DEPARTMENT OF MECHANICAL ENGINEERING
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE AND TECHNOLOGY, HISAR

B. Tech. (Mechanical Engineering) Scheme
(w.e.f. 2016-2017)

I-Semester

Subject Area	Subject Code	Subject Name	Contact Hours per Week			Credits
			Lecture	Tutorial	Practical	
HS-1	HUM-101-L	Essentials of Communication-I	3	-	-	3.0
HS-2	HUM-103-L	Principles of Economics	3	-	-	3.0
BS-1	PHY-101-L	Physics-I	3	1	-	3.5
BS-2	MAT-101-L	Mathematics-I	3	2	-	4.0
BS-3 OR ES-1	CHY-101-L OR EE-101-L	Chemistry (G-B)) OR Basics of Electrical Engineering (G-A)	3	1	-	3.5
ES-2 OR ES-3	ME-101-L OR ECE-101-L	Workshop Technology (G-A) OR Basics of Electronics Engineering (G-B)	3	-	-	3.0
HS-1	HUM-101-P	Essentials of communication-I Lab	-	-	2	1.0
BS-1	PHY-101-P	Physics-I Lab	-	-	2	1.0
BS-3 OR ES-1	CHY-101-P OR EE-101-P	Chemistry Lab (G-B) OR Basics of Electrical Engineering Lab (G-A)	-	-	2	1.0
ES-2 OR ES-4	ME-101-P OR ME-103-P	Workshop Technology Lab (G-A) OR Engineering Drawing (G-B)	-	-	4	2.0
Total			**18**	**04**	**10**	**25.0**
			32			**25.0**
MC-1 OR MC-2	PEY-101-L OR EMV-101-L	Physical Education and Yoga (G-A) OR Professional Ethics for Engineers and Moral Values (G-B)	1 2	- -	2 -	2 units 2 units

II-Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
HS-3	HUM-102-L	Essentials of Communication-II	2	-	-	2.0
BS-4	PHY-102-L	Physics-II	3	1	-	3.5
BS-5	MAT-102-L	Mathematics-II	3	2	-	4.0
BS-3 OR ES-1	CHY-101-L OR EE-101-L	Chemistry (G-A) OR Basics of Electrical Engineering (G-B)	3	1	-	3.5
ES-2 OR ES-3	ME-101-L OR ECE-101-L	Workshop Technology (G-B) OR Basics of Electronics Engineering (G-A)	3	-	-	3.0
ES-5	CSE-101-L	Programming in C	3	-	-	3.0
HS-3	HUM-102-P	Essentials of communication-II Lab	-	-	2	1.0
ES-5	CSE-101-P	Programming in C Lab	-	-	2	1.0
BS-4	PHY-102-P	Physics-II Lab	-	-	2	1.0
BS-3 OR ES-1	CHY-101-P OR EE-101-P	Chemistry Lab (G-A) OR Basics of Electrical Engineering Lab (G-B)	-	-	2	1.0
ES-2 OR ES-4	ME-101-P OR ME-103-P	Workshop Technology Lab (G-B) OR Engineering Drawing (G-A)	-	-	4	2.0
Total			**17**	**04**	**12**	**25.0**
			33			**25.0**
MC-1 OR MC-2	PEY-101-L OR EMV-101-L	Physical Education and Yoga (G-B) OR Professional Ethics for Engineers and Moral Values (G-A)	1 2	- -	2 -	2 units 2 units

Group (G)	Disciplines
A	Mechanical Engineering Electronics and Communication Engineering Printing Technology Packaging Technology
B	Computer Science and Engineering Information Technology Biomedical Engineering Food Technology

Subject Area	Abbreviation
Humanities and Social Sciences	HS
Basic Sciences	BS
Engineering Sciences	ES
Professional subjects-Core	PC
Professional subjects-Electives	PE
Open subjects-Electives	OE
Project Work, Seminar and/or Internship in industry or elsewhere	PW
Mandatory Courses (Qualifying) – Non Credit	MC

III- Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
HS-4	HUM-201-L	Fundamentals of Management	3	-	-	3.0
BS-6	MAT-201-L	Mathematics-III	3	1		3.5
ES-6	ECE-201-L	Instrumentation	2	1	-	2.5
PC-1	ME-201-L	Mechanics of Solids-I	3	1	-	3.5
PC-2	ME-203-L	Production Technology	3	1	-	3.5
PC-3	ME-205-L	Thermodynamics	3	1	-	3.5
PC-4	ME-207-L	Machine Drawing	1	4	-	3.0
PC-1	ME-201-P	Mechanics of Solids Lab	-	-	2	1.0
PC-2	ME-203-P	Production Technology Lab	-	-	3	1.5
			18	9	5	25.0
				32		25.0
MC-3	PSY-201-L	Personality Development	2	1	-	2 units
		Total		**35**		**25.0**

IV- Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
ES-7	EVS-201-L	Environmental Studies	3	-	-	3.0
BS-7	MAT-202-L	Numerical Methods	3	-	-	3.0
PC-5	ME-202-L	Material Science	3	1	-	3.5
PC-6	ME-204-L	Fluid Mechanics	3	2	-	4.0
PC-7	ME-206-L	Steam and Power Generation	3	1	-	3.5
PC-8	ME-208-L	Mechanics of Solids-II	3	2	-	4.0
PC-5	ME-202-P	Material Science Lab	-	-	2	1.0
PC-6	ME-204-P	Fluid Mechanics Lab	-	-	2	1.0
PC-7	ME-206-P	Steam and Power Generation Lab	-	-	2	1.0
BS-7	MAT-202-P	Numerical Methods Lab	-	-	2	1.0
			18	6	8	25.0
				32		25.0
MC-4	ME-210-P	Skills and Innovation Lab	-	-	3	2 units
		Total		**35**		**25.0**

V- Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
OE-1		Open Elective-I*	4	-	-	4.0
PC-9	ME-301-L	Kinematics of Machines	3	1	-	3.5
PC-10	ME-303-L	Fluid Machines	3	1	-	3.5
PC-11	ME-305-L	Internal Combustion Engines and Gas turbines	3	1	-	3.5
PC-12	ME-307-L	Machine Design-I	3	1	-	3.5
PC-13	ME-309-L	Industrial Engineering	3	-	-	3.0
PC-9	ME-301-P	Kinematics of Machines Lab	-	-	2	1.0
PC-10	ME-303-P	Fluid Machines Lab	-	-	2	1.0
PC-11	ME-305-P	Internal Combustion Engines and Gas turbines Lab	-	-	2	1.0
PS-1	ME-311-P	Industrial Training Presentation-I	-	-	2	1.0
			19	4	8	25.0
		Total	31			25.0

***The students have to choose an Open elective subject offered by other Departments of Engineering**

VI- Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
OE-2		Open Elective –II #	4	-	-	4.0
PE-1		Programme Elective –I	4	-	-	4.0
PC-14	ME-302-L	Automobile Engineering	3	1	-	3.5
PC-15	ME-304-L	Heat Transfer	3	1	-	3.5
PC-16	ME-306-L	Dynamics of Machines	3	1	-	3.5
PC-17	ME-308-L	Machine Design-II	3	1	-	3.5
PC-14	ME-302-P	Automobile Engineering Lab	-	-	2	1.0
PC-15	ME-304-P	Heat Transfer Lab	-	-	2	1.0
PC-16	ME-306-P	Dynamics of Machines Lab	-	-	2	1.0
			20	4	6	25.0
			30			
MC-5	ME-310-P	Technical Presentation*	-	-	2	2 units
		Total	**32**			**25.0**

#The students have to choose an Open elective subject offered by other Departments of Engineering

Note- At the end of the VI-semester each student will undergo 4-6 weeks training/internship in an industry/research institute

***Non-Credit**

Programme Elective-I

Course Code	Course Name	L	T	P	Credits
ME-352-L	Operation Research	4	-	-	4.0
ME-354-L	Maintenance Engineering	4	-	-	4.0
ME-356-L	Total Quality Control	4	-	-	4.0
ME-358-L	Production Management	4	-	-	4.0

VII- Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
OE-3		Open Elective –III #	4	-	-	4.0
PE-2		Programme Elective –II	4	-	-	4.0
PC-18	ME-401-L	Computer Aided Design and Manufacturing	3	1	-	3.5
PC-19	ME-403-L	Mechanical Vibrations	3	1	-	3.5
PC-20	ME-405-L	Refrigeration and Air-conditioning	3	1	-	3.5
PC-18	ME-401-P	Computer Aided Design and Manufacturing Lab	-	-	2	1.0
PC-19	ME-403-P	Mechanical Vibrations Lab	-	-	2	1.0
PC-20	ME-405-P	Refrigeration and Air-conditioning Lab	-	-	2	1.0
PS-2	ME-407-P	Minor Project	-	-	5	2.5
PS-3	ME-409-P	Industrial Training Presentation-II	-	-	2	1.0
			17	3	13	25.0
			33			
MC-6	ME-411-P	General Proficiency*	-	-	2	2units
		Total	**35**			**25.0**

#The students have to choose an Open elective subject offered by other Departments of Engineering

Programme Elective -II

Course Code	Course Name	L	T	P	Credits
ME-451-L	Automation in Manufacturing	4	-	-	4.0
ME-453-L	Advanced Welding	4	-	-	4.0
ME-455-L	Tool Engineering	4	-	-	4.0
ME-457-L	Modern Manufacturing Methods	4	-	-	4.0

***Non-Credit**

VIII Semester

Subject Area	Course Code	Course Name	L	T	P	Credits
PE-3	ME- -L	Programme Elective-III	4	-	-	4.0
PE-4	ME- -L	Programme Elective-IV	4	-	-	4.0
PE-5	ME- -L	Programme Elective-V	4	-	-	4.0
PE-6	ME- -L	Programme Elective-VI	4	-	-	4.0
PS-4	ME-402-P	Seminar	-	-	4	2.0
PS-5	ME-404-P	Major Project	-	-	14	7.0
		Total	16	-	18	25.0
			34			**25**

OR

Subject Area	Course Code	Course Name	L	T	P	Credits
PS-6	ME-406-P**	Full semester Industrial Training	-	-	-	25.0

**The student will be required to submit to the department, the offer letter for the full semester industrial training at-least 15 days before the commencement of 8th semester. The options shall be according to the following conditions:

A student may opt for one semester industrial training in lieu of attending the courses of 8th semester. The credits/marks for industrial training will be equal to the total credits/marks of courses offered in the 8th semester study. A student will be allowed to join the industrial training if student is selected for, the job through campus placements during 7th semester and the employer is willing to take the students for the training for a period of full semester.

Programme Elective -III

Course Code	Course Name	L	T	P	Credits
ME-452-L	Introduction to Tribology	4	-	-	4.0
ME-454-L	Computer Numerical Control Machine Tools	4	-	-	4.0
ME-456-L	Reverse Engineering	4	-	-	4.0
ME-458-L	Product Design and Development	4	-	-	4.0

Programme Elective -IV

Course Code	Course Name	L	T	P	Credits
ME-462-L	Robotics	4	-	-	4.0
ME-464-L	Mechatronics	4	-	-	4.0
ME-466-L	Automatic Control	4	-	-	4.0
ME-468-L	Flexible Manufacturing Systems	4	-	-	4.0

Programme Elective -V

Course Code	Course Name	L	T	P	Credits
ME-472-L	Power Plant Engineering	4	-	-	4.0
ME-474-L	Non-conventional energy	4	-	-	4.0
ME-476-L	Design of Heat Exchangers	4	-	-	4.0
ME-478-L	Turbo Machinery	4	-	-	4.0

Programme Elective -VI

Course Code	Course Name	L	T	P	Credits
ME-482-L	Computational Fluid Dynamics	4	-	-	4.0
ME-484-L	Ergonomics Engineering	4	-	-	4.0
ME-486-L	Rapid Prototyping	4	-	-	4.0
ME-488-L	Computer Integrated Manufacturing	4	-	-	4.0

List of Open Elective offered by Mechanical Engineering Department to other Engineering Departments

Subject Area	Course Code	Course Name	L	T	P	Credits
V Semester						
OE-1	OE-ME-391-L	Industrial Engineering	4	-	-	4.0
VI Semester						
OE-2	OE-ME-392-L	Material Science	4	-	-	4.0
VII Semester						
OE-3	OE-ME-491-L	Computer Aided Design and Manufacturing	4	-	-	4.0

B. Tech. (Mechanical Engineering) Syllabus
(w.e.f. 2016-2017)

I-Semester

Subject Area	Subject Code	Subject Name	Contact Hours per Week			Credits
			Lecture	Tutorial	Practical	
HS-1	HUM-101-L	Essentials of Communication-I	3	-	-	3.0
HS-2	HUM-103-L	Principles of Economics	3	-	-	3.0
BS-1	PHY-101-L	Physics-I	3	1	-	3.5
BS-2	MAT-101-L	Mathematics-I	3	2	-	4.0
BS-3 OR ES-1	CHY-101-L OR EE-101-L	Chemistry (G-B)) OR Basics of Electrical Engineering (G-A)	3	1	-	3.5
ES-2 OR ES-3	ME-101-L OR ECE-101-L	Workshop Technology (G-A) OR Basics of Electronics Engineering (G-B)	3	-	-	3.0
HS-1	HUM-101-P	Essentials of communication-I Lab	-	-	2	1.0
BS-1	PHY-101-P	Physics-I Lab	-	-	2	1.0
BS-3 OR ES-1	CHY-101-P OR EE-101-P	Chemistry Lab (G-B) OR Basics of Electrical Engineering Lab (G-A)	-	-	2	1.0
ES-2 OR ES-4	ME-101-P OR ME-103-P	Workshop Technology Lab (G-A) OR Engineering Drawing (G-B)	-	-	4	2.0
Total			**18**	**04**	**10**	**25.0**
			32			**25.0**
MC-1 OR MC-2	PEY-101-L OR EMV-101-L	Physical Education and Yoga (G-A) OR Professional Ethics for Engineers and Moral Values (G-B)	1 2	- -	2 -	2 units 2 units

II-Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
HS-3	HUM-102-L	Essentials of Communication-II	2	-	-	2.0
BS-4	PHY-102-L	Physics-II	3	1	-	3.5
BS-5	MAT-102-L	Mathematics-II	3	2	-	4.0
BS-3 OR ES-1	CHY-101-L OR EE-101-L	Chemistry (G-A) OR Basics of Electrical Engineering (G-B)	3	1	-	3.5
ES-2 OR ES-3	ME-101-L OR ECE-101-L	Workshop Technology (G-B) OR Basics of Electronics Engineering (G-A)	3	-	-	3.0
ES-5	CSE-101-L	Programming in C	3	-	-	3.0
HS-3	HUM-102-P	Essentials of communication-II Lab	-	-	2	1.0
ES-5	CSE-101-P	Programming in C Lab	-	-	2	1.0
BS-4	PHY-102-P	Physics-II Lab	-	-	2	1.0
BS-3 OR ES-1	CHY-101-P OR EE-101-P	Chemistry Lab (G-A) OR Basics of Electrical Engineering Lab (G-B)	-	-	2	1.0
ES-2 OR ES-4	ME-101-P OR ME-103-P	Workshop Technology Lab (G-B) OR Engineering Drawing (G-A)	-	-	4	2.0
Total			**17**	**04**	**12**	**25.0**
				33		**25.0**
MC-1 OR MC-2	PEY-101-L OR EMV-101-L	Physical Education and Yoga (G-B) OR Professional Ethics for Engineers and Moral Values (G-A)	1 2	- -	2 -	2 units 2 units

Group (G)	Disciplines
A	Mechanical Engineering Electronics and Communication Engineering Printing Technology Packaging Technology
B	Computer Science and Engineering Information Technology Biomedical Engineering Food Technology

Subject Area	Abbreviation
Humanities and Social Sciences	HS
Basic Sciences	BS
Engineering Sciences	ES
Professional subjects-Core	PC
Professional subjects-Electives	PE
Open subjects-Electives	OE
Project Work, Seminar and/or Internship in industry or elsewhere	PW
Mandatory Courses (Qualifying) – Non Credit	MC

ESSENTIALS OF COMMUNICATION-I

General Course Information:

Course Code: HUM-101-L Course Credits: 03 Mode: Lecture (L) Contact Hours: 03hours (L) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

About the Course and its Objectives and Outcomes:

The objectives of this course are to:

1. Inculcate minimum level of language proficiency among the students of engineering and technology.
2. To improve comprehension and expression skills of the students required for day to day; and classroom, academic, professional and cultural situations.

By the end of the course a student is expected to:

1. At the end of the course, a student will be able to express himself and to participate in the classroom discussions and other such academic or academic support activities.
2. The student will also be able to comprehend whatever he/she receives from informal interactions with the family, teachers and friends; and from formal communications taking place in lectures, laboratories and the like.
3. In general, the students will develop the ability to communicate effectively using suitable styles and techniques.

Course Contents

UNIT-I

Semantics: Synonyms, Antonyms, Homophones, Homonyms, Form and function of words.
Syntax: Sentence structures, Verb patterns and their usage, Phonetics-Symbols and structure.

UNIT-II

Comprehension: Listening and Reading comprehension: Note taking, Reviewing, Summarising, Interpreting, Paraphrasing and Précis Writing.

UNIT-III

Composition: Descriptive, Explanatory, Analytical and Argumentative, Writing, description of simple objects like instruments, appliances, places, persons, principles; description and explanation of processes and operations; analysis and arguments in the form of debate and group discussion.

UNIT-IV

Text: *English for Students of Science* by A.Roy and P.L. Sharma (Orient Longman)

Chapters for Study:
i) "The year 2050" by Theodore J. Gordon.
ii) "The Mushroom of Death" by A. Bandhopadhyay.
iii) "The Discovery" by Herman Ould.

The prescribed text will be used as a case study for various components of the syllabus.

Text and Reference Books:

1. A. Roy and P.L. Sharma, "English for Students of Science" , Orient Longman
2. R.K. Bansal and J.B. Harrison, "Spoken English for India", Orient Longman.
3. M.L. Tickoo and A.E. Subramanian, "Intermediate Grammar, Usage and Composition", Orient Longman.
4. M.A. Pink and S.E. Thomas, "English Grammar, Composition and Correspondence", S. Chand and Sons Pvt. Ltd.,Delhi.
5. Thomson and Martinet, "A Practical English Grammar", OUP, Delhi.
6. A.S. Hornby, "Guide to Patterns and Usage in English", OUP, Delhi.
7. T. Balasubramanian, "A Textbook of English Phonetics for Indian Students", MacMillan, Chennai.
8. J.D.O'Connor, "Better English Pronunciation", Cambridge Univ. Press, London.
9. McCarthy, "English Vocabulary in Use", Foundation Books (Cambridge University Press), Delhi.
10. Buck, "Assessing Listening", Foundation Books (Cambridge University Press), Delhi.
11. McRae, "Reading Between the Lines", Foundation Books (Cambridge university Press), Delhi.

PRINCIPLES OF ECONOMICS

General Course Information:

Course Code: HUM-103-L Course Credits: 03 Mode: Lecture (L) Contact Hours: 03hours (L) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Acquaint the students with concepts and techniques used in the field of economics.
2. Enable them to apply this knowledge in the field of engineering.
3. To equip the students with the necessary techniques and skills that can be applied to enhance productivity.

By the end of the course a student is expected to:

1. Take better decisions in their field
2. Able to apply resources in more optimal way

Course Contents

UNIT-I

Definition of Economics, Various Definitions, Nature of Economic Problem, Concept of Micro and Macro Economics, Production Possibility Curve, Economic Laws and their nature, Relation between Science, Engineering, Technology and Economics, Time Value of Money, Concepts and Application, Capital Budgeting, Traditional and Modern Methods.

Concepts and Measurement of Utility, Law of Diminishing Marginal Utility, Law of Equi-Marginal Utility and their Practical Applications and Importance.

UNIT-II

Meaning of Demand; Individual and Market Demand Schedule, Law of Demand, Shape of Demand Curve. Elasticity of Demand, Measurement of Elasticity of Demand, Factors Affecting Elasticity of Demand, Practical Importance and Applications of the Concept of Elasticity of Demand, A Brief Note on Demand Forecasting.

Meaning and Factors of Production; Law of Variable Proportions, Returns to Scale. Internal and External Economics, Diseconomies of Scale.

UNIT-III

Various Concepts of Cost; Fixed Cost, Variable Cost, Average Cost, Marginal Cost, Money Cost, Real Cost, Opportunity Cost, Shapes of Average Cost, Marginal Cost, Total Cost in Short Run and Long Run. Break Even Analysis, Relevance of Depreciation towards Industry.

Meaning and types of Market, Perfect Competition, Monopoly, Oligoply, Monoplistic Competition (Main Features of these Markets).

UNIT-IV

Supply and Law of Supply, Role of Demand and Supply in Price Determination, Effect of Changes in Demand and Supply on Prices.

Nature and Characteristics of Indian Economy (Brief and Elementary Introduction), Basic Concepts of Fiscal and Monetary Policy, Privatization, Globalization and Liberalization, Meaning, Merits and Demerits, Brief Explanation of VAT, WTO, GATT, IMF & TRIPS Agreement.

Text and Reference Books:

1. P.N. Chopra, “Principles of Economics”, Kalyani Publishers
2. K.K. Dewett, “Modern Economic Theory”, S.Chand
3. M.L. Jhingan, “Micro Economic Theory”, S.Chand
4. H.L. Ahuja, “Micro Economic Theory”, S.Chand
5. S.K. Mishra, “Modern Micro Economics”, Pragati Publications
6. A.B.N. Kulkarni and A.B. Kalkundrikar, “Economic Theory”, S.Chand & Co
7. Rudar Dutt and K.P.M. Sundhram, “Indian Economy”, S.Chand

PHYSICS - I

General Course Information:

Course Code: PHY-101-L Course Credits: 3.5 Mode: Lecture (L) and Tutorial (T) Contact Hours: 03hours (L)+01hour (T) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of the course are:

Course introduces the students to the following topics:

1. Optics and its behaviour viz; diffraction, polarization, LASER etc.
2. Waves and Oscillations, the famous Maxwell's equation will be covered along with Fibre optics.
3. Special theory of relativity, Doppler shift, variation of mass with velocity.
4. Concepts of Nuclear Physics, Nuclear reactors, GM Counter, solid state detectors, etc. will be taught.

By the end of course a student is expected to:

1. Create awareness about the vital role played by science and engineering in the development of new technologies with the blend of understanding old technology and approach to latest techniques,
2. Provide the necessary exposure to the practical aspects, which is an essential component for learning science. The acquaintance of basic physics principles would help engineers to understand the tools and techniques used in the industry and provide the necessary foundations for inculcating innovative approaches.

Course Contents

UNIT- I

Interference: Division of wave front, Fresnel's biprism, Lloyd's mirror, Division of amplitude, Newton's rings, Michelson interferometer, Applications.

Diffraction: Difference between Fraunhofer and Fresnel diffraction, Fraunhofer diffraction through single slit, two slits, Plane transmission diffraction grating, its dispersive and resolving powers.

UNIT- II

Polarisation: Polarised and unpolarised light, Brewster law, Malus law, Polaroid, Optic axis, Double refraction, Nicol prism, quarter and half wave plates, Polarimetry; Biquartz and Laurent's half-shade polarimeters,

Laser: Coherence (spatial, temporal), Spontaneous and stimulated emissions, Laser action, Population Inversion, Einstein's coefficients, characteristics of laser beam- He-Ne and Semiconductor lasers, Applications in Holography.

UNIT- III

Fibre Optics: Propagation of light in fibres, numerical aperture, Attenuation in optical fibres , single mode and multi mode fibres, simple concepts of wave guides and co-axial cables, Applications in Optical Communication (Elementary idea).

Waves and Oscillations: Simple harmonic motion (expression and differential equation) superposition of two linear SHM's (with same frequency), Simple concepts of Harmonic Oscillator, resonance, quality factor. E.M. wave theory, review of basic ideas, Maxwell's equations, simple plane wave equations, Poynting vector, Continuity equations.

UNIT-IV

Special Theory of Relativity: Einstein's theory of relativity, Michelson-Moreley experiment, Lorentz transformations, variation of mass with velocity, mass energy equivalence, Doppler shift, Longitudinal and transverse doppler shift.

Nuclear Physics: Neutron Cross-section, Nuclear fission, Moderators, Nuclear reactors, Reactor criticality, nuclear fusion. Interaction of radiation with matter: basic concepts, radiation detectors-ionisation chamber, G.M. Counter, Scintillation and solid state detectors, cloud chamber, and bubble chamber.

Text and Reference Books:

1. Wehr, Richards and Adair, "Physics of the Atom", NarosaPublication
2. Arthur Beiser, "Perspectives of Modern Physics", TMH Publication
3. A.S. Vasudeva, "Modern Engineering Physics", S. Chand and Co. Ltd. Publication
4. Brij Lal and Subramanyam, "A Text Book of Optics", S.Chand and Co. Ltd. Publication
5. F.W. Sears, "Electricity and Magnetism", Narosa Publication
6. Resnick & Halliday, "Physics Vol-I & II", Wiley Eastern Publication

MATHEMATICS-I

General Course Information:

Course Code: MAT-101-L Course Credits: 04 Mode: Lecture (L) and Tutorial (T) Contact Hours:03hours (L)+02hours (T) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are:

1. To familiarize students with differentiation, Partial differentiation, integrations and vector calculus.
2. To familiarize students with application of differentiation and integrations.

By the end of the course a student is expected:

Get acquainted with use of various mathematical tools in engineering and sciences.

Course Contents

UNIT-I

Applications of Differentiation: Taylor's and Maclaurin's series, Asymptotes, Asymptotes parallel to coordinate axes and oblique asymptotes. Asymptotes by inspection method, Intersection of curve and its asymptotes, Asymptotes for polar curves, Curvature, radius of curvature for Cartesian, intrinsic, pedal and polar form of equations, Radius of curvature at origin, Newton's method, method of expansion, Centre of curvature, evolute and Involute.

UNIT-II

Partial Differentiation and its Applications : Functions of two or more variables; partial derivatives, Total differential and differentiability, Derivatives of composite and implicit functions, Jacobians, Higher order partial derivatives, Homogeneous functions, Euler's theorem, Taylor's series for functions of two variables (without proof), maxima-minima of function of two variables, Lagrange's method of undetermined multipliers, Differentiation under integral sign.

UNIT-III

Applications of Single and Multiple Integration: Applications of single integration to find volume of solids and surface area of solids of revolution, Double integral, change of order of integration, Double integral in polar coordinates, Applications of double integral to find area enclosed by plane curves, Triple integral, change of variables, Beta and gamma functions and relationship between them.

UNIT-IV

Vector Calculus: Differentiation of vectors, scalar and vector point functions Gradient of a scalar field and directional derivative, divergence and curl of a vector field and their physical interpretations. Integration of vectors, line integral, surface integral, volume integral, Green, Stoke's and Gauss theorems (without proof) and their simple applications.

Text and Reference Books:

1. E. Kreyszig, “Advanced Engineering Mathematics”, Wiley Publication

2. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers

3. Paras Ram, “Engineering Mathematics through Applications”, CBS Publishers

4. S.S. Sastry, “Engineering Mathematics”, Part-I, PHI Learning

5. N. Piskunov, “Differential and Integral Calculus”, Mir Publisher

6. R.K. Jain and S.R.K.Iyengar, “Advanced Engineering Mathematics”, Taylor & Francis

7. Michael D. Greenberg, “Advanced Engineering Mathematics”, Pearson Publication

BASICS OF ELECTRICAL ENGINEERING

General Course Information:

Course Code: EE-101-L Course Credits: 3.5 Mode: Lecture (L) and Tutorial (T) Contact Hours: 03hours (L)+01hour(T) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Impart the fundamentals of electrical circuits.
2. Provide the comprehensive idea about working principles of electrical machines (Transformers, DC, Induction, and Synchronous machines), and measuring instruments.

By the end of the course a student is expected to:

1. Ggain the knowledge of basic concepts of DC/ 1-phase and 3-phase AC circuits.
2. Learn the principle and working of Transformer/ Electrical machine/measuring instruments.

Course Contents

UNIT-I

D.C. Circuits, Ohm's Law, Kirchoff's Laws, D.C. Circuits, Nodal and Loop methods of analysis, Network Theorems, Thevenin's theorem, Norton's theorem, superposition theorem, maximum power transfer theorem, Reciprocity theorem, Tellegen's theorem, Millman's theorem, Star to Delta and Delta to Star transformation.

UNIT-II

A.C. Circuits, Sinusoidal signal, instantaneous and peak values, RMS and average values, phase angle, polar & rectangular, exponential and trigonometric representations, R, L and C components, behaviors of these components in A.C. circuits, Concept of complex power, power factor, Transient responses of RL, RC and RLC Circuits with step input, Series and Parallel A.C. Circuits, Series and Parallel resonance, Q factor, cut-off frequencies and bandwidth.

UNIT III

Three Phase Circuits, Phase and line voltages and currents, balanced star and delta circuits, power equation, measurement of power by two wattmeter method, Importance of earthing, Measuring Instruments, Voltmeter, Ammeter, Watt meter, Energy meter.,

UNIT IV

Transformers, Principle, construction and working of transformer, Efficiency and regulation, Electrical Machines, Introduction to D.C. Machines, Induction motor, Synchronous machines.

Text and Reference Books:

1. Kothari and Nagarath, "Basic Electrical Engineering", 2nd Edition, TMH
2. B.L Theraja and A K Theraja, "Electrical Technology", Vol-I, S.Chand
3. Deltoro, "Electrical Engineering Fundamentals", PHI
4. Valkenburg, "Network Analysis", PHI

CHEMISTRY

General Course Information:

Course Code: CHY-101-L Course Credits: 3.5 Mode: Lecture (L) and Tutorial (T) Contact Hours: 03hours (L)+01hour (T) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

About the Course and its Objectives and Outcomes:

The objectives of this course are to:

1. To make the students familiarize about the basics of Chemistry.
2. Topics include the chemical aspects of engineering.

By the end of the course a student is expected to:

1. Students are expected to critically assess and solve Industrial problems requiring the application of chemical principles.
2. Students are expected to be well versed with applied chemistry involved in engineering.

Course Contents

UNIT-I

Thermodynamics: Concept of Entropy, free energy and work functions, Free energy change, Chemical Potential, Gibb's Helmholtz equation, Claudius - Clapeyron equation.

Phase Equilibrium: Definitions of phase, component and degree of freedom, Gibb's phase rule, One Component System (H_2O System), Two Components Systems (Pb-Ag & Zn-Mg).

UNIT-II

Water and its treatment: Hardness of water and its determination (EDTA method), units of hardness, alkalinity of water and its determination, scale and sludge formation (methods of prevention).

Treatment of water for domestic use, coagulation, sedimentation, filtration and disinfection, water softening, Ion-exchange process, Desalination (reverse osmosis).

UNIT-III

Corrosion: Dry and wet corrosion, electrochemical theory of corrosion, Galvanic corrosion, differential aeration corrosion, factors affecting corrosion, Preventive measures (cathodic protection, protective coatings).

