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

B. Tech. Mechanical Engineering
Scheme & Syllabus (2017-18)

Vision of SGT University

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

Vision of the Department

Department endeavors to be recognized globally through outstanding education & research that produces qualified engineers who are ready to cater the everchanging industrial and social demands.

Mission of the department

- To create environment conducive for the quality teaching-learning interdisciplinary research and innovation.
- To establish academic system facilitating real learning in Mechanical Engineering.
- To prepare the graduates be leader in the profession.
- To inculcate universal human values, professional ethics and life-long learning attitude.
- To empower the learners to device their own unique path of education for acquiring multi specializations and skills.

Program Specific Outcomes (PSOs)

Mechanical Engineering Graduates will be able to:

PSO1 Apply viable aptitudes, learning in significant streams, for example, Thermal, Design, Mechatronics, Manufacturing, Production and Industrial Engineering.

PSO2 Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

PSO3 Improve team building, team working and leadership skills of the students with high regard for ethical values and social responsibilities.

PSO4 Communicate effectively and demonstrate the knowledge of project management and independent research.

Program Outcomes (POs)

At the end of the Bachelor of Technology in Mechanical Engineering program graduates will be able to:
PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization in mechanical engineering for the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex mechanical engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design / Development of Solutions: Design solutions for complex mechanical engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tools Usage: Create, select, and apply proper procedure, resources, and current engineering and mechanical tools including prediction and modelling to complex engineering activities in mechanical engineering with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning inferred by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and Sustainability: Understand the impact of professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO9: Individual and Team work: Function effectively as an individual, and as a member or leader in diverse teams, and multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Lifelong Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Curriculum for B.Tech. (Mechanical Engineering) Program

SEMESTER WISE COURSE STRUCTURE 2017-2018

First Semester

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1	13030101	Engineering Mathematics-I	3	1	0	4	50	50	100
2	13030102	Engineering Physics-I	3	0	0	3	50	50	100
3	13030103	Essential Communication-I	3	0	0	3	50	50	100
4	13030104	Introduction to Computer Hardware and Software	3	0	0	3	50	50	100
5	13030105	Industrial Chemistry	3	0	0	3	50	50	100
6	13030106	Engineering Drawing	3	0	0	3	50	50	100
7	13030107	Industrial Chemistry Lab	0	0	2	1	60	40	100
8	13030108	Computer Hardware and Software Programming Lab	0	0	2	1	60	40	100
9	13030109	Engineering Drawing Lab	0	0	2	2	60	40	100
10	13030110	Engineering Physics Lab-I	0	0	3	1	60	40	100
11	13030111	Essential Communication-I Lab	0	0	2	1	50	-	50
12	13030112	General Proficiency					50	-	50
		Total	**18**	**1**	**11**	**25**	**640**	**460**	**1100**

Second Semester

S. NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1	13030201	Engineering Mathematics-II	3	1	0	4	50	50	100
2	13030202	Engineering Physics-II	3	0	0	3	50	50	100
3	13030203	Essential Communication-II	3	0	0	3	50	50	100
4	13030204	Elements Of Mechanical Engineering	3	0	0	3	50	50	100
5	13030205	Electrical Technology	3	0	0	3	50	50	100
6	13030206	Workshop Technology	2	0	0	3	50	50	100
7	13030207	Fundamental Of Electronics	3	0	0	3	50	50	100
8	13030208	Electrical Technology Lab	0	0	2	1	60	40	100
9	13030209	Elements Of Mechanical Engineering Lab	0	0	2	1	60	40	100
10	13030210	Workshop Technology Lab	0	0	2	1	60	40	100
11	13030211	Engineering Physics Lab-II	0	0	2	1	60	40	100
12	13030212	Essential Communication-II Lab	0	0	2	1	50	-	50
13	13030213	Fundamental Of Electronics Lab	0	0	2	1	60	40	100
		Total	**20**	**1**	**12**	**28**	**700**	**550**	**1250**

Curriculum for B.Tech. (Mechanical Engineering) Program

Semester Wise Course Structure 2017-2018

Third Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1.	13030301	Professional Communication	0	0	4	2	40	60	100
2.	13030302	Complex Analysis & Programming	3	0	0	3	40	60	100
3.		Elective-III	3	0	0	3	40	60	100
4.	13030304	Engineering Mechanics	3	0	0	3	40	60	100
5.	13030305	Materials Engineering and Technology	3	0	0	3	40	60	100
6.	13030306	Engineering Thermodynamics	3	0	0	3	40	60	100
7.	13030307	Fundamentals of Manufacturing Processes	3	0	0	3	40	60	100
8.	13030308	Manufacturing Process Laboratory	0	0	2	1	40	60	100
9.	13030309	Materials and Metrology Laboratory	0	0	2	1	40	60	100
10.	13030310	Technical Skills for Mechanical Engineers-I	0	0	2	1	40	60	100
11.	13030311	Industrial Exposure – I	-	-	-	1	40	60	100
12.		Elective-IV	2	0	2	3	40	60	100
		Total	**19**	**1**	**12**	**27**	**480**	**720**	**1200**

S. No.	Elective-III		S. No.	Elective-IV	
1.	13030303	Psychology & Sociology	1.	13030312	Foreign Languages French–I
2.	**MOOC Course**	Technical English for Engineers*	2.	13030313	Foreign Languages German–I
3.	**MOOC Course**	Principles of Human Resource Management*			

Note: MOOC courses will start on display of list on SWAYAM portal in respective semester.

Curriculum for B.Tech. (Mechanical Engineering) Program

Semester Wise Course Structure 2017-2018

Fourth Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1.	13030401	Aptitude Building	0	0	4	2	40	60	100
2.	13030402	Numerical Methods and Computational Techniques	3	0	0	3	40	60	100
3.		Elective-V	3	0	0	3	40	60	100
4.	13030404	Fluid Mechanics	3	0	0	3	40	60	100
5.	13030405	Strength of Materials	3	0	0	3	40	60	100
6.	13030406	Kinematics of Machinery	3	0	0	3	40	60	100
7.	13030407	Machining Process and Metrology	3	0	0	3	40	60	100
8.	13030408	Computer Aided Machine Drawing	0	0	2	1	40	60	100
9.	13030409	Strength of Materials Laboratory	0	0	2	1	40	60	100
10.	13030410	Kinematics of Machines Laboratory	0	0	2	1	40	60	100
11.	13030411	Fluid Mechanics Laboratory	0	0	2	1	40	60	100
12.	13030412	Numerical Methods Laboratory	0	0	2	1	40	60	100
13.	13030413	Technical skills for Mechanical Engineers-II	0	0	2	1	40	60	100
14.	13030414	Industrial Exposure– II	-	-	-	1	40	60	100
15.		Elective-VI	2	0	2	3	40	60	100
		Total	**19**	**0**	**20**	**30**	**600**	**900**	**1500**

S. No.	Elective-V		S. No.	Elective-VI	
1.	13030403	Universal Human Values	1.	13030415	Foreign Languages French–II
2.	**MOOC Course**	Managing Services*	2.	13030416	Foreign Languages German–II
3.	**MOOC Course**	Language & Mind*			

Note: MOOC courses will start on display of list on SWAYAM portal in respective semester.

Curriculum for B.Tech. (Mechanical Engineering) Program

Semester Wise Course Structure 2017-2018

Fifth Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1.	13030501	Personality Development & Career Building	0	0	4	2	40	60	100
2.	13030502	Probability and statistics	3	0	0	3	40	60	100
3.	13030503	Dynamics of Machinery	3	0	0	3	40	60	100
4.	13030504	Design of Machine Elements	3	0	0	3	40	60	100
5.	13030505	Heat and Mass transfer	3	0	0	3	40	60	100
6.	13030506	Industrial Economics and Management	2	0	0	2	40	60	100
7.		Elective-VII	3	0	0	3	40	60	100
8.		Open Elective-I	3	0	0	3	40	60	100
9.	13030507	Dynamics of Machinery Laboratory	0	0	2	1	40	60	100
10.	13030508	Heat and Mass transfer Laboratory	0	0	2	1	40	60	100
11.	13030509	Technical skills for Mechanical Engineers-III	0	0	2	1	40	60	100
12.	13030510	Industrial Training – I	-	-	-	1	40	60	100
		Total	**20**	**0**	**10**	**25**	**480**	**720**	**1200**

S. No.	Elective- VII	
1.	13030511	Production Planning & Control
2.	13030512	Advanced Machining Process
3.	13030513	Fuels & Combustion
4.	13030514	Refrigeration & Air Conditioning
5.	**MOOC Course**	Basics of Noise & its measurement*
6.	**MOOC Course**	Manufacturing Systems Technology*

S. No.	Open Elective-I	
1.	13030516	Traffic Engineering
2.	13030515	Open Channel Flow
3.	13030519	Air & Noise Pollution
4.	13030520	Resource Management & Control in Construction
5.	13030523	E-Commerce
6.	13030524	Soft Computing
7.	13030525	Data Compression
8.	13030531	Data warehousing & Data Mining
9.	13030526	Electronic Measurements & Instrumentation
10.	13030527	Transmission Lines & Networks
11.	13030532	Advance Digital Signal Processing
12.	13030533	Electro-Mechanical Energy Conversion

Note: MOOC courses will start on display of list on SWAYAM portal in respective semester.

Curriculum for B.Tech. (Mechanical Engineering) Program

Semester Wise Course Structure 2017-2018

Sixth Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1.	13030601	Campus-to-Corporate	0	0	4	2	40	60	100
2.	13030602	Power Plant Engineering	3	0	0	3	40	60	100
3.	13030603	Instrumentation and Control Engineering	3	0	0	3	40	60	100
4.	13030604	Turbo-machines	3	0	0	3	40	60	100
5.	13030605	Entrepreneurship Development	2	0	0	2	40	60	100
6.		Elective-VIII	3	0	0	3	40	60	100
7.		Elective-IX	3	0	0	3	40	60	100
8.		Open Elective-II	3	0	0	3	40	60	100
9.	13030606	Instrumentation Laboratory	0	0	2	1	40	60	100
10.	13030607	Fluid and Turbo-machinery Laboratory	0	0	2	1	40	60	100
11.	13030608	Technical skills for Mechanical Engineers-IV	0	0	2	1	40	60	100
12.	13030609	Industrial Training – II	-	-	-	1	40	60	100
		Total	**20**	**0**	**10**	**26**	**480**	**720**	**1200**

S. No.	Elective-VIII		S. No.	Elective-IX	
1.	13030610	Automobile Engineering	1.	13030614	Mechatronics
2.	13030611	Rapid Manufacturing Technologies	2.	13030615	Mechanical Vibration
3.	13030612	Composite Materials	3.	13030616	Modeling & Simulation of Manufacturing Systems
4.	13030613	Product Design for Manufacturing	4.	13030617	Lean enterprise & Advanced Manufacturing Technologies
5.	**MOOC Course**	Vibrations of Structure*	5.	**MOOC Course**	Basics of Finite Element Analysis*
6.	**MOOC Course**	Manufacturing Process Technology part-I*	6.	**MOOC Course**	Project Planning and Control*

S. No.	Open Elective-II				
1.	13030619	Pre-Stressed Concrete	7.	13030636	Enterprise Resource Planning
2.	13030650	Renewable Energy Sources	8.	13030645	Mobile Computing
3.	13030633	Urban Water Resources Management	9.	13030640	Digital Image Processing
4.	13030627	Architecture & Town Planning	10.	13030641	Digital Logic Design with PLDs & VHDL
5.	13030634	Distributed System	11.	13030643	ASIC Design
6.	13030635	Wireless & Mobile Communication	12.	13030651	Microwave & Radar

Note: MOOC courses will start on display of list on SWAYAM portal in respective semester.

Curriculum for B.Tech. (Mechanical Engineering) Program

Semester Wise Course Structure 2017-2018

Seventh Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1.	13030701	Professional Ethics for Mechanical Engineering	2	0	0	2	40	60	100
2.	13030702	Operations Research Techniques	3	0	0	3	40	60	100
3.	13030703	Design of Transmission Systems	3	0	0	3	40	60	100
4.	13030704	CAD/CAM	2	0	0	2	40	60	100
5.		Elective-X	3	0	0	3	40	60	100
6.		Elective-XI	3	0	0	3	40	60	100
7.		Open Elective-III	3	0	0	3	40	60	100
8.		Open Elective-IV	3	0	0	3	40	60	100
9.	13030705	CAD/CAM Laboratory	0	0	4	2	40	60	100
10.	13030706	Transmission Systems Laboratory	0	0	2	1	40	60	100
11.	13030707	Industrial/Research Project (Phase-I)	-	-	2	3	40	60	100
		Total	**22**	**0**	**8**	**27**	**440**	**660**	**1100**

S. No.	Elective-X		S. No.	Elective-XI	
1.	13030708	Fluid Power System	1.	13030712	Nuclear Power Engineering
2.	13030709	Finite Element Analysis	2.	13030713	Robotics
3.	13030710	Computational Fluid Dynamics	3.	13030714	Gas Dynamics & Jet Propulsion
4.	13030711	Introduction to Biomaterials Science	4.	13030715	Nanomaterials
5.	**MOOC Course**	Foundation of Computational Fluid Dynamics*	5.	**MOOC Course**	Phase Diagrams in Material Science and Engineering*
6.	**MOOC Course**	Computational Fluid Dynamics*	6.	**MOOC Course**	Bio MEMS and Micro fluids*

S. No.	Open Elective-III				
1.	13030716	Radar Remote Sensing	7.	13030748	Software Project Management
2.	13030717	Construction Economics & Financial Management	8.	13030749	Image Processing & Pattern Recognition
3.	13030746	Intelligent Transportation System	9.	13030750	Wireless Sensor Network
4.	13030727	River Engineering	10.	13030738	Sensors & Transducers
5.	13030731	Cloud Computing	11.	13030751	Internet of Things
6.	13030747	Ethical Hacking	12.	13030752	Optical Communications

S.No.	Open Elective-IV	
1	13030753	Principles & Design of water treatment & Disposal
2	13030754	Product Design for

		Manufacturing
3	13030755	E-Commerce
4	13030756	Android App Development
5	13030757	Electronics Measurement & Instrumentation

Note: MOOC courses will start on display of list on SWAYAM portal in respective semester.

Curriculum for B.Tech. (Mechanical Engineering) Program

Semester Wise Course Structure 2017-2018

Eighth Semester

S.NO.	Subject Code	Course Title	L	T	P	C	Examination marks		Subject Total
							Int.	Ext.	
1.	13030801	Industrial/Research Project (Phase-II)	-	-	2	10	50	150	**200**
	Total Credits = 10								
	Overall Total Credits = I to VIII= 200								

13030301	Professional Communication	Learning Schedule			
		L	T	P	C
	Pre-requisites: English Proficiency	0	0	4	2

COURSE OBJECTIVE

1. Enhancing listening-speaking Skills
2. Enhance public speaking to further enhance the Grammar Skills
3. To understand skills pertaining to industry

COURSE OUTCOME:

1.To speak confidently before the audience
2.To be able to convey their ideas in an expressive and effective way
3.Get a holistic industry perspective

COURSE CONTENT

Unit-I: Writing Comprehension

Comprehension of Selected Passages from Stories and Articles, Grammatical Errors Detection, Errors in use of words, nouns, pronouns, adjectives etc i.e., all the grammatical categories, Error Detection, Errors in Sentence Formation: Tenses, Direct-Indirect Speech through Comprehension of Text from various Sources and Lab Software

Unit-II: Reading Comprehension

Developing Skills for Comprehension, Practice for Skills for Reading Comprehension, Using Text from Selected Stories/Newspapers and Handouts.

Unit-III: Narration

Finding out Topic Sentence, Order of Paragraph, Balance in Reading Comprehension, Emphasis will be Given on Correct Pronunciation and Intonation, Reading Practice and Exercise through Pictures, Video Clips and Software.

Unit-IV: Reading Skills and Narration

Reading Newspapers and Passages and Story Telling and Summarizing

Unit-V: Career Building

Mind Mapping, Career Planning, on camera exercises, Assessment Retake,

TEXT BOOKS

1. Sanjay Kumar and Pushp Lata ‘Communication Skills’, Oxford University Press 2012
2. Raymond Murphy ‘Essential English Grammar’, Cambridge University Press 1998

REFERENCE BOOKS

1. Meenakshi Raman and Sangeeta Sharma ‘Technical Communication Principles and Practice’, Oxford University Press 2012
2. Meenakshi Raman and Prakash Singh ‘Business Communication’ Oxford University

Press 2011

13030302	Complex Analysis & Programming	Learning Schedule			
		L	T	P	C
	Pre-requisites: **Advanced Engineering Mathematics**	3	0	0	3

COURSE DESCRIPTION

This course is an introduction to the concepts of Partial differential equations and their solution. The calculus of function of complex variable is discussed. Among the most important topics are Method of separation of variables and its applications to wave equation, one dimensional heat equation and two-dimensional heat flow, Analytic function, Cauchy-Riemann Equations, Harmonic functions with application to flow problem, Zeroes and Singularities of complex valued functions, Residues, Residue theorem and It's application in evaluation of real integrals around unit and semi circle. Z-Transform is also introduced and applied in solving difference equation

COURSE OBJECTIVES

To introduce the concepts of Partial Differential Equations that are often encountered in engineering study and techniques to solve them. To understand the behavior of complex variable function and calculus of complex variable functions. The introduction of Z-Transform and it's application in solving difference equation gives an exposure of discrete transform to the students. Each of these tools has immense practical application and lays a foundation of various courses in their future course of study.

COURSE OUTCOMES

By the end of the course the students are expected to be able to:

1. Understand concepts of Partial Differential Equations and techniques to solve them.
2. Understand the behavior of complex variable function and importance of a special class of function, analytic functions in evaluating complex and real integrals.
3. Understand the application of Z-Transform in solving difference equation.

COURSE CONTENT

Unit I: Linear Programming: Linear programming problems formulation, Solving linear programming problems using Graphical method, Simplex method and Dual simplex method.

Unit II: Functions of Complex Variable: Some standard functions of complex variables, Limit, Continuity, Differentiability of function, Analytic function, Cauchy-Riemann Equations in Cartesian and Polar form (with Proof), Sufficient conditions for a function to be analytic (without Proof), Harmonic functions.

Unit III: Complex Integration : Cauchy- Goursat theorm(Only statement and applications), Generalized Cauchy Integral formula (with-out Proof), Taylor's and Laurent's series (Without Proof), radius and circle of convergence, Zeroes and Singularities of complex valued functions, Residues, Residue theorem and it's application in evaluation of real integrals around unit and semi circle.

Unit IV: Tests of Hypothesis and Significance

Hypothesis testing, Null and Alternate hypothesis, test of hypothesis and significance, Special tests

of significance for Large samples and Small samples (F, chi- square, z, t- test).

Unit V: Probability and its Distributions: Conditional probability, Bayes theorem and its applications, expected value of a random variable. Properties and application of Binomial, Poisson and Normal distributions.

TEXT BOOKS

1. Advanced Engineering Mathematics : *R. K. Jain and S. R. K. Iyengar*, Narosa Publishers.
2. Advanced Engineering Mathematics : B.S. Grewal Khanna Publishers.
3. Advanced Engineering Mathematics : *Michael D. Greenberg*, Pearson Education, Asian
4. Advanced Engineering Mathematics : *E. Kreyszig*, John Wiley & Sons.

13030303	Psychology and Sociology	Learning Schedule			
		L	T	P	C
	Pre-requisites: **NIL**	3	0	0	3

COURSE DESCRIPTION

This course makes the students able to understand and deal with personal and professional aspects of life. They become able to deal with common psychological problems encountered in an engineer's life. Their ability to deal with societal aspects of behavior is enhanced. By application of knowledge their quality of personal living and job is maximized.

COURSE OBJECTIVES

1. To sensitize about Psychological and Sociological issues of human life.
2. To make them able to understand and deal with personal and organization phenomenon.
3. Develop an understanding of society as a system of social relationship and various social processes.
4. Develop capacity to analyze social stratification and social change by using relevant theoretical concepts.
5. To make learners aware of contemporary issues of society.

COURSE OUTCOMES

On completion of this course, the students will

1. Be able to understand and deal with personal and organization phenomenon.
2. Be able to deal with common psychological aspects related to an Engineer's life.
3. Be able to understand the impact of social environment on individuals, groups and communities.
4. Be able to utilize the knowledge of Sociology and to improve the quality of living of self and social relationship at large.

CONTENTS

Unit I: Psychology: Introduction Definition and Scope of Psychology; Psychology as a science, Personality: Definition, types of personality, Measurement of Personality. Perception, Motivation and Learning.

Unit II: Applications

Application of Psychology: Stress-management, Well-being; Self-development: Application of Psychology in building memory and creativity.

Unit III: Sociology: Introduction

Importance of Sociology for Engineers, Sociology: Definition and nature; Origin of Society, Social Processes: - Competition, Cooperation Conflict, Accommodation and Assimilation, Social groups – Types and Characteristics; Social Institutions: Marriage: and Family; Religion: Functions and dysfunctions of religion.

Unit IV: Social concerns

Social Stratification: Nature and types, Prejudices, Social Mobility. Social Changes: - Urbanization, Westernization, and Pluralism. Social Disorganization, Social Problems: - Deviance, Delinquent behavior amongst youth, Crime, Prostitution, Gender injustice, Child Abuse, Terrorism. Social Movements.

TEXT BOOKS

1. Robbins Stephen, Organizational Behavior. P. Prentice Hall International, Inc. Eaglewood Cliff s, 2005, ISBN: 0-13- 191435-9 , 11th Edition
2. Eastwood and Atwater, Psychology for living: Adjustment, growth and behavior today. Prentice Hall, 2005, ISBN: 0-13-118117-3, 8th Edition
3. Sharan, Raka, A Hand Book of Sociology ,Anmol Publications, 1995, ISBN: ISBN- 81-7041-503-1
4. Singh.U.S, Sociology, Priya Books, 1998, ISBN:

REFERENCE BOOKS

1. Meena Hariharan and Radhanath Rath, Coping with life stress. Sage Publications, 2008, ISBN: 0761936556, 10th edition,
2. Dimatto, MR. and Martin, L.R., Health Psychology. Pearson, 2001, ISBN: 0205297773, 10th edition
3. Grace Davie, Sociology of Religion, Sage Publications, 2007, ISBN: 9780761948919
4. Shankar Rao, C .N, Sociology , S.Chand &Co Ltd, 2005, ISBN:
5. Sharma. K.R,Indian Society, Atlantic Publishers, 1997, ISBN:

13030304	Engineering Mechanics	Learning Schedule			
		L	T	P	C
	Pre-requisites: Engg. Physics & Mathematics	3	0	0	3

COURSE DESCRIPTION

Engineering Mechanics course is to expose students to problems in mechanics as applied to real-world scenarios. In this subject students learn the how to apply laws of mechanics to actual engineering problems. By this subject students develop analytical skill of splitting the larger practical problems into a number of small problems like make free body diagrams and solve them easily.

COURSE OBJECTIVES

1. To calculate the reactive forces and analyze the structures.
2. To know the geometric properties of the different shapes.
3. To learn energy and momentum methods.

COURSE OUTCOMES

At the end of this course, the learner will be:

1. Solve the engineering problems in case of equilibrium conditions.
2. Calculate the reaction forces of various supports of different structures.
3. Solve the problems involving dry friction.
4. Determine the centroid, centre of gravity and moment of inertia of various surfaces and solids.
5. Calculate the forces acting on the rigid body, structures using the principle of virtual work.

COURSE CONTENT

Unit I: Equilibrium of Particle and Rigid body

Introduction to Mechanics – Fundamental Principles – Coplanar forces – Equilibrium of particles – Free body diagram – Equilibrium of particle in space – Single equivalent force -- Equilibrium of rigid bodies in two dimensions. Analysis of plane trusses –Method of joints – Method of sections – Zero-force member.

Unit II: Friction and Virtual work

Characteristics of dry friction – Problems involving dry friction – Ladder – Wedges – Square threaded screws. Definition of virtual work – Principle of virtual work – System of connected rigid bodies – Degrees of freedom – Conservative forces – Potential energy – Potential energy criteria for equilibrium.

Unit III: Properties of Surfaces and Solids

Centroid – First moment of area – Theorems of Pappus and Guldinus – Second moment of area – Moment and Product of inertia of plane areas – Transfer Theorems – Polar moment of inertia – Principal axes – Mass moment of inertia.

Unit IV: Kinematic and Kinetics

Position, Velocity and Acceleration – Rectilinear motion – Curvilinear motion of a particle – Tangential and Normal components –Radial and Transverse components – Rotation of rigid bodies about a fixed axis – General plane motion – Absolute and relative motion method – Instantaneous centre of rotation in plane motion.

Linear momentum – Equation of motion – Angular momentum of a particle and rigid body in plane motion – D'Alembert's principle.

Unit V: Energy and Momentum Methods

Principle of work and energy for a particle and a rigid body in plane motion – Conservation of energy - Principle of impulse and momentum for a particle and a rigid bodies in plane motion – Conservation of momentum – System of rigid bodies– Impact - direct and central impact – coefficient of restitution.

TEXT BOOKS

1. J. V. Rao, D. H. Young, S. Timoshenko, Sukumar Pati (2013), Engineering Mechanics, Tata McGraw Hill Education. ISBN: 978-1-259-06266-7

REFERENCE BOOKS

1. P. Ferdinand, E. Beer and J. Russell (2010), Vector Mechanics for Engineers, 9th Edition, McGraw-Hill International Edition. ISBN: 978-0-079-12637-5
2. Irving H. Shames (2012), Engineering Mechanics – Statics and Dynamics, 4th Edition, Prentice-Hall of India Private limited. ISBN: 978-8-131-72883-3

13030305	Materials Engineering and Technology	Learning Schedule			
		L	T	P	C
	Pre-requisites: Advanced Material Physics	3	0	0	3

COURSE DESCRIPTION

This introductory course combines the academic disciplines of chemistry, physics, and engineering to create a MST curriculum. The course covers the fundamentals of ceramics, glass, metals, polymers, and composites. Designed to appeal to a broad range of students, the course combines hands-on activities, demonstrations and long term student project descriptions. The basic philosophy of the course is for students to observe, experiment, record, question, seek additional information, and, through creative and insightful thinking.

COURSE OBJECTIVES

1. The main objective of this course is to provide the basic knowledge needed to explore the discipline of materials science and engineering.
2. To develop the knowledge of how the structure of materials is described technically.
3. To develop the knowledge of how the properties of materials are described and how material failure is analyzed.
4. To introduce the concepts of structure-property.
5. To develop knowledge in various class of materials and their applications.

COURSE OUTCOMES

At the end of this course, the learner will be:

1. Understand how materials are formed and their classification based on atomic arrangement.
2. Describe the mechanical behaviour of metallic systems and its importance.
3. Evaluate system for fatigue failures.
4. Gain knowledge on different class of materials and their applications.

