ion.		
2.	Students able	to understand that h	how to determine the va	rious mater	ial characte	eristics	
5.		e importance of qua	anty of materials.				
9. Cou	irse Outcomes	(COs):					
1.	1. At the end of the course, the student will be able to						
2.	. Differentiate good and poor material for road construction						
3.	. Understand material behavior under loading						
4.	4. Aggregate grading importance						
10. Unit wise detailed content							
1.	1. Aggregate grading importance						
2.	Compaction test						
3.	CBR test						
4.	. Shape tests - Elongation, Flakiness Index & Combined Index						
5.	5. Aggregate impact value test						
6.	5. Los Angeles abrasion value test						
7.	7. Specific gravity determination						
8.	. Striping value test						
9.	9. Ductility test						
10. Penetration test							
11. Viscosity test							

1.	1. Name of the Department: Civil Engineering Department							
2.	Course	CAD in	L	<b>T</b>		Р		
	Name	Transportation						
		Engineering						
3.	Course		0	0		2		
	Code							
4.	Type of Course (use tick mark)		Core (✓)	<b>PE</b> ()		<b>OE</b> ()		
5.	Pre-	Geometric design,	6. Frequency	Even Odd E		Eith	Every Sem	
	requisite (if	Survey	(use tick	0	<b>(</b> ✓ )	er	0	
	any)		marks)			Sem		
_						0		
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Le	ctures = 0	•	Tutorials = 0	Practi	cactical = 28			
δ.	Learning obj	jectives:	ad madaling tool	that ana	hlag th	a mand	and accurate	
	1. MA Road	all types of roads	ed modeling tool	that ena	bies th	le rapid	and accurate	
	2 MX Road	contributes to improving	the quality of dec	ione hv	combi	ning tre	ditional	
	2. MIX Road	recontributes to improving	the quality of des	3D mo	deling	technol	logy	
	engineern	ig working w promie and e			aening	teenno		
9.	9. Course Outcomes (COs):							
At	At the end of the course, the student will be able to							
	1. Understand the input data required for road design							
	2. Understand the surface and excavation work design							
3. Understand the curve design and how to use known theory in the design								
10. Lab Components								
Sr.	Topic C			CO	CO covered			
No	•							
1	Basic co	Basic concepts and view control   1						
2	Survey	Survey input and validation1						
3	String n	String name and drawing style   1						
4	Surface	Surface checker, string creation and edition1						
5	Surface	Surface analysis and earth work calculation2						
6	Alignme	Alignment creation (horizontal and vertical curve)3						
7	Carriage	Carriage way design 3						
8	Junction	Junction design 3						

# Second Semester

1. Name of t	the Department	CIVIL ENGINEERING				
2. Subject	Analysis and Design	L	Т		Р	
Name	of Pavement					
3. Subject		3	0		0	
Code						
4. Type of Subject (use tick		Core (✓)	<b>PE</b> ()		<b>OE</b> ()	
mark)						
5. Pre-	Nil	Frequency (use	Even	Odd ()	Either	Every
requisite		tick marks)	(🗸)		Sem ()	Sem ()
(if any)						
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 4	12	Tutorials = 0	Practica	al =0		

# 7. Brief Syllabus:

Understanding the effect of various environmental factors effecting the pavement design, Traffic load calculation, Design, and analysis of flexible and rigid pavement.

# 8. Learning objectives:

- 1. Students will learn about the behaviour of various materials under various environmental conditions.
- 2. Design philosophy of flexible pavement
- 3. Design philosophy of rigid pavement
- 4. Analysis of flexible and rigid pavement.

# 9. Subject Outcomes:

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

- 1. Ability to analyses of the pavement.
- 2. Ability to design flexible pavement by various methods.
- 3. Ability to design rigid pavement by various methods.

10. Unit wise detailed content						
Unit-1	Number of lectures Title of the unit: Factors effecting the pavement					
	= 10					
Types and component of pavements, Factors affecting design and performance of						
pavements. H	pavements. Highway and airport pavements, functions of pavement components					
Unit - 2 Number of lectures		Title of the unit: Load calculation for pavement design				
	<b>= 10</b>					
Design wheel load, strength characteristics of pavement materials, climatic variations,						
traffic - loa	d equivalence factors	and equivalent wheel loads, aircraft loading, gear				
configuration	n and tyre pressure. D	rainage – Estimation of flow, surface drainage, sub-				
surface drainage systems, design of sub-surface drainage structures.						
Unit - 3 Number of lectures		Title of the unit: Flexible Pavement Design				
	= 10					
Empirical, semi-empirical and theoretical approaches, design of highway and airport pavements						
by IRC, AASHTO Methods, applications of pavement design software						
Unit - 4	it - 4 Number of lectures Title of the unit: Software use in Pavement Design					
	= 12	& Analysis				

Types of joints and their functions, joint spacing; design of CC pavement for roads, highways and airports as per IRC, AASHTO, design of joints. Design of continuously reinforced concrete pavements. Reliability; Use of software for rigid pavement design.

# 11. Books Recommended

# **Text Books**

- (iii) Yoder and Witczak, Principles of Pavement Design, John Wiley and Sons
- (iv) Yang. H. Huang, Pavement Analysis and Design, Second Edition, Prentice Hall Inc. **Reference Books**
- (i) Rajib B. Mallick and Tahar El-Korchi, Pavement Engineering Principles and Practice, CRC Press (Taylor and Francis Group)
- (ii) W.Ronald Hudson, Ralph Haas and Zeniswki, Modern Pavement Management, McGraw Hill and Co
- (iii) Relevant IRC Codes
| 1. Name of the Department  |           | CIVIL          | ENGINEERIN           | G      |              |       |
|--|-----------|----------------|----------------------|--------|--------------|-------|
| 2. Subject   | Transport | L              | Т                    |        | Р            |       |
| Name   | Economics |                |                      |        |              |       |
| 3. Subject   |           | 3              | 0                    |        | 0            |       |
| Code   |           |                |                      |        |              |       |
| 4. Type of Subject (use tick   |           | Core (✓)       | <b>PE</b> ()         |        | <b>OE</b> () |       |
| mark)  |           |                |                      |        |              |       |
| 5. Pre-  | Nil       | Frequency (use | Even (✓)             | Odd () | Either       | Every |
| requisite (if  |           | tick marks)    |                      |        | Sem          | Sem   |
| any)   |           |                |                      |        | 0            | 0     |
| 6.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester) |           |                |                      |        |              |       |
| Lectures = 42  |           | Tutorials = 0  | <b>Practical</b> = 0 |        |              |       |

Understanding the supply, demand and surplus, determinant of elasticity, Transportation cost calculation and economic analysis of project.