Batteries: Introduction, characteristics of batteries, primary and secondary battery systems, lead storage and lithium batteries.

Lubricants: Introduction, classification and properties of lubricants.

UNIT-IV

Polymers: Monomers and polymers, polymerization, types of polymerization, effect of structure on properties of polymers, preparation, properties, and applications of thermoplastics (PVC), thermoset (PF), and elastomer (SBR).

Analytical Methods: Principle and application of Thermogravimetric analysis and Differential thermal analysis (Experimental details are excluded).

Spectral analysis: Electromagnetic radiation, Lambert-Beer's Law, principle and applications of UV-VIS and IR spectroscopy (Experimental details are excluded).

Text and Reference Books:

1. P.C. Jain and Monica Jain, “Engineering Chemistry”, Dhanpat Rai and Co.
2. H.C.Srivastava, “Engineering Chemistry”, Pragati Prakashan
3. B.K.Ambasta, “Chemistry for Engineers”, University Science Press
4. Rajaram and Kuriacose, “Chemistry in Engineering and Technology”, Vol. I and II, TMH
5. Meritt and Willard, “Instrumental methods of Chemical Analysis”, East-West Press
6. P.W. Atkin, “Physical Chemistry”, ELBS, Oxford Press

WOKKSHOP TECHNOLOGY

General Course Information:

Course Code: ME-101-L Course Credits: 03 Mode: Lecture (L) Contact Hours: 03hours (L) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Expose the students to the basic overview of manufacturing processes and idea about engineering materials with their properties and applications.
2. Provide to the students an understanding of industrial safety methods, different types of accidents that may occur in industry, their causes and sources.
3. Impart knowledge of basic metal casting processes and checking of casting for quality.
4. Study metal forming techniques, extrusion, rolling, drawing and sheet metal forming and shearing operations.
5. Impart in depth knowledge of commonly used machine tools in a workshop and metal cutting mechanic.
6. Expose the students to the principles of the metal joining methods and getting familiar with different welding techniques (fusion and non-fusion), resistance and others.
7. Impart knowledge to the students about objectives of layout, types of plant layouts along with their advantages.

By the end of the course a student is expected to:

1. Identify basic manufacturing processes and to ascertain the types of products that are cost effectively produced with each process.
2. Understand the manufacturing of product by metal casting forming, extrusion, rolling, drawing and sheet metal forming and shearing operations.
3. Understand the working and applications of machine tools such as lathe, shaper, planer, milling, drilling and slotter used in a workshop.
4. Understand the application of the different joining techniques and the objectives of different types of plant layout used in industries.

Course Contents

UNIT-I

Introduction: Introduction to Manufacturing Processes and their Classification. Industrial Safety: Introduction, Types of Accidents, Causes and Common Sources of Accidents, Methods of Safety, First Aid.

Engineering Materials: General Properties and Applications of Engineering Materials, Cast Iron, Mild Steel, Medium Carbon Steel, High Carbon Steel and High Speed Steel.

UNIT-II

Foundry: Introduction to Casting Processes, Basic Steps in Casting Process, Pattern, Types of Patterns, Pattern Allowances, Risers, Runners, Gates, Moulding Sand and its Composition, Sand Preparation, Molding Methods, Core Sands and Core Making, Core Assembly, Mold Assembly, Melting (Cupola) and Pouring, Fettling, Casting Defects and Remedies.

Cold Working (Sheet Metal Work): Sheet Metal Operations, Measuring, Layout Marking, Shearing, Punching, Blanking, Piercing, Forming, Bending and Joining.

UNIT-III

Hot Working Processes: Introduction to Hot Working, Principles of Hot Working Processes, Forging, Rolling, Extrusion, Wire Drawing.

Introduction to Machine Tools: Specifications and Uses of commonly used Machine Tools in a Workshop such as Lathe, Shaper, Planer, Milling, Drilling, Slotter. Introduction to Metal Cutting: Nomenclature of a Single Points Cutting Tool and Tool Wear, Mechanics of Chips Formations, Type of Chips, Use of Coolants in Machining.

UNIT-IV

Welding: Introduction to Welding, Classification of Welding Processes, Gas Welding: Oxy-Acetylene Welding, Resistance Welding; Spot and Seam Welding, Arc Welding: Metal Arc, TIG and MIG Welding, Welding Defects and Remedies, Soldering and Brazing.

Plant Layout: Plant Layout, Objectives of Layout, Types of Plant Layout and their Advantages.

Text and Reference Books:

1. Hazra and Chaudhary, "Workshop Technology", Volume I and II, Asian Book Company, New Delhi.
2. Lindberg, R.A., "Process and Materials of Manufacture", Prentice Hall of India, New Delhi.
3. Campbell, J.S., "Principles of Manufacturing Materials and Processes", McGraw - Hill.
4. Amitabh Ghosh and Ashok Kumar Malik, "Manufacturing Science", East-West Press.
5. Ostwald, M, "Manufacturing Process and Systems", John Wiley.
6. Chapman, W.A.J., "Workshop Technology", Volume I, II, and III, Edward A.

BASICS OF ELECTRONICS ENGINEERING

General Course Information:

Course Code: ECE-101-L Course Credits: 03 Mode: Lecture (L) Contact Hours: 03hours (L) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Objectives and Outcomes:

The main objectives of this course are:

1. To make the students familiar with the concept of semiconductor materials, devices and its properties.
2. To explain the construction, characteristics, and operation of PN diode, BJT and FETs.
3. To familiarize with the application of different semiconductor devices.

By the end of the course a student is expected to:

1. Understand the significance of semiconductor materials in electronics.
2. Develop the understanding of basic concepts of diodes and transistors.
3. Become capable of using diode, BJT and FETs in their lab experiments.

Course Contents

UNIT-I

Introduction to Semiconductor Electronics

Energy band in solids, Semiconductor materials, Classification of semiconductors, Energy distribution of electrons, Mass action law, Effect of temperature on semiconductors, Charge densities in a semiconductor, drift current and diffusion current density, total current density, conductivity.

UNIT-II

PN Junction diode and its Applications

PN junction theory, Depletion layer, V-I equation and characteristics, Resistance Levels, Piece-wise linear characteristics & equivalent circuits, Transition and Diffusion capacitance, Reverse recovery time, Varactor diode, Zener diode , LED, Photodiode, Load line analysis of a diode circuit.

Applications: Half wave and Full wave Rectifier, Bridge Rectifier, Clippers, Clampers, Voltage multiplying circuits, Zener voltage regulator.

UNIT-III

Bipolar Junction Transistor

Introduction, Physical Structure and its Operation, Transistor equations, Transistor amplifying action, Types of Configurations and their characteristic curves, Comparison between three configurations, Thermal runaway and heat sink, Operating point of a transistor, Requirement of biasing, fixed bias and potential divider bias circuit.

UNIT-IV

MOSFET and Special Devices

Types of FETs, Construction, Governing equations and characteristic curves of FETs, Comparison of BJT, JFET and MOSFET, MOSFET as an amplifier, Introduction to Thermistor, Optocoupler, SCR, DIAC, TRIAC, UJT.

Text and Reference Books:

1. Boylstad & Neshishkey, “Electronic Devices & Circuit Theory”, 9th Edition, PHI.
2. S Salivahanan, N Suresh Kumar, “Electronics Devices and Circuits”, 3rd Edition, McGraw Hill.
3. Millman, Halkias and Satyabarta, "Millman’s Electronic Devices and Circuits", Tata McGraw Hill, 2010.
4. Donald A Neamen, “Semiconductor Physics and Devices”, 4th ed., Tata McGraw Hill.
5. S.M. Sze, Kwok K. Ng, “Physics of Semiconductor Devices”, Third Edition, Wiley.

ESSENTIALS OF COMMUNICATION-I LAB

General Course Information:

Course Code: HUM-101-P Course Credits: 01 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)**: Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Lab Contents

Good command on the language and communication skills has become need of the hour. The time has come to focus equally on the communicative part of the language besides the conventional teaching. The language lab is very helpful tool with which a student can practice and assess one's own speech in any language.

In this lab, a student is supposed to do the practice of pronunciation of words, grammar rules, tenses, phonemic alphabets, speaking and listening using computer software available in the language lab.

PHYSICS-I LAB

General Course Information:

Course Code: PHY-101-P Course Credits: 01 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)**: Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Lab Contents

1. To find the wavelength of sodium light by Newton's rings experiment.
2. To find the wavelength of sodium light by Fresnel's biprism experiment.
3. To find the wavelength of various colours of white light with the help of a plane transmission diffraction grating.
4. To find the refractive index and cauchy's constants of a prism by using spectrometer.
5. To find the wavelength of sodium light by Michelson interferometer.
6. To find the resolving power of a telescope
7. To find the pitch of a screw using He-Ne laser.
8. To find the specific rotation of sugar solution by using a polarimeter.
9. To compare the capacitances of two capacitors by De'sauty bridge and hence to find the dielectric constant of a medium.
10. To find the flashing and quenching potentials of Argon and also to find the capacitance of unknown capacitor.
11. To study the photo conducting cell and hence to verify the inverse square law.
12. To find the temperature co-efficient of resistance by using platinum resistance thermometer and Callender and Griffith bridge.
13. To find the frequency of A.C. mains by using sonometer.
14. To find the velocity of ultrasonic waves in non-conducting medium by piezo-electric method.
15. To find the Refractive Index of a given liquid by Newton' ring
16. To find the height of an object using sextant.
17. To find the wavelength of a given LASER by diffraction grating.

NOTE: The list is indicative. The teacher can alter/add more number of experiments as per the requirement.

BASICS OF ELECTRICAL ENGINEERING LAB

General Course Information:

Course Code: EE-101-P Course Credits: 01 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)**: Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Provide the students a chance to put theory into practice.
2. Become familiar with dc circuit and theorem with their verification.
3. Understand the basic principles of operation of electric machines and their classification

By the end of the course a student is expected to:

1. Understand the basic concepts of DC/AC circuits.
2. Learn the principle and working of Transformer/ Electrical machine/measuring instruments.
3. Identify an appropriate suitable measuring instrument for measurement of AC/DC electrical quantity

Lab Contents

1. To verify KCL and KVL.
2. To verify Thevenin's and Norton's Theorems.
3. To verify maximum power transfer theorem in D.C. Circuit & A.C circuit.
4. To verify reciprocity and Superposition theorems.
5. To study frequency response of a series R-L-C circuit and determine resonant frequency& Q- factor for various values of R, L, and C.
6. To study frequency response of a parallel R-L-C circuit and determine resonant frequency and Q - Factor for various values of R, L, and C.
7. To perform direct load test of a transformer and plot efficiency Vs load characteristic.
8. To perform direct load test of a D.C. shunt generator and plot load voltage Vs load current curve.
9. To plot V-curve of a synchronous motor.
10. To perform O.C. and S.C. tests of a three phase induction motor.
11. To study various type of meters.
12. Measurement of power by 3-voltmeter / 3-ammeter method.
13. Measurement of power in a 3 phase system by two watt meter method.

NOTE: The list is indicative. The teacher can alter/add more number of experiments as per the requirement.

CHEMISTRY LAB

General Course Information:

Course Code: CHY-101-P Course Credits: 01 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)**: Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Lab Contents

1. To prepare standard oxalic acid solution from crystalline oxalic acid.
2. Determination of Ca^{++} and Mg^{++} hardness of water using EDTA solution.
3. Determination of alkalinity of water sample.
4. Determination of dissolved oxygen (DO) in the given water sample.
5. Determination of concentration of $KMnO_4$ solution spectrophotometrically.
6. Determination of viscosity of lubricant by Red Wood viscometer (No. 1 and No. 2).
7. To determine flash point and fire point of an oil by Pensky - Marten's flash point apparatus.
8. To prepare Phenol-formaldehyde and Urea formaldehyde resin.
9. To determine Rf value of compounds by Thin Layer Chromatography.
10. To determine TDS of water samples.
11. To determine the surface tension of given liquid by means of Stalagmometer by drop number method.
12. Determination of strength of HCl solution by titrating it against NaOH solution conductometrically.
13. Determination of strength of strong acid by titrating it against weak base conductometrically.
14. Estimation of total iron by internal indicator method.

NOTE: The list is indicative. The teacher can alter/add more number of experiments as per the requirement.

WORKSHOP TECHNOLOGY LAB

General Course Information:

Course Code: ME-101-P Course Credits: 02 Mode: Practical Contact Hours: 04 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)**: Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Expose the students to various measuring instruments and tools used in various workshops, working of machine tools like Lathe, Milling, Drilling, and Shaper etc.
2. Practice of the students in for different shops such as welding, foundry, sheet metal, machine, carpentry etc.
3. Impart the knowledge on types of wood used for joints and patterns, mould making, casting etc.

By the end of the course a student is expected to:

1. Understand the basic operations and working of various machine tools, mould making and casting process, various types of welding processes, types of woods and their properties/ use, wooden joints, use of precise measuring instruments.

Lab Contents

I - Machine Shop

1. To prepare a job involving V-groove, slot cutting etc. on Shaper Machine.
2. To prepare a job on the Lathe Machine involving facing, turning, step turning and taper turning.
3. To prepare a job involving side and face milling on Milling Machine.

II - Welding Shop

4. Practice of arc welding, gas welding, MIG welding and TIG welding.
5. To prepare butt and lap joints using Electric Arc welding.

III - Fitting Shop

6. To study different type of measuring/ marking/fitting tools used in fitting shop and determine least count of Vernier Calliper and Micrometer.
7. To prepare a job involving cutting, marking, filing, drilling etc.

IV - Foundry Shop

8. To prepare a mould assembly using single piece pattern.
9. To prepare a mould and core assembly using split pattern for casting.

V - Carpentry Shop

10. To study different type of tools and woods used in carpentry shop.
11. To prepare at least two simple wooden joints like Cross-lap Joint, Dovetail joint, T – joint.

NOTE: The list is indicative. The teacher can alter/add more number of experiments as per the requirement.

ENGINEERING DRAWING

General Course Information:

Course Code: ME-103-P Course Credits: 02 Mode: Practical Contact Hours: 04 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)**: Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Enable the students with various concepts like dimensioning, conventions and standards related to working drawings in order to become professionally efficient.
2. Introduce universally accepted conventions and symbols for their usage in technical drawings.
3. Impart knowledge about principles/methods related to projections of one, two and three dimensional objects.
4. Inculcate the ability to translate geometric and topological information of common engineering object (two/three dimensional) into engineering drawing using standard graphical techniques.
5. Expose students to computer aided drafting tools.

By the end of the course a student is expected to:

1. Understand and appreciate the importance of engineering graphics and drawing in engineering.
2. Understand the theory of projection.
3. Produce geometric construction, multi-view, sectional view, dimensioning and detail drawings of two and three dimensional objects.
4. Improve their visualization skills so that they can apply these skills in developing new products.

Course Contents

UNIT-I

Introduction and Projection of Points: Importance, Significance and Scope of Engineering Drawing, Lettering, Dimensioning, Scales, Various Types of Projections, First and Third Angle Systems of Orthographic Projections, Projection of Points in Different Quadrants.

Projections of Straight Lines: Projection of Line Parallel to One or Both Reference Planes, Projection of Line Contained by One or Both Planes, Projection of Line Perpendicular to One of the Planes, Projection of Line Inclined to One Plane but Parallel to Other Plane, Projection of Line Inclined to Both Planes, True Length of a Line and Its Inclination with Reference Planes, Traces of a Line.

UNIT-II

Projections of Planes: Projection of Plane Parallel to One Reference Plane, Projection of Plane Inclined to One Plane but Perpendicular to the Other, Projection of Plane Inclined to Both Reference Planes.

Projections of Solids: Projection of Solid in Simple Positions with Axis Perpendicular to a Plane, Projection of Solid with Axis Parallel to Both Planes, Projection of Solid with Axis Parallel to One Plane and Inclined to the Other.

UNIT-III

Projections of Sections of Solids: Projection of Section of Cube, Prism, Pyramid, Cylinder and Cone, True Shape of Section.

Development of Surfaces: Development of Surfaces of Various Solids such as Cube, Prism, Pyramid, Cylinder and Cone with and without Sectioning.

UNIT-IV

Orthographic Drawings: Orthographic Drawings of Machines Components and Nuts, Bolted Joints, Screw Threads, Screw Joints.

Isometric Projections: Introduction, Isometric Scale, Isometric Views of Plane Figures, Cube, Prisms, Pyramids, Cone and Cylinders. Introduction to Computer Aided Drafting Tools.

Text and Reference Books:

1. N.D. Bhatt and V.M.Panchal, "Engineering Drawing Plane and Solid Geometry", Charotar Publishing House.
2. Basant and Aggarwal, "Engineering Drawing", Tata McGraw-Hill Publication.
3. P.S. Gill, "Engineering Graphics and Drafting", S.K. Kataria and Sons.
4. S.B. Mathur, "A Text Book of Engineering Drawing", Vikas Publishing House.
5. J.D.Bethune, "Engineering Graphics with Auto CAD 2015", Pearson Education

PHYSICAL EDUCATION AND YOGA

General Course Information:

Course Code: PEY-101-L Course Credits: NIL Mode: Lecture (L) and Practical (P) Contact Hours:01hours (L)+02 hours (P) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30+70)** **This is a non credit course of qualifying nature. The complete internal evaluation is to be done by the Course coordinator.** Internal evaluation (30 marks) will be based on continuous assessment throughout the semester. End semester examination will be of 70 marks that includes theory examination and practical both. The student will be evaluated based upon his/her performance in the theory exam and active participation and performance in sports and/or Yoga activities

Course Objectives and Outcomes:

The objectives of this course are to:

1. Appreciate and understand the value of physical education and yoga and its relationship to a healthy, active lifestyle.
2. Work to their optimal level of physical fitness.
3. Show knowledge and understanding in a variety of physical activities and evaluate their own and others' performances.

By the end of the course a student is expected to:

1. Demonstrate an understanding of the principles and concepts related to a variety of physical activities.
2. Apply health and fitness principles effectively through a variety of physical activities.
3. Support and encourage others (towards a positive working environment).
4. Show self-motivation, organization and responsible behaviour.

Course Contents

UNIT-I

History of physical education: Olympics, Asian games, Cricket, history and records.

UNIT-II

Health education: importance of physical education in modern society, meaning and importance of health, factors influencing health, fitness education, diet plans, body composition etc.

UNIT-III

Measurements and evaluation: measurements of grounds (outdoor- athletic track, football, basketball), indoor games, badminton, table tennis – ground measurements, basic playing skills.

UNIT-IV

Yoga: meaning and types, importance of yoga for healthy life, pranayama,

Text and Reference Books:

1. A. K. Uppal, "Physical Education and Health",
2. M.L.Kamlesh, "Fundamental Elements of Physical Education",
3. Swami Ramdev, "Yog its philosophy and practice", Divya Prakashan
4. V K Sharma, "Health and Physical Education",

PROFESSIONAL ETHICS FOR ENGINEERS AND HUMAN VALUES

General Course Information:

Course Code: EMV-101-L Course Credits: NIL Mode: Lecture (L) Contact Hours: 02hours (L) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30+70)** **This is a non credit course of qualifying nature. The complete internal evaluation is to be done by the Course coordinator.** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

About the Course and its Objectives and Outcomes:

The objectives of this course are to:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To create an awareness on professional ethics and human values.
3. To inculcate moral, ethical and social values and loyalty
4. To appreciate the rights of others.

By the end of the course a student is expected to:

1. Understand the significance of value inputs in a classroom and start applying them in their life and profession.
2. Possess entrepreneurial approach and ability for life-long learning.
3. Have education necessary for understanding the impact of engineering solutions on society and demonstrate awareness of contemporary issues.

Course Contents

UNIT-I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Understanding the need, basic guidelines, content and process for Value Education.

Morals, Values and Ethics: Basic Understanding of the concept of Integrity, Work Ethic, Service Learning, Civic Virtue, Respect for Others, Living Peacefully, Caring, Sharing, Honesty, Courage, Valuing Time, Co-operation, Commitment, Empathy, Self-Confidence, Character and Spirituality**,** Meaning Theories, Perception Theories, Interpretation of Events, Images and Videos of current time

UNIT-II

Engineering ethics: Understanding of 'Engineering Ethics, variety of moral issued, types of inquiry, moral dilemmas, moral autonomy, Kohlberg's theory, Gilligan's theory, consensus and controversy, Models of Professional Roles, theories about right action, Self-interest, customs and religion, uses of ethical theories.

Engineering as social experimentation: Engineering as experimentation, engineers as responsible experimenters, codes of ethics, a balanced outlook on law, the challenger case study.

UNIT-III

Safety, responsibilities and rights: Safety and risk, assessment of safety and risk, risk benefit analysis and reducing risk, the Three Mile Island and Chernobyl case studies.

Collegiality and loyalty: respect for authority, collective bargaining, confidentiality, conflicts of interest, occupational crime, professional rights, employee rights, Intellectual Property Rights (IPR), discrimination.

UNIT-IV

Global issues: Multinational corporations, Environmental ethics, computer ethics, weapons development, engineers as managers, consulting engineers, engineers as expert witnesses and advisors, moral leadership, sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers (IETE), India, Media Ethics etc.

Text and Reference Books:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.
2. Govindarajan M., Natarajan S., Senthil Kumar V. S., "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
3. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint).
4. Charles E Harris, Michael S. Protchard, Michael J Rabins, "Engineering Ethics-Concepts and Cases", Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available).
5. John R. Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
6. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

ESSENTIALS OF COMMUNICATION-II

General Course Information:

Course Code: HUM-102-L Course Credits: 02 Mode: Lecture (L) Contact Hours: 02hours (L) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Sharpen communication skills of the students with reference to organizational structure.
2. Expose them to the modern modes of communication.
3. Show the students importance of team work and give practice in group communication with reference to group dynamics.
4. Prepare the students for campus interviews.

By the end of the course a student is expected to:

1. Be able to express himself through the modern modes of communication and to participate in the group discussion and other such academic or academic support activities.
2. The student will also be able to perform well during GDs, presentations, and interviews.
3. The course, in particular, will enable the students to be effective language user with reference to communication in groups and group behaviour.

Course Contents

UNIT-I

Communicative Grammar: Spotting the errors pertaining to nouns, pronouns, adjective and adverbs; Concord grammatical concord, notional concord and the principle of proximity between subject and verb.

Lexis: Idioms and phrases; Words often confused; One-Word Substitutes; Formation of words (suffixes, prefixes and derivatives); Foreign Words (A selected list).

UNIT-II

Oral Communication:

Part-A: Introduction to principal components of spoken English – Word-stress patterns, Intonation, Weak forms in English.

Part-B: Developing listening and speaking skills through various activities, such as (a) role play activities (b) Practising short dialogues (c) Group discussion (d) Debates (e) Speeches (f) Listening to news bulletins (g) Viewing and reviewing T.V. programmes etc.

UNIT-III

Written Communication:

Developing reading and writing skills through such tasks/activities as developing outlines, key expressions, situations, slogan writing and theme building exercises

Reading verbal and non-verbal texts; like cartoons, Graphs and tabulated data etc.

UNIT-IV

Technical Writing:

(a) Business Letters, Format of Business letters and Business letter writing

(b) E-mail writing

(c) Reports, Types of Reports and Format of Formal Reports

(d) Press Report Writing

Text and Reference Books:

1. A. Roy and P.L. Sharma, “English for Students of Science” , Orient Longman
2. R.K. Bansal and J.B. Harrison, “Spoken English for India”, Orient Longman.
3. M.L. Tickoo and A.E. Subramanian, “Intermediate Grammar, Usage and Composition”, Orient Longman.
4. M.A. Pink and S.E. Thomas, “English Grammar, Composition and Correspondence”, S. Chand and Sons Pvt. Ltd.,Delhi.
5. Thomson and Martinet, “A Practical English Grammar”, OUP, Delhi.
6. A.S. Hornby, “Guide to Patterns and Usage in English”, OUP, Delhi.
7. T. Balasubramanian, “A Textbook of English Phonetics for Indian Students”, MacMillan, Chennai.
8. J.D.O’Connor, “Better English Pronunciation”, Cambridge Univ. Press, London.
9. McCarthy, “English Vocabulary in Use”, Foundation Books (Cambridge University Press), Delhi.
10. Buck, “Assessing Listening”, Foundation Books (Cambridge University Press), Delhi.
11. McRae, “Reading Between the Lines”, Foundation Books (Cambridge university Press), Delhi.

PHYSICS –II

General Course Information:

Course Code: PHY-102-L Course Credits: 3.5 Mode: Lecture (L) and Tutorial (T) Contact Hours: 03hours (L)+01hour (T) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of the course are:

Course introduces the student to the following topics.

1. Elements of Crystallography, Dielectrics and their behaviour in circuit.
2. In Quantum Mechanics students will learn de-broglie hypothesis, Heisenberg uncertainty principle.
3. Free electron theory will make them understand the properties of Solid, Superconductivity, and band theory.
4. To have the glimpses of latest technology; Nanoscience and its approach towards material has been incorporated.

By the end of course a student is expected:

1. The course would provide the necessary exposure to the practical aspects, which is an essential component for learning science.
2. The acquaintance of basic physics principles would help engineers to understand the tools and techniques used in the industry and provide the necessary foundations for inculcating innovative approaches.

Course Contents

UNIT- I

Elements of Crystallography: Space lattice, unit cell, types of unit cell and translation vectors, Miller indices, simple crystal structure, Atomic Bonding (Ionic, Covalent, Metallic, vanderwaals and hydrogen bonding), x-ray diffraction & Bragg's law, Laue method, powder Method, Point defects in solids.

Quantum Mechanics: Difficulties with Classical physics, Introduction to quantum mechanics, simple concepts, discovery of Planck's constant, de-Broglie hypothesis, Group velocity and phase velocity, Schrodinger wave equations, time dependant and time independent Schrodinger equations, Heisenberg Uncertainty principle, Applications.

UNIT- II

Free Electron Theory: Elements of classical free electron theory and its limitations, Drude's Theory of Conduction, quantum theory of free electrons, Fermi level, Density of states, Fermi-Dirac distribution function, hermionic emission, Richardson's equation.

Magnetic Properties of solids: Atomic magnetic moments, orbital diamagnetism, Classical theory of Paramagnetism, Ferromagnetism, antiferromagnetism, and ferrimagnetism, hysteresis, domain theory

UNIT- III

Dielectrics: Molecular theory, polarization, displacement, susceptibility, dielectric coefficient, permitivity and various relations between these, Gauss's law in the presence of a dielectric, Energy stored in a dielectric. Behaviour of dielectrics in a.c. field, simple concepts, dielectric losses

Band Theory of Solids: Origin of energy bands, Kronig, Penney Model (qualitative), E-K diagrams, Brillouin Zones, Concept of effective mass and holes, Classification of solids into metals, Semiconductors and insulators, Fermi energy and its variation with temperature in metal, semiconductors and insulators. Hall Effect and its Applications, Photoconductivity and applications.

UNIT- IV

Super Conductivity: Introduction, Meissner effect, London equation, Curie's Law- Curie temperature, Critical field (H_c), Type I and Type II superconductors, and formation of superconducting gap at Fermi level, Electron-Phonon interaction and BCS theory.

Nano Science: Nanoscale, Nanoparticles (introduction to Quantum Dot, Quantum wire, Quantum well), Properties of nanomaterials, Bucky ball, Carbon Nano tube, Basics of synthesis., Top down- bottom up approach, Ball milling.

Text and Reference Books:

1. Charles Kittel, "Introduction to Solid State Physics", VII Ed., John Wiley
2. Powell and Crasemann, "Quantum Mechanics", Oxford & IBH
3. B.S.Saxena, R.C.Gupta and P.N.Saxena, "Fundamentals of Solid State Physics", Pragati Prakashan
4. Ajoy Ghatak, "Introduction to Quantum Mechanics", Macmillan India Ltd
5. MA Wahab, "Solid State Physics Structure and Properties of Materials", Narosa Publishing House Pvt. Ltd.)
6. C N R.Rao, "Nanoworld: An introduction to Nanoscience and Technology", NPP Ltd.
7. Pillai, "Solid State Physics", New Age
8. Avadhanulu and Kshirsagar, "A text book of Engineering Physics", S.Chand

MATHEMATICS-II

General Course Information:

Course Code: MAT-102-L Course Credits: 04 Mode: Lecture (L) and Tutorial (T) Contact Hours:03hours (L)+02hours (T) per week Examination Duration: 03 hours	Course Assessment Methods (internal: 30; external: 70) Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are:

1. To familiarize students with infinite series, matrices, Laplace transformation, ordinary and partial differential equations.
2. To familiarize students with applications of matrices, Laplace transformation, ordinary and partial differential equations.

By the end of the course a student is expected to:

1. Get acquainted with use of various mathematical tools in engineering and sciences.

Course Contents

UNIT-I

Infinite series : Convergence and divergence, Comparison, D' Alembert's ratio, Integral, Raabe's, Logarithmic and Cauchy root tests, Alternating series, Absolute and conditional convergence.

Matrices and its Applications : Rank of a matrix, elementary transformations, elementary matrices, inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, consistency of linear system of equations, linear and orthogonal transformations, eigen values and eigen vectors, properties of eigen values, Cayley - Hamilton theorem and its applications.

UNIT-II

Ordinary Differential Equations & its Applications : Exact differential equations, Equations reducible to exact differential equations, Applications of Differential equations of first order & first degree to simple electric circuits, Newton's law of cooling, heat flow and orthogonal trajectories, Linear differential equations of second and higher order, Complete solution, complementary function and particular integral, method of variation of parameters to find particular Integral, Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients, Applications of linear differential equations to simple pendulum, oscillatory electric circuits.

UNIT-III

Laplace Transform and its Applications: Laplace transforms of elementary functions, properties of Laplace transforms, existence conditions, transforms of derivatives, transforms of integrals, multiplication by tn, division by t. Evaluation of integrals by Laplace transforms. Laplace transform of Unit step function, unit impulse function and periodic function. Inverse transforms, convolution theorem, application to linear differential equations and simultaneous linear differential equations with constant coefficients.

UNIT-IV

Partial Differential Equations and Applications: Formation of partial differential equations, Lagrange's linear partial differential equation, First order non-linear partial differential equation, Charpit's method, Method of separation of variables and its applications to wave equation and one dimensional heat equation, two dimensional heat flow (steady state solutions only).

Text and Reference Books:

1. E. Kreyszig, “Advanced Engineering Mathematics”, Wiley Publication
2. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers
3. Paras Ram, “Engineering Mathematics through Applications”, CBS Publishers
4. S.S. Sastry, “Engineering Mathematics”, Part-I, PHI Learning
5. R.K. Jain and S.R.K.Iyengar, “Advanced Engineering Mathematics”, Taylor & Francis
6. Michael D. Greenberg, “Advanced Engineering Mathematics”, Pearson Publication

PROGRAMMING IN C

General Course Information:

Course Code: CSE-101-L Course Credits: 03 Mode: Lecture (L) Contact Hours: 03hours (L) per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

About the Course and its Objectives and Outcomes:

The objectives of this course are to:

1. Introduce students to basic terminology of computer.
2. Make them understand different problem solving techniques.
3. To make students learn art of C programming.
4. Make students capable of using pointers, files etc. for solving problems.