COURSE CONTENT

Unit -1 Crystal Structure and their Imperfections

Introduction to materials science – Primary and Secondary bonding in materials- Crystalline and amorphous materials –Single crystal and polycrystalline materials – Space Lattice-Module cell – Crystal systems – Bravais Lattice- Miller indices – Closed packed structures- Principal Metallic crystal structures, stacking sequence and stacking faults, classification of crystal defects- Point, Line, surface and volume, Edge & Screw dislocation, Effect of imperfection on material properties, Numerical Problems on crystallography.

Unit - II Phase Diagram

Basics of Solidification mechanism – Cooling curve of pure metal and alloy – Phase –Phase Diagram–Gibbs's Phase rule – Interpretation of mass fractions using Lever's rule, Binary Iso-morphous system, Binary Eutectic alloy system (Lead-Tin System) –Binary Peritectic alloy system (Iron-Nickel System) – Invariant reactions – Iron-Iron carbide phase diagram- Slow cooling of Hypo and hyper eutectoid steels – Temperature-Time-Transformation (TTT) and Continuous Cooling Transformation (CCT) Diagrams – Effect of alloying elements in steel – types of stainless steel and cast iron

Unit - III Heat Treatment

Heat Treatment – Annealing and its types, Normalizing, Hardening tempering, Aus-tempering and Martempering – Microstructure observation – Surface Heat treatment processes – Carburizing, Nitriding, cyaniding, carbonitriding, flame and induction hardening.

Unit - IV Mechanical Properties of Materials and Testing

Mechanical properties of materials – Strengthening mechanism –- Plastic deformation of single and poly-crystalline materials – Effect of Slip and twinning – Stress-strain curves of various ferrous and non-ferrous metals –Engineering stress strain – true stress strain relations –problems - Tensile test of ductile material – properties evaluation- Hardness measurement tests – Fracture of metals – Ductile and Brittle fracture; Fatigue – Endurance limit of ferrous and non-ferrous metals – Fatigue test ; Creep and stress rupture– mechanism of creep – stages of creep and creep test – SEM, XRD.

Unit - V Advance Material and Application

Composites – Fiber reinforced, Metal Matrix, Ceramic Matrix – properties and applications; Ceramics – Alumina, Zirconia, Silicon Carbide, Sialons, Reaction Bonded Silicon Nitride(RBSN), Glasses– properties and applications- Magnetic materials – Hard and soft magnets – Ferromagnetic Hysteresis – properties of magnetic materials – Intermetallic compounds-Polymers – thermosetting and thermoplastics – mechanical properties of polymers- Material selection procedure (two case studies)

TEXT BOOKS

1. V. Raghavan. Materials science and engineering
2. William D. Callister , David G. Rethwisch, fundamentals of materials science and engineering: an integrated approach
3. O.P.Khanna , T, Dhanpat Rai Publication House, New Delhi

REFERENCE BOOKS

1. William F. Smith and Javad hashemi (2004), Foundations of materials science and engineering 4th ed., mc graw hill.

13030306	Engineering Thermodynamics	Learning Schedule			
		L	T	P	C
	Pre-requisites: Engineering Physics	3	0	0	3

COURSE DESCRIPTION

This course provides a basic grounding in the principles and methods of classical thermodynamics. It concentrates on: understanding the thermodynamic laws in relation to familiar experience; phase change, ideal gas and flow processes; using sources of data like thermodynamic tables and charts; application of the basic principles to the operation of various vapour and gas power cycles; and fuels and combustion.

COURSE OBJECTIVES

1. To learn the basic principles of classical thermodynamics.
2. To apply the laws of thermodynamics to various systems and analyze the significance of the results.
3. To analyze the performance of thermodynamic gas and vapour power cycles.

COURSE OUTCOMES

On completion of this course the student will be able to

1. Differentiate between closed and open systems and analyze related problems.
2. Apply the concept of second law to design thermodynamic systems.
3. Analyze the performance of gas and vapour power cycles and identify methods to improve thermodynamic performance.
4. Solve problems of combustion and stoichiometry

COURSE CONTENT

Unit -1 Basic Concepts and First Law of Thermodynamics

Basic concepts of Thermodynamics - Thermodynamics and Energy - Closed and open systems - Properties of a system - State and equilibrium - Processes and cycles - Forms of energy - Work and heat transfer - Temperature and Zeroth law of thermodynamics -First law of thermodynamics - Energy balance for closed systems - First law applied to steady – flow engineering devices

Unit - II Second Law of Thermodynamics

Limitations of the first law of Thermodynamics - Thermal energy reservoirs - Kelvin-Planck statement of the second law of thermodynamics - Clausius statement - Equivalence of Kelvin-Planck and Clausius statements - Refrigerators, Heat Pump and Air-Conditioners –COP - Perpetual Motion Machines - Reversible and Irreversible process - Carnot cycle – Entropy -The Clausius inequality - Availability and irreversibility -Second law efficiency

Unit - III Vapour and Gas Power Cycles

Properties of pure substance-Property diagram for phase - change processes - Carnot vapour cycle - Rankine cycle - Methods for improving the efficiency of Rankine cycle - Ideal Reheat and Regenerative cycles - Binary vapour cycles - Combined gas – vapour power cycles - Analysis of power cycles - Carnot cycle - Air standard assumptions - Otto cycle - Diesel and Dual cycles – Brayton cycle - Stirling and Ericsson cycles

Unit - IV Ideal Gas Mixtures

Ideal and real gases - Vander Waals equation - Principle of corresponding states - Ideal gas equation of state - Other equations of state - Compressibility factor - Compressibility charts - Composition of gas mixtures - Mass and mole fractions - Dalton’s law of additive pressures - Amagat’s law of additive volumes - Relating pressure, volume and temperature of ideal gas mixtures – Evaluating internal energy - enthalpy - entropy and specific heats.

Unit - V Fuels and Combustion

Types of fuels - Exothermic and endothermic reactions - Combustion equations – Stoichiometry - Combustion analysis by mass and volume - Conversion of gravimetric to volumetric analysis - Conversion of volumetric to gravimetric analysis - Analysis of exhaust gas - Excess air and air-fuel ratio - Combustion problem by mole method - Complete combustion of fuel - Calorific value –Definition - Types of calorimeter.

TEXT BOOKS

1. P. K. Nag (2010), Basic and Applied Thermodynamics, Tata McGraw-Hill Publishing Company Ltd., ISBN 978-0-070-15131-4

REFERENCE BOOKS

1. Yunus A. Cengel (2005), Thermodynamics: An Engineering Approach, Tata McGraw- Hill Publishing Company Ltd.,ISBN 978-0-073-30537-0
2. C. P. Arora, (2001), Thermodynamics, Tata McGraw- Hill Publishing Company Ltd.,ISBN 978-0-074-62014-4.

13030307	Fundamentals of Manufacturing Processes	Learning Schedule			
		L	T	P	C
	Pre-requisites: Adv. Material Physics and Engg. Physics	3	0	0	3

COURSE DESCRIPTION

The fundamental idea of manufacturing or production is to create that has a useful form. This form is most likely predetermined, calculated, with a certain physical geometry. Usually this geometry has certain tolerances that it must meet in order to be considered acceptable. A tolerance outlines the geometric accuracy that must be achieved in the manufacturing process. Students learn Metal Casting Processes, Joining Processes, Metal Forming Processes, Processing of Powder Metals, Ceramics and Glass, Processing of Plastics and Composite Materials, Rapid Prototyping and Tooling.

COURSE OBJECTIVES

1. To acquire basic knowledge about the behaviour and manufacturing properties of engineering materials and concepts of foundry and casting processes.
2. To acquire knowledge about various methods of welding, cold and hot working and forming.
3. To understand forging, moulding and powder metallurgy processes in detail and application of these in manufacture of a product.

COURSE OUTCOMES

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

1. Use the principles of foundry and casting.
2. Choose materials in a manufacturing process based on their properties.
3. Conduct experiments on various manufacturing processes.
4. Demonstrate an ability to solve engineering problems in welding and powder metallurgy processes.
5. Choose correct manufacturing process for a particular engineering application.

COURSE CONTENT

Unit-1 Metal Casting Processes

Manufacturing- selecting manufacturing process – global competitiveness of manufacturing costs – Fundamentals of materials-their behavior and manufacturing properties – Ferrous metals and alloys – Non ferrous metals and alloys –Fundamentals of metal casting – Fluidity of molten metal – Solidification time – Sand casting – Shell mold casting - Investment casting - Plaster mold casting – Ceramic mold casting – Die casting - Centrifugal casting – Melting practice and furnaces - Defects in casting – Testing and inspection of casting.

Unit- 2 Joining Processes

Metal fusion welding processes – Oxy fuel gas welding – Arc welding processes – Consumable electrode: SMAW- SAW – GMAW – FCAW – Electro gas welding – Electro slag welding – Non-consumable Electrode: GTAW- AHW- PAW – EBM – LBM – Solid state welding processes: Ultrasonic welding – Friction welding – Friction stir welding -Resistance welding – Weld quality – Testing welded joints.

Unit-3 Metal Forming Processes

Cold and Hot working: Rolling – Forging – Extrusion – Drawing – Sheet metal forming processes – High Energy Rate Forming Processes: Explosive Forming – Electro Hydraulic Forming – Electro Magnetic Forming.

Unit-4 Processing of Powder Metals, Ceramics and Glass

Production of metal powders: Compaction – Sintering and Finishing – Design considerations for powder metallurgy and Process capability – Shaping of ceramics – Forming and shaping of glass – Design considerations for ceramics and glass – Processing of superconductors.

Unit-5 Processing of Plastics and Composite Materials

Types of Plastics – Types of Molding: Injection molding – Blow molding – Compression molding – Transfer molding – Thermo-forming – Reinforced plastics – Metal Matrix Composites – Ceramic Matrix Composites.

TEXT BOOKS

1. P.N.Rao. (2008), Manufacturing Technology – Foundry, Forging and Welding (Vol-1), 3rd Edition, McGraw Hill Publishing Company Ltd., New Delhi, ISBN: 978-0-070-08798-9.Tata.

REFERENCES BOOKS

1. A.K. Hajra Choudhury, S.K. Hajra Choudhury and Nirjhar Roy (2009), Elements of Workshop Technology, Vol. – I, Media Promoters, ISBN: 978-8-185-09914-9.
2. W.A.J.Chapman (2001), Workshop Technology, Vol 1, 5th Edition, CBS Publishers, ISBN: 978-8-123-90401-6.

13030308	Manufacturing Processes Laboratory	Learning Schedule			
		L	T	P	C
	Pre-requisites: Fundamentals of Manufacturing Processes	**0**	**0**	**2**	**1**

COURSE OBJECTIVES

1. To carry out exercise in foundry shop.
2. To carry out exercise using different welding techniques.

COURSE OUTCOMES

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

1. Produce simple cast components.
2. Demonstrate relationship between different machining parameters.
3. Join the metals using different welding techniques.

LIST OF EXPERIMENTS

1. Study and identification of various types of flames generated in oxy-acetylene.
2. Preparation of butt joint using arc welding.
3. Preparation of joint using spot welding.
4. To establish the relationship between cutting speed, feed rate and depth of cut during forces generated in oblique cutting.
5. Preparation of green sand mould using wooden pattern.
6. Determination of grain fineness number.
7. Determination of permeability number.
8. Welding of stainless steel specimen using TIG welding.

13030309	Materials and Metrology Laboratory	Learning Schedule			
		L	T	P	C
	Pre-requisites: Materials Engineering and Metrology	0	0	2	1

COURSE OBJECTIVES

1. To develop knowledge about micro structure examination and properties of materials this is modified by different heat treatment process.
2. To gain practices in measurements and measuring instruments.

COURSE OUTCOMES

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

1. Compare the microstructures of different metals.
2. Know the procedures of different heat treatment process.
3. Measure the different measurements using measuring instruments and analyse the errors.

List of Experiments

1. Specimen preparation and micro-structural examination.
2. Comparative study of microstructures of given specimens (mild steel, gray C.I., brass, copper etc.)
3. Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
4. Making a plastic mould for small metallic specimen.
5. Study & working of simple measuring instruments- Vernier calipers, micrometer, tachometer.
6. Measurement of effective diameter of a screw thread.
7. Measurement of angle using sine bar & slip gauges.
8. Study & angular measurement using bevel protector.
9. Study of undulation measurement using dial gauge.
10. Study of corrosion in given sample.
11. Measurement of gear dimensions using tool maker's microscope.

TEXT BOOKS

1. V. Raghavan. Materials science and engineering: A first course 5e
2. William D. Callister , David G. Rethwisch, fundamentals of materials science and engineering: an integrated approach 3e: An integrated approach 3e
3. O.P.Khanna , Material Science and Metallurgy, Dhanpat Rai Publication House, New Delhi

REFERENCE BOOKS

1. William F. Smith and Javad hashemi (2004), Foundations of materials science and engineering 4th ed., mc graw hill.

13030310	Technical Skills for Mechanical Engineers-I	Learning Schedule			
		L	T	P	C
	Pre-requisites: Basic Engineering I/II	0	0	2	1

COURSE DESCRIPTION

The aim of this course is to observe the basic principles/concepts and solve problems through creative thinking. This course provides a basic understanding in the principles of classical thermodynamics, materials science and mechanism of machines. Students learn metal cutting technologies of conventional and non-conventional techniques and importance of manufacturing techniques. C programming and CAD modelling included in the course provides basic knowledge in the application of computer language and software in the field of mechanical engineering. It also includes practice session to solve objective types question in the areas of materials science, thermal, machining, manufacturing, instrumentation and C programming, etc.

COURSE OBJECTIVES

1. To provide the basic knowledge to investigate the discipline of materials science.
2. To develop the knowledge in the area of conventional and unconventional machining process.
3. To learn the laws of thermodynamics and analyze the significance of the results.
4. To understand the behaviour of manufacturing techniques.
5. To understand the basics concepts of computer graphics and modelling.

COURSE OUTCOMES

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

1. Gain knowledge on different type of materials and their applications.
2. Apply the concept of laws of thermodynamics to design thermodynamic systems.
3. Describe the various principle of Traditional and non-traditional machining processes.
4. Understand fundamental elements of instrumentation, measurement and control system and CAD modelling.
5. Develop the basic knowledge to solve the multiple choice questions and focus the corporate interviews.

COURSE CONTENT

Unit I: Fundamentals of materials and thermodynamics

Crystal systems – Bravais Lattice - Miller indices. Solidification mechanism, Phase Diagram. Mechanical properties of materials, Stress - strain diagram, elastic constant, bending, torsion. Equilibrium of particle, friction, centroid, motion of a particle. Closed and open systems - law of thermodynamics. COP -Refrigerators and Heat Pump. Carnot- Rankine cycle. Otto cycle - Diesel cycle.

Unit II: Fundamentals of machining, manufacturing and mechanism

Mechanism of chip formation - Lathe, Milling, Gear Generation and Grinding Machines. Non traditional machining procecss- EDM, ECM, AJM, etc. Metal forming - Metal casting - Metal joining process. Degrees of freedom, bar and slider crank mechanisms, Analytical method for four bar and slider crank mechanisms. Types of cams and followers - Simple harmonic motion. Kinematics of gears and gear train

Unit III: Instrumentation and C programming

Measurement Of Vibrations, Pressures, Temperature, Force, Speed. Open And Closed Loop Systems. Overview of operating systems, Assembler, Compilers, Interpreters. Constructs of C- Arrays and Functions.

Unit IV: CAD modelling

Graphics input and output devices, Neutral File formats – IGES, STEP. CAD modelling of simple machine and automobile components - Preparation of assembled and detailed drawings of I.C. engine components using AUTOCAD/CATIA/PRO-E, etc

Unit V: Practice session

Multible choice questions are discussed and tests are conducted based on module I,II, III and IV

TEXT BOOKS

1. S. Kapakjian and S.R. Schmid (2005), Manufacturing Engineering and Technology, 4th Edition, Pearson Education (Singapore) Pvt. Ltd. ISBN: 978-8-177-58170-6.
2. Mikell P. Groover (2008), Automation, Production Systems and Computer Integrated Manufacturing, 3rd Edition, Pearson Education. ISBN: 978-8-120-33418-2.
3. V. Raghavan. Materials Science and Engineering: A First Course 5E, ISBN 9788120324558.
4. V. K. Jain (2004), Advanced Machining Processes, 1st Edition, Affilated Allied Publishers. ISBN: 978-8-177-64294-0.
5. P. K. Nag (2010), Basic and Applied Thermodynamics, Tata McGraw-Hill Publishing Company Ltd., ISBN 978-0-070-15131-4
6. I.J. Nagrath and M. Gopal (1999), Control Systems Engineering, New Age Int. Pub.
7. E. Balagurusamy (2008), Computing Fundamentals and C Programming, Tata McGraw-Hill
8. S. S. Rattan (2011) Strength of material Tata McGraw Hill Education. ISBN: 978-0-071-07256-4.
9. J. V. Rao, D. H. Young, S. Timoshenko, Sukumar Pati (2013), Engineering Mechanics, Tata McGraw Hill Education. ISBN: 978-1-259-06266-7

REFERENCE BOOKS

1. O.P. Khanna & M. Lal (2010), A Text book of Production Technology, Dhanpat Rai, Publications, New Delhi, ISBN: 978-8-189-92832-2.
2. Ibrahim Zeid (2009), Mastering CAD/CAM, 2nd Edition, Tata McGraw Hill International Edition, ISBN: 978-0-070-15134-5.
3. C. P. Arora, (2001), Thermodynamics, Tata McGraw- Hill Publishing Company Ltd.,ISBN 978-0-074-62014-4.
4. William F. Smith and Javad Hashemi (2004), Foundations of Materials Science and Engineering 4th ed., MC GRAW HILL. ISBN: 978-0-073-52924-0
5. Hassan El-Hofy (2005), Advanced Machining Processes, 1st edition Affilated McGraw-Hill. ISBN: 978-0-071-45334-9.
6. A.K. Hajra Choudhury, S.K. Hajra Choudhury and Nirjhar Roy (2009), Elements of Workshop Technology, Vol. – I, Media Promoters, ISBN: 978-8-185-09914-9.
7. J. Uicker John, Gordon R. Pennock Jr. and Joseph E. Shigly (2011), Theory of Machines and Mechanisms, 4th Edition, Oxford University Press, ISBN: 978-0-199-77781-5.
8. Irving H. Shames (2012), Engineering Mechanics – Statics and Dynamics, 4th Edition, Prentice-Hall of India Private limited. ISBN: 978-8-131-72883-3.

13030311	Industrial Exposure -I	Learning Schedule			
		L	T	P	C
	Pre-requisites: Introductory knowledge of Engg. Subjects	-	-	-	1

COURSE OBJECTIVES:

1. To gain industrial exposure through industrial visit in various companies.
2. To experience the discipline of working in a professional organisation and multidisciplinary team.
3. To develop interpersonal, technical and communication skills.

COURSE OUTCOMES

On completion of this component of curriculum, the students will be able to

1. Get exposure to real-life-working environment & practices, and to attain the professionalisms.
2. Work with multi-tasking professionals and multidisciplinary team.
3. To aware about portfolio of industry.

COURSE CONTENT

Industrial visit in various organizations related to Mechanical and Manufacturing discipline.

13030401	Aptitude Building	Learning Schedule			
		L	T	P	C
	Pre-requisites: Professional Communication	0	0	4	2

COURSE OBJECTIVES:

1. To prepare the students write their project report
2. Get ready to write proposals implementing their ideas
3. To prepare them to speak in Public
4. To make them prepare effective Presentations
5. Enable students in Aptitude building
6. Enable students to use their Aptitude Knowledge effectively in decision making

COURSE OUTCOME:

1. Students are trained to write the proposals and assigned projects
2. Students are confident in Public Speaking
3. Students write Presentations on different Industrial topics
4. Improve arithmetic aptitude
5. Learn tricks to solve Aptitude questions faster thereby saving time during competitive exams

COURSE CONTENTS

Unit-I Report, Proposal and Project

Report Writing, Types, Structure, Style and Writing of Reports (on different topics), Characteristics of Report, Categories and Types of Report, Types of Proposal, Nature and Significance, Structure of formal Proposal, Sample Proposal, Writing Proposals on different topics, Difference between Report and Proposal, Project Writing: Essential Features, Structure, Choosing the Subject and Writing the Project on the related Subject.

Unit-II: Speaking Skills

Group Discussions, Public Speaking, Assertive and Negotiation Strategies.

Unit-III: Communication Skills

Activities related to Skills required for Engineers (Managerial Skills, Leadership Skills, and Organizational Skills).

Unit-IV: Strategies for Recruitment

Recruitments and Interviews, Stages in Job Interview, Desirable Qualities, Reviewing the common Question Types of Interviews.

Unit-V: Numbers and Arithmetic Basic

Classification of Numbers, Divisibility rules –LCM/HCF, Remainders – Base System, Surds, Indices, Logarithms, Percentage, Profit and Loss, Ratio and Proportion, Approximations, Vedic Maths, Intro to DI, Comprehensive Practice Test on Number system, Percentage and Calculation,

Simple Arithmetic:

Code-decoding, Analogies, Direction Test, Blood relations ,Comprehension Practice test-1 (Cumulative) ,Comprehension Practice test-2 (Cumulative)

TEXT BOOKS

1. Sanjay Kumar and Pushp Lata ‘Communication Skills’, Oxford University Press 2012

2. Raymond Murphy ‘Essential English Grammar’, Cambridge University Press 1998
3. Meenakshi Raman and Sangeeta Sharma ‘Technical Communication Principles and Practice’, Oxford University Press 2012
4. R. K. Narayan, Malgudi Days: A Collection of Short Stories, Penguin 2006
5. Meenakshi Raman and Prakash ‘Business Communication’ Oxford University Press 2011
6. Hory Sankar Mukerjee ‘Business Communication Connecting at Work’ Oxford University Press 2013
7. E. Suresh Kumar, P. Sreehari and J. Savithri ‘Communication Skills and Soft Skills An Integrated Approach’, Pearson 2012

REFERENCE BOOKS

1. Nitin Bhatnagar and Mamta Bhatnagar ‘Effective Communication and Soft Skills: Strategies for Success’, Pearson 2012
2. Francis Peter S. J ‘Soft Skills and Professional Communication’, Tata McGraw-Hill 2012
3. Barun K. Mitra ‘Personality Development and Soft Skills’, Oxford University Press 2011
4. Dr. Seema Miglani, Shikha Goyal and Rohit Phutela ‘Communication Skills-II’, Vayu Education of India 2009
5. L. Ann Masters and Harold R. Wallace ‘Personal Development for life and Work’ Cengage Learning 2012

13030402	Numerical Methods and Computational Techniques	Learning Schedule			
		L	T	P	C
	Pre-requisites: **Complex Analysis & Prog.**	3	0	0	3

COURSE DESCRIPTION

Numerical methods are extremely powerful problem solving tools .These tools are capable of handling large system of equations, nonlinearities and complicated geometries that are not uncommon in engineering practice and that are often impossible to solve analytically. Numerical methods are an efficient vehicle for learning to use computer. The course starts with the introduction of various types of errors and their sources that are encountered in implementation of these techniques. Students learn various meth-ods in solving non linear equations and very large system of linear equations in the situation when analytical methods fail. They also learn to apply various interpolating methods along with the trade off in using them. Various available techniques for differentiation and integrations are discussed. Numerical solution of differential equations (Ordinary as well as Partial), that are often encountered when a dynamic system is modeled, is explained with special emphasis on standard equations such as heat equation, wave equation and Laplace equation. The practice session in computer Lab gives students an opportunity to learn the development of the code in C/C++ for implementation of these methods on a variety of problems.

COURSE OBJECTIVES

To enhance problem solving skills of engineering students using a powerful problem solving tool namely numerical methods. The tool is capable of handling large systems of equations, nonlinearities and complicated geometries that are common in engineering practice but often impossible to solve analytically.

COURSE OUTCOMES

On completion of this course, the students will be able to apply various numerical methods and appreciate a trade off in using them. Understand the source of various types of errors and their effect in using these methods. To distinguish between Numerical and Analytical methods along with their Merits and demerits.Understand the use of digital computers in implementation of these methods. Develop a code in C/C++ for the solution of problems that may not be solved by analytical methods.

COURSE CONTENT:

Unit-I

Non- Linear Equations and system of Linear Equations: Introduction, error and error propagation, Bisection method, False position Method, Method of Iteration, Newton-Raphson Method, Secant Method, Gauss Elimination method Gauss – Jordan method, Gauss – Seidel method, convergence of iterative methods.

Unit- II

Interpolation: Newton's Forward and Backward Interpolation, Lagrange's Interpolation, Newton's Divided Difference Interpola-tion, Inverse Interpolation.

Unit-III

Numerical Differentiation and Integration: Derivation from difference table, higher order derivation. Newton Cotes integration formula, trapezoidal rule, simpson's rule, Boole's rule and Weddle's rule, Romberg's Integration.

Unit-IV

Numerical Solution of Ordinary: Taylor series method, Euler and modified Euler method, Runge Kutta methods, Milne's method, Finite Difference method.

Unit-V

Partial Differential Equations: Finite difference approximations of partial derivatives, Solution of Laplace's equation (Elliptic) by Liebmann's iteration method, Solution of one dimensional heat equation (Parabolic) by Bender-Schmidt method and Crank – Nicolson method, Von-Neumann stability condition, Solution of one dimensional wave equation (Hyperbolic), CFL stability condition.

TEXT BOOKS

1. Introductory Methods of Numerical Analysis: S.S. Sastry, PHI learning Pvt Ltd.
2. Numerical Methods for Scientific and Engineering computation: M.K Jain, S.R.K Iyengar and R.K Jain, New age Inter-national Publishers.
3. Numerical Method: E. Balagurusamy, Tata McGraw Hill Publication.
4. Applied Numerical Analysis: Curtis F. Gerald and Patrick O. Wheatley – Pearson Education Ltd.
5. Numerical Methods with Programs in C: T. Veerarajan and T. Ramachandran - Tata McGraw Hill Publication.

13030403	Universal Human Values	Learning Schedule			
		L	T	P	C
	Pre-requisites: Psycology & Sociology	3	0	0	3

COURSE DESCRIPTION:

The methodology of this course is universally adaptable, involving a systematic and rational study of the human being vis-à-vis the rest of existence. It is free from any dogma or value prescriptions. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with and within the student himself/herself finally.

COURSE OBJECTIVE:

1. To create an awareness on Engineering Ethics and Human Values.
2. To understand social responsibility of an engineer.
3. To appreciate ethical dilemma while discharging duties in professional life.

COURSE OUTCOMES:

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

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

COURSE CONTENT:

UNIT I: Introduction to Value Education

1. Value Education, Definition, Concept and Need for Value Education.
2. The Content and Process of Value Education.
3. Basic Guidelines for Value Education.
4. Self exploration as a means of Value Education.
5. Happiness and Prosperity as parts of Value Education.

UNIT II: Harmony in the Human Being

1. Human Being is more than just the Body.
2. Harmony of the Self ('I') with the Body.
3. Understanding Myself as Co-existence of the Self and the Body.
4. Understanding Needs of the Self and the needs of the Body.
5. Understanding the activities in the Self and the activities in the Body.