#### 8. Learning objectives:

- 1. Students will be able to understand the economics of road projects.
- 2. Students will learn about the concept of elasticity and how it affects the supply demand.
- 3. Students will understand the governing factors for the choice of travel mode.

#### 9. Subject Outcomes:

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

- 1. Understanding the basic economics term like elasticity, supply, demand etc.
- 2. Understanding the surplus.
- 3. Travel behavior analysis.
- 4. Economic and financial analysis of highway project.

#### 10. Unit wise detailed content

I of e fine wise de	danea content	
Unit-1	Number of	Title of the unit: Demand
	lectures=10	

Transportation economics, Transportation demand, Demand classification, Determinants of demand, Demand function curve, shift in demand curve, Temporal variation of transportation demand and peak problem and measures to mitigate, Price elasticity of demand, Price elasticity of linear demand curve, CRAFT model, Direct and cross elasticity.

Unit - 2	Number of	Title of the unit: Demand, Supply and Equilibrium
	lectures = 10	

Supply curve, Determinant of supply, Price elasticity of supply, Determinant of price elasticity of supply, Constant elasticity supply function, Demand supply equilibrium and in-equilibrium.

Unit - 3	Number of	Title of the unit: Surplus		
	lectures = 06			
Consumer surplus, Change in consumer surplus, Latent demand, Producer surplus, Change in				
producer surplus. Income elasticity.				

Unit - 4	Number of	Title of the unit: Travel behavior analysis		
	lectures = 16			
Behavior analysi	is, its objective a	nd application. Travel Behavior Analysis (TBA), Application of		
TBA, Basic step	s of TBA, Design	n of survey instrument, Data types in behavior analysis, Preference		
elicitation techni	ques, Discrete ch	noice experiment, Identification of attributes and its levels,		
Generation of alt	ternatives, Factor	ial design.		
11. Books Record	mmended			
<b>Text Books</b>				
4. Winfrey,	Economic analy	sis for Highways, International Textbook Company, Pennsylvania,		
1969.				
5. CRRI, Road User Cost Study in India, New Delhi, 1982.				
<b>Reference Book</b>	<u>as</u>			
6. IRC, Mar	nual on Economi	c Evaluation of Highway Projects in India, SP30, 2007.		

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1. Name of the l	Department	ENGINEERIN	G			
2. Subject	Traffic	L	Т		Р	
Name	Engineering					
	and					
	Management					
3. Subject		3	0		0	
Code						
4. Type of Subject (use tick		Core (✓)	<b>PE()</b>		<b>OE</b> ()	
mark)						
5. Pre-	Nil	Frequency (use	Even (✓)	Odd ()	Either	Every
requisite (if		tick marks)			Sem	Sem
any)					0	0
6 .Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		Tutorials =	Practical			

Elements of traffic engineering, Road user facilities, Elements of road design, Traffic regulation & controls, Grade separated intersection design.

#### 8. Learning objectives:

- 1. Students will learn about the traffic studies, traffic forecasting and interpretation.
- 2. Students will learn about the speed study.
- 3. Students will learn about the various kind of traffic control system.

#### 9. Subject Outcomes:

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

- 1. Understand the various design elements
- 2. Understanding the road users, roads and vehicle interaction
- 3. Design of traffic regulations and controls
- 4. Road safety audit

#### 10. Unit wise detailed content

10. Ont whise detailed content				
Unit-1	Number of	Title of the unit:		
	lectures = 08	Elements of traffic engineering		

Road user, vehicle and road way. Vehicle characteristics - IRC standards - Design speed, volume. Highway capacity and levels of service - capacity of urban and rural roads - PCU concept and its limitations.

Unit - 2	Number of	Title of the unit: Roads users facilities
	lectures = 12	

Road user facilities - Parking facilities - Cycle tracks and cycle-ways, Pedestrian facilities. Traffic volume studies, origin destination studies, speed studies, travel time and delay studies, Parking studies, Accident studies.

Unit - 3	Number of	Title of the unit: Elements of design
	lectures = 08	
Alignment - Cros	ss sectional elem	ents - Stopping and passing sight distance. Horizontal curves -
Vertical curves.	Design problems	– Hill Roads.
Unit - 4	Number of	Title of the unit: Traffic regulation and control
	lectures = 14	•

Signs and markings - Traffic System Management - Design of at-grade intersections – Principles of design – Channelization - Design of rotaries - Traffic signals - pre-timed and traffic actuated. Design of signal setting - phase diagrams, timing diagram, signal coordination.

# 11. Books Recommended

#### <u>Text Books</u>

- 1. ITE Hand Book, Highway Engineering Hand Book, McGraw Hill.
- 2. R. J. Salter and N. B. Hounsel, Highway Traffic Analysis and Design, Macmillan Press Ltd, 1996.

#### **References**

- 1. AASHTO A Policy on Geometric Design of Highway and Streets
- 2. John Wiley & Sons Inc., ITE Brian, Traffic Engineering handbook

1. Name of t	the Department	CIVIL F	ENGINEER	RING		
2. Subject	Airport	L	Т		Р	
Name	Infrastructure,					
	Planning and Design					
3. Subject		3	0		0	
Code						
4. Type of Subject (use tick		Core (✓)	<b>PE</b> ()		<b>OE</b> ()	
mark)						
5. Pre-	Nil	Frequency (use	Even (✓)	Odd ()	Either	Every
requisite		tick marks)			Sem()	Sem ()
(if any)						
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 4	12	Tutorials = 0	Practical	=0		

ICAO standard for airport and air traffic operation, Various safety standard for aircraft, Airport components, Zoning laws, Capacity and traffic determination, Runway design, Taxiway design, Marking & signal, Lighting.