By the end of the course a student is expected to:

1. Understand the terminology related to computers.
2. To understand the concepts of Algorithms and flowcharts for their possible use in problem solving.
3. Write, compile and debug programs in C language.
4. Understand the concepts of memory by the use of pointers and to handle different type of files.
5. Analyse problems and write programs for solving them with the help of case studies.

Course Contents

UNIT-I

Computer Fundamentals, Block Diagram along with Computer components, characteristics and generation, classification of computers, .Hardware and software, types of software. Programming Languages, Machine, Assembly, High Level Language, Introduction to Compiler, Assembler, and Interpreter, Operating System, Definition, functions, different types, single user, multi user, time sharing, multiprogramming, batch processing, real time etc., Representation of information inside the computers, Problem solving techniques, Algorithms, Flowcharts, Programming methodologies, top-down and bottom-up programming, Debugging, Types of errors in programming.

UNIT-II

C Programming language, C fundamentals, formatted input/ output, expressions, selection statements, loops and their applications; Basic types, arrays, functions, including recursive functions, program organization, local and external variables and scope, pointers and arrays.

UNIT-III

Strings, strings literals, string variables, I/O of strings, arrays of strings, applications, Preprocessor, preprocessor directives, macro definition, conditional compilation, Structures, Unions and Enumerations, Structure variables and operations on structures, Structured types, nested array structures, unions, enumeration as integers, tags and types, Declaration, Declaration syntax.

UNIT-IV

Storage classes, types of qualifiers, declarators, initializers, Program Design: modules, information hiding, abstract data types, difference between C & C++, Low level programming: Bitwise operators, Bit fields in structures, other low level techniques, Standard library: Input / output; streams, file operations, error handling.

Text and Reference Books:

1. Brian K Williams and Stacey C. Sawyer, "Using Information Technology", 5th Edition, TMH, 2003.
2. Kernighan,B.W and Ritchie,D.M, "The C Programming language", 2nd Edition, PH, 2006
3. E. Balaguruswami, "Programming in ANSI C", TMHl, 5th Edition, 2011
4. Yashavant P. Kanetkar, " Let Us C", BPB Publications, 2011
5. Byron S Gottfried, "Programming with C", Schaum's Outlines, 2nd Edition, 2006.
6. P. K. Sinha and Priti Sinha, "Computer Fundamentals", BPB, 6th edition, 2011.
7. Dennis P. Curtin, Kim Foley, Kunal Sen, Cathleen Morin, "Information technology",TMH, 1998.
8. Barry Press and Marcia Press, "Teach yourself all about computers", IDG Books India, 2000.

ESSENTIALS OF COMMUNICATION-II LAB

General Course Information:

Course Code: HUM-102-P Course Credits: 01 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)**: Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Lab Contents

Good command on the language and communication skills has become need of the hour. The time has come to focus equally on the communicative part of the language besides the conventional teaching. The language lab is very helpful tool with which a student can practice and assess one's own speech in any language.

In this lab, a student is supposed to practice pronunciation of words, grammar rules, tenses, phonemic alphabets, speaking and listening using computer software available in the language lab.

PROGRAMMING IN C LAB

General Course Information

Course Code: CSE-101-P Course Credits: 01 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)**: Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

The objectives of this lab are to:

1. Give students hands on training of C language
2. Learn programming terminology and the syntax of various functions of C
3. Learn C to solve problems given.

By the end of the course a student is expected to be able to:

1. Write, compile and debug programs in C language
2. Use various data types, pointers and file handling functions
3. To formulate problems and implement algorithms in C

Lab Contents

1. Write a program to find the largest of three numbers. (if-then-else)
2. Write a program to find the largest number out of ten numbers (for-statement)
3. Write a program to find the average mail height & average female heights in the class (input is in form of sex code, height).
4. Write a program to find roots of quadratic equation using functions and switch statements.
5. Write a program using arrays to find the largest and second largest no. out of given 50 nos.
6. Write a program to multiply two matrices
7. Write a program to read a string and write it in reverse order
8. Write a program to concatenate two strings
9. Write a program to sort numbers using the quick sort algorithm.
10. Represent a deck of playing cards using arrays.
11. Write a program to check that the input string is a palindrome or not.

NOTE: The list is indicative. The teacher can alter/add more number of experiments as per the requirement.

PHYSICS-II LAB

General Course Information:

Course Code: PHY-102-P Course Credits: 01 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70)**: Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Lab Contents

1. To find the low resistance by carey - Foster's bridge.
2. To find the resistance of a galvanometer by Thomson's constant diffelction method using a post office box.
3. To find the value of high resistances by Substitution method.
4. To find the value of high resistances by Leakage method.
5. To study the characteristics of a solar cell and to find the fill factor.
6. To find the value of e/m for electrons by helical method.
7. To find the ionisation potential of Argon/Mercury using a thyratron tube.
8. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
9. To study the characteristics of (Cu-Fe, Cu-Constantan) thermo couple.
10. To find the value of Planck's constant using a photo electric cell.
11. To find the value of co-efficient of self-inductance by using a Rayleigh bridge.
12. To find the value of Hall Co-efficient of semi-conductor.
13. To study the V-I characteristics of a p-n diode.
14. To find the band gap of intrinsic semi-conductor using four probe method.
15. To calculate the hysteresis loss by tracing a B-H curve.

NOTE: The list is indicative. The teacher can alter/add more number of experiments as per the requirement.

Recommended Books:

1. B.L. Worshnop and H.T. Flint, "Advanced Practical Physics", KPH
2. S.L.Gupta and V.Kumar, "Practical Physics", Pragati Prakashan
3. Chauhan and Singh, "Advanced Practical Physics", Vol. I & II, Pragati Prakashan
4. K. Murlaleedhara Varier, J. Antony, and P. P. Pradyumnan, "Advanced experimental Techniques in Modern Physics", Pragati Prakashan.

2nd Year Syllabus

B.Tech. (Mechanical Engineering) Program

III- Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
HS-4	HUM-201-L	Fundamentals of Management	3	-	-	3.0
BS-6	MAT-201-L	Mathematics-III	3	1		3.5
ES-6	ECE-201-L	Instrumentation	2	1	-	2.5
PC-1	ME-201-L	Mechanics of Solids-I	3	1	-	3.5
PC-2	ME-203-L	Production Technology	3	1	-	3.5
PC-3	ME-205-L	Thermodynamics	3	1	-	3.5
PC-4	ME-207-L	Machine Drawing	1	4	-	3.0
PC-1	ME-201-P	Mechanics of Solids Lab	-	-	2	1.0
PC-2	ME-203-P	Production Technology Lab	-	-	3	1.5
			18	9	5	25.0
			32			25.0
MC-3	PSY-201-L	Personality Development	2	1	-	2 units
		Total	**35**			**25.0**

IV- Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
ES-7	EVS-201-L	Environmental Studies	3	-	-	3.0
BS-7	MAT-202-L	Numerical Methods	3	-	-	3.0
PC-5	ME-202-L	Material Science	3	1	-	3.5
PC-6	ME-204-L	Fluid Mechanics	3	2	-	4.0
PC-7	ME-206-L	Steam and Power Generation	3	1	-	3.5
PC-8	ME-208-L	Mechanics of Solids-II	3	2	-	4.0
PC-5	ME-202-P	Material Science Lab	-	-	2	1.0
PC-6	ME-204-P	Fluid Mechanics Lab	-	-	2	1.0
PC-7	ME-206-P	Steam and Power Generation Lab	-	-	2	1.0
BS-7	MAT-202-P	Numerical Methods Lab	-	-	2	1.0
			18	6	8	25.0
			32			25.0
MC-4	ME-210-P	Skills and Innovation Lab	-	-	3	2 units
		Total	**35**			**25.0**

FUNDAMENTALS OF MANAGEMENT

General Course Information:

Course Code: HUM-201-L Course Credits: 3.0 Contact Hours: 3 hours/week. Mode: Lectures Examination Duration: 3 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Prerequisite:
The students should have basic understanding of the concept of management and business organizations.

Course Objectives and Outcomes:

The objectives of this course are:
1. To enhance knowledge skills and attitude to Management.
2. To understand management and its relationship with organisation.

By the end of the course a student is expected:

1. To develop the basic understanding of the concept of management and functions of management.
2. The students will come to know about Human Resource management and marketing management functions of management.
3. Students will come to know about the production activities of any manufacturing organizations.
4. To know that how finances are arranged and disbursed for all the activities of business organizations.

Course Contents

UNIT-I

Concept of Management: Definitions, Characteristics, Significance, Practical Implications; Management Vs. Administration; Management- Art, Science and Profession; Development of Management Thoughts; Managerial Functions.

UNIT-II

Concept of Human Resource Management: Human resource planning; Recruitment, Selection, Training and Development, Compensation; Concept of Marketing Management: Objectives and functions of Marketing, Marketing Research, Advertising, ConsumerBehaviour.

UNIT-III

Concept of Production Management, Production Planning and Control, Material management, Inventory Control, Factory location and Production Layout.

UNIT-IV

Concept of Financial Management, Capital Structure and various Sources of Finance, Working Capital, Short term and long term finances, Capital Budgeting.

Text Books:
1. Principles and Practices of Management: R. S. Gupta, B. D. Sharma, N. S. Bhalla; Kalyani Publishers.
2. Organisation and Management: R. D. Aggarwal; Tata McGraw Hill.

Reference Books:
1. Marketing Management: S. A. Sherlikar; Himalaya Publishing House.
2. Financial Management: I.M. Pandey; Vikas Publishing House.
3. Production Management: B. S. Goel; Himalaya Publishing House.

MATHEMATICS-III

General Course Information:

Course Code: MAT-201-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Prerequisite:
Basic knowledge of calculus, complex analysis and statistics.

Course Outcomes:

By the end of the course a student is expected:

1. Problems of Fourier series and Fourier transforms used in engineering applications
2. Calculation of improper/ singular integrals with the help of complex analysis
3. Statistical tests for system goodness.
4. Problems of LPP and their interpretation.

Course Contents

UNIT-I

Fourier Series and Fourier Transforms: Euler's formulae, conditions for a Fourier expansion, change of interval, Fourier expansion of odd and even functions, Fourier expansion of square wave, rectangular wave, saw-toothed wave, half and full rectified wave, half range sine and cosine series. Fourier integrals, Fourier transforms, Shifting theorem (both on time and frequency axes), Fourier transforms of derivatives, Fourier transforms of integrals, Convolution theorem, Fourier transform of Dirac delta function.

UNIT-II

Functions of Complex Variable: Definition, Exponential function, Trigonometric and Hyperbolic functions, Logarithmic functions. Limit and Continuity of a function, Differentiability and Analyticity.Cauchy-Riemann equations, necessary and sufficient conditions for a function to be analytic, polar form of the Cauchy-Riemann equations. Harmonic functions. Integration of complex functions. Cauchy Theorem, Cauchy- Integral formula.

UNIT-III

Power series, radius and circle of convergence, Taylor's Maclaurin's and Laurent's series.Zeroes and singularities of complex functions, Residues.Evaluation of real integrals using residues (around unit and semi circle only).

UNIT-IV

Probability Distributions and Hypothesis Testing: Expected value of a random variable. Properties and application of Binomial, Poisson and Normal distributions. Testing of a hypothesis, tests of significance for large samples, Student's t-distribution (applications only), Chi-square test of goodness of fit. Linear Programming: Linear programming problems formulation, Solving linear programming problems using (i) Simplex method.

Text Books:

1. Advanced Engg. Mathematics : F Kreyszig.
2. Higher Engg. Mathematics : B.S. Grewal.

Reference books:

1. Advance Engg. Mathematics : R.K. Jain, S.R.K. Iyenger.
2. Advanced Engg. Mathematics : Michael D. Greenberg.
3. Operation Research : H.A. Taha.
4. Probability and statistics for Engineers : Johnson. PHI.

INSTRUMENTATION

General Course Information:

Course Code: ECE-211-L Course Credits: 2.5 Contact Hours: 3.0 hours/week Mode: Lectures and Tutorials Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are:

1. To learn basic measurement concepts.
2. To learn importance of signal generators and signal analyzers in electronics.
3. To learn relevance of digital instruments in measurements and need for data acquisition systems.

By the end of the course a student is expected:

1. Students will be exposed to general electronic measurement principles and instrumentation techniques ranging from the physical foundations of measurement theory to error theory.
2. Students will learn quantum effect standards and high-sensitivity instrumentations.
3. Students will be able to understand various digital techniques for controlling instruments and acquiring and processing data, from the logic and electrical simulation of integrated circuits and also their automated testing.

Course Contents

UNIT I

Instruments and Their Representation: Introduction, Typical Applications of Instrument Systems, Functional Elements of a Measurement System, Classification of Instruments, Standards and Calibration.

Static and Dynamic characteristics of Instruments: Introduction, Accuracy, Precision, Resolution, Threshold, Sensitivity, Linearity, Hysteresis, Dead Band, Backlash, Drift, Formulation of Differential Equations for Dynamic Performance- Zero Order, First Order and Second order systems, Response of First and Second Order Systems to Step, Ramp, Impulse and Harmonic Functions.

UNIT II

Oscilloscope:

Block diagram, study of various stages in brief, high frequency CRO considerations, Sampling and storage oscilloscope, Measurements of Phase and Frequency (Lissajous Patterns)

Electronic Instruments:
DC and AC voltage measurements, DC and AC current measurements, Multimeter, Ohmmeter, Bolometer, Calorimeter, Power meter, Introduction to digital meters

UNIT III

Generation and Analysis of waveforms:
Block Diagram of pulse generators, signal generators, function generators, wave analyzers, distortion analyzers, spectrum analyzer, Harmonicanalyzer, introduction to power analyzer.

Frequency and Time Measurements:
Study of Decade Counting Assembly(DCA), frequency measurements, period measurements, universal counters, Introduction to digital meters

UNIT IV

Transducers:
Classification, Transducers of types: RLC Photocell, thermocouple, etc., Basic schemes of measurements of displacement, velocity, acceleration, strain, pressure, liquid level & temperature.

Introduction to signal conditioning:
DC signal conditioning systems, AC signal conditioning systems, Data acquisition and conversion system, characteristics of modern digital data acquisition system, Filter, Settling time, Amplifier Characteristics.

Text Books:

1. A course in Electrical and Electronics Measurements and Instrumentation by A.K.Sawhney; Dhanpat Rai & sons

Reference Books:

1. Electronics Measurements and Instrumentation Techniques By H. Cooper; PHI
2. Electronics Instrumentation by Kalsi; TMH.
3. Electrical measurements: E.W. Golding
4. Electrical And Electronic measurement and instrumentation : J.B. Gupta, Kataria and Sons.
5. Electronic instrumentation and measurement technique : W.D. Cooper & A.D. Helfrick Measuring systems : E.O. Doeblin; TMH.

MECHANICS OF SOLIDS-I

General Course Information:

Course Code: ME-201-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Evaluate various kinds of stresses and strains (axial, bending, torsional and shearing) in various structural elements due to different type of external loads.
2. Determine and illustrate principal stresses and maximum shearing stress in complex stress system.
3. Draw shear force and bending moment diagrams in various kinds of beams subjected to different kinds of loads.
4. Determine stresses in various kinds of beams and columns.
5. Understand the theory of simple bending, unsymmetrical bending and torsion.

By the end of the course a student is expected to:

1. Understand the concepts of stress and strain at a point as well as the stress-strain relationships for homogenous, isotropic materials.
2. Determine and illustrate principal stresses, maximum shearing stress, and the stresses acting on a structural member.
3. Calculate the stresses and strains in axially-loaded members, circular torsion members, and members subject to flexural loadings.
4. Design of simple bars, beams, columns and shafts.

Course Contents

UNIT-I

Simple stresses and strains: General equations of equilibrium, free body diagram, Types of stresses and strains, Hooks law, elastic constants & their relationships, concept of stress at a point, stress-strain diagrams, stresses and strains in compound bars under axial loading, stresses in composite systems, thermal stresses.

Complex stresses: Two and three dimensional stress systems, rectangular stress components, principal stresses and planes, Mohr's stress circle.

UNIT-II

Shear force and bending moment diagrams: Relation between the rate of loading, the shear force and the bending moment. SF & BM calculations & diagrams for (i) cantilevers (ii) simply supported beams with or without over-hang (iii) fixed beams under (i) concentrated loads, (ii) uniformly distributed loads over whole

span or a part of it, (iii) combination of concentrated loads and uniformly distributed loads, (iv) varying loads (v) application of moments.

UNIT-III

Centroid and Moment of Inertia: Centroid and MOI for different shaped beam cross sections**,** Parallel axes theorem, perpendicular axis theorem, principal axes**,** principal moments of inertia, product of inertia, ellipse of inertia, Properties of beam cross section**.**

Bending stresses in beams: Theory of simple bending, position of neutral axis, flitched beams. Unsymmetrical Bending, Slope of the neutral axis, stresses & deflections, shear center and the flexural axis.

Shearing stresses: Introduction, shearing stress variation, variation of shear stress in beam cross section, shear stress distribution for typical sections.

UNIT-IV

Torsion: Torsion of circular shafts, comparison of Solid and hollow circular shafts, stepped shaft & composite circular shafts, statically indeterminate shafts, stresses in shafts under combined torsion, bending and axial loads.

Columns & Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formulae for the elastic buckling load, Eulers, Rankine, Gordon's formula, Johnson's empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular & circular sections.

Text and Reference Books:

1. Mechanics of Solid by Muubeen Abdul, Pearson Publications, India.
2. Engineering Mechanics of Solids by Popov E.P, Prentice Hall of India Mechanics of Materials by Ferdinand P. Beer and E. Russel Johnston, Jr. Second Edition, McGraw Hill.
3. Solid Mechanics by Kazmi, Tata Mc Graw Hill.
4. Strength of Materials by G.H.Ryder, Macmillan, India.
5. Strength of Materials by D.S. Bedi, S. Chand & Co. Ltd.
6. Advanced Mechanics of Solids and Structures by N. Krishan Raju and D.R.Gururaje, Narosa Publishing House.
7. Strength of Materials by Andrew Pytel and Fredinand L. Singer, Int. Student Ed. Addison, Wesley Longman.
8. Strength of Materials by Sadhu Singh, Khanna Publishers, India.
9. Strength of Materials by Timoshenko S, East-West Press Pvt. Ltd., New Delhi.

PRODUCTION TECHNOLOGY

General Course Information:

Course Code: ME-203-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Facilitate the student with theory of metal cutting, jigs and fixtures, work holding devices, manufacturing methods, metrology and non-conventional machining techniques being used in industry for production purposes.

By the end of the course a student is expected to:

1. Understand the principles of metal cutting, tool wear and tool life.
2. Differentiate jigs and fixtures and find their applications.
3. Understand different types of gear manufacturing methods.
4. Understand non-conventional machining method and statistical quality control tools.

Course Contents

UNIT-I

Theory of Metal Cutting: Introduction, Metal Cutting Machines and Tools, Elements of Metal Cutting, Geometry of Cutting Tools, Orthogonal and Oblique Cutting, Chip Formation, Chip Control, Forces Acting on a Single Point Tool, Measurement of Cutting Forces, Mechanics of Metal Cutting, Shear Plane, Chip Thickness Ratio, Shear Angle, Velocity Relationship in Orthogonal Cutting, Forces on the Chips, Stress and Strain in the chip, Work done during Metal Cutting, Heat Generation and Temperatures in Metal Cutting

Tool Wear and Machinability: Introduction, Tool Failure, Tool Wear, Tool Life, Cutting Speed, Feed and Depth of Cut, Tool Materials, Cutting Fluids, Power required for cutting, Machinability, Single Pass, Multi Pass and Multistage Machining

UNIT-II

Jigs and Fixtures: Introduction, Definitions and Concepts of Jig and Fixture, Advantages of Using Jigs and Fixtures, Elements of Jigs and Fixtures, Degree of Freedom, Types of Jigs, Types of Fixtures

Work Holding Devices: Basic Requirements of Work Holding Devices, Location: Principles, Methods and Devices, Clamping: Principles, Methods and Devices

UNIT-III

Manufacturing Methods: Turret Lathes and Their Characteristics, Classification of Gear Production Methods, Gear Generation, Indexing of Gears, Gear Hobbing, Gear Shaping, Gear Finishing Methods:Shaving, Burnishing, Grinding, Honing

Economics of Machining: Introduction, Choice of Feed, Economic Cutting Speed, Economics of Metal Removal, Minimum Cost/Component, Determination of Cutting Speed for Minimum Cost, Tool Life for Minimum Cost, Cutting Speed for Maximum Production, Tool Life for Maximum Production, Maximum Production Rate, Maximum Profit Rate

UNIT-IV

Non-Conventional Machining: Introduction, Classification of Non-Conventional Machining Processes, Process Selection, Ultrasonic Machining, Abrasive Jet Machining, Electro Chemical Machining, Electric Discharge Machining, Wire Electric Discharge Machining(WEDM), Electron Beam Machining, Laser Beam Machining

Metrology: Measurements, Linear and Angular Simple Measuring Instruments, Screw Gauge, Sine Bar, Auto-Collimator, Comparator-Mechanical, Electrical, Optical, Surface Finish and its Measurement

Text and Reference Books:

1. Manufacturing science: Ghosh and Malik, E.W. Press
2. Principles of metal cutting: Sen and Bhattacharya, New Central Book.
3. Metal cutting principles: Shaw, MIT Press Cambridge
4. Manufacturing analysis: Cook, Adisson-Wesley
5. Modern machining processes: Pandey and Shan, Tata McGraw Hill Publications
6. Production Technology: P.C. Sharma, S. Chand Publication
7. Production Technology: O.P. Khanna, Dhanpat Rai Publication

THERMODYNAMICS

General Course Information:

Course Code: ME-205-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Expose the basic concepts of engineering thermodynamics and the practical application of thermodynamic laws.
2. Provide an understanding of 1st law of thermodynamics and its implementation in steady and non-steady flow processes and to know the limitations of 1st law of thermodynamics and the importance of 2nd law of thermodynamics.
3. Study the concept of availability and irreversibility of a system during non- flow and steady flow state.
4. Impart in depth knowledge of pure substance and its properties during different phase transformations.
5. Understand basic air standard cycles and different mathematical relations used in thermodynamics.

By the end of the course a student is expected to:

1. Identify basic thermodynamic approaches and types of systems used in thermodynamics.
2. Understand the implementation of 1^{st} law of thermodynamics for different flow processes and learn the basic concepts of heat engine, heat pump and refrigerator used in engineering field.
3. Understand different availability and unavailability of energy during the closed and study flow processes of a system.
4. Understand the properties and behaviour of ideal and real gases and pure substance during its phase transformations.
5. Understand the ideal thermodynamic air standard cycles and mathematical relationships between different thermodynamic properties

Course Contents

UNIT-I

Basic Concepts: Macroscopic and Microscopic Approaches, Thermodynamic Systems, Surrounding and Boundary, Thermodynamic Property– Intensive and Extensive, Thermodynamic Equilibrium, State, Path, Process and Cycle, Quasistatic, Reversible and Irreversible Processes, Working Substance, Concept of Thermodynamic Work and Heat, Equality of Temperature, Zeroth Law of Thermodynamic and its utility. Problems.

First Law of Thermodynamics: Energy and its Forms, Energy and 1st law of Thermodynamics, Internal Energy and Enthalpy, PMM-1, Steady flow energy equation, 1st Law Applied to Non- flow process, Steady Flow Process and Transient Flow Process, Throttling Process and Free Expansion Process. Problems.

UNIT-II

Second Law of Thermodynamics: Limitations of First Law, Thermal Reservoir, Heat Source and Heat Sink, Heat Engine, Refrigerator and Heat Pump, Kelvin- Planck and Clausius Statements and their Equivalence, PMM-2, Carnot Cycle, Carnot Heat Engine and Carnot Heat Pump, Carnot Theorem and its Corollaries, Thermodynamic Temperature Scale, Entropy, Clausius Inequality, Principle of Entropy Increase, Temperature Entropy Plot, Entropy Change in Different Processes, Introduction to Third Law of Thermodynamics. Problems.

Availability and Irreversibility: High and Low Grade Energy, Availability and Unavailable Energy, Loss of Available Energy Due to Heat Transfer Through a Finite Temperature Difference, Dead state of a system, Availability of a Non- Flow or Closed System, Availability of a Steady Flow System, Helmholtz and Gibb's Functions, Effectiveness and Irreversibility, Second law efficiencies of processes & cycles. Problems.

UNIT-III

Ideal and Real Gases: Concept of an Ideal Gas, Basic Gas Laws, Characteristic Gas Equation, Avogadro's law and Universal Gas Constant, P-V-T surface of an Ideal Gas, Vander Waal's Equation of state, Reduced Co-ordinates, Compressibility factor and law of corresponding states, Mixture of Gases, Mass, Mole and Volume Fraction, Gibson Dalton's law, Gas Constant and Specific Heats, Entropy for a mixture of non-reactive gases. Problems.

Pure Substance: Pure Substance and its Properties, Phase and Phase Transformation, Vaporization, Evaporation and Boiling, Saturated and Superheat Steam, Solid – Liquid – Vapour Equilibrium, T-V, P-V and P-T Plots During Steam Formation, Properties of Dry, Wet and Superheated Steam, Property Changes During Steam Processes, Temperature – Entropy (T-S) and Enthalpy – Entropy (H-S) Diagrams, Throttling and Measurement of Dryness Fraction of Steam. Problems.

UNIT-IV

Thermodynamic Air Cycles: Introduction, Assumptions in Thermodynamic Cycles, Classifications of Thermodynamic Cycles, Reversible Cycle, Irreversible Cycle, Working of an Ideal Engine, Stirling Cycle, Ericsson Cycle, Bryton Cycle, Otto Cycle, Diesel Cycle, Dual Combustion Cycle. Problems.

Thermodynamic Relations: Maxwell Relations, Clapeyron Equation, Relations for changes in Enthalpy and Internal Energy & Entropy, Specific Heat Capacity Relations, Joule Thomson coefficient & inversion curve.

Text Books:

1. Advanced engineering thermodynamics – Adrian Bejan, Wiley, 4th edition.
2. Engineering thermodynamics- P. Chattopadhay, OXFORD, Revised 1st edition.

Reference Books:

1. Thermodynamics: An Engineering Approach- Yunus Cengel and Michael Boles, Tata McGraw Hill, 8th edition.
2. Engineering Thermodynamics - P K Nag, Tata McGraw Hill, 5th edition.
3. Fundamentals of Engineering Thermodynamics - Michael J. Moran, Howard N. Shapiro, Daisie D. Boettner and Margaret B. Bailey, Wiley, 7th edition.

MACHINE DRAWING

General Course Information:

Course Code: ME-207-L Course Credits: 3.0 Contact Hours: 1 hours/week Mode: Lectures Examination Duration: 4 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain **five short answers type questions**. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. ***1st question will carry 10 marks. Questions numbers 2-7 set from Units I-III will also carry 10 marks each. Questions numbers 8 and 9 set from Unit IV will carry 30 marks each.***

Course Objectives and Outcomes:

The objectives of this course are to:

1. Familiarize the students with Indian Standards on drawing practices.
2. Impart knowledge of thread forms, fasteners, keys, joints and couplings.
3. Make the students understand and interpret drawings of machine components so as to prepare assembly drawings either manually and using CAD packages.

By the end of the course a student is expected to:

1. Understand the shape and structure of different types of screws, riveted joints, welded joints and pipe joints.
2. Understand shaft bearing, keys and couplings.
3. Produce assembly drawing using part drawings.

Course Contents

UNIT-I

Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Commonly used holes and shafts.

Screw Threads: Drawings of various views of Screw threads, metric and BSW threads, Square thread and multi start threads. Nut bolts, Washers, Setscrew, Locknuts and foundation bolts.

Riveted and Welded Joints: Forms and Proportions of River Heads, Different Views of Different Types of Riveted Lap and Butt Joints. Welding, Types of Welded Joints, Elementary Welding Symbols, Position of the Symbols on Drawings, Dimensioning of Welds, Weld Contours, Surface Contour and Finish of Welds, Weld all Round, Site Weld, Method of Welding, Compound Weld, Projection Weld.

UNIT-II

Shaft Bearing: Solid and Bush Bearing, Plummer Block, Footstep Bearing.

Pipe Joint: Flanged Joint, Socket and Spigot Joint, Hydraulic Joint, Union Joint, Gland and Stuffing Box, Expansion Joint.

Pulley: Belt Pulley, V Belt Pulley, Fast and Loose Pulley, Speed Cone Pulley, Built Up Pulley.

UNIT-III

Keys, Cotters and Joints: Introduction, Key, Key Way, Depth of Immersion, Proportion of Key, Taper of Key, Classification of Keys, Cotter, Gib, Spline Shaft, Joint Used for Connecting Rods, Sleeve and cotter joint, Spigot and Socket Joint, Gib and Cotter Joint, Adjustable Joint, Knuckle Joint.

Shaft Couplings: Introduction, Shaft Coupling, Rigid Coupling, Flange Coupling, Types of Couplings, Protected Type Flange Coupling, Muff Coupling, Half Lag Muff Coupling, Split Muff Coupling, Flexible Coupling, Oldham's Coupling, Universal Coupling, Compression Coupling.

UNIT-IV

Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies: Lathe tail stock, Tool Post, Tool Holder, Machine Vice, Pedestal Bearing (Plummer Block), Steam Stop Valve, I.C. Engine Connecting Rod, Rams Bottom Safety Valve, Drill Jigs and Milling Fixture etc.

Note:

- ***A significant part of the drawing work should also be practiced using any one of solid modeling CAD packages (e.g. AutoCAD, Solidworks, Pro-E, CATIA etc.)***
- ***Both Answer booklet and Drawing Sheet will be provided to attempt questions for the end semester examination.***

Text Books:

1. Machine Drawing - N D Bhatt and V M Panchal, Charotar Publishing House.
2. A Text Book of Machine Drawing - P S Gill, S K Kataria and Sons Publishing House.
3. Engineering Graphics with Auto CAD 2002 -James D Bethune, Pearson Education.
4. A Text Book of Machine Drawing - Laxmi Narayana and Mathur, Jain Brothers Publishing House.
5. Machine drawing - N Sidheshwar, Kaneohe, V S Sastry, TMH, Publishing House.

MECHANICS OF SOLIDS LAB

General Course Information:

Course Code: ME-201-P Course Credits: 01 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Find out the strength of the given specimen subjected to one type of load (tensile, compressive, shear, bending and torsion).
2. Find the hardness value (Rockwell, Vickers, Brinell) of the given specimen.

By the end of the course a student is expected to:

1. Predict the behavior of the solid bodies under various types of loading (tensile, compressive, shear, bending and torsion).
2. Interpret the experimental results for material selection in engineering applications.