UNIT III: Harmony in the Family and Society and Harmony in the Nature

1. Family as a basic unit of Human Interaction and Values in Relationships.
2. The Basics for Respect and today's Crisis: Affection, e, Guidance, Reverence, Glory, Gratitude and Love.
3. Comprehensive Human Goal: The Five Dimensions of Human Endeavour.
4. Harmony in Nature: The Four Orders in Nature.
5. The Holistic Perception of Harmony in Existence.

UNIT IV: Social Ethics

1. The Basics for Ethical Human Conduct.
2. Defects in Ethical Human Conduct.

3. Holistic Alternative and Universal Order.
4. Universal Human Order and Ethical Conduct.
5. Human Rights violation and Social Disparities.

UNIT V: Professional Ethics

1. Value based Life and Profession.
2. Professional Ethics and Right Understanding.
3. Competence in Professional Ethics.
4. Issues in Professional Ethics – The Current Scenario.
5. Vision for Holistic Technologies, Production System and Management Models.

TEXT BOOKS

1.A.N Tripathy, New Age International Publishers, 2003.
2.Bajpai. B. L , , New Royal Book Co, Lucknow, Reprinted, 2004
3.Bertrand Russell Human Society in Ethics & Politics

REFERENCE BOOKS

1.Corliss Lamont, Philosophy of Humanism
2.Gaur. R.R. , Sangal. R, Bagaria. G.P, A Foundation Course in Value Education, Excel Books, 2009.
3.Gaur. R.R. , Sangal. R , Bagaria. G.P, Teachers Manual Excel Books, 2009.
4.I.C. Sharma . Ethical Philosophy of India Nagin & co Julundhar
5.Mortimer. J. Adler, - Whatman has made of man
6.William Lilly Introduction to Ethic Allied Publisher

13030404	Fluid Mechanics	Learning Schedule			
		L	T	P	C
	Pre-requisites: Engg. Maths & Mechanics	3	0	0	3

COURSE DESCRIPTION

Fluid mechanics is a branch of continuum mechanics that deals with the behaviour of fluids (gases or liquids) either in motion or at rest and the subsequent effects of fluids upon boundaries, which may be either solid surfaces or interfaces with other fluids. This course deals fluids and their properties, and the kinematics and dynamics of fluid flow. After that students learn the fundamentals of flow through pipes, turbulent flow, dimensional analysis and boundary layers and their applications in engineering.

COURSE OBJECTIVES

1. Understand fluid behavior for engineering design and control of fluid systems.
2. Develop competence with mass, energy and momentum balances.
3. Study the development of boundary layers.

COURSE OUTCOMES

At the end of this course, the learner will be:

1. Find frictional losses in a pipe for a flow between two places.
2. Analyse the model and prototype.
3. Find the dependent and independent parameters for a fluid flow.
4. Explain various methods available for boundary layer separation.

COURSE CONTENT

Unit I: Fluid Properties and Hydrostatics

Density – Viscosity – Surface tension – compressibility – capillarity – Hydrostatic forces on plane – inclined and curved surfaces –buoyancy – centre of buoyancy – metacentre.

Unit II: Fluid Dynamics

Control volume – Fluid Kinematics - Types of flows; Steady flow, Unsteady flow, Uniform and Non Uniform flow, Rotational flow, Irrotational flow, 1-D, 2-D, 3-D flows– Streamline and Velocity potential lines- Euler and Bernoulli's equations and their applications – moment of momentum – Momentum and Energy correction factors – Impulse – Momentum equation-Navier-Stokes Equations-Applications.

Unit III: Open Channel Flow

Flow through pipes – Open Channels and Measurement pipe flow: Darcy's law – Minor losses – Multi reservoir problems – pipe network design – Moody's diagram – Hagen Poiseuille equation – Turbulent flow. Specific Energy – Critical flow concept – specific force – Hydraulic jump – uniform flow and gradually varying flow concepts. – Measurement of pressure – flow – velocity through pipes and open channels.

Unit IV: Dimensional Analysis

Dimensional homogeneity – Raleigh and Buckingham pi theorems – Non-dimensional numbers – Model laws and distorted models-Module quantities-Specific quantities.

Unit V: Boundary layers

Boundary layers – Laminar flow and Turbulent flow – Boundary layer thickness – momentum – Integral equation – Drag and lift-

Separation of boundary layer-Methods of separation of boundary layer.

TEXT BOOKS

1. R. K. Bansal (2010), A Textbook of Fluid Mechanics and Hydraulic Machines, 9th Edition, Laxmi Publication (P) Ltd. New Delhi. ISBN- 978-8-131-80815-3.

REFERENCE BOOKS

1. Yunus A. Çengel (2010), Fluid Mechanics, Tata McGraw Hill, ISBN: 978-0-070-70034-5.
2. Frank M. White (2011), Fluid Mechanics, 7th edition, Tata McGraw-Hill Education, ISBN- 978-0-071-33312-2.

13030405	Strength of Materials	Learning Schedule			
		L	T	P	C
	Pre-requisites: Basic Engg. I and Mathematics	3	0	0	3

COURSE DESCRIPTION

Strength of Materials (also known as Mechanics of Materials) is the study of the internal effect of external forces applied to structural member. Stress, strain, deformation deflection, torsion, flexure, shear diagram, and moment diagram are some of the topics covered by this subject. The knowledge of this subject is a must in Civil Engineering, Mechanical Engineering,

The main part in this subject is

1. Focuses on the strength of materials and structural components subjected to different types of force and thermal loadings.
2. Investigates materials subjected to different types of force and thermal loadings
3. Emphasizes actual operating conditions.

COURSE OBJECTIVES

1. To develop the relationship between the loads applied to a non-rigid body and the internal stresses and deformations induced in the body.
2. To study the general state of stresses and strains in a given loaded member and the magnitude and direction of the principal stresses.
3. To understand the different approaches to calculate slope and deflection for various types of beams.
4. To analyze the columns with different edge conditions by using different theories.

COURSE OUTCOMES

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

1. Apply concepts of strength of materials to obtain solutions to real time Engineering problems.
2. Able to analyze the different types of loading and the consequent deflection.

COURSE CONTENT

Unit -1 Stresses and Strains

Definition/derivation of normal stress, shear stress, and normal strain and shear strain – Stress-strain diagram- Elastic constants – Poisson's ratio – relationship between elastic constants and Poisson's ratio – Generalized Hook's law – Strain energy – Deformation of simple and compound bars – thermal stresses.

Unit-2 Simple Bending

Types of beams: Cantilever, Simply supported, Overhanging: Shear Force and Bending Moment Diagrams. Theory of simple bending – bending stress and shear stress in beams.

Unit-3 Deflection of Beams

Deflection of beams by Double integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams – Conjugate beam method.

Unit- 4 Torsion and columns

Introduction to Torsion – derivation of shear strain – Torsion formula – stresses and deformations in circular and hollow shafts – Stepped shafts – shafts fixed at the both ends –

Stresses in helical springs.

Theory of columns – Long column and short column - Euler's formula – Rankine's formula - Secant formula - beam column.

Unit-5 Bi-axial Stress system

Biaxial state of stress – Stress at a point – stresses on inclined planes – Principal stresses and Principal strains and Mohr's circle of stress, Theories of failure

Thin cylinders and shells – deformation of thin cylinders and shells; Thick Cylinders, Shrink fits, Compounding. Fundamentals of theory of elasticity.

TEXT BOOKS

1. S. S. Rattan (2011) Strength of material Tata McGraw Hill Education. ISBN: 978-0-071-07256-4.

REFERENCE BOOKS

1. S.P. Timoshenko and D.H. Young (2011), Strength of Materials, 5th edition, East West Press Ltd, ISBN: 978-8-176-71019-0.
2. R.K. Bansal (2010), Strength of Materials, 5th Edition, Laxmi Publications, ISBN: 978-8-131-80814-6.

13030406	Kinematics of Machinery	Learning Schedule			
		L	T	P	C
	Pre-requisites: Engg. Mechanics and Maths	3	0	0	3

COURSE DESCRIPTION

The analysis of a machine requires the determination of the movement or kinematics of its component parts, known as kinematic analysis. The assumption that the system is an assembly of rigid components allows rotational and translational movement to be modelled mathematically. This allows the position, velocity and acceleration of all points in a component to determine from these properties for a reference point and the angular position, angular velocity and angular acceleration of the component. Students learn Basics of Mechanisms, kinematic analysis of simple mechanisms, synthesis of simple mechanisms, kinematics of CAMS and kinematics of gears and gear train.

COURSE OBJECTIVES

1. To familiarize students with basic types of mechanisms, joints and degrees of freedom to perform position, velocity and acceleration analysis using graphical and analytical methods.
2. To provide students an understanding of different types of mechanisms.
3. To teach the basics of synthesis of simple mechanisms.
4. To teach students the kinematic analysis of cam-follower motion and gear train configurations.

COURSE OUTCOMES

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

1. Demonstrate an understanding of the concepts of various mechanisms and pairs.
2. Conduct velocity and acceleration analysis of simple mechanisms.
3. Design a layout of cam for specified motion.
4. Synthesize simple mechanisms for function, path generation and body guidance.
5. Demonstrate an understanding of principles of operation of gears.

COURSE CONTENT

Unit -1 Basics of Mechanisms

Introduction to mechanisms an- Grashoff's law - Kinematic Inversions of 4-bar chain - Single slider and double slider crank chains - Quick return d its terminologies - Degree of freedom – Mobility - Kutzbach criterion - Grubler's criterion for planar mechanisms mechanism - Limiting positions - Mechanical advantage - Transmission angle - Ratchets and escapements – Indexing Mechanisms – Rocking Mechanisms – Straight line generators.

Unit-2 Kinematic Analysis of Simple Mechanisms

Displacement, velocity and acceleration analysis in simple mechanisms having turning, sliding and rolling pair - Coriolis acceleration using graphical relative motion method - Instantaneous center method - Four bar and slider crank mechanisms - Analytical method for four bar and slider crank mechanisms.

Unit-3 Synthesis of Simple Mechanisms

Classification of kinematic synthesis problems - Two position synthesis of slider crank and crank rocker mechanisms - Three position synthesis of double rocker mechanism - Chebychev spacing - Freudenstein analytical method - synthesis of function genera-tor using three precision

positions, Graphical and analytical design of a four bar linkage for body guidance, path generation by graphical method.

Unit-4 Kinematics of CAMS

Types of cams and followers - Definitions related cam profile - Derivatives of follower motion – High speed cams – Undercutting - Graphical disk cam profile design - Simple harmonic motion, Constant acceleration and deceleration, constant velocity, Cycloidal motion for knife edge and roller (in-line and offset), flat faced and oscillating followers - Tangent cam with roller follower - circular arc cam with flat faced follower.

Unit-5 Kinematics of Gearss

Spur gear terminology and definitions - Law of toothed and involute gearing - Interchangeable gears - Gear tooth action - Interference and undercutting - Basics of nonstandard gear teeth - Helical – Bevel – Worm - Rack and pinion gears, cycloidal tooth properties - Comparison of involute and cycloidal tooth forms.

TEXT BOOKS

1. S.S. Rattan (2009), "Theory of Machines", 3rd Edition, Tata McGraw-Hill. ISBN: 978-0-070-14477-4.

REFERENCE BOOKS

1. J. Uicker John, Gordon R. Pennock Jr. and Joseph E. Shigly (2011), Theory of Machines and Mechanisms, 4th Edition, Oxford University Press, ISBN: 978-0-199-77781-5.
2. Thomas Bevan (2009), Theory of Machines, 3rd Edition, Pearson Education, ISBN: 978-8-131-72965-6.
3. A.Ghosh (2009), Theory of Mechanisms and Machines, 3rd Edition, East-West Press Pvt. Ltd., New Delhi, ISBN: 978-8-185-93893-6.
4. Kenneth J Waldron and Gary L. Kinzel (2007), Kinematics, Dynamics, and Design of Machinery, 2nd Edition, John-Wiley and Sons Inc., New York, ISBN: 978-8-126-51255-3.

13030407	Machining Process and Metrology	Learning Schedule			
		L	T	P	C
	Pre-requisites: Fundamental of Mfg. Processes	3	0	0	3

COURSE DESCRIPTION

Machining Processes are the heart of production and manufacturing. Coupled with metrology, the technology is used for shape realization of a variety of products of domestic, industrial and strategic uses. Students learn metal cutting technologies including conventional processes such as turning, boring, shaping, planning, drilling, milling, broaching, grinding etc. as well non-conventional techniques such as AJM, WJM, USM, EDM, ECM, LBM . Upon completion, students should be able to understand the machining processes, chip formation, gear generation and different metrological methods and instruments.

COURSE OBJECTIVES

1. To acquire knowledge about the theory of metal cutting, mechanism of machining and the parameters that influence the machining processes.
2. To get basic idea about different conventional and non conventional machining process.
3. To gain knowledge of various instruments for linear measurement, angular measurement and surface finish etc.

COURSE OUTCOMES

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

1. Explain the mechanism of chip formation in machining.
2. Explain the various machining processes such as turning, drilling, boring, shaping, slotting, milling and grinding.
3. Describe the principle of gear generation and non-traditional machining processes.
4. Identify and suggest correct manufacturing process for particular application.
5. Know the principle of different metrology instrument.

COURSE CONTENT

Unit-1 Theory of Metal Cutting

Mechanism of chip formation – Tool Specification System- Orthogonal and Oblique cutting – Single Point and Multipoint Cutting Tools-Machining forces - Merchant's Circle Diagram - Thermal aspects of metal machining - Cutting fluids - Mach inability - Cutting tool materials - Tool wear and Tool life calculations, Numerical.

Unit-2 Lathe and Basic Machine Tools

Lathe - Types - Operating Parameters - lathe operations – Tool nomenclature - Work holding devices. Shaping, Planning, Slotting, Drilling, Boring, Reaming, Tapping, Broaching.

Unit-3 Milling and Gridding Machines

Milling machines - Cutters - Milling operations - Indexing. Grinding – Types of grinding machines - Grinding wheel designation and selection - Bond and Bonding processes.

Unit-4 Gear Generation

Gear generating principles - Gear Hobber, Gear finishing methods - Bevel gear generator. Vb

Unit -5 Non Traditional Machining Process

Classification of Non-traditional Machining process – Principle of AJM, WJM, USM, EDM, ECM, LBM - Process characteristics –Applications.

Unit -6 Metrology and Instrumentation

Measurement standards - Linear, angular and form measuring instruments – Comparators – Gauge blocks – Gauges – Optical instruments – Profile meter – Coordinate measuring machine.

TEXT BOOKS

1. S. Kapakjian and S.R. Schmid (2005), Manufacturing Engineering and Technology, 4th Edition, Pearson Education (Singapore)
2. B.S. Raghuwanshi – Workshop Technology[Volume 1 & 2], Dhanpat Rai & Company.

REFERENCE BOOKS

1 P.C. Sharma, (2008), Text book of Production Technology, 7th Edition, S.Chand & Company Ltd, New Delhi,
2. O.P. Khanna & M. Lal (2010), A Text book of Production Technology, Dhanpat Rai, Publications, New Delhi,

13030408	Computer Aided Machine Drawing	Learning Schedule			
		L	T	P	C
	Pre-requisites: Engg. Graphics	0	0	2	1

COURSE DESCRIPTION

Computer Aided Machine Drawing forms one of the basic engineering skills for an engineer today with the wide application of computers in industry. The knowledge of engineering specifications, concepts of limits-fits-tolerances and the techniques to draw assembly of engineering components helps a mechanical engineer to conceptualize a machine part using a computer, manufacture it and evaluate the geometrical design. Students learn drawing standards which includes the BIS specifications and conventional representation of machining operations and machine parts. Next follows the study of limits, fits and tolerances for application of machine design. Finally, the student is given to model simple and intricate parts of machines and automobile components using any solid modeling software.

COURSE OBJECTIVES

1. To introduce the students to know the basics and standards of engineering drawing related to machines and components.
2. To teach students technical skills regarding part drawings, production and assembly drawings.
3. To help students to learn modelling and drafting using standard CAD software packages.

COURSE OUTCOMES

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

1. Explain various standards and specifications related to standard machine components.
2. Make assembly drawings with the help of given part drawings.
3. Select, configure and synthesize mechanical components into assemblies.
4. Apply the knowledge of fits and tolerances for various applications.
5. Model components of their choice using CAD software.

COURSE CONTENT

Unit I: Drawing Standards

Code of Practice for Engineering Drawing - BIS specifications –Conventional representation – Welding symbols - riveted joints -keys - fasteners – Reference to hand book for the selection of standard components like bolts - nuts - screws - keys etc.

Unit II: Limits, Fits and Tolerances

Limits - Fits and tolerances – Allocation of fits for various mating parts – Tolerance data sheet – Tolerance table preparation –Geometric tolerance.

Unit III: Computer Aided Assembly and Detailed Drawing

Solid modeling of simple and intricate machine and automobile components - Surface modelling of automobile body and Appliances (electrical and domestic) - Preparation of assembled and detailed drawings of I.C.Engine components viz: Cylinder head -Piston - Connecting rod and Crankshaft assembly - Carburetor - Fuel pump etc.

TEXT BOOKS

1. N.D. Bhatt (2011), Machine Drawing , Published by R.C. Patel, 46th Edition, Charotar Publishing House Book Stall, ISBN: 978-9-380-35846-8.

REFERENCE BOOKS

1. Warren Luzadder and Jon M. Duff (2009), Fundamentals of Engineering Drawing with an Introduction to Interactive

Computer Graphics for Design and Production, 11th Edition, PHI Learning, ISBN: 978-8-120-30885-5.
2. P.S. Gill (2012), Machine Drawing, S. K. Kataria & Sons, ISBN: 978-8-185-74979-2.
3. Ajeet Singh (2012), Machine Drawing (with AutoCAD), 2nd Edition, Tata Mcgraw Hill Education, ISBN: 978-0-071-07294-6.
4. Barclay James and Griffiths Brian (2002), Engineering Drawing for Manufature, Butterworth-Heinemann, ISBN: 978-1

13030409	Strength of Materials Lab	Learning Schedule			
		L	T	P	C
	Pre-requisites: Strength of Materials	0	0	2	1

COURSE OBJECTIVES

To supplement the theoretical knowledge gained in Mechanics of Solids with practical testing for determining the strength of materials under externally applied loads. This would enable the student to have a clear understanding of the design for strength and stiffness.

COURSE OUTCOMES

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

1. Conduct tension and compression tests on the components.
2. To determine hardness, impact strength, fatigue strength of the specimens.
3. Measure strain and load using specific gauges.

LIST OF EXPERIMENTS

1. Evaluation of engineering stress / strain diagram on steel rod, thin and twisted bars under tension.
2. Determination of ultimate strength on bricks, concrete blocks.
3. Verification of Maxwell theorem using deflection test.
4. Comparison of hardness values of steel, copper and aluminium using Brinell hardness testing machine.
5. Comparison of hardness values of steel, copper and aluminium using Rockwell hardness testing machine.
6. Determination of spring constant under tension and compression.
7. Determination of impact strength for the given specimen using Charpy test.
8. Determination of impact strength for the given specimen using Izod test.
9. Determination of shear strength for the given specimen using double shear test.
10. Determination of fatigue strength for the given specimen using Fatigue test.
11. Determination of shear stress for the given specimen using Torsion test.

13030410	Kinematics of Machinery Lab	Learning Schedule			
		L	T	P	C
	Pre-requisites: Kinematics of Machinery	0	0	2	1

COURSE OBJECTIVES

1. To familiarize students with basic types of mechanisms, joints and degrees of freedom to perform position, velocity and acceleration analysis using graphical and analytical methods.
2. To provide students an understanding of different types of mechanisms.
3. To teach the basics of synthesis of simple mechanisms.
4. To teach students the kinematic analysis of cam-follower motion and gear train configurations.

COURSE OUTCOMES

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

1. Demonstrate an understanding of the concepts of various mechanisms and pairs.
2. Conduct velocity and acceleration analysis of simple mechanisms.
3. Design a layout of cam for specified motion.
4. Synthesize simple mechanisms for function, path generation and body guidance.
5. Demonstrate an understanding of principles of operation of gears.

LIST OF EXPERIMENTS

1. To study various types of Kinematic links, pairs, chains and Mechanisms.
2. To study inversions of 4 Bar Mechanisms, Single and double slider crank mechanisms.
3. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
4. To find coefficient of friction between belt and pulley.
5. To study various type of cam and follower arrangements.
6. To plot follower displacement vs cam rotation for various Cam Follower systems.
7. To generate spur gear involute tooth profile using simulated gear shaping process.
8. To study various types of gears – Helical, cross helical worm, bevel gear.
9. To study various types of gear trains – simple, compound, reverted, epicyclic and differential.
10. To find co-efficient of friction between belt and pulley.
11. To study the working of Screw Jack and determine its efficiency.
12. Create various types of linkage mechanism in CAD and simulate for motion outputs and study the relevant effects.
13. Creation of various joints like revolute, planes, spherical, cam follower and study the degree of freedom and motion patterns available.
14. To design a cam profile by using the requirement graph using on-line engineering handbook and verify the same using a 3D mechanism on CAD

13030411	Fluid Mechanics Lab	Learning Schedule			
		L	T	P	C
	Pre-requisites: Fluid Mechanics	0	0	2	1

COURSE OBJECTIVES

1. To compare the results of analytical models to the actual behaviour of real fluid flows.
2. To practice standard measurement techniques of fluid mechanics and their applications.

COURSE OUTCOMES

At the end of this course, the learner will be:

1. Utilize basic measurement techniques of fluid mechanics.
2. Discuss the differences among measurement techniques, their relevance and applications.
3. Demonstrate practical understanding of friction losses in pipes.

LIST OF EXPERIMENTS

1. Conducting experiments to verify Bernoulli's theorem.
2. Determination of the Coefficient of discharge and coefficient of velocity for the given Orifice meter.
3. Determination of the Coefficient of discharge of given Venturi-meter.
4. Determination of the Coefficient of discharge of given of Notch (V and Rectangular types)
5. Comparative study of head loss in pipes connected series and parallel.
6. Study of fluid flow types using Reynolds apparatus.
7. Determination of drag force at different incidence angle in wind tunnel.
8. To determine the coefficient of impact for vanes.
9. To determine the coefficient of discharge of Venturimeter
10. To determine the meta-centric height of a floating body.
11. To determine the minor losses due to sudden enlargement, sudden contraction and bends.

13030412	Numerical Methods Laboratory	Learning Schedule			
		L	T	P	C
	Pre-requisites: **Numerical Methods**	**0**	**0**	**2**	**1**

OBJECTIVES:

The objective of teaching Applied Numerical Methods lab is to develop the computational skills of the students to solve various mathematical problems by numerical techniques using C programming.

EXPECTED OUTCOME:

Students will be able to solve problems of mathematics using computers and apply their knowledge in solving real life problems appearing in various engineering applications that are often impossible to solve using analytical techniques.

1. Program to find a root of a nonlinear equation using the *Method of Bisection*.
2. Program to find a root of a nonlinear equation using the *Method of False Position.*
3. Program to find the root of a nonlinear equation using the *Newton-Raphson method*.
4. Program to obtain the solution of a system of linear equations using *Gauss elimination method.*
5. Program to obtain the solution of a system of linear equations using *Gauss -Seidel method.*
6. Program to construct *Newton's forward difference interpolation polynomial.*
7. Program to construct *Lagrange's interpolation polynomial formula.*
8. Program to evaluate a definite integral by *Trapezoidal rule.*
9. Program to evaluate a definite integral by *Simpson's rule.*
10. Program to find the solution of initial value problem using *Euler's method*.
11. Program to find the solution of initial value problem using *Modified Euler's method.*
12. Program to find solution of initial value problem using fourth order *Runge Kutta method.*
13. Program for solving ordinary differential equation by *Milne method.*
14. Program for solving elliptic partial differential equation by *Liebmann's iteration method.*
15. Program for solving parabolic partial differential equation by *Crank-Nicolson method.*

13030413	Technical skills for Mechanical Engineer-II	Learning Schedule			
		L	T	P	C
	Pre-requisites: Technical skills for Mechanical Engineer-I	0	0	2	1

COURSE DESCRIPTION

The aim of this course is to observe the basic principles/concepts and solve problems through creative thinking. This course is an introduction to the basic principles of design of machining elements, balancing of mechanisms, torsional and bending vibrations, vibration isolation, and the dynamic behavior of drives.. This course provides a basic grounding in the principles of fluid mecahanics, conduction, convection and radiation heat transfer, principals of heat exchanger and mass transfer. Also, cover the importance of combination of mechanics and electronics systems, application of data sturctre and numeric/computer control machine tools. It also includes practice session to solve objective types question in the areas of
machine design, mechnism of machine, fluid mechanics, heat transfer, mechatronics, datastructure and machine tools, etc.

COURSE OBJECTIVES

1. To understand the design methodology and concept for machine elements.
2. To provide basic knowledge of sensors, actuators and their selection for an application.
3. To Understand fluid behaviour and control of fluid systems.
4. To comprehend and evaluate various modes of heat and mass transfer.
5. To develop knowledge in various numerical and computer numerical control machine tools.

COURSE OUTCOMES

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

1. Understand the machine components and know the applications of the various elements used.
2. Identify and select suitable sensors, actuators and controllers to meet specific applications.
3. Apply basic principles of heat transfer for designing heat and mass transfer systems.
4. Perform static and dynamic balancing of high speed rotary and reciprocating machines and acquire knowledge in part programming.
5. Develop the basic knowledge to solve the multiple choice questions and focus the corporate interviews. .

COURSE CONTENT

Unit I: Fundamentals of mechanism and design

Dynamic analysis of four bar mechanism, Balancing of reciprocating masses - Classification of vibrations - Transverse vibrations of shafts and beams - Functions of Governors, Gyroscopic couple. Materials selection - Theories of failures - static and variable loads. Design consideration on Shafts - springs, couplings, Flywheel.

Unit II: Fundamentals of fluid mechanics and heat transfer

Fluid propertiess- Surface tension, compressibility, buoyancy. Types of flows, Velocity potential lines. Euler and Bernoulli's, Navier-Stokes Equations. Darcy's law, Hagen Poiseuille equation. Boundary layers - Laminar flow and Turbulent flow. Laws of conduction - convection and radiation. Derivation in cartesian - cylindrical and spherical coordinates. Lumped parameter system – Non dimensional numbers in conduction. Condensation and boiling. Heat Exchangers- LMTD

Unit III: Mechatronics and Data structure

Sensors and transducers, Microprocessor and microcontroller, Programmable Logic Controllers Fuzzy logic control and Artificial neural networks. Introdution to array, stacks and queues

Unit IV: Numerical and Computer numerical control

Numeric control and CNC machine tools, Manual part Programming, Adaptive Control, APT language, machining from 3D models- Master CAM

Unit V: Practice session

Multible choice questions are discussed and test are conducted based on module I, II, III and IV

TEXT BOOKS

1. V.B. Bhandari (2010), Design of Machine elements, 3rd Edition, Tata Mc Graw Hill. ISBN: 978-0-070-68179-8.2.
2. W. Bolton (2008), Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering, 4th Edition, Prentice Hall. ISBN: 978-0-273-74286-9.
3. R. K. Bansal (2010), A Textbook of Fluid Mechanics and Hydraulic Machines, 9th Edition, Laxmi Publication (P) Ltd., New Delhi. ISBN- 978-8-131-80815-3.
4. Mikell P. Groover and Emory W. Zimmers (2003), CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall Edition, ISBN: 978-8-177-58416-5.
5. S.S. Rattan (2009), “Theory of Machines”, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd, ISBN: 978-0-070-14477-4
6. R. C. Sachdeva (2005), Fundamentals of Heat and Mass Transfer, New Age International (P) Ltd. ISBN: 978-8-122-40076-2.
7. Ellis Horowitz, Sartaj Sahni (1988), Fundamentals of data structure, Computer Science Press, ISBN-10: 0716780429.