# 8. Learning objectives:

- 1. Students will be able to understand the various airport components
- 2. Students will be able to understand the different techniques used for air traffic calculation
- 3. Students will learn about the various factors affecting the runway orientation

# 9. Subject Outcomes:

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

1.Understanding the ICAO standards & regulations

2.Understanding the various design elements of an airport

3. Air traffic calculation

4.Runway design

5. Runway lighting design

	To chit while detailed content				
Unit-1	Number of lectures	Title of the unit:			
	= 10	Classification of airports			
ICAO standa	rds. Planning for airpor	t, airport components, zoning laws.			
Unit - 2	Number of lectures	Title of the unit:			
	= 12	Air traffic forecasting			
Various meth	nods of air traffic foreca	sting, Capacity determination.			
Unit - 3	Number of lectures	Title of the unit: Runways Orientation and Geometric			
	= 10	Design			
Runway patterns. Taxiways alignment geometry and turning radius exit taxiways					

Unit - 4	Number of lectures	Title of the unit:		
	= 10	Aprons Planning and Design		
Design principles of critical, semi-critical, non-critical airport pavements, and FAA and				

PCA methods. Airport hangars, their planning and design criteria.

# 11. Books Recommended

#### **Text Books**

- (v) Airport Engineering, N.J. Ashford, P.H. Wright, John Wiley
- (vi) Planning and Design of Airports, R.M. Horonjeff, F.X. McKelvey, W.J Sproule, Seth Young,

# **References**

- (i) Airport Planning & Management, Wells, Alexander; Young, Seth, McGraw Hill.
- (ii) TMH International Publishers
- (iii) Airport Engineering (Planning and Design), S.C Saxena, CBS Publisher

1. Name of the Department: Civil Engineering Department						
2. Course Name	Pavement	L	Т		Р	
	Design Lab					
3. Course Code		0	0		4	
4. Type of Course (use tick mark)		Core (✓)	<b>PE</b> ()		<b>OE</b> ()	
5. Pre-requisite (if		Frequency (use tick	Even (🗸)	Odd ()	Either	Every
any)		marks)			Sem ()	Sem
						0
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =		Tutorials =0	Practical =	= 28		

Understanding the effect of various environmental factors effecting the pavement design, Traffic load calculation, Design, and analysis of flexible and rigid pavement.

# 8. Learning objectives:

- 1. Appreciate the importance of environmental factors for the pavement design.
- 2. Understand the effect of temperature and rainfall on the material behavior used for road construction
- 3. Understand the importance of gradation

#### 9. Course Outcomes (COs):

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

- 1. Evaluate the effect of temperature and rainfall on the materials.
- 2. Design the required aggregate gradation.
- 3. Choose the suitable binder.

- 1. Soil-Cement / Soil-lime Mix Design
- 2. Blending of aggregates
- 3. Design and blending of sub-base material
- 4. Characterization of Aggregate and Bituminous materials
- 5. Visco-elastic Characteristics of bituminous and modified binders
- 6. Modified Marshall test for bituminous mixes
- 7. Repeated Load Testing of pavement materials

1. Name of the Department: Civil Engineering Department						
2. Course Name	Traffic lab	L	Т		Р	
3. Course Code		0	0		4	
4. Type of Course (use tick mark)		Core (✓)	PE)		<b>OE</b> ()	
5. Pre-requisite (if any)		Frequency (use tick marks)	Even (✓)	Odd ()	Either Sem $()$	Every Sem ()
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =		Tutorials =0	Practic	cal = 28		
7 Brief Syllabus						

Solid waste management, the collecting, treating and disposing of solid material that is discarded because it has served its purpose or is no longer useful. Improper disposal of municipal solid waste can create unsanitary conditions, and these conditions in turn can lead to pollution of the environment and to outbreaks of vector borne disease, that is, disease spread by rodents and insects. The tasks of solid waste management present complex technical challenges. They also pose a wide variety of administrative, economic and social problems that must be managed and solved.

#### 8. Learning objectives:

- 1. Students will understand the importance of traffic studies and traffic forecasting and how important it is for proper efficiency of any transport facility.
- 2. Students able to understand that how to determine the speed criteria.
- 3. Accidents analysis and mitigation

#### 9. Course Outcomes (COs):

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

- 1. Understanding the ADT & AADT calculation from various techniques
- 2. Parking studies.
- 3. Accidents analysis using videography.

- 1. Traffic volume study using videography technique.
- 2. Traffic speed study using videography technique.
- 3. Speed study by radar gun & endoscope
- 4. Determination of reaction time of driver
- 5. Parking study
- 6. Accident investigation study
- 7. Study for improvement of an accident prone location

# Third Semester

1. Name of t	the Department	CIVIL I	ENGINEE	RING			
2. Subject	Sustainable Built	L	Т		Р		
Name	Environment						
3. Subject		3	0	0			
Code							
4. Type of Subject (use tick		Core (✓)	<b>PE</b> ()		<b>OE</b> ()	<b>OE</b> ()	
mark)							
5. Pre-	Nil	Frequency (use	Even ()	Odd	Either	Every	
requisite		tick marks)		<b>(</b> ✓)	Sem()	Sem ()	
(if any)							
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)							
Lectures = 4	Lectures = 42 Tutorials = 0 Practical =0						

The built environment is a complex system that shapes enormous resource flows (i.e., material, energy, labor and economic investments) and impacts the natural environment for decades, if not centuries. If one considers typical design, construction and maintenance practices used today, the relationship between the built environment and the natural environment is not sustainable.

#### 8. Learning objectives:

- 1. Students will be able to understand the various Environmental impacts of building
- 2. Students will be able to understand the various traffic disruptions.
- 3. Students will learn about the on site natural resources.
- 4. Students will learn about the attributes of environmental sustainability.

#### 9. Subject Outcomes:

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

- 1. 1. Students will be able to understand the various Environmental impacts of building
- 2. Students will be able to understand the various traffic disruptions.
- 3. Students will learn about the onsite natural resources.
- 4. Students will learn about the attributes of environmental sustainability.