Lab Contents

1. To study the Universal Testing Machine (UTM) and perform the tensile test on the given specimen (Mild steel and Cast Iron).
2. To perform compression test on UTM on the given specimen (Mild steel and Cast Iron).
3. To perform bending tests on UTM on the given specimen.
4. To perform the shear test on UTM on the given specimen.
5. To perform the torsion test on the given specimen (Mild steel and Cast Iron).
6. To perform the Rockwell hardness test.
7. To perform the Brinell hardness test.
8. To perform the Vickers hardness test.
9. To perform the Impact tests (Izod & Charpy).
10. To perform the Erichsen cupping sheet metal test.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

PRODUCTION TECHNOLOGY LAB

General Course Information:

Course Code: ME-203-P Course Credits: 1.5 Mode: Practical Contact Hours: 03 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Design and manufacture of simple patterns
2. Fabricate the jobs using arc welding, gas welding, TIG and MIG welding equipments
3. Operate wire electric discharge machine and prepare job on it
4. Provide the knowledge of drilling, boring and external threads cutting on a lathe

By the end of the course a student is expected to:

1. Design and manufacture the simple patterns
2. Work with arc welding, gas welding, TIG and MIG welding equipments
3. Work on wire electric discharge machine
4. Perform drilling, boring and external threads cutting operations on a lathe

Lab Contents

1. To make a pattern for a given casting with all the necessary allowances, parting line, running system details. Prepare the mold and make the casting. Investigate the casting defects and suggest the remedial measures.
2. To make a component involving horizontal and vertical welding and study the welding defects and suggests their remedies.
3. To prepare a job on surface grinder/cylindrical grinder and measure the various parameters of the finished piece.
4. To cut external threads on a lathe.
5. Leveling of machine tools and testing their accuracy.
6. Disassembly and assembly of small assemblies such as tail stock, bench vice, screw jack etc.
7. Development and manufacture of complex sheet-metal components such as funnel etc.
8. Multi slot cutting on milling machine by indexing.
9. Drilling and boring of a bush.
10. To study and prepare a job on wire electric discharge machine.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

PERSONALITY DEVELOPMENT

General Course Information:

Course Code: PSY-201-L Course Credit: 0.0 Contact Hours: 3hrs/week Mode: Lectures Examination Duration: 3 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20 marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are:

1. Holistic development of the students.
2. Make the students to understand self and personality through the interactive task based sessions.
3. To develop the life skills required to lead an effective personal and professional life.

By the end of the course a student is expected to:

1. Understand the concept of self and personality.
2. Develop the life skills required to lead an effective personal and professional life.

Course Contents

UNIT-I

Understanding the concept of self, Self-Esteem, Characteristics of individuals with high and low self-esteem. Self- Confidence, Strategies of building self-confidence. Case Study.

UNIT-II

Understanding Personality, Factors affecting Personality: Biological, Psychological Social, Theories of Personality: Freud, Allport. Personality Assessment- Neo-Big Five Personality Test; T.A.T

UNIT-III

Stress: Causes of Stress and its impact, Strategies of stress management. Case study.

UNIT-IV

Emotional Intelligence: Concept, emotional quotient why Emotional Intelligence matters, Measuring EQ, Developing healthy emotions. Management of anger and interpersonal relations. Case study.

Text books:

1. Burger, J.M. (1990), Personality, Wardsworth: California.
2. Hall C.S.,Lindzey, G.(1978), Theories of Personality, New York: Wiley Eastern Limited.
3. Morgan, C.T.King R.A. Weisz, J.R., and Schopler, J. (1987), Introduction to Psychology, Singapore: McGraw Hill.
4. Byronb. D., and Kalley, N. (1961). Introduction to Personality: Prentice Hall.
5. Taylor,S.E., (2009). Health Psychology (9th Ed). New Delhi: Tata McGraw-Hill Publishing Company Ltd.

4th Semester

ENVIRONMENTAL STUDIES

General Course Information:

Course Code: EVS-201-L Course Credits: 3.0 Contact Hours: 3 hours/week. Mode: Lectures Examination Duration: 3 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Prerequisite:

Student should have prior knowledge of basic environment science.

Course Objectives and Outcomes:
The objectives of this course are:

1. To enhance knowledge skills and attitude to environment.
2. To understand natural environment and its relationship with human activities.

By the end of the course a student is expected:

1. Students will be able to enhance and analyze human impacts on the environment.
2. Integrate concepts & methods from multiple discipline and apply to environmental problems.
3. Design and evaluate strategic terminologies and methods for subs table management of environmental systems.
4. Field studies would provide students first-hand knowledge on various local environment aspects which forms an irreplaceable tool in the entire learning process.

Course Contents

UNIT-I

Multidisciplinary nature of Environmental studies: Definition, scope and importance, need for public awareness; Concept, Structure and function of an ecosystem: Producers, consumers and decomposers, Energy flow in the ecosystem ,Ecological succession ,Food chains, Food webs and ecological pyramids; Introduction, types, characteristics features, structure and function of Forest ecosystem, Grassland ecosystem ,Desert ecosystem, Aquatic ecosystem (Ponds, Stream, lakes, rivers, oceans, estuaries); Biodiversity: Introduction, Definition: genetic, species and ecosystem diversity, Bio-geographical classification of India, Value of biodiversity: consumptive use, productive use, social ethical, aesthetic and option values; Biodiversity at global, national and local level, India as a mega-diversity nation, Hot-spot of biodiversity, Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT-II

Renewable and non-renewable resources, Natural resources and associated problems ,Forest resources: Use and over-exploitation, deforestation, case studies, Timber extraction, mining, dams and their effects on forests and tribal people; Water resources: Use and over utilization of surface and ground water, floods, droughts conflicts

over water, dams benefits and problems; Mineral resources: Use and exploitation, environmental effects of extracting and mineral resources; Food resources: World food problem, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity; Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies; Land resources: Land as a resource, land degradation, main induced landslides, soil erosion and desertification, Role of an individual in conservation of natural resources, Equitable use of resources for suitable lifestyle.

UNIT-III

Definition of Environment Pollution; Causes, effects and control measures of: Air Pollution, Water Pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards; Solid waste Management: Causes effects and control measures of urban and industrial wastes; Role of and individual in prevention of pollution, Pollution case studies; Disaster management: floods, earthquake, cyclone and landslides; Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies; different laws related to environment: Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act.; Issues involved in enforcement of environmental legislation, Public awareness

UNIT-IV

Social issues and the Environment: From unsustainable to Sustainable development, Urban problems related to energy; Water conservation, rain water harvesting, watershed management; Resettlement and rehabilitation of people; its problem and concern, case studies; Environment ethics: Issues and possible solutions; Wasteland reclamation; Consumerism and waste products; Human Population growth, variation among nation, Population explosion- Family Welfare Programme, Environment and human health , Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Field Work: Visit to a local area to document environmental assets- river/forest/grassland/hill/mountain; Study of simple ecosystems – ponds, river, hill slopes etc; Study of common plants, insects, birds; Visit to a local polluted site- Urban/Rural/Industrial/Agricultural.

Text Books:

1. Erach Bharucha , "Environmental Studies for Undergraduate Courses", University Grants Commission and Bharati Vidyapeeth Institute of Environment Education and Research, Pune, University press pvt. Ltd. (India)
2. Fundamental concepts in Environmental studies by Dr. D.D. Mishra. S. Chand publications

Reference Books:

1. Essentials of Ecology and Environmental Science by Dr. S .V .S. Rana, PHI Learning Pvt. Ltd, Delhi
2. Environmental Chemistry by Anil Kumar De, Wiley Eastern Limited.
3. Environmental Science by T.G. Miller, Wadsworth Publishing Co, 13th edition.
4. Ecology and Environment by P. D. Sharma, Rastogi publications

NUMERICAL METHODS

General Course Information:

Course Code: MAT-202-L Course Credits: 3.5 Mode: Lectures Contact Hours: 3 hours/week. Examination Duration: 3 hours.	**Course Assessment Methods (Internal: 30; External: 70)** Two minor test each of 20marks, class performance measured through percentage of lecture attended (4 marks), assignments, quiz etc. (6 marks) and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus; it will contain seven short answer type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Prerequisite:
Basic knowledge of algebraic equations, ODE and PDE.

Course Outcomes:
By the end of the course a student is expected:

1. Problem of interpolation/extrapolation
2. Numerical solutions of differential equations
3. Numerical solutions of algebraic system of equations
4. Numerical solutions of PDE encountered in engineering

UNIT-I

Finite differences operators and their relationship, Newton-Gregory forward & Backward Formulas, Newton's, Gregory, Gauss difference interpolation formula, Lagrange interpolation, Inverse interpolation, Newton Divided difference, Least square approximation. Straight line and parabolic approximation.

UNIT-II

Non-Linear Equations: Bisection method, Linear Interpolation methods, Newton's method, fixed-point method. Simultaneous Linear Equations: Elimination method, Gauss and Gauss-Jordan method, Jacobi's method, Gauss-Seidal method, Relaxation method. LU-Decomposition.

UNIT-III

Numerical Differentiation and Integration: Derivatives from differences tables, Higher order derivatives, Newton -cotes integration formula, Trapezoidal rule, Simpson's rule, Boole's rule and Weddle's rule, Romberg's integration. Numerical Solution of Ordinary Differential Equations: Taylor series method, Euler and modified Euler method, Runge -Kutta methods.

UNIT-IV

Milne's method, Adams-Moulton method, Power method for Eigen values by iteration. Numerical Solution of Partial Differential Equations: Finite difference approximations of partial derivatives, solution of Laplace equation (standard 5-point formula only), One-dimensional heat equation (Schmidt method, Crank-Nicolson method, Dufort and Frankel method) and wave equation.

Text books:

1. Applied Numerical Analysis: Curtis F. Gerald and Patrick G. Wheatley, Person, Education Ltd.
2. Numerical Method: E. Balagurusamy, T.M.H.
3. Numerical methods for Scientific and Engg. Computations: M.K. Jain, S.R. L. Lyenfer and R.K. Jain, Wiley Eastern Ltd.
4. Introductory methods of Numerical Analysis: S.S. Sastry, P.H.D.
5. Numerical Methods in Engg. & Science: B.S. Grewal.

MATERIAL SCIENCE

General Course Information:

Course Code: ME-202-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand structure-properties properties relationship
2. Understand the mechanical behavior of materials, phase & phase diagram, heat treatment, failure of materials & their protection, applications of recent materials.
3. Develop intuitive understanding of the subject to present a wealth of real world engineering examples to give students a feel of how material science is useful in engineering practices.

By the end of the course a student is expected to:

1. Analyze the Structure of materials at different levels, basic concepts of crystalline materials.
2. Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy. Construction and identification of phase diagrams and reactions.
3. Understand and suggest the heat treatment process & types.
4. Explain features, classification, applications of newer class materials like smart materials, piezoelectric materials, biomaterials, composite materials etc.

Course Contents

UNIT-I

Crystallography: Review of crystal structure, space lattice, crystal planes and crystal directions, co-ordination number, number of atoms per unit cell, atomic packing factor, Numericals related to crystallography.

Imperfection in metal crystals: Crystal imperfections and their classifications, point defects, line defects, edge & screw dislocations, surface defects, volume defects & effects of imperfections on metal properties.

UNIT-II

Solid solutions and phase diagram: Introduction to single and multiphase solid solutions and types of solid solutions, importance and objectives of phase diagram, systems, phase and structural constituents, cooling curves, unary & binary phase diagrams, Gibbs's phase rule, Lever rule, eutectic and eutectoid systems, peritectic and peritectoid systems, iron carbon equilibrium diagram and TTT diagram.

Heat Treatment: Principles, purpose, classification of heat treatment processes, annealing, normalizing, stress relieving, hardening, tempering, carburizing, nitriding, cyaniding, flame and induction hardening, Allotropic transformation of iron and steel, Properties of austenite, ferrite, pearlite, martensite.

UNIT-III

Deformation of Metal: Elastic and plastic deformation, mechanism of plastic deformation, twinning, conventional and true stress strain curves for polycrystalline materials, yield point phenomena, strain ageing, work hardening, Bauschinger effect, season cracking, Recovery, re-crystallization and grain growth.

Failures of metals: Failure analysis, fracture, process of fracture, types of fracture, fatigue, characteristics of fatigue, fatigue limit, mechanism of fatigue, factors affecting fatigue.

UNIT-IV

Creep & Corrosion: Definition and concept, creep curve, mechanism of creep, impact of time and temperature on creep, creep fracture, creep testing and prevention against creep. Corrosion: Mechanism and effect of corrosion, prevention of corrosion.

Plastic, Composite and Ceramics: Polymers, formation of polymers, polymer structure and crystallinity, polymers to plastics types, reinforced particles-strengthened and dispersion strengthened composites. Ceramic materials: Types of ceramics, properties of ceramic, ceramic forming techniques, mechanical behavior of ceramic.

Text Books:

1. Elements of Material Science and Engineering: VanVlack, Wesley Pub. Comp.
2. Material Science - Narula, Narula and Gupta. New Age Publishers

Reference Books:

1. Material Science & Engineering –V. Raghvan, Prentice Hall of India Pvt. Ltd, New Delhi
2. A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpat Rai & Sons
3. Material Science and Engineering-An Introduction - Callister; W.D., John Wiley & Sons., Delhi.
4. Engineering Materials: Kenneth G. Budinski, Prentice Hall of India, New Delhi

FLUID MECHANICS

General Course Information:

Course Code: ME-204-L Course Credits: 4.0 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Familiar with all the basic concepts of fluids, their properties and fluid flow phenomenon,
2. Understand conservation equations and their applications
3. Understand various fluid flow problems.
4. Knowledge of laminar and turbulent flow
5. Understand the concept of development of boundary layers

By the end of the course a student is expected to:

1. Understand the properties of the fluid
2. Understand the mathematical techniques of practical flow problems.
3. Formulate and solve equations of momentum and energy
4. Solve problems in flow through pipes
5. Explain the various methods available for the boundary layer separation.

Course Contents

UNIT-I

Fluid Properties and Fluid Statics: Concept of fluid and flow, ideal and real fluids, continuum concept, properties of fluids, Newtonian and non-Newtonian fluids. Pascal's law, manometers, hydrostatic equation, hydrostatic forces on plane and curved surfaces, Buoyancy and Flotation, stability of floating and submerged bodies. Problems.

Fluid Kinematics: Eulerian and Lagrangian description of fluid flow; stream, streak and path lines; types of flows, flow rate and continuity equation, differential equation of continuity in cylindrical and polar coordinates, rotation, vorticity and circulation, stream and potential functions, flow net. Problems.

UNIT-II

Fluid Dynamics: Concept of system and control volume, Euler's equation, Bernoulli's equation, venturimeter, orifices, orifice meter, mouthpieces, kinetic and momentum correction factors, Impulse momentum relationship and its applications. Problems.

Potential Flow: Uniform and vortex flow, flow past a Rankin half body, source, sink, source-sink pair and doublet, flow past a cylinder with and without circulation. Problems.

UNIT-III

Viscous Flow: Flow regimes and Reynold's number, Relationship between shear stress and pressure gradient, uni-directional flow between stationary and moving parallel plates, Hagen-Poiseuilli law. Problems.

Flow Through Pipes: Major and minor losses in pipes, hydraulic gradient and total energy lines, series and parallel connection of pipes, branched pipes; equivalent pipe, power transmission through pipes. Problems.

UNIT-IV

Boundary Layer Flow: Boundary layer concept, displacement, momentum and energy thickness, von-karman momentum integral equation, laminar and turbulent boundary layer flows, drag on a flat plate, boundary layer separation and control. Problems.

Turbulent Flow: Shear stress in turbulent flow, Prandtl mixing length hypothesis, hydraulically smooth and rough pipes, velocity distribution in pipes, friction coefficients for smooth and rough pipes. Problems.

Text Books:

1. Fluid Mechanics – Streeter V L and Wylie E B, Mc Graw Hill
2. Mechanics of Fluids – I H Shames, Mc Graw Hill
3. A text book of Fluid Mechanics and Hydraulic Machines", R.K Rajput., S. Chand & Company Ltd., New Delhi
4. Fluid Mechanics and Hydraulics Machines, .R.K. Bansal, Laxmi publications (P) Ltd., New Delhi
5. Hydraulics and Fluid Mechanics, Modi P.N, & Seth S.M Standard Book House, New Delhi

Reference Books:

1. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som and G. Biswas, TMH
2. Fluid Mechanics and Fluid Power Engineering – D.S. Kumar, S.K. Kataria and Sons
3. Fluid Mechanics and Machinery – S.K. Agarwal, TMH, New Delhi
4. Fluid Mechanics, Yunus A Cengel & John M. Cimbala, Tata McGraw Hill Edition, New Delhi, 2006
5. Fluid Mechanics White.F.M, Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
6. Fluid Mechanics & Fluid Machines: Basic Concepts & Principles, Shiv Kumar, Ane Books Pvt. Ltd., New Delhi, 2010.

STEAM AND POWER GENERATION

General Course Information:

Course Code: ME-206-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand the combustion of fuels and formation of flue gases in the exhaust.
2. Understand the energy conversion in steam power plant through various vapor power cycles.
3. Recognize the parts and operations of high and low pressure steam boilers.
4. Analyze flow of steam through nozzles, turbines, engines and condensers.

By the end of the course a student is expected to:

1. Calculate air-fuel ratio for combustion of different fuels and estimate the amount of flue gases in exhaust.
2. Explain the steam power plant components with the help of basic and advanced cycles.
3. Explain the construction and working of different steam boilers and estimate their performance.
4. Calculate the performance of steam nozzle, steam turbine, steam engine, and steam condenser.

Course Contents

UNIT I

Fuels and Combustion: Characteristics of solid, liquid and gaseous fuels, Laws of combustion and reactions, Gravimetric and volumetric analysis, Air-fuel ratio, Exhaust gas analysis, Orsat apparatus. Calorific values of fuel, Bomb calorimeter, Numericals.

Steam: Formation of steam at constant pressure, Variation in steam properties during phase change, Steam tables and their uses, Enthalpy – entropy (Mollier) diagram, Carnot and Rankine vapour cycles, Rankine cycle with reheat and regeneration, Numericals.

UNIT II

Steam Generators: Classification of steam boilers, Essentials of a good boiler, Construction and operational details of Cochran, Babcock Wilcox, Locomotive, Lancashire, Benson, Lamont, Loeffler and Velox boilers, Boiler mountings and accessories.

Boiler Draught (Draft) and Performance: Natural (Chimney) draught, Maximum discharge through a chimney, Artificial draught, Evaporative capacity and efficiency of boilers, Energy balance in a boiler, Numericals.

UNIT III

Steam Nozzles: Steam flow through a nozzle, Critical pressure ratio (maximum discharge condition) and its physical significance, Flow through actual nozzles, Supersaturated expansion of steam, Numericals.

Steam Turbines: Working principle of impulse and reaction steam turbines. Vector diagrams of velocities, Optimum operating conditions of turbines, Compounding of impulse turbines, Losses in steam turbines, Performance analysis of steam turbines, Governing of steam turbines, Numericals.

UNIT IV

Steam Engines: Construction and working of steam engines, Indicator diagrams, Performance of steam engines, Governing of steam engines. Numericals.

Steam Condensers: Elements of a condensing plant, Types of condensers, Comparison of jet and surface condensers, Condenser and vacuum efficiency, Cooling towers, Numericals.

Books recommended:

1. P. L. Ballaney, "Thermal Engineering", Khanna Publishers, 1994
2. Mahesh M. Rathore, "Thermal Engineering", Tata McGraw-Hill Education, 2010
3. R. K. Rajput, "Thermal Engineering", Laxmi Publication, 2017.
4. V. P. Vasandani, D. S. Kumar, "Treatise on Heat Engineering", Metropolitan Book Company, 2012

MECHANICS OF SOLIDS-II

General Course Information:

Course Code: ME-208-L Course Credits: 4.0 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand the concepts of energy theorems.
2. Calculate the stresses and strains in pressure vessels, rotating bodies and springs.
3. Calculate the slope and deflection in beams subjected to different types of loading.
4. Design of machine elements using theories of deformable bodies.
5. Determine stresses in beam columns.

By the end of the course a student is expected to:

1. Understand the concepts energy theorems.
2. Calculate the stresses and strains in pressure vessels, rotating bodies and springs.
3. Determine the stresses and strains in members subjected to combined loading and apply the theories of failure for static loading.
4. Calculate stresses in beam columns.

Course Contents

UNIT-I

Thin Pressure Vessels: Hoop and Longitudinal stresses & strains in cylindrical and spherical vessels under internal pressure, wire would thin cylinders.

Thick Cylinders & Spheres: Derivation of Lame's equations, radial & hoop stresses and strains in thick and compound cylinders and spherical shells subjected to internal fluid pressure only, wire wound cylinders, hub shrunk on solid shaft.

UNIT-II

Rotating Rims & Discs: Stresses in uniform rotating rings & discs, rotating discs of uniform strength, stresses in (I) rotating rims, neglecting the effect of spokes, (ii) rotating cylinders, hollow cylinders & solids cylinders

Beam columns: Beam columns subjected to single concentrated load, number of concentrated loads, continuous lateral Load, end couple, couples at both ends triangular loads.

UNIT-III

Strain Energy & Impact Loading: Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano's & Maxwell's theorems.

Springs: Stresses in open coiled helical spring subjected to axial loads and twisting couples, leaf springs, flat spiral springs, concentric springs.

UNIT-IV

Slope & deflection: Relationship between bending moment, slope & deflection, calculations for slope and deflection using Integration, Macaulay's and area moment methods of (i) cantilevers and (ii) simply supported beams with or without overhang (iii) fixed beams under (i) concentrated loads, (ii) uniformly distributed load and (iii) a combination of concentrated loads & uniformly distributed load (iv) varying load (v) application of moments, propped beams, sinking of prop, continuous beams.

Theories of Elastic Failure: Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading.

Text and Reference Books:

1. Mechanics of Solid by Muubeen Abdul, Pearson Publications, India.
2. Engineering Mechanics of Solids by Popov E.P, Prentice Hall of India Mechanics of Materials by Ferdinand P. Beer and E. Russel Johnston, Jr. Second Edition, McGraw Hill.
3. Solid Mechanics by Kazmi, Tata Mc Graw Hill.
4. Strength of Materials by G.H.Ryder, Macmillan, India.
5. Strength of Materials by D.S. Bedi, S. Chand & Co. Ltd.
6. Advanced Mechanics of Solids and Structures by N. Krishan Raju and D.R.Gururaje, Narosa Publishing House.
7. Strength of Materials by Andrew Pytel and Fredinand L. Singer, Int. Student Ed. Addison, Wesley Longman.
8. Strength of Materials by Sadhu Singh, Khanna Publishers, India.
9. Strength of Materials by Timoshenko S, East-West Press Pvt. Ltd., New Delhi.

MATERIAL SCIENCE LAB

General Course Information:

Course Code: ME-202-P Course Credits: 01 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand structure-properties properties relationship
2. Understand the mechanical behavior of materials, phase & phase diagram, heat treatment, failure of materials & their protection, applications of recent materials.
3. Develop intuitive understanding of the subject to present a wealth of real world engineering examples to give students a feel of how material science is useful in engineering practices.

By the end of the course a student is expected to:

1. Analyze the Structure of materials at different levels, basic concepts of crystalline materials.
2. Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy. Construction and identification of phase diagrams and reactions.
3. Understand and suggest the heat treatment process & types.
4. Explain features, classification, applications of newer class materials like smart materials, piezoelectric materials, biomaterials, composite materials etc.

Lab Contents

1. To study crystal structures of a given specimen.
2. To study crystal imperfections in a given specimen.
3. To study microstructures of metals/ alloys.
4. To prepare solidification curve for a given specimen.
5. To study heat treatment processes (hardening and tempering) of steel specimen.
6. To study microstructure of heat-treated steel.
7. To study thermo-setting of plastics.
8. To study the creep behavior of a given specimen.
9. To study the mechanism of chemical corrosion and its protection.
10. To study the properties of various types of plastics.
11. To study Bravais lattices with the help of models.
12. To study crystal structures and crystals imperfections using ball models.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

FLUID MECHANICS LAB

General Course Information:

Course Code: ME-204-P Course Credits: 01 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Enable the students to acquire knowledge of fluid flow concepts, working principles of flow meters
2. Understand flow discharge measuring device used in pipes channels.
3. Determine fluid and flow properties.
4. Characterize laminar and turbulent flows.
5. Know about major and minor losses during flow

By the end of the course a student is expected to:

1. Understand the working of flow meters.
2. Gain knowledge on different forms of energy of flowing fluids.
3. Determine flow discharge measuring device used in pipes channels
4. Understand about fluid and flow properties
5. Distinguish between laminar and turbulent flows
6. Find out the major and minor losses during fluid flow

Lab Contents

1. To verify the Bernoullis Theorem.
2. To determine the coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of venturimeter.
4. To determine the coefficient of discharge of Notch (V and Rectangular types).
5. To determine the major loss due to friction in pipe flow.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To find critical Reynolds number for a pipe flow.
8. To determine the meta-centric height of a floating body.
9. To determine the minor losses due to pipe fittings in pipes
10. To determine the density and viscosity of any three fluids.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

STEAM AND POWER GENERATION LAB

General Course Information:

Course Code: ME-206-P Course Credits: 01 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand the flue gases formation and calorific value of fuel.
2. Explain the construction and working of different components of high and low pressure boilers.
3. Analyze the flow of steam through steam turbines, engines, condensers, and cooling towers.

By the end of the course a student is expected to:

1. Estimate the composition of flue gases and calculate the calorific value of fuel.
2. Recognize the parts and operations of high and low pressure steam boilers.
3. Calculate the performance of steam turbines, steam engines, steam condensers, and cooling towers.

Lab Contents

1. To estimate the composition of flue gases by Orsat apparatus.
2. To find calorific value of fuel using bomb calorimeter.
3. To study the construction and working of low pressure boilers.
4. To study the construction and working of high pressure boilers.
5. To study the working and performance of impulse and reaction steam turbines.
6. To study the construction and working of steam engines.
7. To study the construction and working of jet and surface condensers.
8. To study the working of cooling tower.
9. A visit to nearby steam power plant can be organized to learn the working of different elements.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

NUMERICAL METHODS LAB

General Course Information:

Course Code: MAT-202-P Course Credits: 01 Mode: Practical Contact Hours: 2 hours/week Examination Duration: 03 hours	**Course Assessment Methods (Internal: 30; External: 70)** Internal continuous assessment of 30 marks on the basis of class performance and attendance in practical classes. For the end semester practical examination the assessment will be done out of 70 marks by the external and internal examiners.

LIST OF EXPERIMENTS

Write down and execute the following programs using C/C++/MATLAB

1. To find the roots of non-linear equation using Bisection method.
2. To find the roots of non-linear equation using Newton's method.
3. Curve fitting by least- square approximations.
4. To solve the system of linear equations using Gauss -elimination method.
5. To solve the system of linear equations using Gauss -Seidal iteration method.
6. To solve the system of linear equation using Gauss –jordan method.
7. To integrate numerically using Trapezoidal rules.
8. To integrate numerically using Simpson's rules.
9. To find the largest eigen value of a matrix by Power -method.
10. To find numerical solution of ordinary differential equations by Euler's method.
11. To find numerical solution of ordinary differential equations by Runge -Kutta method.
12. To find numerical solution of ordinary differential equations by Milne's method.
13. To find the numerical solution of Laplace equation.
14. To find numerical solution of wave equation.
15. To find numerical solution of heat equation.

Note: At-least seven experiments are to be performed by students from the above list. The course coordinator may also design and set experiments in addition to the above list/topic as per the scope and requirement of syllabus.

Books Suggested:

1. Applied Numerical Analysis by Curtis F. Gerald and Patrick G. Wheatley - Pearson Education Ltd.
2. Numerical Methods: E. Balagurusamy, T.M.H.

SKILLS AND INNOVATION LAB

General Course Information:

Course Code: ME-210-P Course Credits: 0.0 Mode: Practical Contact Hours: 03 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** This is a **non-credit course of qualifying nature**. Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to enable students to:

1. Understand and identify research topics related to Mechanical Engineering through brain storming sessions.
2. Propose a novel idea/modified technique/new interpretation after identifying the existing research work.
3. Devise specific identified issue/problem in the form of research objectives.
4. Work in a group and communicate effectively the research topic though presentation and/or brain storming.

By the end of the course a student is expected to:

1. Understand the research analysis of issues/problems on topics related to Mechanical Engineering.
2. Understand the techniques and tools used for research analysis.
3. Understand literature related to a research topic.
4. Communicate effectively the research topic though presentation and/or brain storming.

Lab Contents

A group of 5-7 students are required to carry out a project related to current research & development in the field of Mechanical Engineering. Each group of students will try to propose a novel idea/modified technique/new interpretation after identifying an existing research work. They will work towards finding solutions to the identified problem such as cost reduction, enabling new processes and/or materials, creating a higher impact than the existing practices etc. using their innovative ideas and concept generation abilities.

The topic of the project will be decided by the students in consultation with the course coordinator. The project report will be submitted by a group at the end of semester. The students may use the equipments/machines/instruments available in the labs/workshops with the due permission of Chairperson on recommendation of the course coordinator.