REFERENCE BOOKS

1. V. K. Jadon (2011), Machine Design Data Book, 2nd Edition, I.K. International Pvt. Ltd, ISBN: 978-8-189-86612-9.
2. Ibrahim Zeid (2009), Mastering CAD/CAM, 2nd Edition, Tata McGraw Hill International Edition, ISBN: 978-0-070-15134-5.
3. Thomas G. Beckwith, Roy D. Marangoni and John H. Liennard (1999), Mechanical Measurements, Addison-Wesley Longman, New Delhi.
4. J. Peter Sadler and Charles E. Wilson _ (2008),Kinematics and Dynamics of Machinery, 3rd Pearson Education, ISBN: 978-8-131-72022-6.
5. J. P. Holman (2005), Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited. ISBN: 978-0-070-29618-3.
6. Frank M. White (2011), Fluid Mechanics, 7th edition, Tata McGraw-Hill Education, ISBN-978-0-071-33312-2.
7. E. Balagurusamy (2008), Computing Fundamentals And C Programming, Tata McGraw-Hill.

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13030414	Industrial Exposure -II	Learning Schedule			
		L	T	P	C
	Pre-requisites: Basic knowledge of Engg. Subjects	-	-	-	1

COURSE OBJECTIVES:

1. To gain industrial exposure through industrial visit in core companies.
2. To experience the discipline of working in a professional organisation and multidisciplinary team.
3. To develop interpersonal, technical and communication skills.

COURSE OUTCOMES

On completion of this component of curriculum, the students will be able to

1. Get exposure to real-life-working environment & practices, and to attain the professionalisms.
2. Work with multi-tasking professionals and multidisciplinary team.
3. To aware about portfolio of industry.

COURSE CONTENT

Industrial visit / Industrial Tour in various organisations related to respective discipline.

13030501	Personality Development & Career Building	Learning Schedule			
		L	T	P	C
	Pre-requisites: Aptitude Building	0	0	4	2

COURSE OBJECTIVES:

1. Holistic approach focusing on
2. Negotiation skills
3. Team work
4. Balancing the emotional Quotient of the individuals
5. Ready to apply for a job
6. Skill development related to classification of numbers
7. Implementing logical Aptitude in decision making

COURSE OUTCOMES:

1. Get an idea of industry perspective
2. Give the Effective Presentation
3. Able to develop a logical thought process related to every aspect of life
4. Able to widen the horizon of one's thought process and data analysis skills
5. Able to interpret Data and convert into information

COURSE CONTENT

Unit-I: Strategies and Skills Required for Career building/ Recruitment/ Team building

Learning of Different Strategies to be used: Negotiation, Assertions, Politeness through Conversation, Assertive Strategies, Leadership Skills, Team Work, Management Skills through Group Activities.

Unit-II: Group Discussions and Role Play

Listening and Speaking Comprehensions through Group Discussion and audio-visual aids, Do's and Don'ts of Group Discussions related to various topics (Day-Today life/ Social Issues/ Political and Others.

Unit-III: Business/job Correspondence

Resume Writing, Letter Writing, Job Application Letter

Unit-IV: Time and Work, Data Interpretation

Time and Work ,Time speed and Distance, Table, Line Graph, Bar Graph,Cube,Dice,Calendars,Test on Bar and Pie Charts, Comprehensive Practice test- 1 on Area Covered, Comprehensive Practice test- 2 on Area Covered.

Unit-V: Algebra and Simple Reasoning

Linear and Quadratic Equation, Function Basics, Inequalities, Progression, Set Theory/ Venn diagram, Pie Chart, Permutation and Combination, Probability, Visual Reasoning, Alphabet based Reasoning, Comprehensive Practice test- 1 on Area Covered, Comprehensive Practice test- 2 on Area Covered.

TEXT BOOKS

1. Sanjay Kumar and Pushp Lata ‘Communication Skills’, Oxford University Press 2012
2. Raymond Murphy ‘Essential English Grammar’, Cambridge University Press 1998
3. Meenakshi Raman and Sangeeta Sharma ‘Technical Communication Principles and Practice’, Oxford University Press 2012

REFERENCE BOOKS

1. R. K. Narayan, Malgudi Days: A Collection of Short Stories, Penguin 2006
2. Meenakshi Raman and Prakash ‘Business Communication’ Oxford University Press 2011
3. Hory Sankar Mukerjee ‘Business Communication Connecting at Work’ Oxford University Press 2013

13030502	Probability and Statistics	Learning Schedule			
		L	T	P	C
	Pre-requisites: **Complex Analysis and NMCT**	3	0	0	3

COURSE DESCRIPTION

The course begins with the theoretical study of probability distributions which is widely used in all engineering applications. The student is then introduced to the logic as well as the technical side of the main forms of inference: point estimation, interval estimation and hypothesis testing. Special tests of significance and ANOVA are also dealt with. Lastly, the course emphasizes on the concepts of Correlation and Regression and different types of curve fitting by the method of least squares are discussed.

COURSE OBJECTIVES

1. To give an exposure to the students the basic concepts of Probability and Statistical methods and their application.
2. To serve as a foundation to analyze problems in Science and Engineering applications through Statistical testing Method.

COURSE OUTCOMES

On completion of this course, the students are expected to learn

1. Basics of Probability distributions
2. Sampling theory and Theory of Estimation
3. Various tests of Hypothesis and Significance
4. Correlation and Regression and fitting of different types of curves

COURSE CONTENT

Unit I: Probability Distributions

Review of basic probability, Random variables, Probability Distribution, Mathematical Expectation and Variance of Probability distribution, Standard discrete distributions: Binomial, Poisson and Geometric distributions, Probability density function, Cumulative distribution function, Expectation and Variance, Standard continuous distributions - Uniform, Normal, Exponential, Joint distribution and Joint density functions.

Unit II: Sampling and Estimation Theory

Population and Sample, Statistical inference, Sampling with and without replacement, Random samples, Population parameters, Sample statics, Sampling distributions, Sample mean, Sampling distribution of means, Sample variances, Sampling distribution of variances, Case where population variances is unknown, Unbiased estimates and efficient estimates, point estimate and Interval Estimates, Confidence Interval estimates of population parameters, Confidence intervals for variance of a Normal distribution, Maximum likelihood estimates.

Unit III: Tests of Hypothesis and Significance

Statistical hypothesis, Null and Alternate hypothesis, test of hypothesis and significance, Type I and Type II errors, Level of Significance, Tests involving the Normal distribution, One-Tailed and Two-Tailed tests, P value. Special tests of significance for Large
samples and Small samples (F, chi- square, z, t- test), ANOVA.

Unit IV: Correlation and Regression

Correlation, Rank correlation, Regression Analysis, Linear and Non linear Regression, Multiple regression, Curve fitting by method of least squares, fitting of straight lines, polynomials, exponential curves.

TEXT BOOKS

1. R. E. Walpole, R. H. Mayers, S. L. Mayers and K. Ye, (2007), Probability and Statistics for Engineers and Scientists,8th Edition, Pearson Education, ISBN: 978-8-131-71552-9.
2. Sheldon M. Ross, (2011), Introduction to Probability and Statistics for Engineers and Scientists, 4th Edition, Academic Foundation, ISBN: 978-8-190-93568-5.

REFERANCE BOOKS

1. Douglas C. Montgomery, (2012), Applied Statistics and Probability for Engineers, 5th Edition, , Wiley India, ISBN: 978-8-126-53719-8.
2. Spiegel, M. R., Schiller, J. and Srinivasan, R. A., (2010), Probability & Statistics, 3rdEdition, TataMcGraw Hill, ISBN : 978-0-070-15154-3.

13030503	Dynamics of Machinery	Learning Schedule			
		L	T	P	C
	Pre-requisites: Kinematics of Machinery	3	0	0	3

COURSE DESCRIPTION

Dynamic loads and undesired oscillations increase with higher speed of machines. At the same time, industrial safety standards require better vibration reduction. This course covers parameter identification, balancing of mechanisms, torsional and bending vibrations, vibration isolation, and the dynamic behavior of drives and machine frames as complex systems. Typical dynamic effects, such as the gyroscopic effect, damping and absorption, shocks, nonlinear and self-excited vibrations are covered in dynamics of machinery. Upon completion, students should be able to analyze the effect of dynamic forces on systems and try to minimize negative impact of such effects.

COURSE OBJECTIVES

1. To understand the concepts of turning moment diagrams, flywheel design and the dynamics of reciprocating engines.
2. To understand the balancing procedures for rotating and reciprocating masses, rotors and engines.
3. To understand the fundamentals of free and forced vibrations.
4. To understand the mechanisms for control.

COURSE OUTCOMES

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

1. Demonstrate skills to design flywheel for an IC engine and punching press with the consideration of geometrical and economical constraints.
2. Perform static and dynamic balancing of high speed rotary and reciprocating machines.
3. Analyse free and forced vibrations of machines, engines and structures.
4. Calculate gyroscopic couple find its effect on various vehicles and apply concept of governors for speed control.

COURSE CONTENT

Unit -1 Dynamic Force Analysis

D'Alembert's principle – Equivalent offset inertia force – Dynamic analysis of four bar mechanism – Dynamic Analysis of reciprocating engines – Piston effort, Crank effort, Turning moment on crankshaft, Inertia of connecting rod – Inertia force in reciprocating engines (Graphical method). Turning moment diagrams – Single and multi cylinder engines – Fluctuation of energy – Fly Wheels – Applications in engines and punching presses.

Unit-2 Balancing

Static and Dynamic balancing of rotating masses – Balancing of reciprocating masses – Balancing of locomotives – Partial balancing of reciprocating masses – Multi cylinder Inline and radial engines.

Unit-3 Vibration – Singh Degree of Freedom Systems

Introduction to vibration – Terminology – Classification of vibrations – Undamped and Damped free vibration of single degree of freedom systems – Viscous damping – Introduction to coulomb damping. Forced vibration – harmonic excitation – Magnification factor – Vibration isolation and Transmissibility.

Unit-4 Transverse and Torsional Vibration Systems

Transverse vibrations of shafts and beams – Rayleigh's and Dunkerley's method – Whirling of shafts. Torsional vibrations – Single rotor, two rotors and three rotors systems – Free vibration of geared systems.

Unit-5 Mechanism for Control

Functions of Governors – Gravity controlled and Spring controlled governor characteristics. Stability – Hunting and Isochronisms. Effect of friction – Calculation of equilibrium speeds and ranges of speed of governors. Gyroscopic couple – Gyroscopic effects on the movement of air planes and ships – Stability of two wheel drive and four wheel drive – Gyroscope stabilization.

TEXT BOOKS

1. S.S. Rattan (2009), "Theory of Machines", 3rd Edition, Tata McGraw-Hill. ISBN: 978-0-070-14477-4.

REFERENCE BOOKS

1. J. Uicker John, Gordon R. Pennock Jr. and Joseph E. Shigly (2011), Theory of Machines and Mechanisms, 4th Edition, Oxford University Press, ISBN: 978-0-199-77781-5.
2. Thomas Bevan (2009), Theory of Machines, 3rd Edition, Pearson Education, ISBN: 978-8-131-72965-6.
3. A.Ghosh (2009), Theory of Mechanisms and Machines, 3rd Edition, East-West Press Pvt. Ltd., New Delhi, ISBN: 978-8-185-93893-6.
4. Kenneth J Waldron and Gary L. Kinzel (2007), Kinematics, Dynamics, and Design of Machinery, 2nd Edition, John-Wiley and Sons Inc., New York, ISBN: 978-8-126-51255-3.

13030504	Design of Machine Elements	Learning Schedule			
		L	T	P	C
	Pre-requisites: SOM, KOM	3	0	0	3

COURSE DESCRIPTION

Design of Machine Elements is a required course for mechanical engineering students. This course is an introduction to the basic principles of modern engineering. It provides the students with fundamental skills of engineering and the ability to apply the theories of science to practice and understand the factors; such as stresses, deformations, and failure criteria, influencing the machine elements like shafts, springs, belts, bearings, gears etc. The main objective of design of machine element is that the machine should function properly to satisfy the needs of the customer and it should be safe against the predicted modes of failure.

COURSE OBJECTIVES

1. To understand the design methodology for machine elements.
2. To analyze the forces acting on a machine element and apply the suitable design methodology.
3. To understand the various standards and methods of standardization.
4. To apply the concept of parametric design and validation by strength analysis.

COURSE OUTCOMES

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

1. Analyze and select machine elements/components.
2. To know the applications of the various elements, materials used to make them, and methods used
3. Integrate various machine elements and components into the design of a machine or mechanical system through a design project.

COURSE CONTENT

Unit I: Introduction to Design Process

Introduction to Design process – Factors – Materials selection direct - Bending and Torsional stress equation - Impact and Shock loading - Stress concentration factor - Size factor - Surface limits factor - Factor of safety - Design stress - Theories of failures –Problems.

Unit II: Fatigue strength and design of springs

Variable and cyclic loads – Fatigue strength – S- N curve – Continued cyclic stress – Soderberg and Goodman equations – Design of Helical – Leaf - Disc springs under Constant and Varying loads

Unit III: Design of Shafts and Joints

Design of Shafts – Riveted joints, Welded joints and Screwed fasteners, Computer aided design of machine elements.

Unit IV: Design of Couplings

Design and drawings of couplings – Rigid – Flexible – Design and Drawings of Cotter joints - Knuckle joints, Computer aided design of machine elements.

Unit V: Design of Engine Components

Design and Drawings of Piston – Connecting rod – Crankshaft – Flywheel, Design of Cams for parabolic – SHM and Cycloidal follower motions. Computer aided design of machine elements.

TEXT BOOKS

1. V.B. Bhandari (2010), Design of Machine elements, 3rd Edition, Tata Mc Graw Hill. ISBN: 978-0-070-68179-8.2.

2. V. K. Jadon (2011), Machine Design Data Book, 2nd Edition, I.k. International Pvt. Ltd, ISBN: 978-8-189-86612-9.

REFERENCE BOOKS

1. J. Keith Nisbett, Richard G. Budynas (2011) Specifi cations of Shigley's Mechanical Engineering Design 9th Edition Tata McGraw - Hill Education ISBN: 139-7-800-7107783-5.

13030505	Heat and Mass Transfer	Learning Schedule			
		L	T	P	C
	Pre-requisites: Engineering Thermodynamics	3	0	0	3

COURSE DESCRIPTION

An introductory course in heat and mass transfer covering conduction, convection and radiation heat transfer, principals of heat exchanger and mass transfer. Heat transfer and mass transfer are kinetic processes that may occur and be studied separately or jointly. Studying them apart is simpler, but both processes are modeled by similar mathematical equations in the case of diffusion and convection (there is no mass-transfer similarity to heat radiation), and it is thus more efficient to consider them jointly. Besides,heat and mass transfer must be jointly considered in some cases like evaporative cooling and ablation.

COURSE OBJECTIVES

1. To comprehend and evaluate various modes of heat and mass transfer
2. To design fin enhanced systems, evaporators, condensers and heat exchangers.
3. To understand boundary layer theory, condensation and boiling.
4. To determine effectiveness of heat exchangers using LMTD and NTU.

COURSE OUTCOMES

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

1. Apply basic principles of fl uid mechanics, thermodynamics, heat transfer for designing heat and mass transfer systems.
2. Model heat, mass and momentum transport systems and develop predictive correlation.
3. Assess and evaluate various designs for heat and mass transfer and optimize the solution

COURSE CONTENT

Unit-I Conduction – I

Basic concepts – conduction - convection and radiation – Laws – General equation of heat conduction – Derivation in cartesian -cylindrical and spherical coordinates – One dimensional steady state heat conduction in simple geometries – plane wall – cylinder and sphere – Heat transfer composite walls - composite cylinders and composite spheres – Critical thickness of insulation –Thermal contact resistance – Overall heat transfer coefficient – Electrical analogy – Heat generation in plane wall - cylinder and sphere – Extended surfaces – general equations – types and applications of fins – Fin efficiency and effectiveness – Fin performance.

Unit-II Conduction – II

Two and Three dimensional steady state heat conduction – Analytical - Graphical and Numerical methods – Conduction shape factor – Unsteady state heat conduction – Lumped parameter system – Non-dimensional numbers in conduction – Significance of Biot and Fourier numbers – Transient heat flow in semi-infinite solid – Use of Heisler and Grober charts

Unit-III Convection

Boundary layer theory – Conservation equations of mass - momentum and energy for laminar flow over a fl at plate – Turbulent flow over a fl at plate – Flow over cylinders - spheres - tube bank –Internal flow through pipes – annular spaces – Analogy between momentum and heat transfer – Natural convection in vertical - inclined and horizontal surfaces – Mixed convection – Dimentional analysis.

Unit-IV Condensation, Boiling and Radiation

Condensation and Boiling – Filmwise and dropwise condensation – Film condensation on a vertical plate – Regimes of Boiling –Forced convection boiling – Radiation heat transfer –

Thermal radiation –Laws of radiation – Black body concept – Emissive power – Radiation shape factor – Gray bodies – Radiation shields.

Unit-V Heat Exchanger and Mass Transfer

Heat Exchangers – Types and practical applications – Use of LMTD – Effectiveness – NTU method – Compact heat exchangers– Plate heat exchangers – Fouling factor – Heat pipes – Types and applications – Principle of Mass Transfer-Mass transfer by molecular diffusion – Fick's law of diffusion – Analogy of heat and mass transfer.

TEXT BOOKS

1. R. C. Sachdeva (2005), Fundamentals of Heat and Mass Transfer, New Age International (P) Ltd. ISBN: 978-8-122-40076-2.

REFERENCE BOOKS

1. P. K. Nag (2005), Heat Transfer, Tata McGraw Hill Publishing Company Limited. ISBN: 978-0-070-60653-1.
2. J. P. Holman (2005), Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited. ISBN: 978-0-070-29618-3.
3. Dewitt Lavine, Bergmann and Incropera (2010), Fundamentals of Heat and Mass Transfer, 6th Edition, John Wiley &
Sons, ISBN: 978-8-126-52764-9.

13030506	Industrial Economics and Management	Learning Schedule			
		L	T	P	C
	Pre-requisites: Basic Economics	2	0	0	2

COURSE DESCRIPTION:

The course describes the basics of demand and demand forecasting. It explains cost functions, cost control, cost reduction and pricing techniques.

EXPECTED OUTCOME:

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

1. Apply the concept of demand.
2. Estimate production and cost function.
3. Formulate appropriate pricing strategies.

Unit I Introduction

Introduction: The Scope and Method of Managerial economics – Fundamental Economics concepts – Managerial Economics with other subjects - Objectives of the Firm

Unit II Demand and Supply Analysis

Meaning, Types and Determinants – Demand estimation- Demand elasticities for decision making – Business and Economic forecasting: Qualitative and Quantitative methods – Supply analysis: Meaning, elasticities and determinants – Market equilibrium and price determination

Unit III Production Economics

Production and Production function – Types – Estimation – Returns to Scale – Economies and Diseconomies of Scale and Economies of Scope. Factor Inputs - Input-Output Analysis

Unit IV Market Structure

Perfect Competition – Imperfect Competition: Monopoly – Monopolistic – Oligopolistic Strategy, Cartels, Cournot, Kinked Demand and Price Leadership. Oligopolistic Rivalry & Theory of Games – Measurement of economic concentration – Policy against monopoly and restrictive trade practices - Competition Law – Pricing Practices: Objectives – Determinants – Pricing Methods – Government Policies and Pricing.

Unit V Introduction to Macroeconomics

Circular Flow of Income and Expenditures – Components of National Income and its significance - Measuring Gross Domestic Product (GDP) – Inflation and Business Cycles – Government Fiscal and Monetary Policy - Balance of payments – Foreign exchange markets

TEXT BOOKS

1. P.L. Mehta – Managerial Economics Analysis, Problems and cases, Sultan Chand & Co. Ltd., 2001

REFERENCE BOOKS

1. Peterson and Lewis: Managerial Economics, 4th Ed., Prentice Hall , 2004
2. Dholakia and Oza: Microeconomics for Management Students, 2nd Edition, Oxford University Press
3. Gregory Mankiw: Principles of Microeconomics, Havcourt Asia Publishers, 2001
4. Mote and paul – Managerial Economics, Tata McGraw Hill, 2001

13030507	Production Planning and Control	Learning Schedule			
		L	T	P	C
	Pre-requisites: IE & M	3	0	0	3

COURSE DESCRIPTION

PPC, is the process of production planning sets the objectives, goals, targets on the basis of available resources with their given constraints. Control is the integral part of effective planning. Similarly control involves assessment of the performance; such as-sessment can be made effectively only when some standards are set in advance. Planning involves setting up to such standard. The controlling is made by comparing the actual performance with these present standard and deviations are ascertained and analyzed.

COURSE OBJECTIVES

1. To provide knowledge about various types of productions.
2. To acquire the knowledge of value analysis.
3. To know various types inventory planning.

COURSE OUTCOMES

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

1. Identify and suggest correct type of production planning technique.
2. Analyze the concepts of production planning.
3. Control and implement PPC methods in crucial areas of the industry.
4. Implement the knowledge of ERP systems and shop floor scheduling.

COURSE CONTENT

Unit -I MPC Performance

Factors influencing MPC performance - Review of fundamental features of Material Requirements Planning systems - MRP systems dynamics and system nervousness.

Unit-II Sales and Operations Planning

Sales and operations planning - Production Planning - Master scheduling and order promising - Distribution Resource Planning - Bills of material structuring, master scheduling - and final assembly scheduling.

Unit-III Capacity Management

Capacity management using planning factors - bills of capacity - and capacity requirements planning – CRP and I/O Control - Shop floor control/operations scheduling – Inventory models.

Unit-IV Shop Floor Control

Shop floor control/scheduling - Kanban/pull systems - Alternative pull systems; parameter settings - Pull systems for suppliers.

Unit-V ERP Systems

ERP systems - Technical aspects of SAP - Focus on implementation and system's fit - ERP implementation - Beyond ERP Software for manufacturing firms - Supply Chain Management.

TEXT BOOKS

1. D.W. Fogarty, .J.H. Blackstone and T. Hoffmann. (2009), Production and Inventory Management, 3rd Edition, South-Western Publishing. ISBN: 978-0-324-31137-2.

REFERENCE BOOKS

1. S. K Mukhopadhyay (2009), Production Planning and Control: Text and Cases, 2nd Edition, Phi Learning. ISBN: 978-8-120-33118-1.
2. Stephen N. Chapman (2005), Fundamentals of Production Planning and Control, Prentice Hall. ISBN: 978-0-130-17615-8.
3. Adam Jr. Evertte and R.J. Ebert (2003), Production and Operations Management, 5th Edition, Prentice-Hall of India Private Limited. ISBN: 978-8-129-70000-1.
4. D. Sipper and R.L. Bulfin. (1997), Production Planning, Control, and Integration, 2nd Edition, McGraw Hill. ISBN: 978-0-070-57682-7.

13030508	Advanced Machining Processes	Learning Schedule			
		L	T	P	C
	Pre-requisites: MPM	3	0	0	3

COURSE DESCRIPTION

Today's stringent design requirements and difficult-to-machine materials such as tough super alloys, ceramics, and composites, have made traditional machining processes costly and obsolete. As a result, manufacturers and machine design engineers are turning to advance machining processes. These machining processes utilizes electrical, chemical and optimal sources of energy to machine the given job. Going through this subject students will get insight of various advanced machining processes and there system components, process variables and industrial applications. This is a perfect course for anyone designing, researching or converting to a more advance machining process.

COURSE OBJECTIVES

1. To teach the principles of material removal mechanism of advanced machining processes such as mechanical, electro-chemical and thermal.
2. To provide in depth knowledge in selection of advanced machining process to fabricate intricate and complex shapes in difficult to machine material.
3. To provide awareness of advanced finishing processes to achieve submicron/nano surface finish.

COURSE OUTCOMES

Student will be able to

1. Identify and suggest the suitable manufacturing process for advanced materials and critical finishing.
2. Select a process for a given application such as IBM, EBM, PAM etc.

COURSE CONTENT

Unit-I Mechanical Advanced Machining Processes

Need and classification of nontraditional machining processes – Material removal in traditional and nontraditional machining processes - considerations in process selection. Ultrasonic machining – Working principle, mechanism of metal removal – Theory of Shaw, elements of the processes, tool feed mechanism, effect of parameters, applications and numerical. Abrasive jet machining, Water jet machining and abrasive water jet machine - Basic principles, equipments, process variables, mechanics of metal removal, MRR, application and limitations.

Unit-II Electro – Chemical Processes

Principle of ECM process, chemistry of the ECM processes, Parameters of the process, determination of the metal removal rate, dynamics of ECM process, polarization, tool design, advantages and disadvantages, application, electrochemical grinding, electro-chemical honing, electrochemical deburring, Application of ECM for deep hole drilling – electro stream drilling and shaped tube electrolytic machining. Chemical machining - Fundamental principle, types of chemical machining, maskants, etchants, advantages, disadvantages, applications.

Unit-III Electric Discharge Machining

Working principle of EDM, Power circuits for EDM - RC pulse generator and controlled pulse generator– Analysis of R-C Circuits – Mechanics of metal removal in EDM, Process parameters,

selection of tool electrode and dielectric fluids, surface finish and machining accuracy, characteristics of spark eroded surface and recent development in EDM. Wire EDM – Working principle, process variables, process characteristics and applications. Electric discharge grinding and electric discharge diamond grinding - working principle, process capabilities and applications.

Unit-IV Laser, Electron Beam, Ion Beam and Plasma Arc Machining

General working principle of laser beam machining – Generation of Laser, types of Lasers, process characteristics and applications. Electron Beam Machining - Equipment for production of Electron Beam, theory of EBM, thermal and non-thermal type, process characteristics and applications. Ion Beam Machining - Mechanism of metal removal and associated equipments, process characteristics and applications. Plasma Arc Machining - Metal removal mechanism, process parameters, process characteristics, types of torches, applications.

Unit- V Advanced Finishing Processes

Abrasive flow Machining (AFM) - working principle, AFM system, process variables, process performance and applications. Magnetic abrasive finishing (MAF) - working principle, MAF system, material removal and surface finish, process variables and applications. Chemomechanical polishing, working principle, material removal and surface finish and applications.