Unit-1	Number of lectures	Title of the unit:				
	= 10	Introduction				
Environment	al impacts of building	, Shortage of building materials, Noise, vibration, dust,				
and traffic di	isruptions, Water pollut	tion, Disruption of natural scenery, Disappearing green				
spaces in urb	an areas.					
Unit - 2	Number of lectures	Title of the unit:				
	= 12	Sustainable built environments				
Economy of	resources, Building ma	terials, Energy, On-site natural resources, Three phases				
of building n	naterials.					
Unit - 3	Number of lectures	Title of the unit: Attributes of environmental				
	= 10	Sustainability				

Pollution prevention measures in manufacturing, waste reduction measures in manufacturing, Recycled cement, Embodied energy reduction , Use of natural materials

Unit - 4	Number of lectures	Title of the unit:					
	= 10	Technological innovation and built environments					
Electronic to	echnology in buildings	s, Functional shift of built environments, Human					
interaction							
11. Books Recommended							
<u>Text Books</u>	la to Cradice Domaking	the Wey We Make Things William McDensuch and Michael					

- **<u>1</u>** Cradle to Cradle: Remaking the Way We Make Things, William McDonough and Michael Braungart.
- 2) The Up cycle: Beyond Sustainability-Designing for Abundance, William McDonough and Michael Braungart

1.	Name of the Depa	rtment	CIVIL ENGINER				
2.	Course Name	Research	L	Т		Р	
		Methodology					
		and IPR					
3.	Course Code		3	0		0	
4.	Type of Course (u	ise tick mark)	Core (✓)		PE-()	OE()	
5.	Pre-requisite (if		6. Frequency (use	Even	Odd	Either	Every
	any)		tick marks)	0	(✔)	Sem ()	Sem
							0
7.	7. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Le	ctures = 42		Tutorials $= 00$	Practica	a1 = 0		

The aim of the course is to make students understand the importance of Research Paper Writing. Also, it covers all the concepts which involved in writing the Research Paper.

# 9 Learning objectives:

The objectives of the course are:

- 1. The students are able to recognize the steps involved in doing research work.
- 2. The students will be able to collect data using various media and using the best possible sample available.
- 3. The students would learn to propose their Hypothesis and build models for the problem.
- 4. The students would be able to correctly document their findings in the form of a report.

# **10.Course Outcomes:**

After completion of this course, the student will be able to:

- 1. Recognize the various steps involved in research.
- 2. Collect data from samples, Examine and analyze the data.
- 3. Develop models for problems.
- 4. Explain the entire process in the form of a report.

#### 11.Unit wise detailed content

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

Research - Types, Research process and steps, Hypothesis, Research Proposal and aspects. Research Design- Need, Problem Definition, Variables, Research Design concepts, Literature survey and review, Research design process, Errors in research. Research Modeling- Types of models, model building and stages, Data consideration.

Unit - 2 Number of			Title	Title of the unit: Sampling									
		lectu	res = 10										
a 1'	114	11	- T 1 ·	C	1.	р	1	<b>C</b> ,	1 0		. ·	N / 1/ /	

Sampling and data collection- Techniques of sampling, Random, Stratified, Systematic, Multistagesampling, Primary and secondary sources of data. Design of questionnaire.

Unit - 3	Number of	Title of the unit: Data Collection and Experiments
	lectures = 10	

Design of Experiments- Objectives, strategies, Factorial experimental design, designing engineering experiments, basic principles-replication, randomization, blocking, guidelines for design of experiments.

Unit - 4	Number of	Title of the unit: Models and Hypothesis & Report
	lectures = 12	writing

Single factor experiment- Hypothesis testing, analysis of Variance component (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effect model, estimation of variance components, Model adequacy checking. Structure and components of Scientific Reports, Types of Report, Technical Reports and Thesis; Different steps in the preparation – Layout, structure and Language of typical reports; Illustrations and tables, Bibliography, Referencing and foot notes.

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

https://research-methodology.net/research-methodology/ https://gradcoach.com/what-is-research-methodology/

#### **13.Books Recommended**

**Text Book:** 

1. Research Methodology – Methods and Techniques – C.R. Kothari, New Age International, New Delhi, 2004.

#### **Reference Book:**

1. Design and Analysis of Experiments – Douglas C. Montgomery, Wiley India, 8th Edition, 2012.

2. Practical Research: Planning Design – Paul D. Leddy, London, 1980.

1. Name of the Department			CIVIL ENGI	NEERING	T		
2.	Subject	Research	L	Т		Р	
	Name	Methodology					
		and IPR Lab					
3.	Subject		0	0		2	
	Code						
4.	Type of Subje	ect	Core (✓)	<b>PE()</b>		<b>OE</b> ()	
5.	Pre-	Research	Frequency (use tick	Even ()	Odd	Either	Every
	requisite (if	Methodology	marks)		<b>(</b> ✓)	Sem	Sem
	any)	and IPR				0	0
6. Total Number of Lectures, Tutorials, Practical (Assuming 14 weeks in semester)							
Lectur	res = 00		Tutorials = 00	Practical =28			

# 1. Learning objectives:

The objectives of the course are:

- 2. The students are able to recognize the steps involved in Identifying research problem.
- 3. The students will be able to collect data using various media and using the best possible sample available.
- 4. The students would learn to propose their Hypothesis and build models for the problem.
- 5. The students would be able to correctly document their findings in the form of a report.

#### **Outcomes:**

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

- 1. Choose the topic for writing research paper.
- 2. Develop models for problems.
- 3. The students would learn to write the research paper.

7. Lab C	Content	
Sr. No.	Title	CO covered
1	How to choose topic for research	1,2
2	How to collect data for the particular research problem	1,2
3	Writing Abstract	1,2
4	Writing Literature review	1,2
5	Explaining and writing methodology	1,2
6	How to analyze the data collected	1,2
7	Presentation of analysis and findings	1,2
8	How to write result and conclusion	2,3
9	References in research article	2,3

# Departmental Elective

1. Name of the Department CIVIL			ENGINEERIN	IG		
2. Subject	Construction	L	Т		Р	
Name	Project					
	Management					
3. Subject		3	0		0	
Code						
4. Type of Subject (use tick		Core ()	PE(✓)		<b>OE</b> ()	
mark)						
5. Pre-	Nil	Frequency (use	Even ()	Odd (✓)	Either	Every
requisite (if		tick marks)			Sem	Sem
any)					0	0
6 .Total Number	6.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)					
Lectures = 42		Tutorials =	Practical			

Understanding the various stages of project, Economic and financial analysis of project, Project selection, Network scheduling, Use of computer programs, Project bid, Project operation.

# 8. Learning objectives:

1. Students will understand the importance of project management for any infrastructure project.

2. Overall development of students in how to deal with different – different people involved in the project.

3. Learn about the use of various software in flow less execution of any infrastructure project.

# 9. Subject Outcomes:

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

1.Understand solid waste and its composition

- 2. Understand various processes involved in solid waste collection, segregation and transportation.
- 3. Design Understand solid waste disposal facility.