3rd Year Syllabus

B.Tech. (Mechanical Engineering) Program

V- Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
OE-1		Open Elective-I*	4	-	-	4.0
PC-9	ME-301-L	Kinematics of Machines	3	1	-	3.5
PC-10	ME-303-L	Fluid Machines	3	1	-	3.5
PC-11	ME-305-L	Internal Combustion Engines and Gas turbines	3	1	-	3.5
PC-12	ME-307-L	Machine Design-I	3	1	-	3.5
PC-13	ME-309-L	Industrial Engineering	3	-	-	3.0
PC-9	ME-301-P	Kinematics of Machines Lab	-	-	2	1.0
PC-10	ME-303-P	Fluid Machines Lab	-	-	2	1.0
PC-11	ME-305-P	Internal Combustion Engines and Gas turbines Lab	-	-	2	1.0
PS-1	ME-311-P	Industrial Training Presentation-I	-	-	2	1.0
			19	4	8	25.0
		Total	31			25.0

***The students have to choose an Open elective subject offered by other Departments of Engineering**

VI- Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
OE-2		Open Elective –II #	4	-	-	4.0
PE-1		Programme Elective –I	4	-	-	4.0
PC-14	ME-302-L	Automobile Engineering	3	1	-	3.5
PC-15	ME-304-L	Heat Transfer	3	1	-	3.5
PC-16	ME-306-L	Dynamics of Machines	3	1	-	3.5
PC-17	ME-308-L	Machine Design-II	3	1	-	3.5
PC-14	ME-302-P	Automobile Engineering Lab	-	-	2	1.0
PC-15	ME-304-P	Heat Transfer Lab	-	-	2	1.0
PC-16	ME-306-P	Dynamics of Machines Lab	-	-	2	1.0
			20	4	6	25.0
			30			
MC-5	ME-310-P	Technical Presentation*	-	-	2	2 units
		Total	**32**			**25.0**

#The students have to choose an Open elective subject offered by other Departments of Engineering

Note- At the end of the VI-semester each student will undergo 4-6 weeks training/internship in an industry/research institute

***Non-Credit**

Programme Elective-I

Course Code	Course Name	L	T	P	Credits
ME-352-L	Operation Research	4	-	-	4.0
ME-354-L	Maintenance Engineering	4	-	-	4.0
ME-356-L	Total Quality Control	4	-	-	4.0
ME-358-L	Production Management	4	-	-	4.0

5th Semester

KINEMATICS OF MACHINES

General Course Information:

Course Code: ME-301-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand the concept of machines, mechanisms and related terminologies.
2. Analyse a mechanism for displacement, velocity and acceleration at any point in a moving link
3. Design cams and followers for specified motion profiles and Synthesize planar four bar and slider crank mechanisms
4. Understand the theory of gears and gear trains

By the end of the course a student is expected to:

1. Familiarize with common mechanisms used in machines and everyday life
2. Conduct a complete velocity and acceleration analysis of the mechanism
3. Understand various cam motion profiles and follower mechanism, their classification and design based on prescribed follower motion. Student is expected to synthesize planar four bar and slider crank mechanisms
4. Understand importance of gears and gear trains and their practical applications

Course Contents

UNIT-I

Introduction: Mechanism and Machines, Kinematic Links, Kinematic Pairs, Kinematic Chains, Degree of Freedom, Kinematic Inversion, Inversions of Four Bar Kinematic Chain, Inversions of Single Slider Kinematic Chain, Inversions of Double Slider Kinematic Chain, Problems

Mechanism with Lower Pairs: Pantograph, Straight Line Mechanisms, Exact Straight Line Motion Mechanisms, Approximate Straight Line Motion Mechanisms, Steering Gear Mechanisms, Davis Steering Gear, Ackerman Steering Gear, Problems

UNIT-II

Velocity in Mechanisms: Relative Velocity Method: Motion of a Link, Velocity of a Point on a Link by Relative Velocity Method, Velocities in a Slider Crank Mechanism, Instantaneous Centre Method: Space and Body Centrodes, Velocity of a Point on a Link by Instantaneous Centre Method, Aronhold Kennedy Theorem, Methods of Locating Instantaneous Centres in a Mechanism, Problems

Acceleration in Mechanisms: Acceleration diagram for a link, Acceleration of a point on a link. Acceleration in the Slider Crank Mechanism, Coriolis Component of Acceleration, Problems

UNIT-III

Cams: Classification of Cams and Followers, Disc Cam Nomenclature, Construction of Displacement, Velocity and Acceleration Diagrams for Different Types of Follower Motions, Determination of Basic Dimension, Synthesis of Cam Profile by Graphical Approaches, Problems

Kinematic Synthesis: Kinematic Synthesis: Dimensional synthesis, function generation, path generation and motion generation, Synthesis of Four Bar linkage for specified Instantaneous conditions, Problems

UNIT-IV

Gears: Fundamental Law of Gearing, Forms of Gear Teeth, Path of Contact, Arc of Contact, Interference and Undercutting, Non Standard Gear Teeth, Helical, Spiral, Bevel and Worm Gears, Problems

Gear Trains: Synthesis of Simple, Compound and Reverted Gear Trains, Analysis of Epicyclic Gear Trains, Problems

Text and References Books:

- KJ, Waldron and GL, Kinzel, Kinematics, Dynamics and Design of Machinery, Wiley Publishers, Edition, 2016.
- A, Ghosh and AK, Malik, Theory of Mechanisms and Machines, East West Press Private Limited Publishers, Edition, 2017.
- JJ, Uicker (Jr), GR, Pennock and JE, Shigley, Theory of Machines and Mechanisms, Oxford Publishers, 2016.
- SS, Rattan, Theory of Machines, Tata McGraw Hill Publishers, Edition, 2017.

FLUID MACHINES

General Course Information:

Course Code: ME-303-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Provide fundamentals of impact of jet.
2. Complete detail of hydroelectric power plant unit.
3. Explain, analyze and design the fluid machinery elements like Turbines (Impulse and Reaction) Pumps: reciprocating and centrifugal, other fluid systems like hydraulic jack, hydraulic couplings, torque converter etc.

By the end of the course a student is expected to:

1. Apply the fundamentals of impact of jet to various hydraulic turbines.
2. Design, analysis and solution of the problems for reaction turbines.
3. Design, analysis and solution of the problems for centrifugal and reciprocating pumps.
4. Know about different hydraulic systems and use of dimensional analysis and model similitude in the design of hydraulic turbines and pumps.

Course Contents

UNIT-I

Impact of free jets: 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. Problems

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, Performance Characteristics, Governing of reaction turbine, Introduction to new types of turbine, Deriaz (Diagonal), Bulb, Tubular turbines, Problems.

UNIT-III

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.

Reciprocating Pumps: 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.

UNIT-IV

Dimensional Analysis and Model Similitude: Dimensional homogeneity, Rayleigh's method and Buckingham's π-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.

Hydraulic systems: 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 and Reference Books:

- Hydraulics & Fluid Mechanics – Modi & Seth, Pub. - Standard Book House, N.Delhi, 2010
- Hydraulic Machines – Jagdish Lal, Metropolitan, 1998
- Fluid Mechanics and Hydraulic Machines – S S Rattan, Khanna Publishers, 1998
- Introduction to Fluid Mechanics and Fluid Machines – S K Som and G Biswas, Tata McGraw Hill, 2009
- Fluid Mechanics and Fluid Power Engineering – D S Kumar, S K Kataria and Sons, 2010
- Fluid Mechanics and Hydraulic Machines-R. K. Rajput, S. Chand & Company, 2014
- Fluid Mechanics and Hydraulic Machines-R. K. Bansal, Laxmi Publications, 2010
- Fluid Mechanics-Cengel and Cimbala, Mc Graw Hill Education, 2014

INTERNAL COMBUSTION ENGINES AND GAS TURBINES

General Course Information:

Course Code: ME-305-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:
1. Acquire the knowledge of engine components and fuel air cycles.
2. Understand the working of engine auxiliary systems and the combustion aspects of SI & CI Engines.
3. Know the various alternate fuels, engine emissions, measuring and control techniques.
4. Understand the basic concepts of rotary compressor and gas turbines.

By the end of the course a student is expected to:
1. Learn the basics of SI & CI engines, air standard cycles, and mixture requirements.
2. Understand the combustion phenomenon, lubrication and cooling of IC engines.
3. To calculate engine performance parameters and to know about the emission standards for IC engines.
4. To calculate performance of centrifugal compressor and gas turbines.

Course Contents

UNIT-I

Air Standard Cycles: Internal and external combustion engines; classification of I.C. Engines, Cycles of operation in four stroke and two stroke I.C. Engines, Wankel Engines, Assumptions made in air standard cycle; Otto cycle; diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles; sterling and Ericsson cycles; air standard efficiency, specific work output, specific weight; work ratio; mean effective pressure; deviation of actual engine cycle from ideal cycle. Problems.

Carburetion, fuel Injection and Ignition systems: Mixture requirements for various operating conditions in S.I. Engines; elementary carburetor, Requirements of a diesel injection system; types of inject systems; petrol injection, Requirements of ignition system; types of ignition systems ignition timing; spark plugs. Problems.

UNIT-II

Combustion in I.C. Engines: S.I. engines; Ignition limits; stages of combustion in S.I. Engines; Ignition lag; velocity of flame propagation; detonation; effects of engine variables on detonation; theories of detonation; octane rating of fuels; pre-ignition; S.I. engine combustion chambers, Stages of combustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers.

Lubrication and Cooling Systems: Functions of a lubricating system, Types of lubrication system; mist, wet sump and dry sump systems; properties of lubricating oil; SAE rating of lubricants, engine performance and lubrication, Necessity of engine cooling; disadvantages of overcooling; cooling systems; air-cooling, water cooling; radiators.

UNIT-III

Engine Testing and Performance: Performance parameters: BHP, IHP, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, volumetric efficiency; specific fuel consumption (BSFC, ISFC), thermal efficiency; heat balance; Basic engine measurements; fuel and air consumption, brake power, indicated power and friction power, heat lost to coolant and exhaust gases; performance curves. Problems.

Air pollution from I.C. Engine and Its remedies: Pollutants from S.I. and C.I. Engines, Methods of emission control; alternative fuels for I.C. Engines; the current scenario on the pollution front.

UNIT-IV

Rotary Compressors: Root and vane blowers; Static and total head values; Centrifugal compressors- Velocity diagrams, slip factor, ratio of compression, pressure coefficient, pre-whirl; Axial flow compressor- Degree of reaction, polytropic efficincy, surging, choking and stalling, performance characteristics, Problems.

Gas Turbines: Brayton cycle; Components of a gas turbine plant; open and closed types of gas turbine plants; Optimum pressure ratio; Improvements of the basic gas turbine cycle; multi stage compression with inter-cooling; multi stage expansion with reheating between stages; exhaust gas heat exchanger, Applications of gas turbines. Problems.

Text and References Books:

- Internal Combustion Engines –V. Ganesan, Tata McGraw-Hill.
- Engineering fundamental of the Internal Combustion Engine – W.W. Pulkrabek, Pearson Education, 2007.
- Internal Combustion Engines & Air pollution- Obert E.F, Hopper & Row Pub., New York
- Internal Combustion Engines Fundamentals- J. B. Heywood, McGraw Hill, New York
- Internal Combustion Engines- V.M. Domkundwar, Dhanpat Rai &Co., 2008
- Internal Combustion Engines- R.K. Rajput, Laxmi Publications, 2009
- Internal Combustion Engines- Matur and Sharma, Dhanpat Rai &Co., 2007

MACHINE DESIGN-I

General Course Information:

Course Code: ME-307-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 4 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand the fundamentals for solving engineering problems relating to machine components.

By the end of the course a student is expected to:

1. Design the machine components for static and fluctuating loads.
2. Solve the design problems of different types of joints i.e. riveted joint, welded joint, cotter and knuckle joints under different loading conditions.
3. Solve the design problems of transmission shafts, keys, couplings and flywheel for different loading conditions.
4. Solve the design problems of different types of clutches and brakes.

Course Contents

UNIT-I

Design Philosophy: Problem identification- problem statement, specifications, constraints, Feasibility study-technical feasibility, economic & financial feasibility, societal & environmental feasibility, Generation of solution field (solution variants), Brain storming, Preliminary design, Selection of best possible solution, Detailed design, Selection of Fits and tolerances and analysis of dimensional chains.

Selection of Materials: Classification of engineering materials, Mechanical properties of the commonly used engineering materials, hardness, strength parameters with reference to stress-strain diagram, Factor of safety.

UNIT-II

Mechanical Joints: ISO Metric Screw Threads, bolted joints in tension, eccentrically loaded bolted joints in shear and under combined stresses, Design of power screws, Design of various types of welding joints under different static load conditions.

Riveted Joints, Cotter & Knuckle Joints: Design of various types of riveted joints under different static loading conditions, eccentrically loaded riveted joints, design of cotter and knuckle joints.

UNIT-III

Belt rope and chain drives: Design of belt drives, Flat & V-belt drives, Condition for Transmission of max. Power, Selection of belt, design of rope drives, design of chain drives with sprockets.

Keys, Couplings & Flywheel: Design of Keys – Flat, Kennedy Keys, Splines, Couplings design – Rigid & Flexible coupling, turning Moment diagram, coefficient of fluctuation of energy and speed, design of flywheel – solid disk & rimmed flywheels.

UNIT-IV

Clutches: Various types of clutches in use, Design of friction clutches – Disc. Multidisc, Cone & Centrifugal, Torque transmitting capacity.

Brakes: Various types of Brakes, Self energizing condition of brakes, Design of shoe brakes – Internal & external expanding, band brakes, Thermal Considerations in brake designing.

Text and Reference Books:

- Mechanical Engg. Design - First Metric Editions: Joseph Edward Shigley-MGH, New York.
- Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.
- Machine Design an Integrated Approach: Robert L. Norton, Addison Wesley.
- Machine Design: S.G. Kulkarini - Tata MacGraw Hill.
- Design of machine elements-C S Sharma, Kamlesh Purohit, PHI.

INDUSTRIAL ENGINEERING

General Course Information:

Course Code: ME-309-L Course Credits: 3.0 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:
1. Impart the knowledge of different types of plant layout and material handling
2. Familiarize with the concept of work study and method study
3. Impart the knowledge of work measurement and value engineering
4. Familiarize with the concept of ergonomics and intellectual property rights

By the end of the course a student is expected to:
1. Understand importance of different types of plant layout and material handling
2. Understand importance of work study and method study
3. Understand importance of work measurement and value engineering
4. Understand importance of ergonomics and intellectual property rights

Course Contents

UNIT-I

Plant Layout: Objectives of Good Plant Layout, Importance of Plant Layout, Types of Plant Layout, Advantages and Limitations of Different Types of Plant Layouts

Material Handling: Function of Material Handling, Principles of Material Handling, Material Handling Devices, Relation between Plant Layout and Material Handling

UNIT-II

Work Study: Definition and Concept of Work Study, Need of Work Study, Advantages of Work Study, Techniques of Work Study, Work Study and Management, Work Study and Productivity

Method Study: Objectives and Procedure of Method Study, Process Chart Symbols, Flow Diagram, String Diagram, Therblig, Multiactivity Charts

UNIT-III

Work Measurement: Objectives of Work Measurement, Basic Procedure for Time Study, Difference between Time Study and Motion Study, Various Time Estimates and Production Standard, Level of Performances, Allowances, Various Time Recording Techniques in Time Study

Value Engineering: Types of Values, Concept of Value Engineering, Phases of Value Engineering Studies, Application of Value Engineering

UNIT-IV

Ergonomics: Concept of Ergonomics, Objectives of Ergonomics, Man Machine System Interface, Anthropometry, Ergonomics and Safety, Ergonomics and Fatigue

Intellectual Property Rights: Intellectual Property Rights, Patents, Trade Marks, CopyRights, Law of Contract

Text and Reference Books:

- Industrial Engineering and Management by Hicks, Tata McGraw Hill, New Delhi
- Work study and Ergonomics by Suresh Dalela and Saurabh, Standard Publishers
- Motion and time study by R. Bernes, John-Wiley & Sons
- Ergonomics at work by D.J. Oborne, John Wiley & Sons
- Techniques of Value Analysis and Engineering by Miles, McGraw Hill

KINEMATICS OF MACHINES LAB

General Course Information:

Course Code: ME-301-P Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:
1. Impart the knowledge on link, pair, kinematic chain, mechanism, and inversions of different types of chains.
2. To familiarize with different types of cams and followers, and their applications.
3. To expose students to different types of gears and gear trains, and their applications.

By the end of the course a student is expected to:
1. Understand concept of link, pair, kinematic chain and mechanism.
2. Understand inversions and inversions of different types of kinematic chains.
3. Draw cam profiles and understand their applications.
4. Understand importance of gears, gear trains and their practical applications.

Lab Contents

1. To Study Various Types of Kinematic Links, Pairs, Chains and Mechanisms.
2. To Study Inversions of Four Bar, Single Slider and Double Slider Crank Chains.
3. To Find Coefficient of Friction Between Belt and Pulley, and Rope and Pulley.
4. To Study Various Types of Cam and Follower Arrangements.
5. To Plot Follower Displacement Vs Cam Rotation for Various Cam Follower Systems.
6. To Generate Spur Gear Involute Tooth Profile using Simulated Gear Shaping Process.
7. To Study Various Types of Gears: Spur, Helical, Double Helical, Worm, Spiral and Bevel Gears.
8. To Study Various Types of Gear Trains: Simple, Compound, Reverted and Epicyclic Gear Trains.
9. To Determine the Speed Ratio of a Gear Train.
10. To Compute the Efficiency of an Epicyclic Gear Train.
11. Create various types of linkage mechanism in CAD and simulate for motion outputs and study the relevant effects.
12. Creation of various joints like revolute, planes, spherical, cam follower and study the degree of freedom and motion patterns available.

Note: At least eight experiments should be performed from the above list. The teacher can alter/add more experiments as per the requirements

FLUID MACHINES LAB

General Course Information:

Course Code: ME-303-P Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand the basics of hydroelectric power plant and their operations
2. Provide fundamental details, construction and working of various fluid machinery elements like Turbines, Pumps and other fluid systems.
3. Analyze the performance of various fluid machinery elements like Turbines (Impulse and Reaction), Pumps: reciprocating and centrifugal, other fluid systems like hydraulic jack, hydraulic couplings, torque converter etc.

By the end of the course a student is expected to:

1. Learn the basics elements of hydroelectric power plant and their layout.
2. Get a complete awareness on hydraulic machines and flow measuring instruments.
3. Operate hydraulic machines and evaluate their performance.

Lab Contents

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 a 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.
13. To study the constructional and working details of gas turbines.

Note: At least eight experiments should be performed from the above list. The teacher can alter/add more experiments as per the requirements

INTERNAL COMBUSTION ENGINES AND GAS TURBINES LAB

General Course Information:

Course Code: ME-305-P Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To study the constructional and working details of 4-stroke and 2-stroke petrol and diesel engines.
2. Learn how to determine the power (IP & BP), fuel consumption, efficiency (thermal and volumetric) of 2 stroke, 4 stroke and multi-cylinder petrol engines.
3. To draw heat balance sheet of petrol and diesel engines.
4. To measure CO and hydrocarbons in the exhaust of petrol engines.

By the end of the course a student is expected to:

1. Understand the working of petrol and diesel engines.
2. Perform internal combustion engine (Petrol/Diesel) test to measure power, efficiency, fuel consumption and emissions.

Lab Contents

1. To study the constructional details & working principles of two-stroke/ four stroke petrol engine.
2. To study the constructional detail & working of two-stroke/ four stroke diesel engine.
3. Analysis of exhaust gases from single cylinder/multi cylinder diesel/petrol engine by Orsat Apparatus.
4. To prepare heat balance sheet on multi-cylinder diesel engine/petrol engine.
5. To find the indicated horse power (IHP) on multi-cylinder petrol engine/diesel engine by Morse Test.
6. To prepare variable speed performance test of a multi-cylinder/single cylinder petrol engine/diesel engine and prepare the curves (i) bhp, ihp, fhp, vs speed (ii) volumetric efficiency & indicated specific fuel consumption vs speed.
7. To find fhp of a multi-cylinder diesel engine/petrol engine by Willian's line method & by motoring method.
8. To perform constant speed performance test on a single cylinder/multi-cylinder diesel engine & draw curves of (i) bhp vs fuel rate, air rate and A/F and (ii) bhp vs mep, mechanical efficiency & sfc.
9. To measure CO & Hydrocarbons in the exhaust of 2- stroke / 4-stroke petrol engine.
10. To find intensity of smoke from a single cylinder / multi-cylinder diesel engine.
11. To draw the scavenging characteristic curves of single cylinder petrol engine.
12. To study the effects of secondary air flow on bhp, sfc, Mech. Efficiency & emission of a two-stroke petrol engine.

Note: At least eight experiments should be performed from the above list. The teacher can alter/add more experiments as per the requirements

Industrial Training Presentation-I

General Course Information:

Course Code: ME-311-P Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal:100)** Internal continuous assessment of 100 marks on the basis of report writing, presentation and viva voce in practical classes by the team of panel of faculty members.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions.
2. To have hands-on experience in the students' related field so that they can relate and reinforce what has been taught at the university.
3. To promote cooperation and to develop synergetic collaboration between industry and the university in promoting a knowledgeable society.
4. To set the stage for future recruitment by potential employers.

By the end of the course a student is expected to:

1. Generate a report based on the experiences with the ability to apply knowledge of Engineering fundamentals
2. Demonstrate competency in relevant engineering fields through problem identification, formulation and solution
3. Develop the ability to work as an individual and in group with the capacity to be a leader as well as an effective team member.
4. Master the professional and ethical responsibilities of an engineer.

Course Contents

As a part of the B.Tech Mechanical Engg. Curriculum Industrial Training-I is a Practical course, which the students of Mechanical Engineering should undergo in reputed Private / Public Sector / Government organization / companies as industrial training of six weeks to be undergone by the student in the summer vacation after the IV semester.

6th Semester

AUTOMOBILE ENGINEERING

General Course Information:

Course Code: ME-302-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To expose the students to the basic overview of automobile and idea about drives of automobile with safety features of vehicles.
2. To provide to the students an understanding of clutch & power transmission of automobile.
3. To impart in depth knowledge drive lines, suspension system & steering system of automotive vehicles.
4. To impart knowledge to the students about automotive brakes, tyres & wheels.
5. To impart knowledge on the mechanisms involved in the starting systems, ignition systems and an emission control system of vehicles.

By the end of the course a student is expected to:

1. Identify basic component of automobile & drives of automobile with safety features of vehicles.
2. Understand phenomena of clutches, power transmission & their different types.
3. Understand drive lines, suspension system, steering system of automotive vehicles
4. Understand different types of automotive brakes, tyres & wheels with their application.
5. Understand the mechanisms of starting systems, ignition systems and an emission control system of vehicles.

Course Contents

UNIT-I

Introduction to Automobiles : Classification, Components, Requirements of Automobile Body; Vehicle Frame, Separate Body & Frame, Unitized Body, Car Body Styles, Bus Body & Commercial Vehicle Body Types; Front Engine Rear Drive & Front Engine Front Drive Vehicles, Four Wheel Drive Vehicles, Safety considerations; Safety features of latest vehicle; Future trends in automobiles.

Clutches : Requirement of Clutches – Principle of Friction Clutch – Wet Type & Dry Types; Cone Clutch, Single Plate Clutch, Diaphragm Spring Clutch, Multi plate Clutch, Centrifugal Clutches, Electromagnetic Clutch, Over Running Clutch; Clutch Linkages.

UNIT-II

Power Transmission : Requirements of transmission system; General Arrangement of Power Transmission system; Object of the Gear Box; Different types of Gear Boxes; Sliding Mesh, Constant Mesh, Synchro- mesh Gear Boxes; Epi-cyclic Gear Box, Freewheel Unit. Overdrive unit-Principle of Overdrive, Advantage of Overdrive, Transaxle, Transfer cases.

Drive Lines, Universal Joint, Differential and Drive Axles: Effect of driving thrust and torque reactions; Hotchkiss Drive, Torque Tube Drive and radius Rods; Propeller Shaft, Universal Joints, Slip Joint; Constant Velocity Universal Joints; Front Wheel Drive; Principle, Function, Construction & Operation of Differential; Rear Axles, Types of load coming on Rear Axles, Full Floating, Three quarter Floating and Semi Floating Rear Axles.

UNIT-III

Suspension Systems : Need of Suspension System, Types of Suspension; factors influencing ride comfort, Suspension Spring; Constructional details and characteristics of leaf springs.

Steering System : Front Wheel geometry & Wheel alignment viz. Caster, Camber, King pin Inclination, Toe-in/Toe-out; Conditions for true rolling motions of Wheels during steering; Different types of Steering Gear Boxes; Steering linkages and layout; Power steering – Rack & Pinion Power Steering Gear, Electronics steering.

UNIT-IV

Automotive Brakes, Tyres & Wheels : Classification of Brakes; Principle and constructional details of Drum Brakes, Disc Brakes; Brake actuating systems; Mechanical, Hydraulic, Pneumatic Brakes; Factors affecting Brake performance, Power & Power Assisted Brakes; Tyres of Wheels; Types of Tyre & their constructional details, Wheel Balancing, Tyre Rotation; Types of Tyre wear & their causes.

Emission Control System & Automotive Electrical : Sources of Atmospheric Pollution from the automobile, Emission Control Systems – Construction and Operation of Positive Crank Case Ventilation (PVC) Systems, Evaporative Emission Control, Heated Air Intake System, Exhaust Gas Recirculation (ECR) Systems, Air Injection System and Catalytic Converters; Purpose construction & operation of lead acid Battery, Capacity Rating & Maintenance of Batteries; Purpose and Operation of Charging Systems, Purpose and Operations of the Starting System; Vehicle Lighting System.

Text and Reference Books:

- Automobile Engineering by Anil Chhikara, Satya Prakashan, New Delhi.
- Automobile Engineering by Dr. Kirpal Singh, standard Publishers Distributors.
- Automotive Mechanics – Crouse / Anglin, TMH.
- Automotive Technology – H.M. Sethi, TMH, New Delhi.
- Automotive Mechanics – S.Srinivasan, TMH, New Delhi.
- Automotive Mechanics – Joseph Heitner, EWP.
- Motor Automotive Technology by Anthony E. Schwaller – Delmer Publishers, Inc.
- The Motor Vehicle – Newton steeds Garrett, Butter Worths.

HEAT TRANSFER

General Course Information:

Course Code: ME-304-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are:

1. To understand the concept and basic laws of conduction (steady and transient), convection (free and forced) and radiation (thermal) heat transfer.
2. To analyze the phase change heat transfer.
3. To understand sizing of heat exchangers.

By the end of the course a student is expected to:

1. Appraise the conduction, convection and radiation mode of heat transfer through various applications.
2. Evaluate heat transfer for forced and free convection applications.
3. Calculate the parameters of heat exchangers, condensers and evaporator using LMTD and NTU Methods for various applications.
4. Explain the radiation heat transfer problems and apply principles of heat transfer to basic thermal engineering systems.

Course Contents

UNIT-I

Basics and Laws: Definition of Heat Transfer, Reversible and irreversible processes, Modes of heat flow, Combined heat transfer system and law of energy conservation.

Steady State Heat Conduction: Introduction, I-D heat conduction through a plane wall, long hollow cylinder, hollow sphere and Conduction equation in Cartesian, polar and spherical co-ordinate systems, Numericals.

UNIT-II

Steady State Conduction with Heat Generation: Introduction, 1 – D heat conduction with heat sources, Extended surfaces (fins), Fin effectiveness 2-D heat conduction, Numericals.

Transient Heat Conduction: Systems with negligible internal resistance, Transient heat conduction in plane walls, cylinders, spheres with convective boundary conditions, Chart solution, Relaxation Method, Numericals.

UNIT-III

Convection: Forced convection-Thermal and hydro-dynamic boundary layers, Equation of continuity, Momentum and energy equations, Some results for flow over a flat plate and flow through tube, Fluid

friction and heat transfer (Colburn analogy), Free convection from a vertical flat plate, Empirical relations for free convection from vertical and horizontal planes & cylinders, Numericals.

Thermal Radiation: The Stephen-Boltzmann law, The black body radiation, Shape factors and their relationships, Heat exchange between non black bodies, Electrical network for radiative exchange in an enclosure of two or three gray bodies, Radiation shields, Numericals.

Unit IV

Heat Exchangers: Classification, Performance variables, Analysis of a parallel/counter flow heat exchanger, Heat exchanger effectiveness, Numericals.

Heat Transfer with Change of Phase: Laminar film condensation on a vertical plate, Drop-wise condensation, Boiling regimes, Free convective, Nucleate and film boiling, Numericals.

Text and reference Books:

- Heat Transfer – J.P. Holman, John Wiley & Sons, New York.
- Fundamentals of Heat & Mass Transfer–Incropera, F.P. & Dewill, D.P –John Willey New York.
- Conduction of Heat in Solids – Carslow, H.S. and J.C. Jaeger – Oxford Univ. Press.
- Conduction Heat Transfer – Arpasi, V.S. – Addison – Wesley.
- Compact Heat Exchangers – W.M. Keys & A.L. Landon, Mc. Graw Hill.
- Thermal Radiation Heat Transfer – Cengel, R. and J.R. Howell, Mc. Graw Hill.
- Heat Transmission – W.M., Mc.Adams , Mc Graw Hill.

DYNAMICS OF MACHINES

General Course Information:

Course Code: ME-306-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:
1. Understand the function of flywheel and belt, rope and chain drives
2. Impart the knowledge on principles and operations of governors and gyroscope
3. Impart the knowledge of different types of brakes and dynamometers
4. Impart the knowledge of balancing of rotating and reciprocating parts

By the end of the course a student is expected to:
1. Understand importance of flywheel and belt, rope and chain drives
2. Analyze and design centrifugal governors. Understand the gyroscopic effects on ships, aero planes and road vehicles
3. Understand different types of brakes, dynamometers and their applications
4. Analyze balancing problems in rotating and reciprocating machinery.

Course Contents

UNIT-I

Flywheel: Turning Moment Diagrams, Fluctuation of Energy, Coefficient of Fluctuation of Energy and Speed, Application in Engines and Punching Presses, Problems

Belts, Ropes and Chain Drives: Types of Belt Drives, Velocity Ratio, Slip, Belt Length, Crowning of Pulleys, V-Belts, Condition for Transmission of Maximum Power, Centrifugal Tension, Chain Drive, Types of Chains, Merits and Demerits of Chain Drive over Belt Drive, Problems

UNIT-II

Governors: Governor, Types of Governors, Centrifugal Governors, Watt Governor, Porter Governor, Proell Governor, Hartnell Governor, Hartung Governor, Wilson- Hartnell Governor, Pickering Governor, Sensitiveness of Governors, Stability of Governors, Hunting of Governors, Effort and Power of a Governor, Problems

Gyroscope: Gyroscope, Gyroscopic Couple, Gyroscopic Stabilization of Aeroplane and Ship, Stability of Four Wheel and Two Wheel Vehicles Moving on Curved Path, Problems

UNIT-III

Brakes: Brake, Types of Brakes, Block or Shoe Brake, Band Brake, Differential Band Brake, Band and Block Brake, Internal Expanding Shoe Brake, Braking Effect in a Vehicle, Problems

Dynamometers: Dynamometer, Types of Dynamometers, Prony Brake Dynamometer, Rope Brake Dynamometer, Epicyclic Train Dynamometer, Belt Transmission Dynamometer, Torsion Dynamometer, Problems

UNIT-IV

Balancing of Rotating Parts: Static Balancing, Dynamic Balancing, Balancing of Rotating Masses, Balancing of Several Masses Rotating in Same Plane by Graphical Method, Balancing of Several Masses Rotating in Different Planes by Graphical Method, Problems

Balancing of Reciprocating Parts: Balancing of Reciprocating Masses, Partial Balancing of Locomotives, Effect of Partial Balancing of Reciprocating Parts of Two Cylinder Locomotives, Balancing of Multi Cylinder Inline Engines, Radial Engines and V- Engines, Problems

Text and Reference Books:

- KJ, Waldron and GL, Kinzel, Kinematics, Dynamics and Design of Machinery, Wiley Publishers, Edition, 2016.
- A, Ghosh and AK, Mallik, Theory of Mechanisms and Machines, East West Press Private Limited Publishers, Edition, 2017.
- JJ, Uicker (Jr), GR, Pennock and JE, Shigley, Theory of Machines and Mechanisms, Oxford Publishers, 2016.
- SS, Rattan, Theory of Machines, Tata McGraw Hill Publishers, Edition, 2017.

MACHINE DESIGN-II

General Course Information:

Course Code: ME-308-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 4 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To expose the students to the Design for Production and for variable loading.
2. To impart in depth knowledge of designing of shafts.
3. To impart knowledge of spring and design for different types of spring.
4. To design bearings, selection of bearings for different aspects & lubricants with their properties.
5. To impart in depth knowledge of gears, design of different types of gears with consideration of maximum power transmission and gear lubrication.