TEXT BOOKS

1. V. K. Jain (2004), Advanced Machining Processes, 1st Edition, Affilated Allied Publishers. ISBN: 978-8-177-64294-0.

REFERENCE BOOKS

1. Hassan El-Hofy (2005), Advanced Machining Processes, 1st edition Affilated McGraw-Hill. ISBN: 978-0-071-45334-9.
2. Gary F. Benedict (1987), Nontraditional Machining Processes, 1st Edition, Affilated CRC press. ISBN 082-4-773-527.
3. M. Adithan (2008), Modern Machining Methods, 1st Edition, Affilated Khanna Publishers New Delhi. ISBN: 978-8-174-09225-0.
4. K. P. Mishra (2006), Nonconventional Machining, Edition 1st , Affilated Narosa Publishing House. ISBN: 978-8-173-19138-1.
5. C. P Pandy and H. S. Shan (1980), Modern Machining Processes, Edition 1st, Affilated Tata McGraw Hill Publishing Company Ltd., New Delhi.ISBN: 978-0-070-96553-9.

13030509	Fuel and Combustion	Learning Schedule			
		L	T	P	C
	Pre-requisites: Engg. Thermodynamics	3	0	0	3

COURSE DESCRIPTION

Two and four stroke engines, air standard cycles, fuels and combustion, fundamental of ignition systems, performance and rating of engines, combustion characteristics and combustion chamber for S.I and C.I engines, supercharging.

COURSE OBJECTIVES

To learn about various types of fuels, their composition and properties

1. To acquire depth knowledge of solid, liquid and gaseous fuels.
2. To understand the thermodynamics of combustion.
3. To learn about the types of pollution and its control.

COURSE OUTCOMES

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

1 Analyze the composition of various types of fuels and their properties.
2. Estimate the possible pollution of fossil fuels and its control.
3. Demonstrate the knowledge of combustion thermodynamics.

COURSE CONTENT

Unit I: Fuel Characteristics

Fuels – Types and Characteristics of Fuels – Determination of Properties of Fuels - Fuels Analysis - Proximate and Ultimate Analysis - Moisture Determination – Calorific Value - Gross and Net Calorific Values - Calorimetry - DuLong's Formula for CV Estimation - Flue gas Analysis - Orssat Apparatus - Fuel and Ash Storage and Handling – Spontaneous Ignition Temperatures.

Unit II: Solid and Liquid Fuels

Solid Fuels: Wood and Wood charcoal-Origin of coal-Composition of coal –Analysis and properties of different grades of coal preparation and storage of coal-coal washing –Briquetting. Liquid coals: Origin of petroleum fuels-Production –Composition-Petroleum refining-Various grades of petro-Products-Properties and testing –Alcohol shale oil-Gasification of liquid fuels – Synthetic fuels -Storage and handling of liquid fuels.

Unit III: Gaseous Fuels

Classification - Composition and Properties – Estimation of Calorific Value - Gas Calorimeter. Rich and Lean Gas - Wobbe Index - Natural Gas - Dry and Wet Natural Gas - Stripped NG - Foul and Sweet NG - LPG - LNG - CNG - Methane – Producer Gas - Gasifies - Water Gas – Town Gas - Coal Gasification – Gasification Efficiency - Non - Thermal Route - Biogas - Digesters -Reactions – Viability - Economics.

Unit IV: Combustion: Stoichiometry and Kinematics

Stoichiometry - Mass Basis and Volume Basis – Excess Air Calculation - Fuel and Flue Gas Compositions – Calculations – Rapid Methods - Combustion Processes - Stationary Flame – Surface or Flameless Combustion – Submerged Combustion – Pulsating and Slow Combustion Explosive Combustion. Mechanism of Combustion – Ignition and Ignition Energy - Spontaneous Combustion - Flame Propagation - Solid - Liquid and Gaseous Fuels Combustion - Flame Temperature - Theoretical - Adiabatic and Actual - Ignition Limits – Limits of inflammability.

Unit V: Air Pollution

Types of pollution - Combustion-Generated air pollution - Effects of air pollution - Pollution of fossil fuels and its control – Pollution from automobiles and its control.

TEXT BOOKS

1. Stephen Turns, (2011), an Introduction to Combustion: Concepts and Applications, McGraw Hill.
2. John B. Heywood – Internal Combustion Engine, McGraw Hill.

REFERENCE BOOKS

1. Samir Sarkar (2010), Fuels and combustion, Orient Longman.
2. Samir Sarkar (2009), Fuels and Combustion 3rd Edition, Universities Press.
3. Mishra, D. P, (2000), Fundamentals of Combustion, Prentice Hall of India.
4. Sharma.S.P. Cahandramohan, (1984), Fuels and combustion., Tata McGraw-Hill.

13030510	Refrigeration and Air Conditioning	Learning Schedule			
		L	T	P	C
	Pre-requisites: Engg Thermodynamics	3	0	0	3

COURSE DESCRIPTION

Refrigeration and air conditioning is used to cool products or a building environment. The refrigeration or air conditioning system(R) transfers heat from a cooler low-energy reservoir to a warmer high-energy reservoir.

COURSE OBJECTIVES

1. To understand the principles of refrigeration and air conditioning.
2. To calculate the cooling load for different applications of Refrigeration and Air conditioning.
3. To learn the principles of psychrometry.
4. To develop the knowledge of selecting the right equipment for a particular application of Refrigeration and Air-conditioning.

COURSE OUTCOMES

At the end of this course, the learner will be:

1. Possess the knowledge of system components of refrigeration and air conditioning.
2. Design and implement refrigeration and air conditioning systems using standards.
3. Apply the knowledge of psychrometry in calculating cooling load and heating load calculations.

COURSE CONTENT

Unit I: Refrigeration Cycles and Refrigerants

Vapour compression refrigeration cycles-Air refrigeration cycles-Simple saturated vapour compression refrigeration cycle-P-H charts - Multi stage compression –Multi evaporator system-cascade system-Vapour absorption systems.

Unit II: System Components

Refrigeration classification –Designation-Alternate refrigerants –Global warming and Ozone depleting aspects. Refrigerant compressors Reciprocating –Rotary - Condensers - Evaporators - Expansion devices - Cooling towers.

Unit III: Cycling Controls and System Balancing

Pressure temperature control range and different settings - Selection and balancing of system components - Graphical method.

Unit IV: Psychrometry

Moist air properties - Psychrometric chart - Different Psychrometric process analysis.

Unit V: Air Conditioning

Air conditioning systems – classification - Cooling load calculations - different types of loads - GRSHF - ERSHF - Estimation Oftotal load - Air distribution patterns - Dynamic and frictional losses in air ducts - Equal friction method - Fan characteristics of duct system.

TEXT BOOKS

1. Arora, C. P., (2008), Refrigeration and Air Conditioning, Tata McGraw-Hill Publishing Company Ltd. ISBN: 978-0-070-08390-5.

REFERENCE BOOKS

1. Manohar Prasad, (2003), Refrigeration and Air conditioning, New Age International. ISBN : 978-81-224-1429-5
2. W. F. Stocker and J. W. Jones, (2002), Refrigeration and Air conditioning, McGraw Hill. ISBN: 978-0-070-66591-0.

13030525	Dynamics of Machinery Laboratory	Learning Schedule			
		L	T	P	C
	Pre-requisites: Dynamics of Machinery	**0**	**0**	**2**	**1**

COURSE OBJECTIVES

1. To supplement the principles learnt in Kinematics and Dynamics of Machinery.
2. To understand how certain measuring devices are used for dynamic testing.

COURSE OUTCOMES

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

1. Understand kinematics of various mechanisms, balancing of rotating systems.
2. Study the performance of different types of governors, gyroscopic effect.
3. Plot profile of cam.
4. Determine frequency of the vibrating systems.

LIST OF EXPERIMENTS

1. To determine natural frequency of longitudinal vibration in spring mass system.
2. Determination of torsional frequency of a single rotor system.
3. To study nomenclature of cam and plotting the cam profile.
4. To determine gyroscopic couple on motorized gyroscope.
5. To perform experiment on Watt and Porter governors to determine performance characteristic curves, and to find stability & sensitivity.
6. To determine the frequency of un-damped free vibration of an equivalent spring mass system.
7. To determine the radius of gyration ‘k’ of the given compound pendulum.
8. Comparative study of static and dynamic balancing in rotors.
9. To find out critical speed and to compare the whirling speed of a shaft.
10. To study TRI –FILAR / BI-FILAR System.
11. Comparative study of different types of clutches.

13030526	Heat and Mass Transfer Laboratory	Learning Schedule			
		L	T	P	C
	Pre-requisites: Heat and Mass Transfer	0	0	2	1

COURSE OBJECTIVES

This laboratory provides good practical knowledge of various heat transfer principles

COURSE OUTCOMES

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

1. Determine thermal conductivity of slab, composite wall, insulating power and the given liquid.
2. Measure heat transfer co-efficient of cylinder and pipe under natural and forced convection.
3. Evaluate the heat transfer through parallel flow and counter flow heat exchangers.

List of Experiments

1. To calculate thermal conductivity of insulating material in the form of slab.
2. To calculate total thermal resistance and thermal conductivity of composite wall.
3. To calculate the thermal conductivity of insulating powder.
4. To calculate the thermal conductivity of given liquid (glycerin).
5. To calculate the average heat transfer co-efficient of vertical cylinder under natural convection.
6. To calculate surface heat transfer coefficient for a pipe by forced convection and compare heat transfer coefficient for different air flow rates and heat flow rates.
7. To calculate the heat transfer coefficient experimentally and theoretically for free and forced convection and compare the theoretical temperature distribution with experimentally obtained distribution.
8. To study the Boiling Heat Transfer phenomenon for pool boiling of water.
9. To conduct test on a heat pipe and compare the temperature distribution and rate of heat transfer with geometrically similar copper and stainless steel tubes.
10. To determine the value of Stefan-Boltzman constant for radiation heat transfer.
11. To measure the property of emissivity of the test plate surface at various temperatures.
12. To study and compare temperature distribution, heat transfer rate, overall heat transfer co-efficient in parallel flow and counter flow heat exchanger.

TEXT BOOKS

1. R. C. Sachdeva (2005), Fundamentals of Heat and Mass Transfer, New Age International (P) Ltd. ISBN: 978-8-122-40076-2.

REFERENCE BOOKS

1. P. K. Nag (2005), Heat Transfer, Tata McGraw Hill Publishing Company Limited. ISBN: 978-0-070-606531.
2. J. P. Holman (2005), Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited. ISBN: 978-0-070-29618-3.
3. Dewitt Lavine, Bergmann and Incropera (2010), Fundamentals of Heat and Mass Transfer, 6th Edition, John Wiley & Sons, ISBN: 978-8-126-52764-9.

13030527	Technical skills for Mechanical Engineer-III	Learning Schedule			
		L	T	P	C
	Pre-requisites: Technical skills for Mechanical Engineer-II	0	0	2	1

COURSE DESCRIPTION

The aim of this course is to understand the basic principles/concepts and solve problems through creative thinking. This course provides understanding of the basic theories of thermal engineering systems, automobiles, refrigeration and air-conditioning systems and the design aspects of a transmission system. This course covers the concept of finite element modelling (FEM) and application of analysis software in the field of mechanical engineering. This course also covers the significance of computer aided modelling principles in the product development and the importance of modelling in manufacturing environment. The practice sessions are included to solve objective type problems in the areas of thermal, design, finite element and advanced manufacturing techniques.

COURSE OBJECTIVES

1. To apply the concepts of thermal energy systems to practical problems and finding solutions.
2. To broaden the understanding of students in the structure of vehicle chassis and engines.
3. To understand the various elements involved in a transmission system.
4. To apply control engineering techniques to the automatic control systems in modern manufacturing, processing and transportation applications.
5. To develop the knowledge in basic characteristics of finite element modelling.

COURSE OUTCOMES

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

1. Acquire skills to differentiate the various types of gas cycles, engine cycles, refrigeration cycles and power cycles.
2. Gain the ability to apply the concepts of heat engineering and applied thermodynamics
3. Know the applications of the various systems, materials used to make them, and methods used.
4. Use commercial FEA packages like ANSYS and modern CAD tools for solving real life problems.
5. Develop the basic knowledge to solve the multiple type questions and focus the corporate interviews.

COURSE CONTENT

Unit I: Fundamentals of thermal engineering system

Engine - Types- working of two stroke and four stroke engines, Performance test. Carburetor - Fuel pumps - Fuel injection systems. Reverse Carnot cycle- Bell-Colman's cycle – Vapor compression cycle. Vapour absorption system. Psychrometric - Processes – Chart

Unit II: Fundamentals of transmission systems

Design of belts, ropes, pulleys and chain drives. Design of spur and helical gears. Gear box layout. Function of Clutches - Universal joint- Propeller shaft. Principle of steering- Gearbox- Brakes

Unit III: Finite element modelling

Plane stress – plane strain analysis. Structural analysis of bar, truss and beam using ANSYS/ ABAQUS, etc.

Unit IV: Advanced manufacturing

Flexible manufacturing systems (FMS), Rapid prototyping, Knowledge Based Engineering, Lean manufacturing. Artificial Intelligence and Expert system in Computer integrated manufacturing

Unit V: Practice session

Multible choice questions are discussed and test are conducted based on module I, II, III and IV

TEXT BOOKS

1. Kirpal Singh (2011), Automobile Engineering, 12th edition, Standard Publications, ISBN : 978-8-180-14177-5.
2. Mikell P. Groover (2008), Automation, Production Systems and Computer Integrated Manufacturing, 3rd Edition, Pearson Education. ISBN: 978-8-120-33418-2.
3. Sundarajamoorthy T.V. and Shanmugam, 'Machine Design', Anuradha Agencies Publications ,2000
4. C.P Arora (2009), Refrigeration and Air Conditioning, Tata McGraw-Hill Publishing Company Ltd. ISBN: 978-0-071-26756-4.
5. Tirupathi R. Chandrupatla (2009), Finite Element Analysis for Engineering and Technology, 1st Edition, University Press. ISBN: 978-8-173-71427-6.

REFERENCE BOOKS

1. James A. Rehg and Henry W. Kraebber (2004), Computer Integrated Manufacturing, 3rd Edition, Pearson Education, ISBN: 978-0-131-13413-3
2. V. Ganesan (2008), Internal Combustion Engines, Tata McGraw-Hill Publishing Company Ltd. ISBN: 978-0-070-64817-3.
3. Joseph Edward Shigley and Charles, R. Mischke (2011), Mechanical Engineering Design, 9th Edition,McGraw –Hill International Editions, ISBN: 978-0-071-07783-
4. Bathe, K.J, (1996), Finite Element Procedures, Prentice-Hall of India Pvt. Ltd., third Edition. ISBN- 978-0-979-00490-2.
5. W. F. Stocker and J. W. Jones, (2002), Refrigeration and Air conditioning, McGraw Hill. ISBN: 978-0-070-66591-0.

13030528	Industrial Training -I	Learning Schedule			
		L	T	P	C
	Pre-requisites: Introductory Engineering Knowledge	-	-	-	1

COURSE OBJECTIVES:

4. To gain first-hand experience of working as an engineering professional, including the technical application of engineering knowledge.
5. To experience the discipline of working in a professional organisation and multidisciplinary team.
6. To develop technical, interpersonal and communication skills.

COURSE OUTCOMES

On completion of this component of curriculum, the students will be able to

4. Apply engineering knowledge in solving real-life problems.
5. Attain new skills and be aware of the state-of-art in engineering disciplines of their own interest.
6. Get exposure to real-life-working environment & practices, and to attain the professionalisms.
7. Work with multi-tasking professionals and multidisciplinary team.
8. Prepare a technical report, to improve presentation and other soft skills.

COURSE CONTENT

Exposure to real life problems at various reputed industries engaged in areas of Mechanical Engineering.

13030601	Campus - to - Corporate	Learning Schedule			
		L	T	P	C
	Pre-requisites: Personality Development & Career Building	0	0	4	2

COURSE OBJECTIVES:

1. To make the students aware of some more techniques of Presentation.
2. To make them practice the interview questions (Moke interviews)

COURSE OUTCOMES:

1. Students are confident to give independent presentations professionally.
2. Prepare for the interviews.

COURSE CONTENT

Unit-I Presentation Strategies:

Defining purpose, audience and locale, organizing content, Preparing outlines ,audio visual aids ,nuances of body language ,space, setting nuances and voice dynamics, build confidence, handling questions, collocations to be used for day to day conversation, improve the ability to present in front of the group

Unit-II: Situation Based Conversation

Conversations in Pairs to be Conducted (based on situations related to day-today life), Enhancing communication Skills through Situation Based Conversations.

Unit-III: Professional Skills

Meetings, Agenda, Minutes of the Meeting, Business Etiquette.

Unit-IV Group Discussions and Role Play

Personality Traits to be evaluated, Dynamics of Group Behavior, Group Etiquettes and Mannerism, Tips for Effective Group Discussion, Situation Based Role Play in Groups,

Unit-V: Mock Interviews

Practice through Mock Interviews for Recruitment.

TEXT BOOKS

1. E. Suresh Kumar, P. Sreehari and J. Savithri 'Communication Skills and Soft Skills An Integrated Approach', Pearson 2012
2. Nitin Bhatnagar and Mamta Bhatnagar 'Effective Communication and Soft Skills: Strategies for Success', Pearson 2012
3. Francis Peter S. J 'Soft Skills and Professional Communication', Tata McGraw-Hill 2012
4. Barun K. Mitra 'Personality Development and Soft Skills', Oxford University Press 2011

REFERENCE BOOKS

1. Dr. Seema Miglani, Shikha Goyal and Rohit Phutela 'Communication Skills-II', Vayu Education of India 2009
2. L. Ann Masters and Harold R. Wallace 'Personal Development for life and Work' Cengage Learning 2012.

13030602	Power Plant Engineering	Learning Schedule			
		L	T	P	C
	Pre-requisites: ET & HMT	3	0	0	3

COURSE DESCRIPTION

Power Plant engineering course is concerned with the types, construction, working principles and performance of various conventional and non conventional power plants. This course covers the design, construction, operations and performance of various components of steam, gas turbine, nuclear, hydral and diesel power plants. The course also focus on various sub components of power plants, such as steam generators, condensers, cooling towers, fuel and air handling system, super-heaters, inter-coolers, re-heaters and waste handling systems; to have a proper understanding. This course also discusses the Steam power plant in detail as 60% of total energy produced in world are generated by thermal power plants. The syllabus also covers nuclear power plant in detail which is a need of current scenario.

COURSE OBJECTIVES

1. To teach students about the working of various power generation Modules and steam cycles.
2. To introduce students to steam generators, combustion and firing methods in order to make the fullest use of thermal power potentialities of the country.
3. To enable students understand in detail about nuclear, gas turbine, hydro and diesel power plants which play an important role in power generation.

COURSE OUTCOMES

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

1. Understand basic power generation types and steam cycles.
2. Know about the kind of boilers being used in various industries and their applicability.
3. Solve problems related to gas turbine and Rankine cycles.
4. Distinguish between various power generation Modules and choose one that meets desired economic, environmental and social requirements.

COURSE CONTENT

Unit -I Introduction to Power Plant

Power plants-Features - Components and layouts-Working principle of Steam - Hydro - Nuclear - Gas Turbine and Diesel power plants-Selection of site-Analysis of steam cycles-Rankine cycle-Reheating and Regenerative cycles.

Unit-II Steam Generators

Boiler classification-Types of Boiler-Fire tube and Water tube boilers-High pressure and Supercritical boilers-Positive circulation boilers-Fluidized bed boiler-Waste heat recovery boiler-Feed water heaters-Super heaters- Reheaters-Economiser-Condenser-Cooling tower-Feed water treatment-Air heaters.

Unit-III Combustion and Firing Methods

Coal handling and preparation-Combustion equipment and firing methods-Mechanical stokers-Pulverized coal firing systems-Cyclone furnace-Ash handling systems-Electrostatic precipator-Fabric filter and Bag house-Forced draft and Induced draft fans-Chimney.

Unit-IV Nuclear and Gas Turbine Power Plants

Principles of nuclear energy-Energy from nuclear reactions-Energy from fission and fuel Burn up-Decay rates and Half-Lives-Boiling water reactor-Pressurized water reactor-Pressurized Heavy Water Reactor-Gas cooled reactor-High temperature gas cooled reactor-Pebble bed reactor-Fast breeder reactor-Liquid metal fast breeder reactor-reactor materials-Radiation shielding-Waste disposal-Gas turbine power plant-Open and closed cycles-Intercooling - Reheating and Regenerating-Combined cycle power plant.

Unit-V Hydro and Diesel Power Plants

Classification of Hydro-electric power plants and their applications-Selection of prime movers-Governing of turbine-Diesel power plant- Subsystems-Starting and stopping-Heat balance-Supercharging of Diesel engines.

TEXT BOOKS

1. R. K. Rajput, (2008), A Text Book of Power Plant Engineering, 4th Edition Laxmi Publications (P) Ltd. ISBN: 978-81-318-0255-7.

REFERENCE BOOKS

1. M. M. El-Wakil, (2010), Power Plant Technology, Tata McGraw-Hill Education, 1st Editions. ISBN: 978-00-707-0244-8.
2. P. K. Nag, (2007), Power Plant Engineering: Steam and Nuclear, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd. ISBN: 978-00-706-4815-9.

13030603	Instrumentation & Control Engineering	Learning Schedule			
		L	T	P	C
	Pre-requisites: Basics of Engineering-II	3	0	0	3

COURSE DESCRIPTION

The objective of this course is to present sufficient background in different instruments and sensors and their use in control system design. This course combines knowledge, techniques, and methodologies from various sources, using techniques from transform theory and basic principle of classical physics based upon which different instruments and sensors are built.

COURSE OBJECTIVES

1. To introduce a variety of sensors and instruments commonly used in Mechanical Engineering practice.
2. To instill a fundamental understanding of various instrumentation and control detection circuits as they relate to temperature, pressure, flow, and level monitoring.
3. To learn professional measurement techniques used to engineer thermal and mechanical systems.
4. To enable students apply control engineering techniques to the automatic control systems found in modern manufacturing, processing and transportation environments.
5. Identify, formulate, and solve engineering problems

COURSE OUTCOMES

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

1. Understand fundamental elements of instrumentation, measurement and control systems.
2. Build mathematical models of simple physical systems using transfer functions.
3. Will be able to design a control system for any required objective by using the theory of control system and implementing

it with various sensors and transducers.

COURSE CONTENT

Unit-I Fundamentals of Measuring Systems

General concepts of Mechanical measuring instruments – Elements of a measuring system – Requirements of measuring instruments – Static and dynamic characteristics of measuring instruments – Errors in measurements – Introduction to Transducers and Sensors – Classification and types

Unit-II Measuring Devices - I

Measurement of vibrations – Accelerometer – Measurement of Low, Medium, and High pressures- Measurement of temperature:bi-metallic thermometer, thermocouple, RTD, thermistor, pyrometer – Measurement of flow- hot wire anemometer – magnetic flow meter – ultrasonic meter.

Unit-III Measuring Devices - II

Measurement of displacement – Measurement of Force – Proving Ring,, Strain gauge, Load cells- Measurement of torque – Measurement of Speed – Case study assignments.

Unit-IV Fundamentals of Control System

Introduction to Control systems – Open and Closed loop systems – servomechanisms. Transfer function: Block diagram reduction algebra, signal flow graphs – Basics of Controllers – Problems.

Unit V: Response Analysis

Time response of First and Second order systems –Frequency domain analysis – Polar and Bode plots – Concept of Stability-Routh-Hurwitz Criterion– Problems.

TEXT BOOKS

1. Thomas G. Beckwith, Roy D. Maranon and John H. Lien nard (1999), Mechanical Measurements, Addison-Wesley Longman, New Delhi
2. Katsuhiko Ogata (1996), Modern Control Engineering, Prentice-Hall of India Pvt. Ltd., New Delhi.
3. B.C. Kuo (2003), Automatic Control Systems, 7th Edition, Prentice-Hall of India Pvt. Ltd

REFERENCE BOOKS

1. Ernest O. Doeblin (2004), Measurement Systems: Application and Design, Tata McGraw-Hill.
2. J.P. Holman (2004), Experimental Methods for Engineers, Tata McGraw-Hill.
3. I.J. Nagrath and M. Gopal (1999), Control Systems Engineering, New Age Int. Pub.
4. R.S. Sirohi and H.C. Radhakrishna (1996), Mechanical Measurements, New Age International Publications.
5. A. Nagoor Kani (2005), Control Systems, RBA Publications.

13030604	Turbo machines	Learning Schedule			
		L	T	P	C
	Pre-requisites: KOM & DOM	3	0	0	3

COURSE DESCRIPTION

The devices which are invariably of rotary type where energy transfer is brought about by dynamic action, without an impervious boundary that prevents the free flow of a fluid at any time. The fluid machines is used in several applications, the primary ones being electrical power generation, aircraft propulsion and vehicular propulsion for civilian and military use. In this course student will learn about various hydraulic machines and their working. This course will also tells about how to calculate different performance
parameters, governing and selection of fluid machines.

COURSE OBJECTIVES

1. To know the operation of turbo machines for compressible and incompressible fluids.
2. To draw velocity triangles and analyze thermodynamic plots and losses in hydraulic-machinery.

COURSE OUTCOMES

On completion of this course the student will be able to
1. Solve analytical problems in fluid machines for both compressible and incompressible fluid flows.
2. Calculate performance parameters, governing and selection of fluid machines.

COURSE CONTENT

Unit-I Impact of free jets and Impulse Turbines

Impulse – momentum principle, jet impingement - on a stationary flat plate, inclined plate and a hinged plate, at the center of a stationary vane, on a moving flat plate, inclined plate, a moving vane and a series of vanes, Jet striking tangentially at the tip of a stationary vane and moving vane(s),jet propulsion of ships. Impulse Turbines: Classification – impulse and reaction turbines, water wheels, component parts, construction,operation and governing mechanism of a Pelton wheel, work done, effective head, available head and efficiency of a Pelton wheel, design aspects, speed ratio, flow ratio, jet ratio, number of jets, number of buckets and working proportions, Performance Characteristics, governing of impulse turbines. Problems

Unit-II Francis Turbines

Component parts, construction and operation of a Francis turbine, governing mechanism, work done by the turbine runner, working proportions and design parameters, slow, medium and fast runners, degree of reaction, inward/outward flow reaction turbines, Performance Characteristics, Problems.Propeller and Kaplan turbines: Component parts, construction and operation of a Propeller, Kaplan turbine,differences between the Francis and Kaplan turbines, draft tube - its function and different forms,PerformanceCharacteristics,Governing of reaction turbine, Introduction to new types of turbine, Deriaz (Diagonal), Bulb,Tubular turbines, Problems

Unit-III Dimensional Analysis and Model Similitude

Dimensional homogeneity, Rayleigh's method and Buckingham's-theorem, model studies and similitude, dimensionless numbers and their significance. Unit quantities, specific speed and model relationships for turbines, scale effect, cavitations – its causes, harmful effects and prevention,Thomas cavitation factor, permissible installation height, Problems.