# 10. Unit wise detailed content

Unit-1	Number of	Title of the unit: Introduction
	lectures = 06	
<b>F</b> 1 1		

Foundations of Project Management, Project Life Cycle, Project Environment, Project Selection, Project Proposal, Project Scope

Unit - 2	Number of	Title of the unit: Project planning
	lectures = 12	

The Breakdown Structure. Network Scheduling, Critical Path Method, Program Evaluation & Review Technique, Planning and Scheduling of Activity Networks, Assumptions in PERT

Unit - 3	Number of	Title of the unit: Modeling
	lectures = 12	
Modeling, Time-	cost Trade-offs,	Linear Programming and Network Flow Formulations, PERT/COST
Accounting.		

Unit - 4	Number of	Title of the unit: Project schedule
	lectures = 12	

Scheduling with limited resources, Resource Planning, Resource Allocation, Project Schedule Compression, Project Scheduling Software, Precedence Diagrams, Decision CPM, Generalized Activity Networks, GERT

# 11. Books Recommended

# <u>Text Books</u>

(i) Projects: Planning, Analysis, Selection, Implementation & Review, Prasanna Chandra, 5th Ed., 2002.

(ii) Project Management: A systems approach to planning and controlling, Harold Kerzner, CBS Publisher, New Delhi, 2nd Ed., 2000.

# **References**

(i) Lock, D., 2003, Project Management, 8th edition, Gower Publishing Limited(ii) AMS REALTIME projects http://www.amsrealtime.com/products/project.htm

1. Name of the Depar	1. Name of the Department: Civil Engineering Department					
2. Course Name	Construction	L	Т		Р	
	Project					
	Management					
	Laboratory					
3. Course Code		0	0		2	
4. Type of Course (us	e tick mark)	Core ()	PE(✓)		OE()	
5. Pre-requisite (if		Frequency (use tick	Even	Odd (✓)	Either	Every
any)		marks)	Sem ()		Sem ()	Sem
						0
6. Total Number of L	ectures, Tutorials,	Practical (assuming 14	weeks o	f one seme	ester)	
Lectures =0		Tutorials =0	Practica	al = 28		

Lectures =0

**Practical = 28** 

# 7. Brief Syllabus:

Understanding the various stages of project, Economic and financial analysis of project, Project selection, Network scheduling, Use of computer programs, Project bid, Project operation.

# 8. Learning objectives:

1. Students will understand the importance of project management for any infrastructure project.

2. Overall development of students in how to deal with different - different people involved in the project.

3. Learn about the use of various software in flow less execution of any infrastructure project.

# 9. Course Outcomes (COs):

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

1. Understand solid waste and its composition

2. Understand various processes involved in solid waste collection, segregation and transportation.

3. Design Understand solid waste disposal facility.

- 1. Study of Foundations of Project Management.
- 2. Study of Project Selection, Project Proposal, Project Scope.
- 3. Study of Critical Path Method.
- 4. Evaluation by Program Evaluation & Review Technique.
- 5. Networking for Planning and Scheduling of Activity Networks.
- 6. Scheduling with limited resources, Resource Planning, Resource Allocation.
- 7. Project Scheduling Software, Precedence Diagrams.

1. Name of the	Department	CIVIL	ENGINEERIN	G		
2. Subject	Intelligent	L	Т		Р	
Name	Transportation					
	System					
3. Subject		3	0		0	
Code						
4. Type of Subject (use tick		Core ()	<b>PE</b> (✓)		<b>OE</b> ()	
mark)						
5. Pre-	Nil	Frequency (use	Even ()	Odd (✓)	Either	Every
requisite (if		tick marks)			Sem	Sem
any)					0	0
6. Total Number of Lectures. Tutorials. Practical (assuming 14 weeks of one semester)						

Lectures = 42Tutorials =Practical

# 7. Brief Syllabus:

Introduction to ITS and overview, Its applications and Highway Safety, Advance traffic management system, Interactive voice recognition and its applications, ITS standards .

#### 8. Learning objectives:

- 1. Students will able to understand the various types of stresses developed in pavements.
- **2.** Students will able to understand the causes of the road failure and how to mitigate them to the extent possible.
- 3. Students will learn about the overlay design.

# 9. Subject Outcomes:

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

- 1. Understand the need for ITS and the subsets of ITS.
- 2. To equip the students with practical case studies leading to IT'S rather than conventional methods.

10. Unit wise de	10. Unit wise detailed content				
Unit-1	Number of	Title of the unit: Introduction to ITS			
	lectures = 10				
Overview and hi	story of ITS Ove	rview of ITS Applications Federal ITS Programs, Improving			
Highway Safety	with ITS				
Unit - 2	Number of	Title of the unit: Advanced traffic management system			
	lectures = 10				
Advanced Trave	ler Information S	ystems A Case Study – VA DOT Active Traffic Management			
Concept ITS Te	elecommunication	s Technologies Connected Vehicle Technology Connected			
Vehicle Technol	ogy and Applicati	ons			
Unit - 3	Number of	Title of the unit: Interactive Voice Recognition			
	lectures = 10				

Interactive Voice Recognition (IVR) Technologies ITS Mobile Applications

Unit - 4	Number of	Title of the unit: ITS Standards ITS Architecture
	lectures = 12	
Economics of ITS Conception Driving Devenue Conception Models		

Economics of ITS Congestion Pricing Revenue Generation Models

#### 11. Books Recommended

#### <u>Text Books</u>

- 1. Joseph M. Sussman, Perspectives on Intelligent Transportation Systems, Springer2005.
- 2. Bob Williams, Intelligent Transportation Systems Standards, Artech House 2008.

#### **References**

- 1. Sumit Ghosh, and Tony.S.Lee, Intelligent Transportation Systems: Smart and Green Infrastructure Design, CRC press, 2010.
- 2. Mashrur A. Chowdhury and Adel Wadid Sadek Fundamentals of Intelligent Transportation Systems planning, Artech House 2009.