By the end of the course a student is expected to:

1. Identify Design for Production and for variable loading.
2. Understand designing of shafts.
3. Understand spring and design for different types of spring.
4. Understand designing of bearings, selection of bearings for different aspects & lubricants with their properties.
5. Understand the gears, design of different types of gears with consideration of maximum power transmission and gear lubrication.

Course Contents

UNIT-I

Design for Production; Ergonomic and value engineering considerations in design, Role of processing in design, Design considerations for casting, forging and machining. Variable Loading: Different types of fluctuating/ variable stresses, Fatigue strength considering stress concentration factor, surface factor, size factor, reliability factor etc., Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's Criterion, Fatigue design using Miner's equation, Problems.

Shafts: Detailed design of shafts for static and dynamic loading, Rigidity and deflection consideration.

UNIT-II

Springs: Types of Springs, Design for helical springs against tension and their uses, compression and fluctuating loads, Design of leaf springs, Surging phenomenon in springs, Design Problem.

UNIT-III

Bearings : design of pivot and collar bearing , Selection of ball and roller bearing based on static and dynamic load carrying capacity using load-life relationship, Selection of Bearings from manufacturer's catalogue, types of lubrication – Boundary, mixed and hydrodynamic lubrication, Design of journal bearings using Raimondi and Boyd's Charts, Lubricants and their properties, Selection of suitable lubricants, Design Problems.

UNIT-IV

Gears: Classification, Selection of gears, Terminology of gears, Force analysis, Selection of material for gears, Beam & wear strength of gear tooth, Form or Lewis factor for gear tooth, Dynamic load on gear teeth -Barth equation and Buckingham equation and their comparison, Design of spur, helical, bevel & worm gear including the Consideration for maximum power transmitting capacity, Gear Lubrication, Design Problems.

Text and Reference Books:

1. Mechanical Engg. Design- Joseph Edward Shigley-Mc Graw Hill Book Co.
2. Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.
3. Engineering design – George Dieter, McGraw Hill, New York.
4. Product Design and Manufacturing –: A.K.Chitale and R.C.Gupta, PHI, New Delhi.
5. Machine Design An Integrated Approach: Robert L.Norton,Second Edition – Addison Wisley Longman
6. Machine Design: S.G. Kulkarni , TMH , New Delhi

AUTOMOBILE ENGINEERING LAB

General Course Information:

Course Code: ME-302-P Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Expose the students to various automotive engine system and fuel supply system.
2. Impart the knowledge on various components with their operation of an automobile.
3. Impart the knowledge on Automotive Emission / Pollution control systems.
4. Impart the knowledge of modelling and designing of automotive system using educational software.

By the end of the course a student is expected to:

1. Understand the automotive engine system and fuel supply system.
2. Understand the construction, principle & working of various automobile components.
3. Understand the Automotive Emission / Pollution control systems.
4. Understand the designing and modelling of automotive system.

Course Contents

1. To study and prepare report on the constructional details, working principles and operation of the following Automotive Engine Systems & Sub Systems.
    a. Multi-cylinder: Diesel and Petrol Engines.
    b. Engine cooling & lubricating Systems.
    c. Engine starting Systems.
    d. Contact Point & Electronic Ignition Systems.
2. To study and prepare report on the constructional details, working principles and operation of the following Fuels supply systems:
    a. Carburetors
    b. Diesel Fuel Injection Systems
    c. Gasoline Fuel Injection Systems.
3. To study and prepare report on the constructional details, working principles and operation of the following Automotive Clutches.
    a. Coil-Spring Clutch
    b. Diaphragm – Spring Clutch.
    c. Double Disk Clutch.
4. To study and prepare report on the constructional details, working principles and operation of the following Automotive Transmission systems.
    a. Synchromesh – Four speed Range.
    b. Transaxle with Dual Speed Range.
    c. Four Wheel Drive and Transfer Case.
    d. Steering Column and Floor – Shift levers.
5. To study and prepare report on the constructional details, working principles and operation of the following Automotive Drive Lines & Differentials.
    a. Rear Wheel Drive Line.
    b. Front Wheel Drive Line.
    c. Differentials, Drive Axles and Four Wheel Drive Line.
6. To study and prepare report on the constructional details, working principles and operation of the following Automotive Suspension Systems.
    a. Front Suspension System.
    b. Rear Suspension System.

7. To study and prepare report on the constructional details, working principles and operation of the following Automotive Steering Systems.
    a. Manual Steering Systems, e.g. Pitman –arm steering, Rack & Pinion steering.
    b. Power steering Systems, e.g. Rack and Pinion Power Steering System.
    c. Steering Wheels and Columns e.g. Tilt & Telescopic steering Wheels, Collapsible Steering Columns.
8. To study and prepare report on the constructional details, working principles and operation of the following Automotive Tyres & wheels.
    a. Various Types of Bias & Radial Tyres.
    b. Various Types of wheels.
9. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.
    a. Hydraulic & Pneumatic Brake systems.
    b. Drum Brake System.
    c. Disk Brake System.
    d. Antilock Brake System.
    e. System Packing & Other Brakes.
10. To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.
11. Modeling of any two automotive systems on 3D CAD using educational softwares (eg. 3D modeling package/Pro Engineering/I-Deas/ Solid edge etc.)
12. Crash worthiness of the designed frame using Hypermesh and LS-Dyna solver or other software.

Note: At least eight experiments should be performed from the above list. The teacher can alter/add more experiments as per the requirements

HEAT TRANSFER LAB

General Course Information:

Course Code: ME-304-P Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are:

1. To understand the concept of conduction (steady), convection (free and forced) and radiation heat transfer.
2. To analyze the phase change heat transfer.
3. To know the parallel and counter-flow types heat exchangers.

By the end of the course a student is expected to:

1. Perform steady state conduction, free and forced convection experiments.
2. Conduct radiation heat transfer experiment.
3. Study the performance of various types of heat exchangers.

Course Contents

1. To determine the thermal conductivity of a metallic rod.
2. To determine the thermal conductivity of an insulating power.
3. To determine the thermal conductivity of a solid by the guarded hot plate method.
4. To find the effectiveness of a pin fin in a rectangular duct natural convective condition and plot temperature distribution along its length.
5. To find the effectiveness of a pin fin in a rectangular duct under forced convective and plot temperature distribution along its length.
6. To determine the surface heat transfer coefficient for a heated vertical tube under natural convection and plot the variation of local heat transfer coefficient along the length of the tube. Also compare the results with those of the correlation.
7. To determine average heat transfer coefficient for externally heated horizontal pipe under forced convection & plot Reynolds and Nusselt numbers along the length of pipe. Also compare the results with those of the correlations.
8. To measure the emmisivity of the gray body (plate) at different temperature and plot the variation of emmisivity with surface temperature.
9. To find overall heat transfer coefficient and effectiveness of a heat exchange under parallel and counter flow conditions. Also plot the temperature distribution in both the cases along the length of heat of heat exchanger.
10. To verify the Stefen-Boltzmann constant for thermal radiation.
11. To demonstrate the super thermal conducting heat pipe and compare its working with that of the best conductor i.e. copper pipe. Also plot temperature variation along the length with time or three pipes.
12. To study the two phases heat transfer unit.
13. To determine the water side overall heat transfer coefficient on a cross-flow heat exchanger.

Note: At least eight experiments should be performed from the above list. The teacher can alter/add more experiments as per the requirements

DYNAMICS OF MACHINE LAB

General Course Information:

Course Code: ME-306-P Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners

Course Objectives and Outcomes:

The objectives of this course are to:
1. Impart the knowledge of different types of governors
2. Familiarize with gyroscopic effect on two wheelers, four wheelers, ships and aircrafts
3. Expose students to the concept of dynamometers and their applications
4. Familiarize with static and dynamic balancing analysis as applied to machines

By the end of the course a student is expected to:
1. Understand sensitiveness and stability of different types of governors
2. Measure gyroscopic couple
3. Measure BHP using rope brake dynamometer
4. Understand static and dynamic balancing

Course Contents

1. To Perform Experiment on Watt Governor to Prepare Performance Characteristic Curves, and to Find Stability and Sensitivity.
2. To Perform Experiment on Porter Governorto Prepare Performance Characteristic Curves, and to Find Stability and Sensitivity.
3. To Perform Experiment on Proell Governor to Prepare Performance Characteristic Curves, and to Find Stability and Sensitivity.
4. To Perform Experiment on Hartnell Governor to Prepare Performance Characteristic Curves, and to Find Stability and Sensitivity.
5. To Study Gyroscopic Effects Through Models.
6. To Determine Gyroscopic Couple on Motorized Gyroscope.
7. To Perform the Experiment for Static Balancing on Static Balancing Machine.
8. To Perform the Experiment for Dynamic Balancing on Dynamic Balancing Machine.
9. Determine the Moment of Inertial of Connecting Rod by Compound Pendulum Method and Triflair Suspension Pendulum.
10. To Find BHP of an Engine by Using Rope Brake Dynamometer.

Note: At least eight experiments should be performed from the above list. The teacher can alter/add more experiments as per the requirements

TECHNICAL PRESENTATION

General Course Information:

Course Code: ME-310-P Course Credits: 0.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (Internal: 100):** This is a **non-credit course of qualifying nature**. Internal practical evaluation is to be done by the course coordinator.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Impart the technical knowledge of the current topics of Mechanical Engineering
2. Improves the presentation and communication skills
3. Overall improvement in their technical skills

By the end of the course a student is expected to:

1. Gain the knowledge in recent development in the field of Mechanical Engineering.
2. Learnt report writing and presentation skills
3. Develop technical skills along with overall development

Contents

The topic of the technical presentation will be related to the current research & development in the field of Mechanical Engineering. Each student is required to submit a report on the topic of seminar as per the guidelines decided by the department from time to time. During the semester, each student is required to give a presentation before the class and course coordinator.

Departmental Elective-I

Course Code	Course Name	L	T	P	Credits
ME-352-L	Operation Research	4	-	-	4.0
ME-354-L	Maintenance Engineering	4	-	-	4.0
ME-356-L	Total Quality Control	4	-	-	4.0
ME-358-L	Production Management	4	-	-	4.0

OPERATION RESEARCH

General Course Information:

Course Code: ME-352-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Pursue the study of OR to solve the problems of society and organization.
2. To be a leader for effective decision making.

By the end of the course a student is expected to:

1. Understand the concepts of Operations Research.
2. Study the principles of linear programming problems and for their applications.
3. Study the principles of transportation problems and assignment problems.
4. Formulate the OR models for various needs of the society and organization.
5. Solve the problems of society and organization using OR techniques.

Course Contents

UNIT-I

Introduction: Definition, role of operations research in decision-making, applications in industry. Concept on O.R. model building –Types & methods.

Linear Programming (LP): Programming definition, formulation, solution- graphical, simplex Gauss-Jordan reduction process in simplex methods, BIG-M methods computational, problems.

Unit II

Deterministic Model: Transportation model-balanced & unbalanced, north west rule, Vogel's Method, least cost or matrix minimal, Stepperg stone method, MODI methods, degeneracy, assignment, traveling salesman, problems.

Advanced Topic Of LP: Duality, PRIMAL-DUAL relations-its solution, shadow price, economic interpretation, dual-simplex, post-optimality & sensitivity analysis, problems.

Unit III

Waiting Line Models: Introduction, queue parameters, M/M/1 queue, performance of queuing systems, applications in industries, problems.

Project Line Models: Network diagram, event, activity, defects in network, PERT & CPM, float in network, variance and probability of completion time, project cost- direct, indirect, total, optimal project cost by crashing of network, resources leveling in project, problems.

Unit IV

Simulation: Introduction, design of simulation, models & experiments, model validation, process generation, time flow mechanism, Monte Carlo methods- its applications in industries, problems.

Decision Theory: Decision process, SIMON model types of decision making environment- certainty, risk, uncertainty, decision making with utilities, problems.

Text and Reference Books:

- Operation Research – Hira, D.S.
- Operation Research – TAHA, PHI, New Delhi.
- Principle of Operations Research – Ackoff, Churchaman, arnoff, Oxford IBH, Delhi.
- Operation Research- Gupta & Sharma, National Publishers, New Delhi.
- Quantitative Techniques- Vohra, TMH, New Delhi
- Principles of operation Research (with Applications to Managerial Decisions) by H.M.Wagher, Prentice Hall of India, New Delhi.
- Operation Research – Sharma, Gupta, Wiley Eastern, New Delhi.
- Operation Research – Philips, Revindran, Solgeberg, Wiley ISE.

MAINTENANCE ENGINEERING

General Course Information:

Course Code: ME-354-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Impart the knowledge on importance and objectives of maintenance.
2. To familiarize the students with preventive maintenance, condition based maintenance and reliability centered maintenance.
3. Expose the students to application of computers to maintenance management.

By the end of the course a student is expected to:

1. Understand the importance and objectives of maintenance.
2. Understand the difference between preventive maintenance, condition based maintenance and reliability centered maintenance.
3. Understand the uses and applications of computers to maintenance management.

Course Contents

UNIT-I

Introduction: Evolution of maintenance, objective of maintenance, maintenance policies and philosophies, maintenance concept maintenance management & terotechnology, relationship with other functional areas, importance of maintenance, elements of good maintenance, economics of maintenance, training and safety aspects in maintenance.

Maintenance Strategies: Classification of maintenance programs, corrective, preventive and predictive maintenance, comparison of maintenance programs, preventive maintenance- concept functions, benefits, limitations.

Unit II

Condition Based Maintenance (CBM): Objectives, what to monitor, when to monitor, principles of CBM, condition based maintenance techniques, manual inspections, performance monitoring, vibration monitoring, current monitoring, oil debris/spectroscopy, thermography and corrosion monitoring, steps in implementation of CBM, benefits of CBM.

Reliability Centred Maintenance (RCM): RCM logic, maintenance and RCM, benefits of RCM, total productive maintenance (TPM), introduction, key supporting elements of TPM, methodology, evaluation and benefits.

Unit III

Non-Destructive Testing (NDT): Purpose and challenges; Techniques, visual aidsboroscopes, endoscopes, fibre obtics scanners, magnetic particles inspection, liquid penetrants, eddy current, ultrasonic radiography, selection of NDT techniques, merits/demerits and applications of various techniques.

Maintenance Planning and Control: Basic ingredients, basic steps in maintenance management, maintenance planning and control system, documentation, maintenance productivity areas for improvement.

Unit IV

Reliability, Maintenance & Availability: Techniques for improvement of operational reliability, safety and availability of machines and production systems, maintainability criteria, checklist to assess the maintainability of a system, maintainability programs, objectives, key issues in availability improvement program, fault diagnosis

Application of Computers to maintenance management: Data processing systems for integrated maintenance, maintenance information and reporting systems.

Text and Reference Books:

- Maintenance planning and control - Higgin L.R. Mc Graw Hill Book Company
- Maintenance planning and control - Kelley Anthony, East-West Press Pvt. Ltd.,
- Maintainability principle and practices – Blanchard B.S., Lowey E.E., Mc Graw Hill.
- Practical NDT – Raj B., Jayakumar T., Thavasimutyi K., Narora Publishing House.
- Engineering maintenance management – Niebel Benjamin W., Marcel Dekher.

TOTAL QUALITY CONTROL

General Course Information:

Course Code: ME-356-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:
1. Understand the philosophy and core values of Total Quality Control (TQC)
2. Determine the voice of the customer and the impact of quality on economic performance and long-term business success of an organization;
3. Apply and evaluate best practices for the attainment of total quality.

By the end of the course a student is expected to:
1. learn about the statistical control in production.
2. Use control charts for monitoring process.
3. Select and apply appropriate techniques in identifying customer needs, as well as the quality impact that will be used as inputs in TQC methodologies;
4. Understand different quality standards

Course Contents

UNIT-I

Quality Control: Introduction, objectives, quality of design, quality of production, quality of conformance to design, quality of inspection, process monitoring, quality and productivity, quality cost. Advantages of Statistical Quality Control in Industry.

Fundamentals of Statistics and Probability in Quality Control: Events and probability, laws of probability. Statistical Distributions: Normal, Binomial and Poisson distribution, their importance in SQC. Poisson Probability as approximation to Normal Probability, use of Normal and Poisson distribution tables.

Unit II

Control Charts for Variables: Fundamentals of process control, tools of process control, quality characteristic, Design and use of Control Charts for Variables: Trial control limits, control limits for future use, revision of control limits. Cause and effect diagram, inferences on the state of the process from control charts, Type I and Type II errors and methods to reduce them. Use of X (X bar) charts and R- charts, X (X bar) and σ- charts. Efficiency of a control chart. OC curve of a control chart. Computing average run length for X- chart.

Trend Control Charts: Control Charts with Reject Limits and Modified Control Charts. Relationship between Specification Limits and Control Chart Limits, Process capability analysis and its importance in quality of conformance.

Unit III

Control Charts for Attributes: Defects and Defectives, control charts for fraction defectives and percent fraction defectives and number of defectives. Control charts for number of defects. Comparison of control charts for variables with the charts for attributes. Computing Average run length for a p-chart.

Product Control and its Tools: Fundamentals of lot-by-lot acceptance sampling by attributes: Notations, OC curve and its importance in acceptance sampling, AQL and LTPD for a sampling plan, Producer and consumer risks, Single and Double sampling plans and constructing OC curves, interpretation of the operating characteristics curve, Effect of change of sample size and acceptance number on OC curve, ATI, ASN, AOQ and AOQL concepts, economics of inspection. Item- by- item sequential sampling plans, OC curve and ASN curve for sequential sampling plan.

Unit IV

Standard Sampling Plans: Types of Standard Sampling Plans, Difference between Acceptance Rectification and Acceptance- Rejection Plans, single and double sampling plans based on AOQL and LTPD. Sampling plans based on Mil-Standards 105 E.

Motivation for quality assurance, zero defect program, quality circles, total quality management. Indian Standards on Process and Product Control. ISO-9000 Standards.

Text and Reference Books:

- Quality control Application – By Hansen BL, Ghare PH; Prentice Hall of India.
- Statistical Quality Control - By E.L. Grant & R.S. Levenworth; T MH.
- Quality Control – Paranthaman, D.; Tata McGraw Hill, India
- Quality Planning and Analysis – Juran J.M. and F.M. Gryna, TMH, India
- Total Quality Control – By Feigenbaum, A.V.; McGraw Hill International.
- Statistical Quality Control – By Montgomery, D.C.; John Wiley & Sons (Asia)

PRODUCTION MANAGEMENT

General Course Information:

Course Code: ME-358-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To provide basic understanding for the analysis and management of production
2. To understand the relationship between Production management and Quality control.
3. To understand the role of material management, JIT, Forecasting etc. in Production management.
4. To provide knowledge of material handling and its effective utilization.

By the end of the course a student is expected to:

1. Learn the concepts of various tools of Production management.
2. Gain the knowledge about material management.
3. Understand the role of Production planning & control in Production management
4. Implement the Just in time technique in Production management.

Course Contents

UNIT-I

Introduction to Production Management:- Introduction ,History of Production Management, Definitions of Production Management, Objevtives of Production Management, Scope of Production Management.

Forecasting:- Purpose of sale forecasting, Importance of forecasting, Forecasting and Product life cycle, Forecasting methods, Qualitative and Quantitative techniques of forecasting.

UNIT-II

Material handling:- Objectives and Principles of material handling, Relation between plant layout and material handling, Material handling equipments and their effective utilasation.

Material Management:- Material planning and control, Purchasing methods, Purchasing procedure, inventory control, stores management and coding, inventory control, Material requirement planning (MRP).

UNIT-III

Production planning and control:- Objectives and need for Production planning and control, Operations scheduling, Aggregate planning, Master production schedule (MPS).

Quality control:- Quality and inspection, Seven tools for Quality control, Control charts, Acceptance sampling, Quality circles.

UNIT-IV

Man power and facilities planning:- Man power requirement and planning, Plant Heuristics, Facilities requirement and planning, Role of advanced process planning.

Just in Time (JIT):- Introduction and characteristics of JIT, Benefits of JIT, Implementation of JIT, Processes to eliminate waste, JIT inventory.

Text and Reference Books:

- S.Anil Kumar & N.Suresh, "Production and operations Management", New Age International.
- Buffa & Sarin, "Modern Production Management", John Wiley Publication
- M.Mahajan., "Statistical Quality Control", Dhanpat Rai Publication.

VII- Semester

Subject Area	Subject Code	Subject Name	Contact Hours			Credits
			Lecture	Tutorial	Practical	
OE-3		Open Elective –III #	4	-	-	4.0
PE-2		Programme Elective –II	4	-	-	4.0
PC-18	ME-401-L	Computer Aided Design and Manufacturing	3	1	-	3.5
PC-19	ME-403-L	Mechanical Vibrations	3	1	-	3.5
PC-20	ME-405-L	Refrigeration and Air-conditioning	3	1	-	3.5
PC-18	ME-401-P	Computer Aided Design and Manufacturing Lab	-	-	2	1.0
PC-19	ME-403-P	Mechanical Vibrations Lab	-	-	2	1.0
PC-20	ME-405-P	Refrigeration and Air-conditioning Lab	-	-	2	1.0
PS-2	ME-407-P	Minor Project	-	-	5	2.5
PS-3	ME-409-P	Industrial Training Presentation-II	-	-	2	1.0
			17	3	13	25.0
			33			
MC-6	ME-411-P	General Proficiency*	-	-	2	2units
		Total	**35**			**25.0**

#The students have to choose an Open elective subject offered by other Departments of Engineering

Programme Elective -II

Course Code	Course Name	L	T	P	Credits
ME-451-L	Automation in Manufacturing	4	-	-	4.0
ME-453-L	Advanced Welding	4	-	-	4.0
ME-455-L	Tool Engineering	4	-	-	4.0
ME-457-L	Modern Manufacturing Methods	4	-	-	4.0

***Non-Credit**

VIII Semester

Subject Area	Course Code	Course Name	L	T	P	Credits
PE-3	ME- -L	Programme Elective-III	4	-	-	4.0
PE-4	ME- -L	Programme Elective-IV	4	-	-	4.0
PE-5	ME- -L	Programme Elective-V	4	-	-	4.0
PE-6	ME- -L	Programme Elective-VI	4	-	-	4.0
PS-4	ME-402-P	Seminar	-	-	4	2.0
PS-5	ME-404-P	Major Project	-	-	14	7.0
		Total	16	-	18	25.0
			34			**25**

OR

Subject Area	Course Code	Course Name	L	T	P	Credits
PS-6	ME-406-P**	Full semester Industrial Training	-	-	-	25.0

**The student will be required to submit to the department, the offer letter for the full semester industrial training at-least 15 days before the commencement of 8th semester. The options shall be according to the following conditions:

A student may opt for one semester industrial training in lieu of attending the courses of 8th semester. The credits/marks for industrial training will be equal to the total credits/marks of courses offered in the 8th semester study. A student will be allowed to join the industrial training if student is selected for, the job through campus placements during 7th semester and the employer is willing to take the students for the training for a period of full semester.

Programme Elective -III

Course Code	Course Name	L	T	P	Credits
ME-452-L	Introduction to Tribology	4	-	-	4.0
ME-454-L	Computer Numerical Control Machine Tools	4	-	-	4.0
ME-456-L	Reverse Engineering	4	-	-	4.0
ME-458-L	Product Design and Development	4	-	-	4.0

Programme Elective -IV

Course Code	Course Name	L	T	P	Credits
ME-462-L	Robotics	4	-	-	4.0
ME-464-L	Mechatronics	4	-	-	4.0
ME-466-L	Automatic Control	4	-	-	4.0
ME-468-L	Flexible Manufacturing Systems	4	-	-	4.0

Programme Elective -V

Course Code	Course Name	L	T	P	Credits
ME-472-L	Power Plant Engineering	4	-	-	4.0
ME-474-L	Non-conventional energy	4	-	-	4.0
ME-476-L	Design of Heat Exchangers	4	-	-	4.0
ME-478-L	Turbo Machinery	4	-	-	4.0

Programme Elective -VI

Course Code	Course Name	L	T	P	Credits
ME-482-L	Computational Fluid Dynamics	4	-	-	4.0
ME-484-L	Ergonomics Engineering	4	-	-	4.0
ME-486-L	Rapid Prototyping	4	-	-	4.0
ME-488-L	Computer Integrated Manufacturing	4	-	-	4.0

List of Open Elective offered by Mechanical Engineering Department to other Engineering Departments

Subject Area	Course Code	Course Name	L	T	P	Credits
V Semester						
OE-1	OE-ME-391-L	Industrial Engineering	4	-	-	4.0
VI Semester						
OE-2	OE-ME-392-L	Material Science	4	-	-	4.0
VII Semester						
OE-3	OE-ME-491-L	Computer Aided Design and Manufacturing	4	-	-	4.0

COMPUTER AIDED DESIGN AND MANUFACTURING

General Course Information:

Course Code: ME-401-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Provide the basic overview of CAD/CAM and 3D modeling approaches.
2. Provide an understanding about the types of geometric transformation and mathematical representation of curves.
3. Impart knowledge of mathematical representations of surfaces and solids.
4. Expose the students about computer assisted part programming for CNC machines.

By the end of the course a student is expected to:

1. Understand the scope and applications of CAD/CAM and geometric modeling techniques.
2. Understand the basic overview of geometric transformations and curves.
3. Understand the representation schemes of the surfaces and solids.
4. Understand the part programming and able to generate CNC part programmes.

Course Contents

UNIT-I

Introduction to CAD/CAM: Historical developments, product life cycle, CAD/CAM systems, scope of CAD/CAM, CAD/CAM applications, 3D modeling approaches, types of geometric modeling, coordinate systems, sketching and sketch planes, basic features of a CAD/CAM system (extrusion, revolution, hole, cut, sweep, loft, fillet, chamfer, rib, shell, draft, patterns spiral and helix), feature based modeling, parametric modeling, datum features, geometric constraints, modeling operations, heterogeneous modeling, modeling strategies, master model, system modes, model viewing .

UNIT-II

Transformations: Introduction, transformation of points and line, 2-D translation, rotation, reflection, scaling, homogeneous representation, concatenated transformation, mapping of geometric models, 3-D scaling, shearing, rotation, reflection and translation, combined transformations, orthographic, Isometric and perspective projections.

Curves: Algebraic and geometric forms, tangents and normal, blending functions re-parameterization, straight lines, conics, cubic Splines, Bezier curves and B-Spline curves.

UNIT-III

Surfaces: Algebraic and geometric forms, tangents and normal, blending functions, re-parameterization, sixteen point form, four curve form, plane surface, ruled surface, surface of revolution, tabulated cylinder, bi-cubic surface, Bezier surface, B-Spline surface, surface manipulations.

Solids: Geometry and topology, Solid models and representation schemes, boundary representation, constructive solid geometry, sweep representation, cell decomposition, spatial occupancy enumeration, solid manipulators.

UNIT-IV

CNC Technology: Introduction, types of NC systems, NC machine tools, principle of operation of CNC, advantages and limitations of CNC systems, Direct numerical control (DNC) and its application, MCU and other components.

Part Programming: Integrating CAD, NC and CAM, preparing CAD data for NC system, NC part programming, coordinate systems, NC programming languages, G & M codes, Part program for simple parts, CNC part programming, axes of CNC machines, computer aided part programming using APT, Automatic NC program generation from CAD models.

Text and Reference Books:

1. Zeid, I., "CAD/CAM", McGraw Hill, 2008.
2. Groover and Zimmer, "CAD/ CAM", Prantice Hall.
3. Rogers, D. F. and Adams, J. A., "Mathematical Elements for Computer Graphics", McGraw Hill.
4. Radhakrishnan, P. and Kothandaraman, C. P., "Computer Graphics & Design", Dhanpat Rai Publication", 2nd edition, 2005.
5. Krishnamoorathy, C. S. and Rajeev, J. S., "Computer Aided Design (Software and Analysis Tools)", Narosa Publication House, 2nd edition, 2005.
6. Kundra T. K., Rao P. N. and Tiwari N. K, "Numerical Control and Computer Aided Manufacturing", McGraw Hill.

MECHANICAL VIBRATIONS

General Course Information:

Course Code: ME-403-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To understand the fundamentals of mechanical vibrations and principles for single degree of freedom system with applications.
2. To introduce the fundamentals of forced mechanical vibrations with applications.
3. To understand the fundamentals of mechanical vibration for two degree of freedom system and continuous systems.
4. To understand various methods and solutions of multiple degree of freedom systems.

By the end of the course a student is expected to:

1. Understand the principles of mechanical vibration for the single degree of freedom systems with applications.
2. Able to understand harmonically excited vibration with applications.
3. Understand the fundamentals of two degree of freedom systems and their applications
4. Understand the multi degree of freedom systems of all types with their exact and approximate solutions along with their applications

Course Contents

UNIT-I

Free and Damped Vibrations : Importance of Study of Vibrations, Classifications of Vibrations, Free and Forced, Undamped and Damped, Linear and Non-linear, Deterministic and Random, Harmonic Motion, Vector and Complex Number Representations, Definitions and Terminology, Periodic Functions, Harmonic Analysis, Fourier Series Expansion. Single Degree of Freedom system, D'Alemberts Principle, Energy Methods, Rayleighs Method, Application of these Methods, Damped Free Vibrations, Logarithmic Decrement, Under Damping, Critical and Over Damping, Coulomb Damping.

.

UNIT-II

Harmonically Excited Vibrations : Forced Damped Harmonic Vibration of Single Degree of Freedom Systems, Rotating Unbalance, Rotor Unbalance, Critical Speeds and Whirling of Rotating Shafts, Support Motion, Vibration Isolation, Energy Dissipated by Damping, Equivalent, Viscous Camping, Structural Damping Sharpness of Resonance, Vibration Measuring Instruments.

UNIT-III

Two Degrees of Freedom Systems : Introduction to Multi-Degree of Freedom Systems,Normal Mode Vibrations, Coordinate Coupling, Principal Coordinates, Free Vibrations in Terms of Initial Conditions, Forced Harmonic Vibrations, Vibration Absorber, Centrifugal Vibration Absorber, Vibration Damper. Normal Mode Vibration of Continuous System**:** Vibrating String, Longitudinal Vibrations of Rod, Torsional Vibrations of Rod, and Lateral Vibrations of Beam.

UNIT-IV

Multi degrees of Freedom Systems and Numerical Methods: Introduction, Influence Coefficients, Stiffness Matrix, Flexibility Matrix, Natural Frequencies and Normal Modes, Orthogonality of Normal Modes, Dunkerley's Equation, Method of Matrix Iteration, The Holzer Type Problem, Geared and Branched Systems, Beams.