Unit-IV Centrifugal Pumps

Classification, velocity vector diagrams and work done, manometric efficiency, vane shape,head capacity relationship and pump losses, pressure rise in impeller, minimum starting speed, design considerations, multi-stage pumps. Similarity relations and specific speed, net positive suction head, cavitation and maximum suction lift, performance characteristics. Brief introduction to axial flow, mixed flow and submersible pumps, Problems

Unit-V Reciprocating Pumps and Hydraulic systems

Construction and operational details, discharge coefficient, volumetric efficiency and slip, work and power input, effect of acceleration and friction on indicator diagram (pressure – stroke length plot),separation, air vessels and their utility, rate of flow into or from the air vessel, maximum speed of the rotating crank, characteristic curves, centrifugal vs reciprocating pumps, brief introduction to screw, gear, vane and radial piston pumps, Problems. Function, construction and operation of Hydraulic accumulator, hydraulic intensifier, hydraulic crane, hydraulic lift and hydraulic press, Fluid coupling and torque converter, Hydraulic ram, Problems.

TEXT BOOKS

1. Hydraulics & Fluid Mechanics – Modi & Seth, Pub. - Standard Book House, N.Delhi
2. Hydraulic Machines – Jagdish Lal, Metropolitan

REFERENCE BOOKS

1. Fluid Mechanics and Hydraulic Machines – S S Rattan, Khanna Publishers
2. Introduction to Fluid Mechanics and Fluid Machines – S K Som and G Biswas, Tata McGraw Hill
3. Fluid Mechanics and Fluid Power Engineering – D S Kumar, S K Kataria and Sons

13030605	Entrepreneurship Development	Learning Schedule			
		L	T	P	C
	Pre-requisites: IE & M	2	0	0	2

COURSE OBJECTIVES:

The objective of the section is to develop conceptual understanding of the topic among the students and comprehend the environment of making of an Entrepreneur. Specific topics to be covered in the section are as follows:

COURSE OUTCOMES

1. To inculcate entrepreneurship skills to students.
2. To aware about industry structure and how to start up a company

COURSE CONTENT

Unit I : Entrepreneurship

Definition, requirements to be an entrepreneur, entrepreneur and intrapreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.

Unit II : Entrepreneurial Motivation

Motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland' s Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programmes.

Unit III : Types of Enterprises and Ownership Structure:

Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, Ltd. companies and co-operatives: their formation, capital structure and source of finance.

Unit IV: Projects:

Identification and selection of projects; project report: contents and formulation, concept of project evaluation, methods of project evaluation: internal rate of return method and net present value method.

Unit V: Management of Enterprises

Objectives and functions of management, scientific management, general and strategic management; introduction to human resource management: planning, job analysis, training, recruitment and selection, etc.; marketing and organizational dimension of enterprises; enterprise financing : raising and managing capital, shares, debentures and bonds, cost of capital; break-even analysis, balance sheet its analysis..

Institutional Support and Policies: institutional support towards the development of entrepreneurship in India, technical consultancy organizations, government policies for small scale enterprises.

TEXT BOOKS

1. Ram Chandran, 'Entrepreneurial Development', Tata McGraw Hill, New Delhi
2. Saini, J. S., 'Entrepreneurial Development Programmes and Practices' , Deep & Deep Publications (P), Ltd.
3. Khanka, S S. 'Entrepreneurial Development', S Chand & Company Ltd. New Delhi

REFERENCE BOOKS

1. Badhai, B 'Entrepreneurship for Engineers', Dhanpat Rai & co. (p) Ltd.
2. Desai, Vasant, ' Project Management and Entrepreneurship', Himalayan Publishing House, Mumbai, 2002.
3. Gupta and Srinivasan, 'Entrepreneurial Development', S Chand & Sons, New Delhi.

13030606	Automobile Engineering	Learning Schedule			
		L	T	P	C
	Pre-requisites: HMT & DOM	3	0	0	3

COURSE DESCRIPTION

Automobile engineering is the one of the stream of mechanical engineering. It deals with the various types of automobiles, their mechanism of transmission systems and its applications. Automobiles are the different types of vehicles used for transportation of passengers, goods, etc. Basically all the types of vehicles works on the principle of internal combustion processes or sometimes the engines are called as internal combustion engines. Different types of fuels are burnt inside the cylinder at higher temperature to get the transmission motion in the vehicles. Most of the automobiles are internal combustion engines vehicles only. Therefore, every mechanical and automobile engineers should have the knowledge of automobile engineering its mechanism and its various applications.

COURSE OBJECTIVES

1. To broaden the understanding of students in the structure of vehicle chassis and engines.
2. To introduce students to steering, suspension, braking and transmission systems.
3. To introduce students to engine auxiliary systems like heating, ventilation and air-conditioning and also the importance of alternate fuels.

COURSE OUTCOMES

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

1. Develop chassis and identify suitable engine for different applications.
2. Formulate steering, braking and suspension systems.
3. Select a suitable conventional and automatic transmission system.
4. Identify the usage of Electrical vehicles / Hybrid vehicles and power plants.

COURSE CONTENT

Unit -1 Introduction to Vehicle Structure and Alternate Fuels

Vehicle construction - Chassis and body - Specifications - Engine - Types - Construction - Location of engine - Cylinder arrangement - Construction details - Cylinder block - Cylinder head - Cylinder liners - Piston – piston rings - Piston pin - Connecting rod - Crankshaft - Valves. Lubrication system - Types - Oil pumps - Filters - Cooling system - Types - Water pumps - Radiators-Thermostats - Anti-freezing compounds - Ignition system.

Unit-2 Ignition, Fuel Supply and Emission Control System

Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Module injector – Nozzle types - Electronic Fuel Injection system (EFI) - Automobile Emissions - Source of formation – Effects on human health and environment - Control techniques - Exhaust Gas Recirculation (EGR) - Catalytic converter - Emission tests and standards (Indian and Europe).

Unit-3 Transmission System

Clutches - Function - Types - Single plate, Multiple plate and Diaphragm Clutch - Fluid coupling - Gearbox - Manual - Sliding - Constant - Synchromesh - Overdrive - Automatic transmission - Torque converter - Epicylic and Hydromatic transmission - Continuously variable transmission - Universal joint - Propeller shaft - Hotchkiss drive – Final drive - Rear axle assembly - Types - Differential - Need - Construction – Non-slip differential – Differential locks - Four wheel drive.

Unit-4 Steering, Suspension and Braking System

Principle of steering - Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers-Wheels and Tires - Construction - Type and specification - Tire wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders.

Unit-5 Instrumentation and Advances in Automobile Engineering

Dash board instrumentation – Passenger comfort – Safety and security – HVAC – Seat belts – Air bags – Automotive Electronics - Electronic Control Module (ECU) - Common-Rail Diesel Injection (CRDI) – Multipoint fuel injection system(MPFI) - Gasoline Direct Injection (GDI) - Variable Valve Timing (VVT) - Active Suspension System (ASS) - Anti-lock Braking System (ABS) - Electronic Brake Distribution (EBD) – Electronic Stability Program(ESP) Traction Control System (TCS) - Global Positioning System (GPS) - X-by-wire - Electric - Hybrid vehicle.

TEXT BOOKS

1. William.H.Crouse (2006), Automotive Mechanics, 10th Edition, McGraw-Hill, ISBN: 978-0-07-063435-0.
2. Kirpal Singh (2011), Automobile Engineering, 12th edition, Standard Publications, ISBN **:** 978-8-180-14177-5.

REFERENCE BOOKS

1. Joseph Heitner (1999), Automotive Mechanics: Principles and Practices, 2nd edition, Affiliated East West Pvt. Ltd, ISBN: 978-8-176-71015-2.
2. Bosch Automotive Hand Book (2007), 8th Edition, SAE Publications,ISBN: 978- 0-7680-4851-3.
3. K. Newton and W. Steeds (2001), The motor vehicle, 13th Edition, Butterworth-Heinemann Publishing Ltd, ISBN: 978-0-080-53701-6.

13030607	Rapid Manufacturing Technologies	Learning Schedule			
		L	T	P	C
	Pre-requisites: FMP & MPM	3	0	0	3

COURSE DESCRIPTION

This course covers scientific as well as technological aspects of various additive, subtractive and formative rapid manufacturing processes.Variety of applications also will be covered ranging from rapid prototyping, rapid manufacturing to mass customization.These rapid manufacturing processes are gaining importance as they respond quickly to market needs and reduce the time required to design and manufacture products. This course will cover wide range of contemporary methodologies/technologies and tools for rapid manufacturing.

COURSE OBJECTIVES

1. To obtain knowledge of rapid prototyping technologies, systems and its applications in various fields.
2. To familiarize CAD modeling techniques.
3. To know mechanical properties and geometrical issues related to specific rapid prototyping applications.

COURSE OUTCOMES

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

1. Demonstrate the concepts of various types of rapid prototyping/manufacturing Technologies.
2. Show the application and benefits of rapid prototyping
3. Do modeling of the components through CAD tools.

COURSE CONTENT

Unit I Introduction

Mechanism of chip formation – Tool Sepcification System- Orthogonal and Oblique cutting – Single Point and Multipoint Cutting Tools-Machining forces - Merchant's Circle Diagram - Thermal aspects of metal machining - Cutting fl uids - Machinability -cutting tool materials – Tool wear and Tool life calculations.

Unit II Reverse Engineering and CAD Modeling

Basic concept - Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation,Data Requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – Data formats - Data interfacing- Part orientation and support generation - Support structure design - Model Slicing and contour data organization – Direct and adaptive slicing - Tool path generation.

Unit III: Liquid Based and Solid Based Rapid Prototyping Systems

Stereolithography (SLA): Apparatus, principle, per-build process, part-building, post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): Working principle, process, strengths, weaknesses and applications. Fused Deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications.Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

Unit IV Powder Based Rapid Prototyping Systems

Selective Laser Sintering(SLS): Principle, process, Indirect and direct SLS - Powder structures, modeling of SLS, materials, post processing, post curing, surface deviation and accuracy, Applications.Direct Metal Laser Sintering (DMLS); Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages,

limitations and applications– Case Studies.

Unit V: Other Rapid Prototyping Technologies

Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system.Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM): Introduction, basic process, shape decomposition, mold SDM and applications. Selective Laser Melting, Electron Beam Melting – Rapid Manufacturing.

TEXT BOOKS

1. Ali K. Kamrani, Emad Abouel Nasr, (2006), Rapid Prototyping: Theory and Practice, Springer. ISBN: 978-0-387-23290-4.

REFERENCE BOOKS

1. Liou W. Liou, Frank W. Liou, (2007), Rapid Prototyping and Engineering applications: A Tool Box for Prototype Development, CRC Press. IBSN: 978-0-849-33409-2.
2. C. K. Chua, K. F. Leong and C. S. Lim (2003), Rapid Prototyping: Principles and Applications, 2nd Edition, World Scientific Publishers. ISBN: 978-9-812-38120-0.
3. Peter D. Hilton and Paul F. Jacobs, (2000), Rapid Tooling: Technologies and Industrial Applications, Marcel Dekker Publication, ISBN: 978-0-824-78788-2.
4. Jacobs, P. F., (1996), Stereolithography and other RP&M technologies, ASME. ISBN: 978-0-872-63467-1.

13030608	Composite Materials	Learning Schedule			
		L	T	P	C
	Pre-requisites: MET	3	0	0	3

COURSE DESCRIPTION

Composites are a unique class of materials made from two or more distinct materials that when combined are better than each would be separately. They are non-corroding, non-magnetic, radar transparent and they are designed to provide strength and stiffness where it is needed. This course will describe different types of composites. Student will also get the idea about design and manufacturing methods involved in making of composites. Joining method and failure theories for composites are also discussed in this course. Since composites are affordable high performance material and expanded commercial as well as industrial utilization,
hence this course is quite useful.

COURSE OBJECTIVES

1. To understand the properties and design of composite materials.
2. To familiarize with the manufacturing methods for composites.
3. To get acquainted with practical requirements associated with joining and manufacturing.

COURSE OUTCOMES

On completion of this course, the students will

1 Design and manufacture composite materials for various applications.
2. Conduct mechanical testing of composite structures and analyze failure modes.
3. Analyze economic aspects of using composites.
4. Explain the relevance and limitations of the destructive and non-destructive test methods used for composites.
5. Demonstrate the ability to use appropriate design and analysis tools and techniques.

COURSE CONTENT

Unit I: Introduction

Definitions: Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.

Unit II: Manufacturing Methods

Hand and spray lay-up, press molding, injection molding, resin injection, RRIM, filament winding, pultrusion, centrifugal casting and prepress. Fibre/Matrix Interface, Theories of adhesion; absorption and wetting, Inter diffusion, electrostatic, chemical, and mechanical. Measurement of interface strength. Characterization of systems; carbon fibre/epoxy, glass fibre/polyester, etc. Influence of interface on mechanical properties of composite.

Unit III: Mechanical Properties

Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements – length and orientation distributions. Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear. Fracture: Typical fracture processes; effect of transverse ply. Review of fracture mechanics methods and application to composites. Impact: Typical impact damage; role of fibre, matrix and interface. Low and high speed impact test methods. Fatigue: Behavior of notched and unnotched specimens. Tension testing of composites. Fatigue damage – Effect of matrix and fibre properties. Implications for component design. Environmental Effects: Influence of moisture and other contaminants on fibre, matrix, interface and effect on mechanical properties. Stress corrosion cracking. Influence of high and low temperatures.

Unit IV: Laminates

Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Anti-symmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angle-ply Laminate. Orthotropic Laminate, Laminate Moduli, Design Using Carpet Plots, Stiffness Controlled Design, Design for Bending, Hydrothermal Stresses.

Unit V: Joining Methods and Failure Theories

Joining –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures. Design philosophy and procedures (systems approach). Simple design studies (pressure vessels, torsion bar); factors of safety. Case studies for failure design process, materials selection, manufacturing method. Economic aspects of using composites. Stress Analysis: Free edge stresses; typical distributions, significance of stacking sequence, significance of ply blocking, effect on failure modes,
experiment al evidence. Development of engineer's theory of bending for thin walled beams comprising several different materials and analysis of the shear flow distribution. Buckling; strut buckling, buckling of especially orthotropic plates, significance of bending-twisting coupling.

TEXT BOOKS

1. K.K. Chawla, (2007), Composite Materials, Springer-Verlag, New York.

REFERENCE BOOKS

1. B. Frank L. Matthews and Rees D. Rawlings (1999), Composite Materials: Engineering and Science, Woodhead Publishing.
2. Ning Hu (2012), Composites and Their Applications, in Tech Publisher
3. Pavla Tesinova (2011) Advances in Composite Materials: Analysis of Natural and Man-Made Materials, in Tech Publisher.

13030609	Product Design for Manufacturing	Learning Schedule			
		L	T	P	C
	Pre-requisites: Engg. Drawing & CAMD	3	0	0	3

COURSE DESCRIPTION

Product design for manufacturing is the general engineering art of designing products in such a way that they are easy to manufacture. This design practice not only focuses on the design aspect of a part but also on the producibility. In simple language it means relative ease to manufacture a product, part or assembly. DFM describes the process of designing or engineering a product in order to facilitate the manufacturing process in order to reduce its manufacturing costs. This course will impart knowledge of various methods and approaches used in design of manufacturing. Moreover, students will get familiar to DFMA software through case studies. In the end of course, student will be able to utilize the knowledge gained through coursework for the development of new product.

COURSE OBJECTIVES

1. To expose with basics of product design and manufacturing.
2. To introduce principles and evaluation methods of various aspects of designing components.
3. To teach about the manufacturability requirements and assembly processes

COURSE OUTCOMES

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

1. Apply customer-oriented, manufacturing and life cycle sensitive approach to product design and development with product design principles and structured design methodologies.
2. Possess methods and approaches for developing, implementing and nurturing an effective DFM process within the firm.
3. Demonstrate the knowledge of DFMA software for case studies.
4. Develop a new product as per the requirement.

COURSE CONTENT

Unit I: Introduction to Product design

Introduction to Product design: Asimow's Model - Product design practice in Industry - Strength consideration in product design- Design for stiffness and rigidity.

Unit II: Principles and evaluation methods

Principles and evaluation methods of various aspects of Design for X (machining - sheet metal working - injection molding - environment- service and repair - etc.).

Unit III: Manufacturability requirements

Manufacturability requirements - Forging design - Pressed component design - Casting design - Die Casting and special castings.

Unit IV: Assembly and assembly process

Assembly and assembly process - principles of Design for assembly and applications (Boothroyd/Dewhurst Method – case studies using DFMA software).

Unit V: Other supporting techniques

Other supporting techniques for new product development processes such as quality function deployment - and quality engineering and Taguchi Method.

TEXT BOOKS

1. Geoffrey Boothroyd, Peter Dewhurst and Winston Anthony Knight (2009), Product Design for Manufacture and Assembly, Taylor & Francis e-Library. ISBN: 978-1-420-08927-1.

REFERENCE BOOKS

1. A.K. Chitale and R.C. Gupta, (2005), Product Design and Manufacturing, 3rd Edition, Printice Hall of India. ISBN: 978-8-120-32636-1.
2. Karl T. Ulrich and Steven D. Eppinger (2011), Product Design and Development, 3rd Edition, Tata McGraw-Hill Education. ISBN: 978-0-073-40477-6.

13030610	Mechatronics	Learning Schedule			
		L	T	P	C
	Pre-requisites: Basics of Electronics & Mechanical	3	0	0	3

COURSE DESCRIPTION

Mechatronics is a design process that includes a combination of mechanical engineering, electrical engineering, control engineering and computer engineering. Mechatronics is a multidisciplinary field of engineering, that is to say, it rejects splitting engineering into separate disciplines. Originally, mechatronics just included the combination of mechanics and electronics, hence the word is a combination of mechanics and electronics; however, as technical systems have become more and more complex the word has been "updated" during recent years to include more technical areas.

COURSE OBJECTIVES

1. To introduce integrated approach to the design of complex engineering systems.
2. To provide knowledge of sensors, actuators and their selection for an application.
3. To expose interfacing of devices with controllers.

COURSE OUTCOMES

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

1. Identify the elements of mechatronics system.
2. Select suitable sensors, actuators and controllers to meet specific requirements.
3. Demonstrate intelligent mechatronics system for engineering applications.

COURSE CONTENT

Unit I: Introduction to Mechatronics

Introduction to Mechatronics – Conventional and Mechatronics approach in designing products – Mechatronics design process –Mechatronics in manufacturing – Adaptive and distributed control systems – Modeling and simulation of Mechatronics Systems.

Unit II: Sensors and Actuators

Overview of sensors and transducers – Microsensors – Signal conditioning – Operational amplifiers – Protection – Filtering – Analog and Digital converters. Electro-pneumatics and Electro-hydraulics – Solenoids – Direct Current motors – Servomotors – Stepper motors – Micro actuators – Drives selection and application.

Unit III: Microprocessor based Controllers

Architecture of microprocessor and microcontroller – System interfacing for a sensor, keyboard, display and motors – Application cases for temperature control, warning and process control systems.

Unit IV: Programmable Logic Controllers

Architecture of Programmable Logic Controllers – Input/Output modules – Programming methods – Timers and counters – Master controls – Branching – Data handling – Analog input/output – Selection of PLC and troubleshooting.

Unit V: Intelligent Mechatronics and Case Studies

Fuzzy logic control and Artificial Neural Networks in mechatronics – Algorithms – Computer-based instrumentation – Real-time Data Acquisition and Control – Software integration – Man-Machine Interface – Vision system – Mechatronics system case studies

TEXT BOOKS

1. W. Bolton (2008), Mechatronics - Electronic Control Systems in Mechanical and Electrical Engineering, 4th Edition, Prentice Hall. ISBN: 978-0-273-74286-9.

REFERENCE BOOKS

1. Devdas Shetty and Richard A. Kolk (2012), Mechatronics System Design, 2nd Edition, C. L. Engineering, ISBN: 978-8-131-51828-1.
2. Michael B. Histand and David G. Alciatore (2005), Introduction to Mechatronics and Measurement systems, McGraw- Hill. ISBN: 978-0-070-64814-2
3. B.P. Singh (2006), Advanced Microprocessor and Microcontrollers, New Age International Publisher.ISBN: 978-8-122-41956-6.
4. A. Smaili and F. Mrad (2008), Mechatronics: Integrated Technologies for Intelligent Machines, 1st Edition, Oxford University Press. ISBN: 978-0-198-06016-1.

13030611	Mechanical Vibrations	Learning Schedule			
		L	T	P	C
	Pre-requisites: Kinematics & Dynamics of Machines	3	0	0	3

Course Description

This course deals with the study of vibration in mechanical systems which is concerned with the oscillatory motions of bodies and the forces associated with them. This course aims to provide you with an understanding of the nature and behaviour of dynamic engineering systems and the capability of applying the knowledge of mathematics, science, and engineering to solve engineering vibration problems.

Course Objectives

This course contributes to the following program learning objectives:

1. Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline.
2. Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline.
3. In-depth understanding of specialist bodies of knowledge within the engineering discipline.
4. Fluent application of engineering techniques, tools and resources

Course Outcomes

Upon successful completion of this course you should be able to:

1. Develop mathematical model of dynamic systems with single degree of freedom.
2. Develop mathematical model of dynamic systems with multiple degrees of freedom.
3. Calculate natural frequency and period of simple vibrating mechanical systems.
4. Obtain the analytical solution for system's time response.
5. Deal with engineering systems involving vibration isolation and rotating imbalance.

COURSE CONTENT

Unit -1 Fundamentals of Vibrations

Terminology, Single degree freedom systems – Response to arbitrary periodic excitations – Duhamel`s integral – Impulse response function – Virtual work – Lagrange`s equation – Single degree freedom forced vibration with elastically coupled viscous dampers – System identification from frequency response – Transient vibration – Laplace transformation formulation.

Unit-2 Two Degree Freedom System

Free vibration of spring-coupled system – Mass coupled system – Bending vibrations of two degree freedom system – Forced vibration – Vibration Absorber - -Vibration Isolation.

Unit-3 Multi Degree Freedom System

Normal mode of vibration – Flexibility matrix and Stiffness matrix – Eigen value and Eigen vector – Orthogonal properties – Modal matrix – Modal analysis – Forced vibration by matrix inversion – Modal damping in forced vibration – Numerical methods for fundamental frequencies.

Unit-4 Vibration of continuous Systems

System governed by wave equations – Vibration of strings – Vibration of rods – Euler`s equation for beams – Effects of Rotary Inertia and shear deformation – Vibration of plates.

Unit-5 Experimental Methods in Vibration Analysis

Vibration Measuring Instruments – Vibration Exciters – Vibration Tests – Free and Forced Vibration Tests. Examples of Vibration Tests – Industrial Case Studies.

TEXT BOOKS

1. William T. Thomson (2005), Theory of vibration with applications, 5th Edition, Pearson Education India. ISBN: 978-8-131-70482-0.

REFERENCE BOOKS

1. R V Dukkipati (2008), Advanced Mechanical Vibrations, Alpha Science. ISBN: 978-1-842-65222-0.
2. G K Grover (2003), Mechanical Vibrations , Nem Chand & Bros. Roorkee , ISBN 81-85240-75-2.

13030612	Modeling and Simulation of Manufacturing Systems	Learning Schedule			
		L	T	P	C
	Pre-requisites: Computer Aided Machine Design	3	0	0	3

COURSE DESCRIPTION

The objective of this course is to give a sound knowledge of the fundamental aspects of system simulation, which is used in the analysis of complex system and finds applications in a wide range of real life situations. Modeling and Simulation of Manufacturing Systems course is concerned with the concepts of system, system modeling and simulation, has been expanded to include the details of types of models and simulation software. This course covers the mathematical and statistical models. This course provides the knowledge of random number generation and inverse transform techniques. This course also discusses the analysis of simulation data and application of simulation system in manufacturing and material handling systems

COURSE OBJECTIVES

1. To introduce modeling, simulation and optimization as it applies to the study and analysis of manufacturing systems for decision support.
2. To expose with a wide range of applications for simulation methods and models and to integrate them with their introduction to operations management

COURSE OUTCOMES

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

1. Develop the practical skills necessary to design, implement and analyze discrete-event simulation systems.
2. Cover the basic theory underlying discrete-event simulation methodologies in order to enable a critical understanding of simulation output in managerial environments.
3. Build the foundations necessary to quickly adapt for future advances in simulation technology.

COURSE CONTENT

Unit I: Introduction to System Simulation

Introduction to system simulation – Applications – Discrete and Continuous simulation – Simulation models – Simulation procedure– Simulation Examples – General Principles - Simulation software.

Unit II: Mathematical and Statistical Models

Review of basic probability and Statistics – Statistical models in simulation - Selecting input probability distributions.

Unit III: Random Numbers

Random number generation-Testing of Random numbers – Techniques for generating random numbers- Random Variate Generation– Inverse transform techniques-Acceptance-Rejection techniques- Special properties.

Unit IV: Analysis of Simulation Data

Input modeling – Data collection – Identifying the distribution with data- Parameter estimation - Goodness of fit tests – Fitting a non-stationery Poisson`s process- Selecting input models without data-Multi Variate and Time Series Input Models- Model Building – Verification, Validation and Calibration of Simulation Models – Output analysis – Comparison and Evaluation of Alternative System designs

Unit V: Applications

Simulation of Manufacturing and Material Handling systems – Simulation of Computer Systems – Simulation of Computer Networks

TEXT BOOKS

1. Jerry banks, John S Carson, Barry L Nelson and David M Nicol (2006), Discrete Event System Simulation, 4th Edition,Pearson Education Asia. ISBN: 978-8-177-58591-9.

REFERENCE BOOKS

1. Averill M. Law and W David Kelton (2000), Simulation Modeling and Analysis, 3rd Edition, McGraw Hill. ISBN: 978-0-071-16537-2.
2. W David Kelton, Randoll P Sadowski and Debroah A Sasowski (2003), Simulation with ARENA, 3rd Edition, McGraw Hill. ISBN: 978-0-072-91981-3.

13030613	Lean Enterprises and New Manufacturing Technology	Learning Schedule			
		L	T	P	C
	Pre-requisites: Industrial Economics & Management & Machining process & Metrology	3	0	0	3

COURSE DESCRIPTION

Lean manufacturing reduces waste in manufacturing processes. It involves producing high quality products using the least amount of resources possible. The faster a business is able to produce the final product, the lesser the cost of holding finished inventory and raw materials. Further Cellular manufacturing employs setup reduction and gives the workers the machine tools to be multi process, operating multiple processes, owning quality improvements, waste reduction, and simple machine maintenance. This allows workers to easily self-balance within the cell while reducing lead times, resulting in the ability for companies to manufacture high quality products at a low cost, on time.

COURSE OBJECTIVES

1. To provide overall view of modern management techniques
2. To study lean manufacturing principles and its benefits
3. To know about value stream mapping and its associated advantages

COURSE OUTCOMES

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

1. Identify value in all walks of their life
2. Use of process mapping and Group Technology in the industry
3. Enhance the productivity through applications of modern management techniques

COURSE CONTENT

Unit I: Introduction to Lean manufacturing

General - Brief history of lean manufacturing – Just in time – Toyota systems – Pioneers of lean manufacturing – Ohno and Shingo – Benefits of lean manufacturing – Theory of constraints – Reduction of wastes.

Unit II: Lean Manufacturing Principles

Lean manufacturing: - Principles - Basic tools - Techniques - Definition - Assessment tools - Implementing lean manufacturing –Science behind lean manufacturing – Capacity utilization - Variability – Delivery.