1. Name of the Depar	tment: Civil Engin	eering Department				
2. Course Name	Intelligent	L	Т		Р	
	Transportation					
	System					
	Laboratory					
3. Course Code		0	0		4	
4. Type of Course (us	e tick mark)	Core ()	<b>PE(</b> √)		<b>OE</b> ()	
5. Pre-requisite (if		Frequency (use tick	Even	Odd (✓)	Either	Every
any)		marks)	Sem ()		Sem ()	Sem
						0
6. Total Number of L	ectures, Tutorials,	Practical (assuming 14	weeks o	f one seme	ster)	
Lectures =0		Tutorials =0	Practica	al = 28		

Lectures =0

Practical = 28

# 7. Brief Syllabus:

Introduction to ITS and overview, Its applications and Highway Safety, Advance traffic management system, Interactive voice recognition and its applications, ITS standards.

# 8. Learning objectives:

- 1. To gain insight into traffic data collection.
- 2. Understand the various techniques of traffic data collection using ITS.
- 3. Understand the various techniques for traffic data analysis.

# 9. Course Outcomes (COs):

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

- 1. Understand the need for ITS and the subsets of ITS.
- 2. To equip the students with practical case studies leading to ITS rather than conventional methods.

- 1. Traffic data collection techniques.
- 2. Traffic data analysis.
- 3. Transportation modeling using network computing software like TRANSYT.
- 4. Dynamic Intersection Signal Control Optimization (DISCO),
- 5. Multi-class static and dynamic traffic assignment.
- 6. Traffic simulation via neural network modeling, and transportation network reliability.
- 7. Understanding the outcome of traffic data analysis.

1. Name of the I	Department	CIVIL	ENGINEERIN	G		
2. Subject	Highway	L	Т		Р	
Name	Construction					
	Practices					
3. Subject		3	0		0	
Code						
4. Type of Subject (use tick		Core ()	<b>PE</b> (✓)		<b>OE</b> ()	
mark)						
5. Pre-	Foundation	Frequency (use	Even ()	Odd (✓)	Either	Every
requisite (if	Engineering	tick marks)			Sem	Sem
any)					0	0
6 .Total Number	6.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)					
Lectures = 42		Tutorials = 0	<b>Practical =0</b>			

Embankment construction, WBM & WMM, Dry lean concrete and cement treated base, Concrete road construction, Road construction in mountainous region.

# 8. Learning objectives:

1. Students will learn about the various layers of road and the material used in them for construction.

- 2. Construction of road embankment & base.
- 3. WBM & WMM construction techniques.
- 4. Construction of concrete road.

# 9. Subject Outcomes:

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

- 1. Ability to prepare road sub-grade.
- 2. Ability to construct GSB, various types of unbounded base course.
- 3. Ability to construct various types of binder courses.

#### 10. Unit wise detailed content

Unit-1	Number of	Title of the unit: Embankment Construction
	lectures = 06	

Formation cutting in Soil and hard rock, Preparation of Sub grade, Ground improvement, Retaining and Breast walls on hill roads.

Unit - 2	Number of	Title of the unit: Granular and Stabilized
	lectures = 12	

Sub – bases / bases, Water Bound Macadam (WBM), Wet Mix Macadam (WMM), and Cement treated bases, Dry Lean Concrete (DLC).

Unit - 3	Number of	Title of the unit: Bituminous Constructions		
0	lectures $= 12$			
Types of Bituminous Constructions, Interface Treatments, Bituminous Surfacing and wearing				
Courses for roads and bridge deck slabs, Selection of wearing Course under different Climatic and				
Traffic conditions, IRC specifications, Construction techniques and Quality Control.				

Unit - 4	Number of	Title of the unit: Concrete road construction
	lectures = 12	

Test on Concrete mixes, Construction equipment, Method of construction of joints in concrete pavements, Quality Control in Construction of Concrete pavements, Overlay Construction.

#### 11. Books Recommended <u>Text Books</u>

(i) Principles & practice of Highway Engg.-Dr. L. R. Kadiyali & Dr. N. B. Lal - Khanna Publishers(ii) MOST, Specifications for Road and Bridge Work (4th Revision), Ministry of Road Transport and Highways, 2001.

# **References**

(i) C. A. O' Flaherty, Highways – The Location, Design, Construction, & Maintenance of Pavements, Butterwsorth Heinemann, 2002.

(ii) R. N. Hunter, Bituminous Mixtures in Road Construction, Thomas Telford Services Ltd., 1995.

1. Name of the Depa	1. Name of the Department: Civil Engineering Department					
2. Course Name	Highway	L	T P		Р	
	Construction					
	Practices					
	Laboratory					
3. Course Code		0	0		4	
4. Type of Course (u	se tick mark)	Core ()	PE(✓)		OE()	
5. Pre-requisite (if		Frequency (use tick	Even ()	Odd	Either	Every
any)		marks)		(✔)	Sem ()	Sem
						0
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures =00		Tutorials =0	Practical :	= 28		

Structural understanding of the road pavement, Characterization of the materials used in road construction, testing of the materials, Testing of the road pavement.

#### 8. Learning objectives:

- 1. Students will learn about the pavement system as the multilayer system.
- 2. Students will learn about the materials used in each layer.
- 3. Learn about the various test to evaluate the performance of the materials used in various layers.

#### 9. Course Outcomes (COs):

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

- 1. Perform the necessary test on the soil.
- 2. Perform the necessary test on the bitumen.
- 3. Able to evaluate the existing pavement structural conditions.

- 1. Sub-grade material testing
- 2. Sub-grade stabilization techniques mechanical stabilization
- 3. Sub-grade stabilization techniques chemical stabilization
- 4. Preparation of WBM
- 5. Preparation of WMM
- 6. Test on aggregate
- 7. Test on bitumen

1. Name of the I	Department	CIVIL	ENGINEERIN	G		
2. Subject	Highway	L	Т		Р	
Name	Traffic					
	Analysis and					
	Design					
3. Subject		3	0		0	
Code						
4. Type of Subject (use tick		Core ()	PE(✓)		<b>OE</b> ()	
mark)						
5. Pre-	Geometric	Frequency (use	Even ()	Odd (✓)	Either	Every
requisite (if	Design &	tick marks)			Sem	Sem
any)	Traffic				0	0
	Engineering					
6.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						

Lectures = 42Tutorials = 0Practical = 0

# 7. Brief Syllabus:

Highway safety, Drivers behavior, Highway safety management system, Crash statistics and road safety audit.