Text and Reference Books:

1. Mechanical vibrations: J.S. Mehta & A.S. Kailey, S.Chand.
2. Mechanical vibrations: V.P. Singh, Dhanpat Rai & Co.
3. Theory of Vibrations with Applications W.T. Thomson, Prentice Hall of India.
4. Mechanical Vibration: G.K. Grover and S.P. Nigam, Nem Chand and Sons.
5. Theory and Practice of Mechanical Vibrations J.S. Rao and K. Gupta, Wiley Eastern Ltd.
6. Mechanical Vibrations S.S. Rao, Addison – Wesely Publishing Company

REFRIGERATION AND AIR-CONDITIONING

General Course Information:

Course Code: ME-405-L Course Credits: 3.5 Contact Hours: 3 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Familiarize with the terminology associated with refrigeration systems and air conditioning
2. Understand basic refrigeration systems and identify methods for performance improvement.
3. To understand the basics of psychrometry and practice of applied psychrometrics
4. To evaluate cooling and heating loads in an air-conditioning system.

By the end of the course a student is expected to:

1. To apply the principles and applications of refrigeration systems
2. Analyse vapour compression and other refrigeration system and identify methods for performance improvement.
3. Understand the air-conditioning processes using the principles of psychrometry.
4. Understand the main components, accessories and controls of refrigeration and air-conditioning systems.

Course Contents

Unit I

Introduction: Definition of refrigeration & air conditioning; Necessity; Methods of refrigeration; Unit of refrigeration; Coefficient of performance (COP), Fundamentals of air-conditioning system; Refrigerants-Definition, Classification, Nomenclature, Desirable properties, Comparative study, secondary refrigerants, Introduction to eco-friendly Refrigerants; Introduction to Cryogenics.

Air Refrigeration System: Carnot refrigeration cycle. Temperature. Limitations; Brayton refrigeration or the Bell Coleman air refrigeration cycle; Necessity of cooling the aero plane; Air craft refrigeration systems, Simple cooling and Simple evaporative types, Boot strap and Boot strap evaporative types, Regenerative type and Reduced Ambient type system, Comparison of different systems, problems.

Unit II

Vapour Compression (VC) Refrigeration Systems:(A) Simple Vapour Compression (VC) Refrigeration Systems-Limitations of Reversed Carnot cycle with vapour as the refrigerant; Analysis of VC cycle considering degrees of sub cooling and superheating; VC cycle on p-v, t-s and p-h diagrams; Effects of operating conditions on COP; Comparison of VC cycle with Air Refrigeration cycle.

(B) Multistage Ref. Systems- Necessity of compound compression, Compound VC cycle , Inter-cooling with liquid sub –cooling and / or water inter cooler: Multistage compression with flash inter-cooling and / or water inter-cooling; systems with individual or multiple expansion valves; Individual compression

system with individual or multiple expansion valves; Individual compression systems with individual or multiple expansion valves but with and without intercoolers.

Other Refrigeration Systems:(A) Vapour Absorption Refrigeration Systems – Basic Systems, Actual COP of the System, Performance, Relative merits and demerits; Properties of aqua ammonia; Electrolux Refrigeration; Problems.
(B) Steam Jet Refrigerating System- Introduction, Analysis, Relative merits and demerits, Performance Applications, Problems.
(C) Cascade Refrigerating Systems-Necessity Selection of Pairs of refrigerants for the system, Concept of cascade temperature, Analysis, Multistaging, Comparison with V.C. systems, Applications, Problems.

Unit III

Psychrometry of Air & Air Conditioning Processes: Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temp., Thermodynamics wet bulb temp., Psychrometric chart; Psychrometry of air-conditioning processes, Mixing Process, Basic processes in conditioning of air; Psychrometric processes in air washer, Problems.

Air- Conditioning Load Calculations: Outside and inside design conditions; Sources of heating load; Sources of cooling load; Heat transfer through structure, Solar radiation, Electrical applications, Infiltration and ventilation, Heat generation inside conditioned space; Apparatus selection; Comfort chart, Problems.

Unit IV

Air Conditioning Systems with Controls & Accessories: Classifications, Layout of plants; Equipment selection; Air distribution system; Duct systems Design; Filters; Refrigerant piping; Design of summer air-conditioning and Winter air conditioning systems; Temperature sensors, Pressure sensors, Humidity sensors, Actuators, Safety controls; Accessories; Problems.

Refrigeration and Air Conditioning Equipments: Type of compressors and their performance curves; Types of Condensers, Heat transfer in condensers; Types of expansion devices; types of evaporators, Cooling and Dehumidifying coils, Problems.

Text and Reference Books:

- Refrigeration & Air conditioning –R.C. Jordan and G.B. Priester, Prentice Hall of India.
- Refrigeration & Air conditioning –C.P. Arora, TMH, New Delhi.
- A course in Refrigeration & Air Conditioning – Arora & Domkundwar, Dhanpat Rai & Sons.
- Refrigeration & Air conditioning –W.F. Stocker and J.W. Jones, TMH, New Delhi.
- Refrigeration & Air conditioning- Manohar Prasad Wiley Estern limited, New Delhi.

COMPUTER AIDED DESIGN AND MANUFACTURING LAB

General Course Information:

Course Code: ME-401-P Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Impart knowledge on using CAD softwares.
2. Impart knowledge of CAM softwares.
3. Explain the working of CNC machines.

By the end of the course a student is expected to:

1. Prepare the component drawings using CAD softwares.
2. Make part programs by using CAM softwares.
3. Machine the industrial parts on CNC machines.

Lab Contents

1. To prepare part drawing on CAD softwares (Auotcad, Draftsight etc.)
2. To perform parametric modelling on CAD softwares (Creo/Solid Works/Catia/Inventor etc.).
3. To understand CNC codes and their syntax in respect of CNC Turning Center, CNC Machining Center, and CNC Wire Cut EDM.
4. To perform component identification and work setting of CNC Turning Center.
5. To perform component identification and work setting of CNC Machining Center.
6. To perform component identification and work setting of CNC Wire Cut EDM.
7. To prepare part program for CNC Turning center using CAM software (Cam Concept, Fusion 360, Master Cam etc.)
8. To prepare part program for CNC Machining center using CAM software (Cam Concept, Fusion 360, Master Cam etc.)
9. To prepare part program for CNC Wire Cut EDM using CAM software (Elcam etc.)
10. To machine an industrial part using CNC Turning Center.
11. To machine an industrial part using CNC Machining Center.
12. To machine an industrial part using CNC Wire Cut EDM.

Note: At least eight experiments should be performed from the above list. The teacher can alter/add more experiments as per the requirements

MECHANICAL VIBRATIONS LAB

General Course Information:

Course Code: ME-403-P Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are :

1. To understand the principles of damped and undamped free vibration systems.
2. To understand the torsional vibrations and its analysis for single and two degree freedom systems.
3. To understand the effect of free and force vibration on spring mass system.

By the end of the course a student is expected to:

1. Understand the principles of mechanical vibration for the single degree of freedom systems.
2. Understand the torsional vibrations for single and two rotor systems and able to evaluate the natural frequencies experimentally.
3. Able to understand harmonically excited vibrations and its analysis.

Course Contents

1. To verify the relation of simple pendulum.
2. To determine the radius of gyration 'k' of a given compound pendulum.
3. To determine the radius of gyration of a given bar by using bi-filar suspension.
4. To determine the radius of gyration of trifilar suspension.
5. To study the torsional vibration of single rotor system.
6. To study the free vibration of two rotor system and to determine the natural frequency of vibration theoretically and experimentally.
7. To study the damped torsional oscilation & to determine the damping coefficient.
8. To verify the Dunkerly's rule viz .
9. To study the undammed free vibration of equivalent spring mass system.
10. To study the forced damped vibration of equivalent spring mass system.
11. To study the forced vibration of the beam for different damping.

Note: At least eight experiments should be performed from the above list. The teacher can alter/add more experiments as per the requirements

REFRIGERATION AND AIR-CONDITIONING LAB

General Course Information:

Course Code: ME-405-P Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To teach students how to apply the knowledge of refrigeration and air conditioning principles to conduct experiments.
2. To help the students to know different types of refrigeration systems.
3. Give knowledge of various components of refrigeration and air-conditioning equipments

By the end of the course a student is expected to:

1. Conduct the experiments on refrigeration and air conditioning
2. Analyze the performance of VCR systems and vapour absorption system.
3. Know about the components of the Refrigeration and air-conditioning systems..

Course Contents

1. To study the vapour compression Refrigeration System and determine its C.O.P. and draw P-h and T-S diagrams.
2. To Study the Mechanical heat pump and find its C.O.P.
3. To study the Air and Water heat pump and find its C.O.P.
4. To study the cut- sectional models of Reciprocating and Rotary Refrigerant compressor.
5. To study the various controls used in Refrigerating & Air Conditioning systems.
6. To study the Ice- plant, its working cycle and determine its C.O.P and capacity.
7. To study the humidification, heating, cooling and dehumidification processes and plot them on Psychrometric charts.
8. To determine the By-pass factor of Heating & Cooling coils and plot them on Psychrometric charts on different inlet conditions.
9. To determine sensible heat factor of Air on re-circulated air-conditioning set up.
10. To study the chilling plant and its working cycle.

Note: At least eight experiments should be performed from the above list. The teacher can alter/add more experiments as per the requirements

MINOR PROJECT

General Course Information:

Course Code: ME-407-P Course Credits: 2.5 Mode: Practical Contact Hours: 05 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Provide more weightage for project work
2. Enable the students to identify a problem in mechanical engineering field using literature survey/ industry survey.
3. Generate innovative ideas for the solution of identified problems or improvement in the existing system of mechanical engineering field.
4. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

By the end of the course a student is expected to:

1. Analyze and identify the problems in the mechanical systems.
2. Select and apply proper modern tools.
3. Find solution for problems.
4. Make use of the benefits of team work.

LAB CONTENT

Project involving design/ fabrication/ testing computer simulation/ case studies etc. which is commenced in VIIth Semester, will be completed in VIIIth Semester. The student will be required to submit his ideas/objectives in the form of a synopsis to project coordinator and to project guide. Group of 5-6 students choose a project guide and works on the development of any new ideas in the field of Mechanical Engineering

Note:

- ***The design work should also be practiced through latest tools such as ANSYS, solid modeling CAD packages (e.g. AutoCAD, Solidworks, Pro-E, CATIA etc.)***

INDUSTRIAL TRAINING PRESENTATION-II

General Course Information:

Course Code: ME-409-P Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal:100)** Internal continuous assessment of 100 marks on the basis of report writing, presentation and viva voce in practical classes by the team of panel of faculty members.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To expose students to the 'real' working environment and get acquainted with the organization structure, business operations and administrative functions.
2. To have hands-on experience in the students' related field so that they can relate and reinforce what has been taught at the university.
3. To promote cooperation and to develop synergetic collaboration between industry and the university in promoting a knowledgeable society.
4. To set the stage for future recruitment by potential employers.

By the end of the course a student is expected to:

1. Generate a report based on the experiences with the ability to apply knowledge of Engineering fundamentals
2. Demonstrate competency in relevant engineering fields through problem identification, formulation and solution
3. Develop the ability to work as an individual and in group with the capacity to be a leader as well as an effective team member.
4. Master the professional and ethical responsibilities of an engineer.

Course Contents

As a part of the B.Tech Mechanical Engg. Curriculum Industrial Training-II is a Practical course, which the students of Mechanical Engineering should undergo in reputed Private / Public Sector / Government organization / companies as industrial training of six weeks to be undergone by the student in the summer vacation of the VI semester.

GENERAL PROFICIENCY

General Course Information:

Course Code: ME-411-P Course Credits: 0.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal: 100):** This is a **non-credit course of qualifying nature**. Internal practical evaluation is to be done by the course coordinator.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Emphasize on extra-curricular activities along with academics.
2. Overall development of the students
3. Tackle the problems in work culture.

By the end of the course a student is expected to:

1. Improves presentation and communication skills
2. Improves the confidence while facing Interviews and group discussion
3. Learn importance of social activities
4. Learn to work in groups as in job environment

At the end of semester students will be evaluated on the basis of their performance in various fields. The evaluation will be made by the course coordinator. A specimen perform indicating the weight age to each component/ activity is given below :-

Name : _____
Roll No. _____
Branch _____
Year of Admission _____

I. Academic Performance (15 Marks) :

(a) Performance in University Examination :-

Sem.	Result (%age of marks obtained)	Number of Attempt in which the Sem. exam. has been cleared
I		
II		
III		
IV		
V		
VI		
VII		

II. Extra Curricular Activities (10 Marks) :

Item	Level of Participation	Remarks (Position Obtained)
Indoor Games	_____	_____
(Specify the	_____	_____
Games	_____	

Outdoor Games (Specify the Games) _____ _____
_____ _____
_____ _____

Essay Competition _____
_____
_____

Scientific Technical Exhibitions _____
_____
_____

Debate _____
_____
_____

Drama _____
_____
_____

Dance _____
_____
_____

Music _____
_____
_____

Fine Arts _____
_____
_____

Painting _____
_____
_____

Hobby Club _____
_____
_____

N.S.S. _____
_____
_____

Hostel Management Activities _____
_____
_____

Any other activity (Please Specify) _____
_____
_____

III. Educational tours/visits/Membership of Professional Societies (5 Marks)

1. _____
2. _____
3. _____
4. _____
5. _____

IV. Contribution in NSS Social Welfare Floor Relief/draught relief/Adult Literacy mission/Literacy Mission/Blood Donation/Any other Social Service
(5 Marks)

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

V. Briefly evaluate your academic & other performance & achievements in the Institution (5 Marks)

_____
_____
_____
_____

VI. Performance in Viva voce before the committee (10 Marks)

_____
_____
_____
_____
_____

*Marks obtained 1.( )+II( )+III( )+IV( )+V( )+VI( ) =

**Total Marks :

Departmental Elective -II

Course Code	Course Name	L	T	P	Credits
ME-451-L	Automation in Manufacturing	4	-	-	4.0
ME-453-L	Advanced Welding	4	-	-	4.0
ME-455-L	Tool Engineering	4	-	-	4.0
ME-457-L	Modern Manufacturing Methods	4	-	-	4.0

AUTOMATION IN MANUFACTURING

General Course Information:

Course Code: ME-451-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Describe the basic concepts of automation in manufacturing systems.
2. Acquire the fundamental concepts of automated flow lines and their analysis.
3. Classify automated material handling, automated storage and retrieval systems.

By the end of the course a student is expected to:

1. Understand the concepts of automation theory and its applications in various fields of manufacturing.
2. Understand principles, methods, and hardware/software tools used in Hydraulics/Pneumatics Electro-pneumatic controls and devices.
3. Understanding the principles of Rapid Prototyping, classifications of different RP techniques along with their applications.
4. Understanding the concepts of Automatic transfer machines with assembly automation.

Course Contents

UNIT-I

Introduction to Factory Automation and Integration: Basic Concepts, Types of automation, Automation. Modern developments in automation in manufacturing and its effect on global competitiveness, Need and implications of automation in Manufacturing.

UNIT-II

Introduction to Hydraulics/Pneumatics Electro-pneumatic controls and devices, Basic elements hydraulics/pneumatics, Electro-pneumatic systems, Fluid power control elements and standard graphical symbols for them, Construction and performance of fluid power generators, Hydraulic & pneumatic cylinders - construction, design and mounting, Hydraulic & pneumatic valves for pressure, Flow & direction control, Servo valves and simple servo systems with mechanical feedback, Solenoid, Different sensors for electro-pneumatic system, hydraulic, pneumatic & electro-pneumatic circuits.

UNIT-III

Introduction to rapid prototyping (RP), Basic Principles of RP, Steps Classifications of Different RP Techniques. Materials for RP: Plastics, Ceramics, Resins, Metals, Selection criterions processes, the advantages and limitations of different types of materials.

UNIT-IV

Automatic transfer machines: Classifications, Analysis of automated transfer lines, without and with buffer storage, Group technology and flexible manufacturing system.

Assembly automation: Types of assembly systems, Assembly line balancing, Performance and economics of assembly system.

Text and Reference Books:

- Groover, M. P., "Automation, Production systems and Computer Integrated Manufacturing", 2nd Ed., Prentice Hall, 2005.
- Boothroyd, G., "Assembly Automation and Product Design", 2nd Ed., Marcel Dekker, 1992.
- Boothroyd, G., Dewhurst, P. and Knight, W., "Product Design for Manufacture and Assembly", 2nd Ed., Taylor & Francis, 2002.
- Boothroyd, G., Poli, C. and Murch, L. E., "Automatic Assembly", Marcel Dekker, 1982.
- Tergan, V., Andreev, I. and Lieberman, B., "Fundamentals of Industrial Automation", Mir Publishers,

ADVANCED WELDING

General Course Information:

Course Code: ME-453-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

About the Course and its Objectives & Outcomes:

The objectives of this course are to:

1. To expose the students to the welding with its mechanism.
2. To impart in depth knowledge of welding processes.
3. To impart knowledge of allied welding processes and after effects of welding.
4. To impart in depth knowledge welding defects and their maintenance.

By the end of the course a student is expected to:

1. Understand welding with its mechanism.
2. Understand welding processes.
3. Understand allied welding processes and after effects of welding.
4. Understand welding defects and their maintenance.

Course Contents

UNIT-I

Introduction- Classification of welding processes, physics of welding arc, arc stability, arc blow, polarity, welding symbols, safety and hazards in welding. Metal Transfer: Mechanism and types of metal transfer in various arc welding processes. Welding consumables: Classification and selection of welding electrodes and filler rods, welding fluxes, characteristics and manufacturing of the welding fluxes, characteristics of different shielding gases.

UNIT-II

Welding processes: Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electrogas and Electroslag, Flux Cored Arc Welding, Resistance welding, Friction welding, Brazing, Soldering and Braze welding processes, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding & Microwave welding. Weldability: Definition, different tests of weldability, weldabitity of steel, stainless steel, cast iron, aluminum and titanium.

UNIT-III

Joining of ceramics and plastics processes: Used in joining of ceramics & plastics, adhesive bonding. allied welding processes: brazing, soldering, metal spraying, and gas & arc cutting of steels, stainless steel and cast iron, thermal spraying, plasma cutting. heat flow welding: calculation of peak temperature; width of heat affected zone (haz); cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention.

UNIT-IV

Welding defects: Different types of welding defects, causes and remedies, testing for identifying defects. Welding distortion and residual stresses**:** Types, factors affecting the distortion and residual stresses, methods of

reducing the distortion. Repair & Maintenance Welding: Hardfacing, Cladding, Surfacing, Metallizing processes and Reclamation welding.

Text and Reference Books:

- Welding and Welding Technology, by- Richard L. Little, McGraw Hill Education.
- Welding Principals and Practices, by- Edwars R. Bohnart, McGraw Hill Education.
- Welding Engineering and Technology, by- R. S. Parmar, Khanna Publishsers.
- Jean Cornu, Advanced welding systems, IFS, 1988.

TOOL ENGINEERING

General Course Information:

Course Code: ME-455-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:
The objectives of this course are to:
1. Impart the knowledge of different cutting tool materials and cutting tool design
2. Familiarize with the concept gages and work holding devices
3. Impart the knowledge of drill jigs and fixtures
4. Impart the knowledge of different types of dies and tool design for numerically controlled machine tools

By the end of the course a student is expected to:
1. Understand importance ofdifferent types of cutting tool materials and able to design cutting tools
2. Understand importance of gages and work holding devices
3. Understand importance of different types of jigs and fixtures
4. Understand bending, forming and drawing operations and able to tool design for numerically controlled machine tools

Course Contents

UNIT-I

Cutting Tool Materials: Desirable Properties of Cutting Tool Materials, Different Types of Cutting Tool Materials, Cutting-Tool Reconditioning

Design of Cutting Tools: Basic Mechanics and Geometry of Chip Formation, General Considerations for Metal Cutting, Design of Single Point Cutting Tools, Design of Milling Cutters, Design of Drills
.

UNIT-II

Gages: Definition of gage, Types of Gages, Gage Tolerances, Material for Gages

Work Holding Devices: Location: Principles, Methods and Devices, Clamping: Principles, Methods and Devices

UNIT-III

Drill Jigs: Definition and Types of Drill Jigs, General Considerations in the Design of Drill Jigs, Drill Bushings

Fixtures: Fixtures and Economics, Types of Fixtures

UNIT-IV

Bending, Forming and Drawing Dies: Bending Dies, Forming Dies, Drawing Operations, Variables that Affect Metal Flow during Drawing

Tool Design for Numerically Controlled Machine Tools: Fixture Design for Numerically Controlled Machine Tools, Cutting Tools for Numerical Control, Tool-Holding Methods for Numerical Control.

Text and Reference Books:

- Mehta, N. K., "Metal Cutting and Design of Cutting Tools, Jigs & Fixtures" , McGraw Hill Education (India) Private Limited
- Cyril Donaldson, George H LeCain, Goold V.C., JoyjeetGhose , "Tool Design", Tata-McGraw Hill.
- Jeff Lantrip, John G. Nee, David Alkire Smith, "Fundamentals of Tool Design", Society of Manufacturing Engineers
- Jones E.J.H., Town H.C., "Production Engineering: Jig and Tool Design", Butterworth and Co (Publishers) Ltd

MODERN MACHINING METHODS

General Course Information:

Course Code: ME-457-L Course Credits: 4.0 Contact Hours: 4hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand the basic concepts of modern machining methods.
2. Learn the working of EDM and ECM machines.
3. Gain knowledge about EBM, EBW, LBW, USM, AJM, WJM, and CHM.
4. Compare non-traditional machining processes.

By the end of the course, a student is expected to:

1. List the non-traditional machining processes.
2. Explain schematically about modern machining methods.
3. List the applications, advantages, and limitations of new machining methods.
4. Select the correct non-conventional material removal process.

Course Contents

UNIT-I

Unconventional Machining Process: Characteristics of Modern Machining Processes, Basic Principles of New Machining Methods, Advantages and Limitations of Non-traditional Machining Processes.

Electric Discharge Machining (EDM): Operating Principles of Spark Erosion, Construction details and components of Spark Erosion Machines (Schematic Diagrams), Applications, Advantages, and Limitations of EDM process.

UNIT-II

Electro-Chemical Machining (ECM): Principle of ECM process, ECM process Details with Chemical Reactions (Schematic Diagram), Advantages, Disadvantages and Application of ECM process.

Electron Beam Machining (EBM): Description of EBM process (Schematic Diagrams), Applications and Limitations of Electron Beam Machining, Electron Beam Welding (EBW), and Laser beam Welding (LBW).

UNIT-III

Ultrasonic Machining (USM): Basic Principle of the USM, Essential components of USM, Performance Parameters of USM, Applications, Advantages and Limitations of USM.

Abrasive Jet Machining (AJM): Features of AJM (Schematic Diagrams), Practical Applications of AJM, Advantages and Disadvantages of AJM, Water Jet Machining (WJM).

UNIT-IV

Chemical Machining (CHM): Basic Techniques of CHM, Mechanism of CHM, Process Variables in CHM, Advantages and Applications of CHM.

Comparison of Unconventional Machining Processes: Comparison on Power Consumption basis, Selection of Non-traditional Machining process, Effect of Non-conventional Material removal processes on Surface Integrity.

Text and Reference Books:

1. Unconventional Machining Process – M.Adithan, Atlantic
2. Modern Machining Processes – P.C.Pandey, H.S.Shan, Tata McGraw Hill
3. Machining Science- Ghosh and Malik, Affiliated East-West Press
4. Non Traditional Manufacturing Processes- Benedict G.F, Marcel Dekker
5. Advanced Methods of Machining- Mc Geongh J.A, Chapman and Hall

8th SEMESTER

Subject Area	Course Code	Course Name	L	T	P	Credits
DE-3	ME- -L	Programme Elective-III	4	-	-	4.0
DE-4	ME- -L	Programme Elective-IV	4	-	-	4.0
DE-5	ME- -L	Programme Elective-V	4	-	-	4.0
DE-6	ME- -L	Programme Elective-VI	4	-	-	4.0
PS-4	ME-402-P	Seminar	-	-	4	2.0
PS-5	ME-404-P	Project	-	-	14	7.0
		Total	16	-	18	25.0
			34			**25**

Programme Elective -III

Course Code	Course Name	L	T	P	Credits
ME-452-L	Introduction to Tribology	4	-	-	4.0
ME-454-L	Computer Numerical Control Machine Tool	4	-	-	4.0
ME-456-L	Reverse Engineering	4	-	-	4.0
ME-458-L	Product Design and Development	4	-	-	4.0

Programme Elective -IV

Course Code	Course Name	L	T	P	Credits
ME-462-L	Robotics	4	-	-	4.0
ME-464-L	Mechatronics	4	-	-	4.0
ME-466-L	Automatic Control	4	-	-	4.0
ME-468-L	Flexible Manufacturing Systems	4	-	-	4.0

Programme Elective -V

Course Code	Course Name	L	T	P	Credits
ME-472-L	Power Plant Engineering	4	-	-	4.0
ME-474-L	Non-conventional energy	4	-	-	4.0
ME-476-L	Design of Heat Exchangers	4	-	-	4.0
ME-478-L	Turbo Machinery	4	-	-	4.0

Programme Elective -VI

Course Code	Course Name	L	T	P	Credits
ME-482-L	Computational Fluid Dynamics	4	-	-	4.0
ME-484-L	Ergonomics Engineering	4	-	-	4.0
ME-486-L	Rapid Prototyping	4	-	-	4.0
ME-488-L	Computer Integrated Manufacturing	4	-	-	4.0

INTRODUCTION TO TRIBOLOGY

General Course Information:

Course Code: ME-452-L Course Credits: 4.0 Contact Hours: 4hours/week Mode: Lectures Examination Duration: 3hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To introduce the concept of analysis of friction, wear, lubricants, bearings and other tribological applications.
2. To develop an understanding of the Tribological behavior of different machine elements.
3. To introduce tribology as an important design consideration that affects the performance of machine elements.

By the end of the course a student is expected to:

1. To understand the interdisciplinary subject 'tribology' and its technological significance
2. To understand the concepts of friction and wear
3. To learn about the principles of lubrication, lubrication regimes, hydrodynamic lubrication and hydrostatic lubrication
4. To analyze real life problem in tribology.

Course Contents

UNIT-I

Introduction: History of Tribology, Introduction to Friction, Wear and Lubrication, Characteristic features of tribological systems, Surface topography, environmental and Economic aspects of tribology.

UNIT-II

Friction: Causes of friction, Adhesion theory, Abrasive theory, Junction growth theory, Laws of rolling friction, Modeling of friction. Wear: Wear mechanisms, Adhesive wear, Abrasive wear, Corrosive war, Fretting wear, Modeling of wear.

UNIT-III

Physical Properties of Lubricants: Introduction, Oil viscosity, Viscosity temperature relationship, Viscosity index, Viscosity pressure relationship, Viscosity-shear rate relationship, Viscosity measurements, Viscosity of mixtures, Oil viscosity classification, Lubricant density and specific gravity, Thermal properties of lubricants, Temperature characteristics of lubricants, Other lubricants characteristics, Optical properties of lubricants, Additive compatibility and solubility, Lubricant impurities and contaminants, Solubility of gases in oils.

Lubricants and Their Composition: Introduction, Mineral oils, Synthetic oils, Emulsions and aqueous lubricants, Greases, Lubricant additives.

UNIT-IV

Fluid Film Lubrication: Regimes of fluid film lubrication, Hydrodynamic Lubrication; Introduction, Generalized Reynolds equation, Converging-diverging wedges, Journal bearings, Thermal effects in bearings,

Limits of hydrodynamic lubrication, Hydrodynamic lubrication with non-Newtonian fluids, Reynolds equation for squeeze films, Porous bearings. Hydrostatic Lubrication; Basic concepts, Aerostatic bearings, Hybrid bearings, Stability of journal bearings.

Text and Reference Books:

1. Conner, J.J. and Boyd, J., "Standard Handbook of Lubrication Engineering",McGraw Hill (1968)
2. Khonsari, M. M. and Booser, E. R., "Applied Tribology: Bearing Design andLubrication", 2nd Ed, Wiley (2008)
3. Kudish, I. I. and Covitch, M. J., "Modeling and Analytical Methods inTribology", Chapman and Hall/CRC (2010)
4. Bhushan, B., "Principles and Applications of Tribology", 2nd Ed., Wiley (2013)
5. Stachowiak, G.W. and Batchelor, A. W., "Engineering Tribology", 4th Ed,Butterworth-Heinemann (2013)
6. Wyong B., "Tribology: Engineering Applications", NY Research Press (2015)
7. Hirani H., "Fundamentals of Engineering Tribology with Applications", Cambridge University Press(2016)

COMPUTER NUMERICAL CONTROL MACHINE TOOLS

General Course Information:

Course Code: ME-454-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand the concepts and working of CNC machines.
2. Learn the fundamentals of part programming.
3. Learn the programming of CNC turning Centre and CNC machining Centre.
4. Learn the APT language and tooling system of CNC machines.

By the end of the course a student is expected to:

1. Explain the working of CNC machines.
2. Explain the coding and concepts used in CNC machine Tools.
3. Make manual part programs for CNC machine tools.
4. Make program in APT language and select cutting tools for CNC machines.

Course Contents

UNIT-I

Computer Numerical Control (CNC) Technology: Numerical Control (NC), Historical Development of CNC Machines, NC Coordinate Systems, NC Modes, Advantages and Limitations of CNC Machine Tools.
CNC Hardware: Structure of CNC Machine tools, Drives used in CNC machines, Actuation Systems of CNC Machines Tools, Feedback Devices used in CNC Machine.

UNIT-II

CNC Programming Fundamentals: Part Programming Steps, Axes Identification in CNC Turning and Machining Centres, Machine Zero and Home Position, ISO Standards for Coding.

Manual Part Programming: Preparatory Functions, Miscellaneous Functions, Absolute and Incremental Programming, Tool Length Compensation.

UNIT-III

Turning Centre Programming: Motion Commands, Tool Nose Radius Compensation, Cut Planning, Thread Cutting, Part Program Numericals.

Machining Centre Programming: Canned Cycles, Cutter Radius Compensation, Part Program Numericals.

UNIT-IV

Computer Aided Part Programming : APT Language, Geometry Statements, Motion Statements, Post Processor Statements, Auxiliary Statements, Part Program Numericals.

CNC Tooling: Cutting Tool Material and Characteristics, Turning Tool Geometry, Tooling System for Turning, and Milling. Tool Presetting, Automatic Tool Changers, Work Holding.

Text and Reference Books:

- Jon S. Stenerson, Kelly Curran , "Computer Numerical Control: Operation and Programming", Prentice Hall, 3rd edition 2007.
- Mattson Mike, "CNC Programming: Principles & Applications", Cengage learning, 1st edition 2013.
- Fitzpatrick, "Machining and CNC Technology", McGraw-Hill Higher Education, 3rd edition 2013.
- Michael J. Peterson, "CNC Programming: Basics & Tutorial Textbook", Create Space Independent Publishing Platform, 1st edition 2008.
- Peter Smid, "CNC Tips and Techniques: A Reader for Programmers", Industrial Press Inc., 1st edition 2013.

REVERSE ENGINEERING

General Course Information:

Course Code: ME- 456 -L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Study three phases of reverse engineering for geometric model development.
2. Familiar with methodologies and techniques used for reverse engineering.
3. Study reverse engineering hardware and software.
4. Discuss case studies for understanding relationship between reverse engineering and rapid prototyping.