Unit III: Strategic Issues

Strategic issues: - Actions - Issues - Focus - Leadership - Management of teams – Training. Lean accounting: Activity based costing- Product costing - Volume adjusted costing – Focused factory concept – Building strategic advantage through enterprise wide.

Unit IV: Process Mapping

Value stream and process mapping: - Overview - Where to use - Step by step approach – How to use – Reduce stream mapping –Present and future states - VSM symbols - Process mapping - Detailed instructions - limits – facilitation.

Unit V: Cellular Manufacturing

Cellular manufacturing: - Work cell – Cell design - Facility planning – Plant layout – Balancing the work in work cells – Tact time – Defining - Benefits - Uses - Limitations – Facilities planning tools. Group technology coding classification - Productivity Improvement Aids -

Kaizen – Kanban - 5S - TPM - Automation - Jidoka – Mistake proofing – Yoko poko Design Root cause analysis - Failure models and effects

TEXT BOOKS

1. Taiichi Ohno (1988), Toyota Production System: Beyond Large-Scale Production (English translation ed.), Portland,Oregon: Productivity Press, ISBN 978-1-563-27268-4.

REFERENCE BOOKS

1. Kigoshi Suzaki (1988), Th e New Manufacturing Challenge, Free Press, New York, Simon & Schuster ISBN: 978-0-029-32040-2.
2. Shigeo Shing (1989), Study of Toyota Production System, Portland, Oregon Productivity Press. ISBN 978-0-915-29917-1.
3. R. G. Askin and J. B. Goldberg (2007), Design and Analysis of Lean Production Systems, 1st Edition, Wiley India Edition.ISBN: 978-8-126-51449-6.

13030642	Instrumentation Laboratory	Learning Schedule			
		L	T	P	C
	Pre-requisites: Instrumentation & Control Engg.	**0**	**0**	**2**	**1**

COURSE OBJECTIVES

1. To understand the principles of measurements, methods of measurements and its application in manufacturing industries.

COURSE OUTCOMES

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

1. Demonstrate the various parameter measurements using instruments.
2. Determine the magnitude of parametric measurements such as load, speed and torque
3. Measure pressure and temperature.

List of Experiments

1. To study the characteristics of LVDT
2. To measure the load using load cell
3. To measure the temperature using thermocouple
4. Measurement of torque using torque measurement setup.
5. To measure the temperature using RTD
6. Speed measurement using stroboscope
7. Flow measurement experiment.
8. DC motor speed control
9. Experiment on Dynamometers.

13030643	Fluid and Turbo Machinery laboratory	Learning Schedule			
		L	T	P	C
	Pre-requisites: Turbo Machines	**0**	**0**	**2**	**1**

COURSE OBJECTIVES

1. To compare the results of analytical models to the actual behaviour of real fluid flows.
2. To practice standard measurement techniques of fluid mechanics and their applications.
3. To impart the practical knowledge about the performance characteristics of pumps and turbines.

COURSE OUTCOMES

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

1. Utilize basic measurement techniques of fluid mechanics.
2. Discuss the differences among measurement techniques, their relevance and applications.
3. Demonstrate practical understanding of friction losses in pipes.
4. Carryout the performance analysis of pumps and turbines.

List of Experiments

1. To study the constructional details of a Pelton turbine and draw its fluid flow circuit.
2. To draw the following performance characteristics of Pelton turbine-constant head, constant speed and constant efficiency curves.
3. To study the constructional details of a Francis turbine and draw its fluid flow circuit.
4. To draw the constant head, constant speed and constant efficiency performance characteristics of Francis turbine.
5. To study the construction details of a Kaplan turbine and draw its fluid flow circuit.
6. To draw the constant head, speed and efficiency curves for a Kaplan turbine.
7. To study the constructional details of a Centrifugal Pump and draw its characteristic curves.
8. To study the constructional details of a Reciprocating Pump and draw its characteristics curves.
9. To study the construction details of a Gear oil pump and its performance curves.
10. To study the constructional details of a Hydraulic Ram and determine its various efficiencies..
11. To study the constructional details of a Centrifugal compressor.
12. To study the model of Hydro power plant and draw its layout.

13030644	Technical skills for Mechanical Engineer-IV	Learning Schedule			
		L	T	P	C
	Pre-requisites: Technical skills for Mechanical Engineer-III	0	0	2	1

COURSE DESCRIPTION

The aim of this course is to understand the basic principles/concepts and solve problems through creative thinking. This course provides understanding of the basic theories of thermal engineering systems, computer graphics and software like Auto-CAD, Pro-E, Catia and solid works. This course covers the concept of tool mechanics. This course also covers the significance of manufacturing a product to give its desired shape and size. The practice sessions are included to solve objective type problems in the areas of thermal, manufacturing, mechanical design and conventional and unconventional machining process.

COURSE OBJECTIVES

1. To apply the concepts of thermal energy systems to practical problems and finding solutions.
2. To broaden the understanding of students in manufacturing and tool mechanics..
3. To understand the fluid mechanics concepts.
4. To understand the basics concepts of computer graphics and modelling.
5. To understand the conventional and unconventional machining processes.

COURSE OUTCOMES

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

1. Acquire skills to differentiate the various types of thermodynamic systems.
2. Gain the ability to apply the concepts of heat engineering and applied thermodynamics
3. Describe the various principle of Traditional and non-traditional machining processes.
4. Understand fundamental elements of instrumentation, measurement and control system and CAD modelling.
5. Develop the basic knowledge to solve the multiple type questions and focus the corporate interviews.

COURSE CONTENTS

Unit I: Review of Thermal Science and Engineering

Closed and open systems - law of thermodynamics. COP -Refrigerators and Heat Pump. Carnot-Rankine cycle. Otto cycle - Diesel cycle. Laws of conduction - convection and radiation. Derivation in cartesian - cylindrical and spherical coordinates. Lumped parameter system – Non dimensional numbers in conduction. Condensation and boiling. Heat Exchangers- LMTD, Reverse Carnot cycle- Bell-Colman's cycle – Vapor compression cycle. Vapour absorption system and their applications.

Unit II: Review of fluid mechanics & machinery

Fluid propertiess- Surface tension, compressibility, buoyancy. Types of flows, Velocity potential lines. Euler and Bernoulli's, Navier-Stokes Equations. Darcy's law, Hagen Poiseuille equation. Boundary layers - Laminar flow and Turbulent flow. Hydraulic turbines- Pelton, Kaplan, Francis, Hydraulic pumps-reciprocating and centrifugal, applications.

Unit III: Review of conventional and unconventional machining process

Conventional machining process- introduction, limitations, advantage, conventional machines- Lathe, milling, shaper, grinding machine, drilling etc, Unconventional machining process- introduction, limitation, classification, parameters of process selection, EDM, EBM, LBM, IBM, ECM, ECG, AJM, USM etc. And their applications.

Unit IV: Design of mechanical elements using software

Materials selection - Theories of failures - static and variable loads. Design consideration on Shafts - springs, couplings, Flywheel, CAD modelling of simple machine and automobile components - Preparation of assembled and detailed drawings of I.C. engine components using AUTOCAD/CATIA/PRO-E, Solid works etc.

Unit V: Practice session

Multible choice questions are discussed and test are conducted based on module I, II, III and IV.

TEXT BOOKS

1. P. K. Nag (2010), Basic and Applied Thermodynamics, Tata McGraw-Hill Publishing Company Ltd., ISBN 978-0-070-15131-4
2. S. Kapakjian and S.R. Schmid (2005), Manufacturing Engineering and Technology, 4th Edition, Pearson Education (Singapore) Pvt. Ltd. ISBN: 978-8-177-58170-6.
3. O.P. Khanna & M. Lal (2010), A Text book of Production Technology, Dhanpat Rai, Publications, New Delhi, ISBN: 978-8-189-92832-2.
4. Hassan El-Hofy (2005), Advanced Machining Processes, 1st edition Affilated McGraw-Hill. ISBN: 978-0-071-45334-9.
5. A.K. Hajra Choudhury, S.K. Hajra Choudhury and Nirjhar Roy (2009), Elements of Workshop Technology, Vol. – I, Media Promoters, ISBN: 978-8-185-09914-9.
6. C.P Arora (2009), Refrigeration and Air Conditioning, Tata McGraw-Hill Publishing Company Ltd. ISBN: 978-0-071-26756-4.
7. Ibrahim Zeid (2009), Mastering CAD/CAM, 2nd Edition, Tata McGraw Hill International Edition, ISBN: 978-0-070-15134-5.
8. R. K. Bansal (2010), A Textbook of Fluid Mechanics and Hydraulic Machines, 9th Edition, Laxmi Publication (P) Ltd., New Delhi. ISBN- 978-8-131-80815-3.
9. R. C. Sachdeva (2005), Fundamentals of Heat and Mass Transfer, New Age International (P) Ltd. ISBN: 978-8-122-40076-2.

REFERENCE BOOKS

1. C. P. Arora, (2001), Thermodynamics, Tata McGraw- Hill Publishing Company Ltd.,ISBN 978-0-074-62014-4.
2. William F. Smith and Javad Hashemi (2004), Foundations of Materials Science and Engineering 4th ed., MC GRAW HILL. ISBN: 978-0-073-52924-0
3. Hassan El-Hofy (2005), Advanced Machining Processes, 1st edition Affilated McGraw-Hill. ISBN: 978-0-071-45334-9.
4. J. P. Holman (2005), Heat Transfer, 9th Edition, McGraw-Hill Publishing Company Limited. ISBN: 978-0-070-29618-3.
5. W. F. Stocker and J. W. Jones, (2002), Refrigeration and Air conditioning, McGraw Hill. ISBN: 978-0-070-66591-0.
6. James A. Rehg and Henry W. Kraebber (2004), Computer Integrated Manufacturing, 3rd Edition, Pearson Education, ISBN: 978-0-131-13413-3

13030645	Industrial Training -II	Learning Schedule			
		L	T	P	C
	Pre-requisites: Basic Mechanical Engineering Knowledge	-	-	-	1

COURSE OBJECTIVES:

1. To gain first-hand experience of working as an engineering professional, including the Mechanical and Manufacturing engineering knowledge.
2. To experience the discipline of working in a professional organisation and multidisciplinary team.
3. To develop technical, interpersonal and communication skills.

COURSE OUTCOMES

On completion of this component of curriculum, the students will be able to

1. Apply engineering knowledge in solving real-life problems.
2. Attain new skills and be aware of the state-of-art in engineering disciplines of their own interest.
3. Get exposure to real-life-working environment & practices, and to attain the professionalisms.
4. Work with multi-tasking professionals and multidisciplinary team.
5. Prepare a technical report, to improve presentation and other soft skills.

COURSE CONTENT

Exposure to real life problems at various reputed industries engaged in areas of Design, Development and Manufacturing of Engineering products.

13030701	Professional Ethics for Mechanical Engineering	Learning Schedule			
		L	T	P	C
	Pre-requisites: Universal Human Values	2	0	0	2

COURSE DESCRIPTION

The methodology of this course is universally adaptable, involving a systematic and Inter-relationship of technology growth and social, economic and cultural growth. It is free from any dogma or value prescriptions. This subject mainly deals with workmanship culture, social and ethical responsibilities of Mechanical Engineers.

COURSE OBJECTIVES

1. To create an awareness in Mechanical Engineers about Ethics in engineering profession.
2. To understand professional responsibility of an engineer.
3. To appreciate ethical dilemma while discharging duties in professional life.

COURSE OUTCOMES

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

1. Understand the significance of value inputs in a classroom and start applying them in their professional life.
2. Understand the role of a human being in ensuring harmony in society and nature.
3. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

COURSE CONTENTS

Unit I: Engineering knowledge as social and professional activities

Science, Technology and Engineering as knowledge and as social and professional activities. Inter-relationship of technology growth and social, economic and cultural growth; historical perspective. Ancient, medieval and modern technology/industrial revolution and its impact; the Indian Science and Technology.

Unit II: Social and human critiques of technology

Social and human critiques of technology; Mumford and Ellul. Rapid technological growth and Depletion of resources; reports of the club of Rome; limits to growth; sustainable development. Energy crisis, renewable energy resources. Environmental degradation and pollution; eco friendly Technologies; environmental regulations; environmental ethics. Technology and the arms Race; the nuclear threat. Appropriate technology movement of Schumacher; later developments.

Unit III: Technology and the developing nations

Technology and the developing nations; problems of technology transfer; technology Assessment/impact analysis. Human operator in engineering projects and industries; problems of Man-machine interaction; impact of assembly line and automation; human centered technology. Industrial hazards and safety; safety regulations, safety engineering.

Unit IV: Politics and technology

Politics and technology; authoritarian versus democratic control of technology; social and ethical audit of industrial organizations.

Unit V: Engineering profession

Engineering profession; ethical issues in engineering practice; Conflicts between business demands and professional ideals; social and ethical responsibilities of the engineer; codes of professional ethics; whistle blowing and beyond; case studies.

TEXT BOOKS

1. Baum, R.J., ed, Ethical Problems in Engineering

REFERENCE BOOKS

1. Beabout, G.R., Wennemann, D.J., Applied Professional Ethics

13030702	Operation Research Techniques	Learning Schedule			
		L	T	P	C
	Pre-requisites: IE & M	3	0	0	3

COURSE DESCRIPTION

Operation research is having many powerful tools to optimize the real life problems. The study of this subject will give knowledge to the students regarding transportation and inventory related problems. This also describes the method of sequencing of jobs through different number of machines. Focus is also given to most common problems of waiting of either jobs/machines/peoples. Emphasis is given to decision models and replacement problems. So the study of this subject will develop the capability among students to solve effectively many problems arising during their career.

COURSE OBJECTIVES

1. To provide students the knowledge of optimization techniques and approaches.
2. To enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
3. To introduce students to research methods and current trends in Operations Research.

COURSE OUTCOMES

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

1. Apply operations research techniques in industrial optimization problems.
2. Solve transportation problems using various OR methods.
3. Illustrate the use of OR tools in a wide range of applications in industries.
4. Explain current topics and advanced techniques of Operations Research for industrial solutions.

COURSE CONTENT

Unit -1 Linear Models

Introduction to Operations Research – Linear Programming - Mathematical Formulation – Graphical method – Simplex method – Duality – Two – Phase Simplex method – Transportation problems – Northwest Corner method – Vogel's Approximation method – MODI method – Transhipment problems - Assignment problems – Applications Introduction to dynamic programming and non linear programming- Goal programming.

Unit - II Sequencing and Networks

Sequencing –Problem with N jobs and 2 machines using Johnson's method, Problems with N jobs - 3 machines and 'M' machines. using modified Johnson's method.

Network models – Basic Concepts – Construction of Networks – Project Network – CPM and PERT - Critical Path Scheduling – Crashing of Network.

Unit - III Inventory Models

Inventory models – Various Costs and Concepts–EOQ–Deterministic inventory models – Production models – Stochastic Inventory models – Buffer stock.

Unit - IV Queuing Models

Queuing models – Poisson arrivals and Exponential service times – Single channel models and Multi channel models. Simulation – Basic concepts – Advantages and Disadvantages – Random number generation – Monte-Carlo Simulation models.

Unit - V Decision Models

Decision models – Game theory – Two person zero sum game – Graphic solution - Property of dominance – Algebraic solution.

Replacement models – Items that deteriorate with time - When money value changes – Items that fail completely – Individual replacement and Group replacement.

TEXT BOOKS

1. Kanti Swarup, P.K. Gupta and Manmohan Lal (2010), Operations Research, 15th Edition, S.Chand & Sons, ISBN: 978- 8-180-54771-3.
2. H. M. Wagner (2009), Principles of Operation Research, 2nd Edition, Prentice Hall of India Ltd ISBN: 978-8-120- 30162-7.

REFERENCE BOOKS

1. Hamdy Taha, (2008), Operations Research-An Introduction, 8th Edition, Pearson Education, ISBN: 978-8-131-71104-0.
2. R. Panneerselvan (2006), Operation Research, 2nd Edition, Prentice Hall of India Pvt Ltd ISBN: 978-8-120-31743-7.
3. J. K. Sharma (2013), Operation Research, 5th Edition, Macmillan Publications, ISBN: 978-9-350-59336-3.

13030703	Design of Transmission Systems	Learning Schedule			
		L	T	P	C
	Pre-requisites: SOM & DOM	3	0	0	3

COURSE DESCRIPTION

Transmission system is most important part of any automotive vehicle. Often transmission refers simply to the gearbox that uses gears and gear trains to provide speed and torque conversions from a rotating power source to another device. But in broad understanding transmission also refers to refers to the whole drive train, including clutch, gearbox, prop shaft (for rear-wheel drive), differential, and final drive shafts. In design of transmission system course, student learns to design various components of transmission such as gears, bearings, clutches, brakes, cams etc. After going through the course, students will be able to understand the design aspects of a transmission system and the materials which are used to make them.

COURSE OBJECTIVES

1. To understand the various elements involved in a transmission system.
2. To design the system based on input and output parameters.
3. To produce working drawings of the system involving pulleys, gears, clutches and brakes.

COURSE OUTCOMES

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

1. Design pulleys, chain drives, rope drives and belt drives.
2. Determine performance requirements in the selection of commercially available transmission drives.
3. Design Brakes and Clutches
4. Design various types of gear boxes.
5. Know the applications of the various systems, materials used to make them, and methods used.

COURSE CONTENT

Unit -1 Design of bearing and flexible power transmission systems

Design of sliding contact bearing using Sommer field number – Design using Mckee's equation – Selection of rolling contact bearings. Design of Belts – Flat Belts and Pulleys – V Belts and Pulleys – Design of chain drives – Wire ropes.

Unit - II Spur Gear

Gear geometry – Kinematics – Forces on gear tooth – Stresses in Gear tooth – Selection of gear material based on bending stress and contact stress – Design of Spur gear – Power transmitting capacity. Computer – Aided Spur gear Design and Analysis.

Unit - III Helical, Bevel and Worm Gears

Parallel Helical Gears – Kinematics – Tooth proportions – Force analysis – Stresses in Helical gear – Design of helical gear – Crossed Helical gears – Straight Bevel gears – Kinematics – Force analysis – Stresses in straight bevel gear tooth – Design of bevel gear – Worm gearing – Kinematics – Forces - Friction and Efficiencies – Stresses in worm gear tooth.

Unit - IV Design of Gear boxes

Design of Speed reducers – Design of multi speed gear boxes for machine tools – Structural and ray diagrams.

Unit - V Motion control: clutches, brakes and cams

Internal – Expanding Rim clutches and Brakes, External- Contracting Rim clutches and Brakes – Band type Clutches – Core clutches and Brakes – Energy considerations – Temperature rise – Friction materials.

TEXT BOOKS

1. Joseph Edward Shigley and Charles, R. Mischke (2011), Mechanical Engineering Design, 9th Edition, McGraw –Hill International Editions, ISBN: 978-0-071-07783-
2. P. Kanniah, 'Design of Transmission Elements', Scitech publisher, ISBN 978-81-8-963-8733.

REFERENCE BOOKS

1. Hall A.S. Holowenko A.R. and Laughlin H.G., 'Th eory and Problems in Machine Design', Schaum's Series, 2000.
2. Joseph Edward Shighley, 'Mechanical Engineering', McGraw Hill, 2002.
3. Sundarajamoorthy T.V. and Shanmugam, 'Machine Design', Anuradha Agencies Publications, 2000.

13030704	CAD/CAM	Learning Schedule			
		L	T	P	C
	Pre-requisites: MPM & CAMD	2	0	0	2

COURSE DESCRIPTION

CAD is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. Students learn the importance of CAD/CAM principles in the Product development, programs related to manufacturing using codes and analyze the importance of networking in manufacturing environment.

COURSE OBJECTIVES

1. To understand the basics of CAD/CAM and concepts of computer graphics.
2. To learn about the geometric issues concerned to the manufacturing and its related areas.
3. To understand the latest advances in the manufacturing perspectives and their applications.

COURSE OUTCOMES

1. To understand the importance of CAD/CAM principles in the Product development.
2. To develop programs related to manufacturing using codes.
3. To analyze the importance of networking in manufacturing environment.

COURSE CONTENT

Unit -1 Computer Hardware

Product Development Cycle – Introduction to CAD/CAM – Graphics input devices- cursor control devices, Digitizers, Scanners, speech oriented devices and touch panels, Graphics display devices – CRT, color CRT monitors, DVST, Flat- panel display, Graphics output Devices – Printers and Plotters – Graphics Standards – Neutral File formats –IGES, STEP.

Unit - II Principles of Computer Graphics

Geometric Modeling – Wireframe, Surface and Solid – CSG and B-Rep- World/device co-ordinate representations, 2D and 3Dn geometric transformations, Matrix representation-translation, scaling, shearing, rotation and reflection, composite transformations, concatenation – Graphics software, Graphics functions, output primitives- Bresenham's Algorithm and DDA.

Unit - III CNC Machine Tools

Introduction to NC, CNC, DNC- Manual part Programming – Computer Assisted Part Programming – Examples using NC codes- Adaptive Control – Canned cycles and subroutines – CAD / CAM approach to NC part programming – APT language, machining from 3D models.

Unit - IV Group Technology, CAPP and FMS

Introduction to part families-parts classification and cooling – group technology machine cells-benefits of group technology – Process Planning – CAPP & types of CAPP – Flexible manufacturing systems (FMS) – the FMS concept-transfer systems – head changing FMS – Introduction to Rapid prototyping, Knowledge Based Engineering.

Unit - V Computer Integrated Manufacturing

CIM wheel – CIM Database- CIM-OSI Model– Networking Standards in CIM Environment – Network structure – Network architecture –TCP/IP, MAP – Virtual Reality, Augmented Reality-Artificial Intelligence and Expert system in CIM.

TEXT BOOKS

1. Mikell P. Groover (2008), Automation, Production Systems and Computer Integrated Manufacturing, 3rd Edition, Pearson Education. ISBN: 978-8-120-33418-2.

REFERENCE BOOKS

1. Ibrahim Zeid (2009), Mastering CAD/CAM, 2nd Edition, Tata McGraw Hill International Edition, ISBN: 978-0-070- 15134-5.
2. P N Rao (2010), CAD/CAM Principles and Applications, 3rd Edition, Tata McGraw-Hill Education, ISBN: 978-0-070- 68193-4.
3. James A. Rehg and Henry W. Kraebber (2004), Computer Integrated Manufacturing, 3rd Edition, Pearson Education, ISBN: 978-0-131-13413-3
4. Mikell P. Groover and Emory W. Zimmers (2003), CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall Edition, ISBN: 978-8-177-58416-5.

13030705	Fluid Power System	Learning Schedule			
		L	T	P	C
	Pre-requisites: Fluid Mechanics	3	0	0	3

COURSE DESCRIPTION

A fluid power system has a pump driven by a prime mover (such as an electric motor or IC engine) that converts mechanical energy into fluid energy. This fluid flow is used to actuate a device such as: A Hydraulic cylinder or Pneumatic cylinder, A Hydraulic motor or Pneumatic motor, A Rotary actuator etc.

COURSE OBJECTIVES

1. Understanding of basics of hydraulics and pneumatics (pumps and various power supply sources).
2. To learn students about the utilization of cylinders, accumulators, valves and various control components.
3. To learn about fluid power maintenance and troubleshooting.

COURSE OUTCOMES

At the end of this course, the learner will be:

1. Find the importance of fluid power technology in industries and to obtain knowledge on hydraulic and pneumatic components.
2. Get exposure to the basics of fluid flow including the physical laws affecting fluid standards and symbols used in industrial applications.
3. Gain knowledge of the various components in fluid power industry and solve problems related to pumps.

COURSE CONTENT

Unit-I Introduction to Fluid Power

Definition- Hydraulics Vs Pneumatics – Standards- Application – Basic Principle of Hydraulics-Pascal's Law-Transmission and multiplication of force-Basic properties of hydraulic fluids-liquid flow- static head pressure-pressure loss – Power-Basic principle of pneumatics: absolute pressure and Temperature- gas laws- vacuum.

Unit-II Hydraulic and Pneumatic Power Supply Source

Hydraulic Pump- graphic symbol- pump types -pump flow and pressure- pump drive torque and Power- pump efficiency –air compressor- graphic symbol-compressor types-compressor sizing-vacuum pumps.

Unit-III Hydraulic and Pneumatic Control Components

Cylinders-accumulators –FRL-Directional control Valves- Pressure control valves-Flow control Valves-electronic control components- symbols.

Unit-IV Basic Circuits

DCV controlling single acting, double acting cylinder-counter balance circuit-Fail safe circuit-AND and OR valve circuit- regenerative circuit-meter in and meter out circuit for extended and retracted stroke-pressure intensifier circuit-accumulator circuits.

Unit-V Fluid Power System Maintenance

Introduction, Sealing Devices - Reservoir System - Filters and Strainers - Beta Ratio of Filters - Wear of Moving Parts - Gases in Hydraulic Fluids - Temperature Control - Troubleshooting.

TEXT BOOKS

1. Ilango and soundarrajan (2011), introduction to hydraulics and pneumatics, 2nd edition, prentice hall, isbn: 978-81-203-4406-8.

REFERENCE BOOKS

1. M. Rabie (2009), Fluid power Engineering, McGraw-Hill, NY, ISBN: 978-0-071-62246-2.
2. Espositho (2009), Fluid power with application, 6th edition, Prentice Hall, ISBN: 978-81-7758- 580-3.
3. Robert P.Kokernak (1999), Fluid power technology, 2nd edition, Prentice Hall, ISBN: 978-0-139-12487-7.

13030706	Finite Element Analysis	Learning Schedule			
		L	T	P	C
	Pre-requisites: Complex analysis & Programming and Strength of Materials	**3**	**0**	**0**	**3**

COURSE DESCRIPTION

The finite element method (FEM) is among one of the most powerful tool for the numeric solution of wide range of engineering problems. The application ranges from deformation and stress analysis of civil and mechanical structures, automotive components, aircraft designs, heat flux analysis, fluid flow problems, electrical magnetic flux problem. Upon completion, students should be able to solve the problems in solid mechanics and heat transfer using FEM.

COURSE OBJECTIVES

1. To enable the students understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis.
2. To understand the characteristics of various finite elements.
3. To develop finite element equations for simple and complex domains.

COURSE OUTCOMES

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

1. Apply the knowledge of mathematics and engineering to solve problems in structural and thermal engineering by approximate and numerical methods.
2. Design a new component or improve the existing components using FEA.
3. Solve the problems in solid mechanics and heat transfer using FEM.
4. Use commercial FEA packages like ANSYS and modern CAD/CAE tools for solving real life problems.

COURSE CONTENT

Unit-I Introduction to Theory of Elasticity

Introduction to Theory of Elasticity: Definition of stress and strain – plane stress – plane strain – stress strain relations in three dimensional elasticity. Introduction to Variational Calculus: Introduction –General field problems, discrete and continuous models, Variational formulation in finite elements – Ritz method - Weighted residual methods – Galerkin – sub domain – method of least squares and collocation method - numerical problems.