# 8. Learning objectives:

- 1. The course addresses several sub-areas of transportation safety. Proactive and reactive safety planning and design.
- 2. Hotspot" identification and remediation.
- 3. Human factors considerations in highway safety.
- 4. State of the practice analysis methods for evaluating counter measures.

# 9. Subject Outcomes:

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

- 1. Provide students with a working knowledge of traffic safety concepts, covering the range from traffic planning, operations, and design.
- 2. Gain an understanding of safety management systems, different safety countermeasures, statistical issues with countermeasures and their effectiveness, and crash investigation.

10. Unit wise detailed content					
Unit-1	Number of lectures=10	Title of the unit: Elements of Traffic Engineering			
.Road user, vehicle and road way. Vehicle characteristics - IRC standards - Design speed, volume.					

Highway capacity and levels of service - capacity of urban and rural roads - PCU concept and its limitations

Unit - 2	Number of	Title of the unit: Road users facilities	
	lectures = 10		
Road user facilities - Parking facilities - Cycle tracks and cycle-ways, Pedestrian facilities. Traffic			

volume studies, origin destination studies, speed studies, travel time and delay studies, Parking studies, Accident studies.

Unit - 3	Number of	Title of the unit: Elements of design
	lectures = 10	

Alignment - Cross sectional elements - Stopping and passing sight distance. Horizontal curves - Vertical curves. Design problems – Hill Roads.

Unit - 4	Number of	Title of the unit: Traffic regulation and control
	lectures = 12	

Signs and markings - Traffic System Management - Design of at-grade intersections – Principles of design – Channelization - Design of rotaries - Traffic signals - pre-timed and traffic actuated. Design of signal setting - phase diagrams, timing diagram – Signal co-ordination

#### 11. Books Recommended Text Books

- 1. KW Ogden, Safer Roads: A Guide to Road Safety Engineering, Averbury Technical Press, Ash gate Publishers, 1996.
- 2. Rune Elvik and Truls Vaa, the Handbook of Road Safety Measures, Elsevier, 2004.

# **Reference Books**

- 1. Leonard Evans, Traffic Safety, Science Serving Society, 2004.
- 2. Ezra Hauer, Observational Before-After Studies in Road Safety, Pergamon Press, 1997 (reprinted 2002).
- 3. Highway Safety Manual (HSM).

1. Course Name	Highway Traffic Analysis and Design Laboratory	L	Т		Р	
2. Course Code		0	0		2	
3. Type of Course (	use tick mark)	Core ()	<b>PE</b> (✓)		<b>OE</b> ()	
4. Pre-requisite (if any)		Odd ()	Either Sem ()	Odd (✓)	Either Sem ()	Every Sem O
5. Total Number of	Lectures, Tutorials	s, Practical (assun	ning 14 weeks	of one sem	nester)	
Lectures = 0		Tutorials =0	Practic	al = 28		
<ol> <li>7. Learning objective</li> <li>1. Knowledge on anal</li> <li>2. Ability to work with</li> <li>3. Ability to conduct r</li> </ol>	es: yzing and solving transportation plan	affic engineering p ning software	roblems			
8. Course Outcomes						
At the end of the cour	(COS): se, the student will h	e able to				
<ol> <li>To introduce the produce the and</li> <li>To introduce the and</li> <li>To introduce the transmission</li> </ol>	actical problems on alysis software insportation planning	traffic engineering g software	and road safet	у		
9. Unit wise detailed	content					
1. Data Collection on	traffic stream param	eters and analysis				
a) Mid-block section						
b) Intersection						
2. Journey Time and I	Delay Studies by Mo	ving Car Observer	method			
3. Design of Roundab	out					
4. Noise Level Measu	rements					
5. Parking Study						
6. Introduction to Trai	ns CAD					

7. Introduction to EMME

1. Name of the I	Department	CIVIL	ENGINEERIN	G		
2. Subject	Environment	L	Т		Р	
Name	Impact					
	Assessment					
3. Subject		3	0		0	
Code						
4. Type of Subject (use tick		Core ()	PE(✓)		<b>OE</b> ()	
mark)						
5. Pre-	Waste water	Frequency (use	Even ()	Odd (✓)	Either	Every
requisite (if	Engineering	tick marks)			Sem	Sem
any)					0	0
6.Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures $= 42$		Tutorials =	Practical			

Understanding the importance of environmental effect of any infrastructure project and evaluating the socio-economic cost of that project, Understanding the various legal guideline to ensure proper evaluation and smooth execution of any project, Use of mathematical Models, Total Impact Assessment, Carbon trading.

# 8. Learning objectives:

1. Students will able to understand the Environment Damaging effects of any infrastructure project and how to minimize that.

2. Students will learn about the various legal guidelines for environment safety.

3. Students will learn about the use development of various mathematical models for Impact Assessment.

4. Concept of Carbon Trading.

# 9. Subject Outcomes:

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

1. Recognizing the growing need of civil engineering professionals to be acquainted with the potential environmental risks of infrastructure projects

2. Their nature, methods of qualitative and quantitative assessments, environmental risk evaluation,

risk management and remediation techniques and development of predictive model

3. The emerging aspects of environmental management including techniques of ecological foot printing and carbon trading will be illustrated.

10. Unit wise detailed content				
Unit-1	Number of	Title of the unit: Introduction to Environmental Impact		
	lectures = 08	Assessment (EIA)		
Technical and pr	ocedural aspects	of Environmental Impact assessment, Guidelines and legal aspects		
of environmental	protection.			
Unit - 2	Number of	Title of the unit:		
	lectures = 10	Adverse effect of pollution		
General Framew	ork for character	izing environmental dislocation disruption due to pollution		
Unit - 3	Number of	Title of the unit: Applications of Mathematical Theories		
	lectures = 14			
Theory and application of mathematical models:- Mathematical modeling for water quality systems,				
Stream and Estua	arine models for	pollution control		

Unit - 4	Number of	Title of the unit: Socio Economic effect of pollution
	lectures = 10	

Socio economic aspects, Measures of effectiveness of pollution control activities, Inter-sector pollutant transfers, total impact assessment.

# 11. Books Recommended

#### **Text Books**

(i) L. W. Canter, Environmental Impact Assessment, 2nd Ed., McGraw-Hill, 1997
(ii) P. Judith and G. Eduljee, Environmental Impact Assessment for Waste Treatment and Disposal Facilities, John Wiley & Sons, 1994.