Unit-II Discretization of the problem

Discretization of the Problem: Introduction – Geometrical approximations – Simplification through symmetry – Element shapes and behaviour – Choice of element types – size and number of elements – Element shape and distortion – Location of nodes – Node and Element numbering. Interpolation Function: Simplex - complex and multiplex elements – Linear interpolation polynomials for various simplex elements – Convergence requirements – derivation of shape function equations.

Unit-III Stiffness matrix formulation

One dimensional elasticity – Bar with constant and varying cross section - and Pin jointed truss member – Two dimensional elasticity – Plane stress - plane strain and axisymmetric simplex elements only - simple numerical problems.

Unit-IV Field problems

General field equation – Formulation of 1D and 2D – steady state heat transfer problems involving conduction and convection and torsion of prismatic members – simple numerical problems.

Unit-V Higher order problems

Natural coordinate system and numerical integration – Higher order 1D and 2D elements – Derivation of shape function equations for Four node quadrilateral - six node triangle and eight node quadrilateral elements – formulation of element equation.

TEXT BOOKS

1. Tirupathi R. Chandrupatla (2009), Finite Element Analysis for Engineering and Technology, 1st Edition, University Press. ISBN: 978-8-173-71427-6.
2. P. Seshu (2010), Text book of Finite Element Analysis, Prentice Hall of india. ISBN: 978-8-120-32315-5.

REFERENCE BOOKS

1. J.N. Reddy (2005), An Introduction to the Finite Element Method, McGraw-Hill, Third Edition. ISBN: 978-0-070-60741-5.
2. S. S. Rao (2012), The Finite Element Method in Engineering, 5th Edition, Elsevier. ISBN: 978-9-380-93155-5.
3. O.C. Zienkiewicz, R.L. Taylor and J. Z. Zhu (2005), The Finite Element Method: Its Basis and Fundamentals, 6th Edi-tion, Butterworth-Heinemann. ISBN: 978-0-750-66320-5.

13030707	Computational Fluid Dynamics	Learning Schedule			
		L	T	P	C
	Pre-requisites: Fluid Mechanics	3	0	0	3

COURSE DESCRIPTION

Computational Fluid Dynamics is one of the fastly-evolving fields engineering which takes essential concepts from continuum mechanics, numerical analysis, computer programming and data structures and applies to almost all engineering problems where fluid flow occurs. This course enables a thorough understanding of the basics of CFD like the governing equations, meshing issues, heat transfer applications and the method of finite differences.

COURSE OBJECTIVES

1. To understand the mathematical basis and evolution of the governing equations of fluid flow and heat transfer.
2. To solve one and two-dimensional partial differential equations using traditional CFD tools.
3. To learn meshing methods and intricacies and techniques of discretization.
4. To apply the various finite differencing schemes to CFD problems.
5. To learn the algorithms for standard CFD problems.

COURSE OUTCOMES

At the end of this course, the learner will be:

1. Use the knowledge of CFD techniques, basic aspects of discretization and grid generation.
2. Solve fluid flow fields using CFD methods.
3. Model fluid flow problems and heat transfer.

COURSE CONTENT

Unit I: Introduction and Governing Equations

Introduction - Impact and applications of CFD in diverse fields - Governing equations of fluid dynamics – Continuity – Momentum and energy - Generic integral form for governing equations - Initial and Boundary conditions - Classification of partial differential equations – Hyperbolic - Parabolic - Elliptic and Mixed types - Applications and relevance.

Unit II: Discretization

Basic aspects of discretization - Discretization techniques – Finite difference - Finite volume and Finite Element Method– Comparison of discretization by the three methods - Introduction to Finite differences - Difference equations - Uniform and non-uniform grids - Numerical errors - Grid independence test - Optimum step size.

Unit III: Grid Generation and Transformation

Grid generation – Transformation of non-uniform grids to uniform grids - General transformation of the equations - Form of the governing equations suitable for CFD - Compressed grids - Boundary fitted co-ordinate systems – Elliptic grid generation - Adaptive grids - Modern developments in grid generation.

Unit IV: Numerical Heat Transfer

Steady one-dimensional, two and three-dimensional conduction - Steady one-dimensional convection and diffusion – Transient one-dimensional and two-dimensional conduction – Explicit - Implicit - Crank-Nicolson - ADI scheme – Stability criterion.

Unit V: Calculation of Flow Field

Discretization of convection - Diffusion – Central difference, upwind, hybrid and power law schemes - Representation of the pressure - Gradient term and continuity equation –

Staggered grid - Momentum equations - Pressure and velocity corrections – Pressure Correction equation - Numerical procedure for SIMPLE algorithm - Boundary conditions for the pressure correction method. Stream function – Vorticity method - Discussion of case studies.

TEXT BOOKS

1. J.D. Anderson, Jr., (2012), Computational Fluid Dynamics – Th e basics with applications, McGraw-Hill, ISBN: 978-1-259-02596-9.

REFERENCE BOOKS

1. John D. Ramshaw (2011), Elements of Computational Fluid Dynamics, Imperial College Press. ISBN: 978-1-848-16695-0.
2. Oleg Zikanov (2010), Essential Computational Fluid Dynamics, John Wiley & Sons. ISBN: 978-0-470-42329-5.

13030708	Introduction to Biomaterial Science	Learning Schedule			
		L	T	P	C
	Pre-requisites: Material Engineering & Technology	3	0	0	3

COURSE DESCRIPTION

A biomaterial is any matter, surface, or construct that interacts with biological systems. As a science, biomaterials are about fifty years old. The study of biomaterials is called biomaterials science. It has experienced steady and strong growth over its history, with many companies investing large amounts of money into the development of new products. Biomaterials science encompasses elements of medicine, biology, chemistry, tissue engineering and science. In this subject students will enables to learn about biomaterials science, tissue Engineering, bio mineralization and Bio-mimicking materials.

COURSE OBJECTIVES

1. To learn about Biomaterials.
2. Overview on ongoing research in Biomaterials Science.
3. To learn new concepts in the interface of biology and materials science.

COURSE OUTCOMES

On completion of this course, the students will

1. Explain the basic knowledge on the subject of Biomaterials Science.
2. Apply new researches in the field.

COURSE CONTENT

Unit-I Introduction

Introduction to Biomaterials Science; Bulk properties of Materials; Surface properties and Surface characterization of materials; Role of bonding in biomaterials. Polymers; Silicone Biomaterials; Medical Fibres and Biotextiles; Hydrogels; Smart Polymers; Bioerodable and Bioresorbable materials; Natural materials; Metals, Ceramics, glasses and glass-ceramics; Pyrolytic carbon; Composites; Non-fouling surfaces; hysiochemical surface modifi cation for medicinal usage; Textured and porous materials; Surface immobilized biomolecules.

Unit-II Introduction to Biological Concept

Biochemistry basics (Amino acids, Proteins, Lipids, carbohydrates); Cells and cell injury; Tissues, matrix and cell-biomaterial interaction; Mechanical forces on cells; Role of adsorbed proteins on biomaterials; Biological fl uids. Infl ammation, wound healing and foreign body response; Innate and adaptive immunity – the immune response to foreign materials; system toxicity and hypersensitivity; blood coagulation mechanism and blood-materials interaction; Tumorigenesis; Biofilms; Biomaterials and device related infections.

Unit-III Tissue Engineering

Tissue Components; Overview of Tissue Engineering; Immunoisolation; Synthetic bioresorbable polymer scaff olds; Stem Cells and Tissue Engineering.

Unit-IV Biomineralization and Bio Mimicking Material

Biomineralization overview; Chiton tooth; Mollusk shells; Other examples of Biomineralization in nature; Synthesis of materials inspired by biomineralization; Bio-inspired Materials overview; Gecko foot; Hydrophobicity and Hydrophilicity; Wetabbility; Lotus leaf as an example; Lbl polymer films; lipid films; Tomography for investigation of biomineralization.

Unit-V Materials in Biology – Medicines and Artificial Organs & Miscellaneous

Applications in Cardiology; Applications in Nephrology; Applications in Opthalmology; Applications in dentistry; Skin substitutes; Wound dressings and sutures; Bioelectrodes; Biosensors; Intravenous Catheters; Bioglasses; Hydrogels; Cloning; Biopolymers; Frontiers in biomaterials science research; Legal and ethical aspects in biomedical sciences; Implant and device failure; Standardization and Regulation of products using Biomaterials; Sterilization; Implant retrieval and Evaluation.

TEXT BOOKS

1. Allan S. Hoff man, Buddy D. Ratner, Frederick J. Schoen (2012), Biomaterials Science: An Introduction to Materials in Medicine,3rd Edition, Academic Press Publisher. IBSN: 978-0-123-74626-9.

REFERENCE BOOKS

1. Astrid Sigel, Helmut Sigel and K. O. Roland Sigel (2008), Biomineralization: From Nature to Application, Wiley Publisher. ISBN: 978-0-470-03525-2.
2. Amar K. Mohanty , Manjusri Misra and Lawrence T. Drzal (2005), Natural Fibers, Biopolymers, and Biocomposites, First Edition, CRC Press. ISBN: 978-0-849-31741-5.
3. JB Park and RS Lakes (2010), Biomaterials - An Introduction, Springer. ISBN: 978-1-441-92281-6.

13030709	Nuclear Power Engineering	Learning Schedule			
		L	T	P	C
	Pre-requisites: Physics & Power Plant Engineering	3	0	0	3

COURSE DESCRIPTION

Nuclear Power Engineering concentrate on the principles, techniques and processes involved in generation of power from nuclear fuels. This involves studying and exploring various aspects of science ranging from processing of nuclear fuel to merits and demerits of various nuclear reactors and from reprocessing of nuclear waste to their safely disposal. Upon completion of this course students will be able to have better understanding of nuclear processes involved in nuclear power generation, know working and pros & cons of various reactors and also have understanding of nuclear power generation and safety rules implemented during power generation from nuclear fuels and nuclear waste disposal.

COURSE OBJECTIVES

1. The student will be exposed to the basic physics of nuclear reactions and operation of nuclear reactors.
2. To learn various types of power generation methods, safety and its impact on environment.

COURSE OUTCOMES

At the end of this course, the learner will be:

1. Know the nuclear fission and fusion processes
2. Understand the working of a nuclear reactors
3. Understand power generation and safety aspects

COURSE CONTENT

Unit-I Nuclear Reactors

Mechanism of nuclear fission – Nuclides - Radioactivity – Decay chains - Neutron reactions - Fission process – Reactors - Types of reactors – Design and construction of nuclear reactors - Heat transfer techniques in nuclear reactors - Reactor shielding.

Unit-II Reactor Materials

Nuclear fuel cycles – Characteristics of nuclear fuels – Uranium – Production and purification of uranium – Conversion to UF4 and UF6 – Other fuels like Zirconium, Thorium, Berylium.

Unit-III Reprocessing

Nuclear fuel cycles - Spent fuel characteristics - Role of solvent extraction in reprocessing - Solvent extraction equipment.

Unit-IV Separation of Reactor Products

Processes to be considered - Fuel element dissolution - Precipitation process – Ion exchange - Redox - Purex - TTA – Chelation -U235 -Hexone - TBP and Thorax processes - Oxidative slagging and electro-refining - Isotopes – Principles of isotope separation.

Unit-V Waste Disposal and Radiation Protection

Types of nuclear wastes – Safety control and pollution control and abatement - International convention on safety aspects – Radiation hazards prevention.

TEXT BOOKS

1. Janet Wood (2007), Nuclear Power, Institution of Engineering and Technology. ISBN: 978-0-863-41668-2.

REFERENCE BOOKS

1. Samuel Glasstone, Alexander Sesonske (2012), Nuclear Reactor Engineering: Reactor Systems Engineering, 4th Edition, CBS Publisher. ISBN: 978-1-461-35866-4.
2. J. Kenneth Shultis, Richard E. Faw, Marcel Dekker (2002), Fundamentals of Nuclear Science and Engineering, Marcel Dekker. ISBN: 978-0-824-70834-4.
3. Samuel Glasstone (1994), Nuclear Reactor Engineering: Reactor Design Basics, Volume-1, 4th Edition, Kluwer Academic Publishers. ISBN: 9780412985218
4. A.E. Walter and A.B. Reynolds (1981), Fast Breeder Reactor, Pergamon Press, ISBN: 978-0-080-25982-6.
5. R.H.S. Winterton (1981), Thermal Design of Nuclear Reactors, Pergamon Press, ISBN: 978-0-080-24215-6.

13030710	Robotics	Learning Schedule			
		L	T	P	C
	Pre-requisites: Basics of Electronics & Instrumentation & Control Engineering	**3**	**0**	**0**	**3**

COURSE DESCRIPTION

This subject deals with fundamentals of robotics, its components and various types of sensing. Further, robot programming and its industrial applications has been covered in detail. Robots are very useful and efficient in repeated kind of tasks such as pick and place, welding, assembly etc. Over a period of time intelligent robots are also developed which serves specific objectives.

COURSE OBJECTIVES

1. To get acquainted with constructional features and other basic information on robotics.
2. To know about the sensors used in robotics.
3. To learn robot programming of a typical robot and also the concepts of path planning and applications.

COURSE OUTCOMES

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

1. Know the basics of robotics.
2. Do robot programming.
3. Appreciate the applications of robotics and apply economic measures to justify advantages of robots in industry.

COURSE CONTENT

Unit-I Introduction

Definition of a Robot – Basic Concepts –Robot configurations – Types of Robot drives – Basic robot motions – Point to point control – Continuous path control.

Unit-II Components and Operation

Basic control system concepts – Control system analysis – Robot actuation and feed back - Manipulators – direct and inverse kinematics - Coordinate transformation – Brief Robot dynamics. Types of Robot and Effectors – Robot/ End – Effector interface.

Unit-III Sensing and Machine Vision

Range sensing – Proximity sensing –Touch sensing – Force and Torque sensing. Introduction to Machine vision – Sensing and Digitizing – Image processing and analysis.

Unit-IV Robot Programming

Methods – Languages – Capabilities and limitation – Artificial intelligence – Knowledge representation –Search techniques in A I and Robotics.

Unit-V Industrial Applications

Application of robots in machining – Welding – Assembly – Material handling –Loading and Unloading – CIM – Hostile and Remote environments.

TEXT BOOKS

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, (2010), Robotic Engineering An Integrated Approach, 1st Edition, Prentice-hall of India. ISBN: 978-8-120-30842-8.

REFERENCE BOOKS

1. John J. Craig (2008), Introduction to Robotics: Mechanics and Control, 3rd Edition, Pearson Education. ISBN: 978-8-131-71836-0.
2. S. R. Deb and Sankha Deb (2009), Robotics Technology and Flexible Automation, 2nd Edition, Tata McGraw-Hill Edu-cation. ISBN: 978-0-070-07791-1.
3. Robert Joseph Schilling (2007), Fundamentals of Robotics: Analysis and Control, Prentice Hall India. ISBN: 978-8-120-31047-6.

13030711	Gas Dynamics And Jet Propulsion	Learning Schedule			
		L	T	P	C
	Pre-requisites: Heat & Mass Transfer	3	0	0	3

COURSE DESCRIPTION

The principles of jet propulsion are of prime significance in designing and constructing aircraft engines. The primary focus of this course is on the teaching of thermodynamics and gas dynamics in aircraft engines. This course provides information that will enable the engineering analysis of ramjets and turbine engines and its separate components including inlets, nozzles, combustion chambers, compressors.

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COURSE OBJECTIVES

1. To provide an insight into applications of compressible flows and the fundamentals of jet propulsion systems.
2. To formulate and solve problems in one-dimensional steady compressible flow.
3. To derive the conditions for change in pressure, density and temperature for flows through normal and oblique shocks.
4. To solve problems in two-dimensional compressible flows.

COURSE OUTCOMES

On completion of this course, the students will

1. Demonstrate the knowledge of major elements in a jet engine and calculate the overall performance of a jet engine.
2. Apply the concepts of gas dynamics for applications related to compressible flows and jet propulsion.
3. Possess the knowledge of jet engines and aircraft propulsion theories.

COURSE CONTENT

Unit-I Gas Dynamics

Conservation laws for mass - Momentum and energy in steady flow - Velocity of sound - Bulk modulus of elasticity – Coefficient of Compressibility - Stagnation state - Critical state - Various regions of flow - Physical significance of Mach number – Crocco Number - Characteristic Mach number - Critical Mach number - Mach cone - Von – Karma's rules for supersonic flow – Differences between Incompressible and Compressible flows. Properties of atmosphere - Effect of Mach number on compressibility: T-S and H-S diagrams showing Nozzle and Diff user process.

Unit-II Isentropic Flow

Isentropic flow through a constant area duct – Absence of any of the factors which can trigger a change in fluid flow behavior like area change - Heat transfer - Friction and work transfer – Non variation of properties. Isentropic flow through a variable area duct – Mach number variation - Area ratio as a function of mach number - Impulse function - Mass flow rate through nozzles and diff users. Phenomenon of choking – subsonic and supersonic designs - Pressure values for nozzles - Diff users.

Unit-III Flow Through Constant Area Duct

Fanno flow - Fanno curves - Equation and its solution - Variation of flow properties with duct length - Applications. Isothermal flow with friction – Variation of flow properties – Applications Rayleigh flow - Rayleigh flow equation - Rayleigh line – Variation of flow properties - Maximum heat transfer applications. on Isothermal flow with heat transfer and friction - Basic formulation– Elementary treatment only.

Unit-IV Normal Shock Gas Dynamics

Flow with normal shock waves - Governing equations - Prandtl–Meyer equation - Impossibility of rarefaction shock – Mach number downstream of shock - Property variation across shock - Strength of shock wave - entropy change. Characteristics of flow through a C-D nozzle at various back pressures. Normal shocks in Fanno and Rayligh flow. Flow with oblique shock waves (Qualitative treatment)

Unit-V Jet Propulsion

Air craft propulsion – Types of jet engines - Energy flow through jet engines - Thrust - Thrust power and Propulsive efficiency - Turbojet components - Diff user compressor - Combustion chamber - Turbines - Exhaust system - Performance of jet engines – Thrust augmentation - Pulse jet and Ram jet engines. Rocket propulsion – Rocket engines - Basic theory of equation – Thrust effective jet velocity - Specific impulse - Rocket engine performance - Solid and Liquid propellant rockets - Comparison of various propulsion systems - Principle and Working of Helicopter.

TEXT BOOKS

1. S.M.Yahya, (2012), 4th edition, Fundamentals of compressible fl ow with Aircraft and Rocket propulsion, New Age International.ISBN : 978-81-224-2668-7..

REFERENCE BOOKS

1. P. Balachandran (2006), Fundamentals of Compressible Fluid Dynamics, Prentice Hall of India.ISBN: 978-8-120-3285-7.
2. Murugaperumal (2005), Gas Dynamics and Jet Propulsion, 1st Edition, Scitech Publishers. ISBN: 978-8-188-42993-6.
3. P.H.Oosthaizen and W.E. Carscallen (1999), Compressible Fluid Flow, McGraw-Hill ISE.ISBN 007-0-481-970.

13030712	Nano Materials	Learning Schedule			
		L	T	P	C
	Pre-requisites: Material Engineering & Technology	**3**	**0**	**0**	**3**

COURSE DESCRIPTION

Nano and micro electromechanical machines (NEM and MEM) are manufactured in the billions annually for sensing, ink jet printing, automotive applications, communications, and medicine. In medicine, bio MEMS promise to revolutionize biotechnology and biomedical engineering through fabrication of devices under 100 micrometers using novel micro and nano-fabrication techniques. Nanofabrication is the group of techniques that allows scientists and engineers to build structures and devices at the atomic scale. Traditional top-down nanofabrication consists of carving nanoscale materials from a bulk structure through chemical means or by using beams of electrons or ions to strip away layers of material. Bottom-up methods create structures by adding atomic layers one at a time by deposition or by molecular or nanoparticle self-assembly.

COURSE OBJECTIVES

1. To understand the basic concepts of Nanotechnology.
2. To enhance the knowledge of nonmaterial.
3. To familiarize with the properties of nonmaterial and their applications and explore the MEMS / NEMS devices and their applications.

COURSE OUTCOMES

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

1. Use Nanomaterials for various industrial applications.
2. Design MEMS / NEMS devices for various applications.
3. Demonstrate the knowledge of devices used in MEMS/NEMS.

COURSE CONTENT

Unit I Introduction to Nanotechnology

Nanotechnology – Background and definition of nanotechnology –Types of nano materials- Microstructure – Properties – Application in different fields – Reliability issues of MEMS/NEMS

Unit II Synthesis of Nano materials

Nano materials synthesis and applications – Chemical methods- Gas phase synthesis – Liquid phase synthesis –Plasma vapor deposition– Spray synthesis – Extrusion forging – ECAP – Characterization : Description of AFM/FFM and various measurement techniques , TEM.

Unit III: Types of Nano materials

Types of nano materials :Metallic nano particles – Metallic alloys – Nano wires and rods – Thin films – Carbon nano tubes :Structure – Synthesis – Growth mechanisms - Properties – Applications – Nano wires: Synthesis – Characterization and physical properties – Applications - Polymer ceramic nano composites- Biological based nano materials- Importance of hierarchy and third dimension of bone – Self assembly –Applications.

Unit IV Mechanical Properties of Nanostructures

Mechanical properties of nano structures : Melting and solidification of nano phase materials- Creep in nano materials – Experimental techniques for measurement of mechanical properties of nano structures - Self assembled mono layers for controlling adhesion - Friction and Wear.

Unit V: MEMS/NEMS Devices and Applications

MEMS devices and applications, NEMS devices and applications, Current challenges and future trends, MEMS fabrication techniques – Tribological issues in MEMS/NEMS – Lubrication studies for MEMS/NEMS - Manufacturing strategy – Robust manufacturing – MEMS packaging – Hermetic and vacuum packaging and applications

TEXT BOOKS

1. Charles P. Poole and Frank J. Owens (2007), Introduction to Nanotechnology, John Wiley & Sons. ISBN: 978-8-126-51099-3.

REFERENCE BOOKS

1. Jin Zhang, Zhong-lin Wang, Jun Liu, Shaowei Chen and Gang-yu Liu, (2003), Self Assembled Nanostructures, Kluwer Academic/Plenum Publishers.ISBN: 978-0-306-47299-2.
2. Bharat Bhushan (2007), Hand book of Nanotechnology, Springer Hand Book. ISBN: 978-3-540-29855-7.
3. Mark Ratner and Daniel Ratner (2009), Nanotechnology: A Gentle Introduction to the Next Big Idea, 5th Edition, Pearson Education India. ISBN: 978-8-177-58743-2.

13030740	CAD / CAM Laboratory	Learning Schedule			
		L	T	P	C
	Pre-requisites: CAD / CAM	0	0	4	2

COURSE OBJECTIVES

To provide the necessary foundation for students, in advance understanding of design and manufacturing problems in a systematic manner.

COURSE OUTCOMES

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

1. Gain practical experience in handling 2D drafting and 3D modelling software systems.
2. Understand and handle design problems in a systematic manner.
3. Understand the concepts of G and M codes and manual part programming.
4. To know the application of various CNC machines.

LIST OF EXPERIMENTS

1. Introduction to Finite Element Analysis.
2. Structural analysis of Trusses.
3. Structural analysis of Beams.
4. Structural analysis of Bar.
5. Plane stress/Plane strain analysis.
6. Introduction to CNC programming.
7. CNC part programming for Turning, External Thread Cutting and Drilling.
8. CNC part programming for Facing, contour Tool and Groove Tool.
9. CNC part programming for milling machine of Linear Interpolation, Circular Interpolation.
10. CNC code generation using MASTER CAM lathe.
11. CNC code generation using MASTER CAM mill.

13030741	Transmission Systems Laboratory	Learning Schedule			
		L	T	P	C
	Pre-requisites: Design of Transmission Systems	0	0	2	1

COURSE OBJECTIVES

1. To study steering mechanism, suspension and braking system.
2. To study different types of clutches.
3. To understand the functioning of gear box and differential gear mechanism.

COURSE OUTCOMES

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

1. Identify the different transmission components.
2. Understand function of car body and safety.
3. Understand the working of steering, braking and suspension systems.

LIST OF EXPERIMENTS

1. Study on Gear Box
2. Study of manual steering Mechanism
3. Study of power steering Mechanism.
4. Study of suspension System.
5. Study of braking system.
6. Study of clutches (Centrifugal, Claw, Single and multiple, Conical).
7. Study on Differential Gear Mechanism of Rear Axle.
8. Study of Car Chassis.
9. Visit of an Automobile factory.

13030742	Industrial / Research Project (Phase-I)	Learning Schedule			
		L	T	P	C
	Pre-requisites: Industrial Training I & II	-	-	2	3

COURSE DESCRIPTION

The project work can be an investigative analysis of a technical problem in the relevant area, planning and/or design project, experimental project or computer application based project on any of the topics. Each project group will submit project synopsis within three weeks from start of seventh semester. Project evaluation committee consisting of three or four faculty members specialised in the various fields of department, shall study the feasibility of each project work before giving consent.

COURSE OBJECTIVES

1. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.
2. Foster collaborative learning skills.
3. Develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.

COURSE OUTCOMES

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

1. Submit a project synopsis comprising of the application and feasibility of the project.
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety and sustainability.
3. Work and communicate efficiently in multidisciplinary teams
4. Identify, formulate, and solve engineering problems.
5. Develop an understanding of professional and ethical responsibility.

CONTENTS

Project work is of duration of two semesters and is expected to be completed in the eighth semester. Each student group consisting of not more than five members is expected to design and develop a complete system or make an investigative analysis of a technical problem in the relevant area. The project batches are expected to fix their topics, complete preliminary studies like literature survey, field measurements etc. in the seventh semester.

13030801	Industrial / Research Project (Phase-II)	Learning Schedule			
		L	T	P	C
	Pre-requisites: Industrial Training I & II	-	-	2	10

COURSE DESCRIPTION

The project work can be an investigative analysis of a technical problem in the relevant area, planning and/or design project, experimental project or computer application based project on any of the topics. Each project group will submit project synopsis within three weeks from start of seventh semester. Project evaluation committee consisting of three or four faculty members specialized in the various fields of department, shall study the feasibility of each project work before giving consent.

COURSE OBJECTIVES

1. To develop the capacity of students in correlating theoretical knowledge into practical systems either to perform creative works or to perform analysis and hence to suggest solutions to problems, pertaining to civil engineering domain.
2. Foster collaborative learning skills.
3. Develop self-directed inquiry and life-long skills.
4. To enhance the communication skills of the students by providing opportunities to discuss in groups and to present their observations, findings and report in formal reviews both in oral and written format.

COURSE OUTCOMES

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

1. Submit a project synopsis comprising of the application and feasibility of the project.
2. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health care, safety and sustainability.
3. Work and communicate efficiently in multidisciplinary teams
4. Identify, formulate, and solve engineering problems.
5. Develop an understanding of professional and ethical responsibility.

CONTENTS

Project work is of duration of two semesters and is expected to be completed in the eighth semester. Each student group consisting of not more than five members is expected to design and develop a complete system or make an investigative analysis of a technical problem in the relevant area. The project batches are expected to fix their topics, complete preliminary studies like literature survey, field measurements etc. in the seventh semester.