#### **References**

(i) G. Burke, B. R. Singh and L. Theodore, Handbook of Environmental Management and Technology, 2nd Ed., John Wiley & Sons, 2000.

(ii) K. Whitelaw and Butterworth, ISO 14001: Environmental System Handbook, 1997.

(iii)R. Welford, Corporate Environmental Management - Systems and Strategies, Universities Press, 1996.

1. Name of the Department: Civil Engineering Department						
2. Course Name Environment		L	Т		Р	
	Impact					
	Assessment					
	Laboratory					
3. Course Code		0	0		4	
4. Type of Course (use tick mark)		Core ()	PE(✓)		<b>OE</b> ()	
5. Pre-requisite (if		Frequency (use tick	Even	$\operatorname{Odd}(\checkmark)$	Either	Every
any)		marks)	0		Sem ()	Sem
						0
6. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Loctures -		Tutorials -0	Practical - 28			

**7. Brief Syllabus:** Understanding the importance of environmental effect of any infrastructure project and evaluating the socio-economic cost of that project, Understanding the various legal guideline to ensure proper evaluation and smooth execution of any project, Use of mathematical Models, Total Impact Assessment, Carbon trading.

#### 8. Learning objectives:

1. Students will able to understand the Environment Damaging effects of any infrastructure project and how to minimize that.

2. Students will learn about the various legal guidelines for environment safety.

3. Students will learn about the use development of various mathematical models for Impact Assessment.

4. Concept of Carbon Trading.

#### 9. Course Outcomes (COs):

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

1. Recognizing the growing need of civil engineering professionals to be acquainted with the potential environmental risks of infrastructure projects

2. Their nature, methods of qualitative and quantitative assessments, environmental risk evaluation, risk management and remediation techniques and development of predictive model

3. The emerging aspects of environmental management including techniques of ecological foot printing and carbon trading will be illustrated.

- 1) Study of Guidelines and legal aspects of environmental protection.
- 2) Characterizing environmental dislocation disruption.
- 3) Theory and application of mathematical models
- 4) Mathematical modeling for water quality systems
- 5) Stream and Estuarine models for pollution control
- 6) Measures of effectiveness of pollution control activities

1. Name of the I	Department	CIVIL ENGINEERING				
2. Subject	Bridge L T			Р		
Name	Engineering					
3. Subject		3	0		0	
Code						
4. Type of Subject (use tick		Core ()	<b>PE</b> (✓)		<b>OE</b> ()	
mark)						
5. Pre-	Nil	Frequency (use	Even ()	Odd (✓)	Either	Every
requisite (if		tick marks)			Sem	Sem
any)					0	0
6 .Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						
Lectures = 42		Tutorials =0	<b>Practical =0</b>			

Bridge Aesthetics, Analyzing techniques, Prestress concrete, Steel bridge, Bridge in service.

#### 8. Learning objectives:

- 1. Various structural elements of bridge.
- 2. Students will be able to understand the various types of loading used for bridge analysis like Class A loading, 70R loading.
- 3. Steel structure analysis.
- 4. Maintenance of bridge.

#### 9. Subject Outcomes:

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

- 1. Understanding the importance of bridge aesthetics.
- 2. Understanding the various components and there importance in bridge.
- 3. Understanding the various kind of loading on bridge.
- 4. Use of concrete and steel bridge and their maintenance.

10. Unit wise detailed content					
Unit-1	Number of	Title of the unit: Introduction & Bridge Aesthetics			
	lectures=06				
Introduction, Pla	nning, Aesthetics	s and Bridge, Road bridges, Loading and IRC codes.			
Unit - 2	Number of	Title of the unit: Analyzing Techniques			
	lectures = 08				
Slab Bridges and	RCC T Beam B	ridges, Different analysis techniques-finite element, finite strip,			
finite difference. Grillage analysis.					
Unit - 3	Number of	Title of the unit: Prestress Concrete			
	lectures = 12				
Pre-stressed Concrete I Girder Bridges, Box Girder Bridges and Segmental Box Girder Bridges,					
Substructures inc	luding Abutmen	ts.			

Unit - 4	Number of	Title of the unit: Steel Bridge			
	lectures = 16				
Railway Bridges and IRS codes, Steel bridges: Truss Bridges and Plate Girder Bridges					
11. Books Reco	mmended				
7. Relevant IRC & IRS codes.					
9 N. Krishna Dain "Dasian of Dridge" Outand & Ikh (ISDN 9120417094)					

- 8. N. Krishna Raju, "Design of Bridge", Oxford & Ibh. (ISBN 8120417984).
- 9. Johnson Victor," Essentials Of Bridge Engineering", Oxford & Ibh, 2016.
- 10. Krishna Raju, "Prestressed Concrete", McGraw Hill Education; Sixth edition.

1.	Name of the Department: Civil Engineering Department						
2.	Course Name	Bridge	L	Т		Р	
		Engineering					
		Lab					
3.	Course Code		0	0		2	
4.	I. Type of Course (use tick mark)		Core ()	<b>PE</b> (✓)		<b>OE</b> ()	
5.	Pre-requisite (if	Structural	Odd ()	Either	Odd (✓)	Either	Every
	any)	Analysis		Sem ()		Sem ()	Sem
							0
6.	5. Total Number of Lectures, Tutorials, Practical (assuming 14 weeks of one semester)						

<b>Tutorials</b>	=0
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**Practical = 28** 

# 7. Brief Syllabus:

Lectures = 0

Bridge Aesthetics, Analyzing techniques, Prestress concrete, Steel bridge, Bridge in service.

#### 8. Learning objectives:

1. Various structural elements of bridge.

2. Students will be able to understand the various types of loading used for bridge analysis like Class A loading, 70R loading.

- 3. Steel structure analysis.
- 4. Maintenance of bridge.

# 9. Course Outcomes (COs):

1. Students will understand the various elements of bridge.

- 2. Students will appreciate the complexity of bridge design and analysis
- 3. Students will appreciate the importance of wind load in bridge stability analysis

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

- 1. Study of relevant IS codes and other guidelines
- 2. Understanding class-A loading
- 3. Understanding 70R loading
- 4. Various types of bridge foundation design
- 5. Bridge piers design
- 6. Understanding the load transfer mechanism in various types of bridges
- 7. Wind load analysis for bridge