By the end of the course a student is expected to:

1. Understand three phases of reverse engineering for geometric model development.
2. Familiar with methodologies and techniques used for reverse engineering.
3. Get knowledge of reverse engineering hardware and software.
4. Understand relationship between reverse engineering and rapid prototyping.

Course Contents

UNIT-I

Introduction: Reverse engineering fundamentals-The generic process-Three phases of reverse engineering-Phase I: Scanning, Phase II: Point processing, Phase III: Geometric model development, Case studies.

UNIT-II

Methodologies and techniques of Reverse Engineering: Computer aided reverse engineering, Computer vision and reverse engineering, Structured light range imaging, Scanner pipeline, case studies.

UNIT-III

Reverse engineering hardware and software: Introduction, Reverse engineering hardware, Reverse engineering software, Selection of a reverse engineering system, Case studies with implementation.

UNIT-IV

Introduction to rapid prototyping: Introduction to RP: Need & Development of RP systems, RP process chain, Impact of Rapid prototyping and Tooling on Product Development, Benefits, Digital prototyping, Virtual prototyping, Applications, Relationship between reverse engineering and rapid prototyping, Case studies with implementation.

Reference Books:

- K. Otto and K. Wood, Product Design: Techniques in Reverse Engineering and New Product Development, 1st edition, Prentice Hall, 2001. ISBN-13: 978-0130212719.
- V. Raja and K. Fernandes, Reverse Engineering: An Industrial Perspective, Springer- Verlag, 2008. ISBN: 978-1-84628-855-5.
- K. A. Ingle, Reverse Engineering, McGraw-Hill, 1994. ISBN-13: 978-0070316935.
- L. Wills and P. Newcomb, Reverse Engineering, 1st edition, Springer-Verlag, 1996. ISBN-13: 978-1475788280.
- C. K. Chua, K. F. Leong and C. S. Lim, Rapid Prototyping: Principles and Applications, 4th edition, World Scientific, 2010. ISBN: 978-981-277-897-0.

PRODUCT DESIGN AND DEVELOPMENT

General Course Information:

Course Code: ME-458-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Study the basic concepts of product design and development process.
2. Study the design considerations for different manufacturing processes and assembly.
3. Study the concept of aesthetics and ergonomics in product design.
4. Study the different tools used for product design.

By the end of the course a student is expected to:

1. Understand concepts of product design and development process.
2. Understand the design considerations for different manufacturing processes and assembly.
3. Understand the concept of aesthetics and ergonomics in product design.
4. Understand the different tools used for product design.

Course Contents

UNIT-I

Product Design Philosophy: Design process, design models, design phases, product design strategies, product design planning and specification, need analysis, concept generation, concept selection, concept testing, Modern product development process, Innovative thinking, Morphology of design.

UNIT-II

Design considerations: General considerations in design for casting, forging, machining, powder metallurgy and welding, Design considerations for assembly.

Material selection processing and Design: Material Selection Process, Economics, Cost Vs Performance, Weighted property Index, Value Analysis

UNIT-III

Design for aesthetics and ergonomics: Human Factors in Design, Aesthetics considerations in design-Basic types of product forms, designing for appearance, shape, features, materials and finishes, Ergonomic considerations in design display and controls, workspace design, hand tool design, human engineering considerations-Relation between man, machine and environmental factors.

Societal consideration – Contracts, Product liability, Protecting intellectual property, Legal and ethical domains, Codes of ethics, Ethical conflicts, Environment responsible design-future trends in interaction of engineering with society.

UNIT-IV

Industrial Design concepts: human factors design, user friendly design, design for serviceability, design for environment, prototyping and testing , cost evaluation, categories of cost, overhead costs, activity based costing, methods of developing cost estimates, manufacturing cost, value analysis in costing.

Tools for product design: Concurrent Engineering, Rapid prototyping, Drafting/Modeling software CAM, Interface Reverse Engineering.

Text and Reference Books:

1. Product design and development, by K.T. Ulrich and S.D. Eppinger, Tata McGraw Hill.
2. Product Development, by Chitale & Gupta, Tata McGraw Hill
3. The Mechanical Process Design, by David Ullman, McGrawhill Inc
4. Engineering Design Process, by Yousef Haik, T M MShahin, Cengage Learning
5. Product design & process Engineering by Niebel & deeper, McGraw hill
6. Value Management by Heller, Addison Wasley
7. Value Engineering A how to Manual S.S.Iyer, New age International Publishers
8. Value Engineering : A Systematic Approach by Arthur E. Mudge - Mc GrawHill
9. New Product Development Timjones. Butterworth Heinmann, Oxford.
10. Value Engineering A how to Manual S. S. Iyer, New age International Publishers
11. Value Engineering : A Systematic Approach by Arthur E. Mudge - Mc GrawHill
12. Assembly automation and product design – by Geoffrey Boothroyd, CRC Taylor & Francis

Departmental Elective -IV

ROBOTICS

General Course Information:

Course Code: ME-462-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To introduce the students to the standard terminologies, applications, design specifications, and mechanical design aspects both kinematics, Trajectory planning, work cell control and dynamics of industrial robotic manipulators.

By the end of the course a student is expected to:

1. Understand the robot kinematics and trajectory planning.
2. Apply the concepts of robotic workspace analysis for design of robotic manipulator for required work cell applications.
3. Develop the algorithms for design of robotic work cell controller and its programming for given serial robotic manipulator.

Course Contents

UNIT-I

Robotic Manipulation: Automation and Robots; Robot Classification – Drive Technologies, Work-Envelope Geometries, Motion Control Methods, Applications; Robot Specifications – No. of Axes, Capacity and Speed, Reach and Stroke, Tool Orientation, Repeatability, Precision, Accuracy, Operating Environment, An Example; Rhino X-3.

Direct Kinematics: The Arm Equation Homogenous Co-ordinates – Frames, Translations and Rotations, Composite Homogenous Transformations; Screw Transformations; Link Co-ordinates; The Arm Equation; A Five-Axis Articulated Robot; A Four-Axis SCARA Robot; A Six-Axis Articulated Robot; Problems.

UNIT-II

Inverse Kinematics: Solving the Arm Equation: The Inverse Kinematics Problem; General Properties of Solutions; Tool Configuration; Inverse Kinematics of a Five-Axis Articulated Robot, Four-Axis SCARA Robot, Six-Axis Articulated Robot and Three-Axis Planer Articulated Robot; A Robotic Work Cell; Problems.

Work Space Analysis and Trajectory Planning: Work Space Analysis; Work Envelope of a Five-Axis Articulated Robot; Work Envelope of a Four Axis SCARA Robot; Work Space Fixtures; The Pick and Place Operation; Continuous Path Motion; Interpolated Motion; Straight Line Motion; Problems.

UNIT-III

Differential Motion and Statics: The Tool Configuration Jacobian Matrix; Joint – Space Singularities; Generalised Inverses; Resolved – Motion Rate Control; n > 6; Rate Control of Redundant Reboots : n > 6; Rate Control using (1) – Inverses; The Manipulator Jacobian; Induced Joint Torques and Forces; Problems.

Manipulator Dynamics: Lagrange's Equation; Kinetic & Potential Energy; Generalised Force; Lagrange – Euler Dynamic Model; Dynamic Models of a Two-Axis Planer Articulated Robot and A Three-Axis SCARA Robot; Direct & Inverse Dynamics; Recursive Newton - Euler Formulation; Dynamic Model of a One-Axis Robot; Problems.

UNIT-IV

Robot Control: The Control Problems; State Equations; Constant Solutions; Linear Feedback Systems; Single-Axis PID Control; PD-Gravity Control; Computed –Torque Control; Variable-structure Control; Impedance Control; Problems.

Methods of Robot Programming: Robot programming methods, introduction to basic robot programming languages, and various on-line and off-line robot programming methods.

Text and Reference Books:

1. Fundamental of Robotics (Analysis &Control) by Robert J. Schilling, Published by PHI, Pvt. Ltd., New Delhi.
2. Introduction to Robotics (Mechanics & Control) by John J. Craig, Published by Addition Wesley (Intl. Student Edition).
3. Analysical Robotics & Mechatronics by Wolfram Stadler, Published by Mc-Graw Hill, Inc., New Delhi.
4. Industrial Robotics - Technology, Programming &Applications byMikell P. Grover, Weiss, Nagel and Ordef, Published by Mc-Graw Hill International Edition.
5. A Robot Engg. Test Book - Mohsen Shahinpoor, Harper & Low, Publishing New York.
6. Robotic Engineering – An Integrated Approach: Richard D.Klafter, Thomas A. Chmielewski and Michael Negin PHI 1989.
7. Foundations of Robotics Analysis and Control - Tsuneo Yashikawa MIT Press 1990, Indian Reprint 1998.
8. Robots and Control - R.K.Mittal and I.J.Nagrath - Tata McGraw Hill 2003.

MECHATRONICS

General Course Information:

Course Code: ME-464-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To impart interdisciplinary knowledge to study modern Electro-Mechanical Devices.
2. To familiarize the students with all the important elements of a Mechatronics device.
3. To understand the importance of each control action and how to choose a proper controller for an engineering problem.

By the end of the course a student is expected to:

1. Construct the block diagram of any physical Mechatronics device used in day-to-day life.
2. Calculate the output to input relation of any physical model in the form of a transfer function.
3. Evaluate the performance of any physical system in terms of its performance parameters.
4. Develop the mathematical model of any physical model from any engineering domain.
5. Recognize the key features of different type of controllers and develop a suitable controller to obtain the desired performance from the system.

Course Contents

UNIT-I

Introduction and Basics: What is Mechatronics? A Measurement System with its constituent elements; Open and Closed Loop Systems; Sequential Controllers; Micro-processor Based Controllers; The Mechatronics Approach.

Hardware of Measurement Systems: A review of Displacement, Position Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors / along with Performance Terminology; Selection of Sensors; Input Data by Switches; Signal Conditioning; Brief Review of Operational Amplifier; Protection; Fitering; Wheat Stone Bridge; Digital Signals; Multiplexers; Data Acqusition; Digital Signal Processing; Pulse Modulation; Data Presentation Systems – Displays; Data Presentation Elements; Magnetic Recording; Data Acquisition Systems; Testing & Calibration; Problems.

UNIT-II

Pneumatic, Hydraulic, Mechanical and Electrical Actuation Systems: Pneumatic and Hydraulic Systems; Directional Control Valves; Valve Symbols; Pressure Control Valves; Cylinder Sequencing; Process Control Valves; Rotary Actuators; Mechanical Systems – Types of Motion, Kinematic Chains, Cams, Gear Trains, Ratchet & Pawl, Belt & Chain Drives, Bearings, Mechanical Aspect of Motor Selection; Electrical Systems; Mechanical & Solid State Switches; Solenoids; D.C. & A.C. Motors; Stepper Motors; Problems.

System Modeling and Performance: Engg. Systems; Rotational – Translational Systems; Electro-mechanical Systems; Hydraulic – Mechanical Systems; A review of modeling of First and Second Order Systems and Performance Measures; Transfer Functions for first order System, Second Order System, Systems in series & Systems with Feedback Loops; Frequency Response of First Order and Second Order Systems; Bode Plots: Performance Specifications: Stability; Problems.

UNIT-III

Closed Loop Controllers: Continuous and Discrete Processes – Lag, Steady State Error; Control Modes; Two- step Mode; Proportional Mode – Electronic Proportional Controllers; Derivative Control – Proportional plus Derivative Control; Integral Control - Proportional plus Integral Control; PID Controller – Operational Amplifier PID Circuits; Digital Controllers – Implementing Control Modes; Control System Performance; Controller Tuning – Process Reaction Method & Ultimate Cycle Method; Velocity Control; Adaptative Control; Problems.

Digital Logic and Programmable Logic Controllers: A Review of Number Systems & Logic Gates; Boolean Algebra; Kanaugh Maps; Sequential Logic; Basic Structure of Programmable Logic Controllers; Input/ Output Processing; Programming; Timers, Internal Relays and Counters; Master & Jump Controls; Data Handling; Analogue Input/ Output; Selection of a PLC; Problems.

UNIT-IV

Microprocessors and Input/Output Systems: Control; Microcomputer Structure; Micro- controllers; Applications; Programming Languages; Instruction Sets; Assembly Language Programs; Subroutines; Why C Language? A review of Program Structure, Branches, Loops, Arrays, Pointer; Examples of Programs; Interfacing; Input/ Output; Interface Requirements; Peripheral Interface Adaptors; Serial Communication Interface; Examples of Interfacing; Problems.

Design and Mechatronics: Design Process; Traditional and Mechatronics Design; Possible Mechatronics design solutions for Timed Switch, Wind Screen Wiper Motion, Bath Room Scale, A Pick & Place Robot, Automatic Camera, Engine Management System & Bar Code Recorder.

Text and Reference Books:

1. Mechatronics by W. Bolton, Published by Addition Wesley.
2. Mechatronics System Design – Devdas Shetty and Richard A. Kolx Brooks/ Cole.
3. Introduction to Mechatronics and Measuring System: david G. Alciation and Michael B. Hist and Tata McGraw Hill.
4. Mechtronics – Sensing to Implementation - C.R.Venkataraman, Sapna .

AUTOMATIC CONTROL

General Course Information:

Course Code: ME-466-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:
The objectives of this course are to:

1. To impart interdisciplinary knowledge.
2. To make a bridge between mechanical, electronics, instrumentation, computer and controls field.
3. Understand response analysis and stability criteria of control system.

By the end of the course a student is expected to:

1. Students will be able to understand basic concepts of control systems
2. Understand the application of those principles in practice.
3. Understand the various components of Hydraulics/Pneumatics electro-pneumatic control systems
4. Stability criteria of various control system

Course Contents

UNIT-I

Introduction: Types of control systems; Typical Block Diagram: Performance Analysis; Representation of Processes & Control Elements – Mathematical Modeling. Block Diagram Representation, Representation of Systems or Processes, Comparison Elements; Representation of Feedback Control systems – Block Diagram & Transfer Function Representation, Representation of a Temperature Control System, Signal Flow Graphs, Problems.

Types of Controllers : Introduction : Types of Control Action; Hydraulic Controllers; Electronic Controllers; Pneumatic Controllers; Problems.

UNIT-II

Transient And Steady State Response: Time Domain Representation; Laplace Transform Representation; System with Proportional Control; Proportional – cum – Derivative control; Proportional – cum – Integral Control; Error Constants; Problems.

Frequency Response Analysis: Introduction; Closed and Open Loop Transfer Function; Polar Plots; Rectangular Plots; Nichols Plots: Equivalent Unity Feed Back Systems; Problems.

UNIT-III

Stability Of Control Systems: Introduction; Characteristic Equation; Routh's Criterion; Nyquists Criterion, Gain & Phase Margins: Problems.

Root Locus Method : Introduction; Root Ioci of a Second Order System; General Case; Rules for Drawing Forms of Root Ioci; Relation between Root Locus Locations and Transient Response; Parametric Variation; Problems.

UNIT-IV

State Space Analysis of Control Systems: Introduction; Generalized State Equation; Techniques for Deriving System State – Space Equations; Transfer Function from State Equations; Solution of State Vector Differential Equations; Discrete Systems; Problems.

Applications of automatic control – Machine Tool Control, Boiler Control, Engine Governing, Aerospace Control, Active Vibration Control and other control systems

Text and Reference Books :

1. Theory & Applications of Automatic Controls by B.C. Nakra, Published by New Age International Pvt. Ltd. Publishers, 2014, New Delhi.
2. Modern Control Engg. by Ugata, Prentice Hall of India, 2012, New Delhi.
3. Automatic Control Systems by Kuo' Published by Prentice Hall of India, 2007, New Delhi.
4. Control System Engineering, I. J. Nagrath and M. Gopal, New Age International Pvt. Ltd. Publishers, 2012, New Delhi.

FLEXIBLE MAUFACTURING SYSTEM

General Course Information:

Course Code: ME-468-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To expose the students to the basic overview of automation, types of automation and transfer mechanism.
2. To provide to the students an understanding automated assembly systems, quantitative and operational analysis of assembly machine.
3. To impart knowledge of group technology, optimum machine arrangement & benefits of group technology.
4. To study flexible manufacturing system, material handling, computer controlled system with their application & benefits.
5. To impart in depth knowledge of robotics & sensors used in robotics.

By the end of the course a student is expected to:

1. Identify basic automation, types of automation and transfer mechanism.
2. Understand different automated assembly systems, quantitative and operational analysis of assembly machine.
3. Understand the technology, optimum machine arrangement & benefits of group technology
4. Understand flexible manufacturing system, material handling, computer controlled system with their application & benefits.
5. Understand the robotics & sensors used in robotics.

Course Contents

UNIT-I

Automation: Types of automation, reasons for automating, automation strategies, Detroit-type automation: Automated flow lines, methods of work part transport, Transfer mechanisms, buffer storage, automation for machining operations.

Automated assembly systems: Design for automated assembly, types of automated assembly systems, part feeding devices, quantitative analysis of the delivery system operation, analysis of a single-station assembly machine, numericals.

UNIT-II

Group Technology: Part families, parts classification and coding, types of classification and coding systems. Machine cell design: The composite part concept, types of cell designs, determining the best machine arrangement, benefits of group technology.

Flexible Manufacturing Systems: Components of an FMS, types of systems, where to apply FMS technology, FMS work stations. Material handling and storage system: Functions of the handling system, FMS layout configurations. Material handling equipment. Computer control system: Computer function, FMS data file, system reports. Planning the FMS, analysis methods for FMS, applications and benefits.

UNIT-III

Robotic technology: Joints and links, common robot configurations, work volume, types of robot control, accuracy and repeatability, other specifications, end effectors, sensors in robotics.

UNIT-IV

Robot programming: Types of programming, lead through programming, motion Programming, interlocks, advantages and disadvantages. Robot languages: Motion programming, simulation and off-line programming, work cell control.

Robot applications: Characteristics of robot applications, robot cell design, types of robot applications: Material handling, processing operations, assembly and inspection.

Text and Reference Books:

1. Automation, Production Systems and Computer Integrated Manufacturing. Groover M.P, Prentice Hall of India.
2. CAD/CAM – Groover M.P, Zimmers E.W, Prentice Hall of India..
3. Approach to Computer Integrated Design and Manufacturing Nanua Singh, John Wiley and Sons, 1998.
4. Production Management Systems: A CIM Perspective Browne J, Harhen J, Shivnan J, Addison Wesley, 2nd Ed. 1996.

Departmental Elective -V

POWER PLANT ENGINEERING

General Course Information:

Course Code: ME-472-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Know the functions of various parts of different thermal power plants and about renewable energy sources.
2. Understand the constructional and working details of thermal power plant systems.
3. Familiarize with operation of nuclear, hydroelectric, and combined power Plants.
4. Familiarize with non-conventional power generation, direct energy conversion systems and power plant economics.

By the end of the course a student is expected to:

1. Understand the working of hydro electric and to know about the renewable energy resources.
2. Understand the working of steam power plant and combined cycle systems.
3. Solve the problems based on tariffs for energy and to understand the working of nuclear power plant.
4. Understand the non-conventional power generation and direct energy conversion systems.

Course Contents

UNIT-I

Introduction: Energy resources and their availability, types of power plants, selection of the plants, review of basic thermodynamic cycles used in power plants.

Hydro Electric Power Plants : Rainfall and run-off measurements and plotting of various curves for estimating stream flow and size of reservoir, power plants design, construction and operation of different components of hydro-electric power plants, site selection, comparison with other types of power plants.

UNIT-II

Steam Power Plants: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, site selection, coal storage, preparation, coal handling systems, feeding and burning of pulverized fuel, ash handling systems, dust collection-mechanical dust collector and electrostatic precipitator.

Combined Cycles: Constant pressure gas turbine power plants, Arrangements of combined plants (steam & gas turbine power plants), re-powering systems with gas production from coal, using PFBC systems, with organic fluids, parameters affecting thermodynamic efficiency of combined cycles. Problems.

UNIT-III

Nuclear Power Plants: Principles of nuclear energy, basic nuclear reactions, nuclear reactors-PWR, BWR, CANDU, Sodium graphite, fast breeder, homogeneous; gas cooled. Advantages and limitations, nuclear power station, waste disposal.

Power Plant Economics: load curve, different terms and definitions, cost of electrical energy, tariffs methods of electrical energy, performance & operating characteristics of power plants- incremental rate theory, input-out put curves, efficiency, heat rate, economic load sharing, Problems.

UNIT-IV

Non-Conventional Power Generation: Solar radiation estimation, solar energy collectors, low, medium & high temperature power plants, OTEC, wind power plants, tidal power plants, geothermal power plants.

Direct Energy Conversion Systems: Fuel cell, MHD power generation-principle, open & closed cycles systems, thermoelectric power generation, thermionic power generation.

Text Books:

- Power Plant Engineering –Arora & Domkundwar, Dhanpat Rai & Co, 2011.
- Power Plant Engineering –Samsher Gautam, Vikash publications, 2013.
- Power Plant Engineering –P.C. Sharma, Katson Books, 2010.
- Power Plant Engineering –G.D. Rai, Khanna Publishers, 2010.
- Power Plant Engineering –R.K. Rajput, Laxmi Publishers, 2012.
- Power station Engineering and Economy by B. G.A. Skrotzki and W.A. Vopat, Mc Graw Hill Publishing Campany Ltd., New Delhi.
- Power Plant Engineering- P.K. Nag Tata McGraw Hill second Edition, 2001.
- Power Plant Engg.- M.M. El-Wakil McGraw Hill, 1985.

NON CONVENTIONAL ENERGY

General Course Information:

Course Code: ME-474-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:
The objectives of this course are to:
1. Acquire the knowledge of solar energy and its applications.
2. Understand the working of bio gas digester rotors used to harness wind energy.
3. Know about the geothermal and tidal energy.
4. Understand the basic concepts in non conventional energy sources and how to use ocean thermal energy.

By the end of the course a student is expected to:
1. Learn the basics of solar energy applications.
2. Understand the working of bio conversion and wind energy devices and its applications.
3. Learn about the geo-thermal and tidal energy.
4. Understand about the principles of ocean energy and other non conventional energy sources.

Course Contents

UNIT-I

Introduction: Trends of energy consumption, sources of energy – conventional and renewable, fossil fuel – availability and limitations, need to develop new energy sources.

Solar Energy: Solar radiation characteristics and estimation, Solar Collectors, Flat Plate and concentrating types. Their comparative study, design and material selection, efficiency. Selective paints and surfaces. Heating of air and water for building and other uses. Thermal storages, Solar Ponds, Solar pumps, solar Power, Solar Cookers etc. Direct Conversion of Solar energy to electricity and its various uses, materials, limitations and costs.

UNIT-II

Bio-conversion: Generation of bio-gas, digesters and their design, selection of material, feed to digester, paralytic gasification, production of hydrogen, Algae production and their uses.

Wind Energy: Types of rotors, horizontal axis and vertical axis systems, system design and site selection.

UNIT-III

Geo-thermal Energy: Sites, potentiality and limitation, study of different conversion systems.

Tidal Energy: Sites, potentiality and possibility of harnessing from site, limitations.

UNIT-IV

Ocean Thermal Energy: Principle of utilization and its limitations, description of various systems.

Other non-conventional energy sources: Fluidized bed combustions, heat from waste and other sources.

Text and References Books:

1. Solar Energy Utilization – G.D. Rai
2. Solar Heating and Cooling – Duffie and Bakeman
3. Power Plant Technology – M.M EL – Wakil, McGraw Hill Book Co., 1985
4. Power Plant Engineering- P.K. Nag Tata McGraw Hill second Edition, 2001.
5. Non Conventional Energy Sources- G.D. Rai, Khanna Publishers, 1988.
6. Power Plant Engineering –P.C. Sharma, Katson Books, 2010.
7. Power Plant Engineering –G.D. Rai, Khanna Publishers, 2010.

DESIGN OF HEAT EXCHANGER

General Course Information:

Course Code: ME-476-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:
The objectives of this course are to:

1. To impart the knowledge basic concepts of heat exchangers and their design considerations.
2. To understand the types and significance of different of heat exchangers.
3. To study various types of compact heat exchangers and their performance parameters.
4. To understand the basic concepts of condensers, evaporators and regenerators.

By the end of the course a student is expected to:

1. Understand the basic concepts of heat exchangers.
2. Understand the functioning different types of heat exchangers
3. Understand the performance parameters various types of compact heat exchangers.
4. Understand the basic concepts of condensers, evaporators and regenerators.

Course Contents

UNIT-I

Classification of Heat exchangers: Introduction, Recuperation and regeneration, Transfer processors, Geometry of construction–tubular heat exchangers, plate heat exchangers, extended surface heat exchanges, Heat transfer mechanisms, Flow arrangements, Selection of heat exchangers.

Basic Design Methods of Heat Exchanges: Introduction, Arrangement of flow path in heat exchangers , Basic equations in design, Overall heat transfer coefficient , Log mean temperature difference method for heat exchanger analysis, The $\mathcal{E}$-NTU method for heat exchanger analysis, Heat exchanger design calculation, Variable overall heat transfer coefficient , Heat exchanger design methodology.

UNIT-II

Design Correlations for Condensers and Evaporators: Introduction, Condensation, Film condensation on a single horizontal tube-laminar film condensation, forced convection, Film condensation in tube bundles-effect of condensate inundation, effect of vapor shear, Combined effects of inundation and vapor shear, Condensation inside tubes-condensation in vertical tubes, Flow boiling-subcooled boiling, flow pattern, flow boiling correlations.

Shell and Tube Heat Exchangers: Introduction, Basic components-shell types, tube bundle types, tubes and tube passes, tube layout, baffle type and geometry, allocation of streams, Basic design procedure of a heat exchanger-preliminary estimation of unit size, rating of preliminary design, Shell-slide heat transfer and pressure drop-shell-side heat transfer coefficient, shell-side pressure drop, tubeside pressure drop, Bell-Delaware method.

UNIT-III

Compact Heat Exchangers: Introduction, Plate-fin heat exchangers, tube-fin heat exchangers, Heat transfer and pressure drop-heat transfer, pressure drop for finned-tube exchangers, pressure drop for plate-fin exchangers.

Gasketed Plate Heat Exchangers: Introduction, Mechanical features-plate pack and frame, plate types, Operational characteristics-main advantages, performance limits, Passes and flow arrangements, Application-corrosion, maintenance, Heat transfer and pressure drop calculations heat transfer area, mean flow channel gap, channel equivalent diameter, heat transfer coefficient, channel pressure drop, port pressure drop, overall heat transfer coefficient, heat transfer surface area, performance analysis, Thermal performance.

UNIT-IV

Condensers and Evaporators: Introduction, Shell-and-tube condensers-horizontal shell-side condensers, vertical shell-side condensers, vertical tube-side condensers, horizontal in-tube condensers, Steam turbine exhaust condensers, Plate condensers, Air-cooled condensers, Direct contact condensers, Thermal design of shell-and-tube condensers, Design and operational considerations, Condensers for refrigeration and air-conditioning-water cooled condensers, aircooled condensers, evaporative condensers, Evaporative for refrigeration and airconditioning-water-cooling evaporators (chillers), air-cooling evaporators (air coolers), Thermal analysis-shah correlation, Kandlikar correlation, Gungor and Winterton correlation, Standards for evaporators and condensers.

Regenerators: Classifications-fixed bed regenerators, rotary regenerators, basic design method, Influence of fluid bypass carry-over, Pressure drop evaluation, The rating problem, surface geometrical properties, Pressure drop, Sizing problem.

Text and Reference Books:

1. Compact Heat Exchangers: Selection, Application, Design and Evaluation, Bahman Zohuri, 2017.
2. Heat Exchanger Design Guide – practical guide for planning, selecting and designing of shell and tube exchangers, Dr. Manfred Nitsche and Mr. R.O. Gbadamosi, Essevier, 2015.
3. Heat Exchanger Design Handbook, Second Edition, Kuppan Thulukkanam, CRC press, 2013.
4. Fundamentals of heat exchanger design, R.K. Shah, Jon Wily & Sons, 2003.
5. Fundamentals of heat exchanger design, Ramesh K. Shah, Dusan P. Sekulic, John Wiley & Sons, 2003.

TURBO MACHINERY

General Course Information:

Course Code: ME-478-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. To apply the concepts of thermodynamics and fluid mechanics to analyze turbo machines.
2. To study the practical working of gas turbine and propulsion cycles.
3. To understand the basic concepts of gas turbines and rankine cycle.
4. To evaluate the performance of turbo machine components like steam nozzles and turbines.

By the end of the course a student is expected to:

1. Understand appliction of thermodynamics and fluid mechanics.
2. Understand the analyses of practical gas turbine and propulsion cycles.
3. Understand the performance characteristics of gas turbines.
4. Understand the performance characteristics of steam nozzles and turbines.

Course Contents

UNIT-I

Review of Basics: Introduction to Prime Movers, Gas Turbines, Review of Basic principles – Thermodynamics, Review of Basic principles – Fluid Dynamics and Heat Transfer, Fundamentals of Rotating Machines – Energy Equation, Dimensional Analysis, Airfoil Theory.

Ideal Gas Turbine Cycles: Analysis of Ideal Gas Turbine Cycles, Simple Cycle, Regeneration Cycle, Reheat Cycle, Inter cooling Cycle.

UNIT-II

Practical Gas Turbine Cycles: Analysis of Practical Gas Turbine Cycles, Methods of accounting for component losses, Efficiencies, changes in the composition of the working fluid.

Propulsion Cycles: Jet Propulsion Cycles and their Analysis for turbojet, turboprop and turbofan engines-efficiency and specific thrust Factors Affecting Flight Performance & Methods of Thrust Augmentation.

UNIT-III

Gas Turbines: Axial Flow Gas Turbines – Impulse and reaction Turbines, Single Impulse stage, Single Reaction stage, Performance characteristics.

Rankine Cycle: Properties of Pure Substances, Property diagrams, Steam Power plant Layout, Rankine Cycle-Analysis, Modified Rankine Cycle, and Combined Cycle.

UNIT-IV

Steam Nozzles: Steam Nozzles: Introduction, Area- velocity relationship, Mass flow rate, Choking of Nozzles, Performance characteristics of Nozzles, Super saturated flow Steam Turbines: Steam Turbines : Impulse and

reaction Turbines, Compounding of steam turbines, Multistage reaction Turbines, Reheat factor and Efficiency, Governing of Steam Turbines

Text and Reference Books:

1. Principles of turbomachinery, Seppo A. Korpela, Wiley, 2011.
2. Fundamentals of turbomachinery, B.K. venkanna, PHI, 2009
3. Fundamentals of turbomachinery, William W.Peng, Willey, 2007.
4. Turbomachinery: Physics and Dynamics, Meinhard T. Schobeiri, Springer, 2005.
5. Tribo-Machinery Dynamics, A.S. Rangwala, Mc Graw Hill, 2005.

Departmental Elective -VI

COMPUTER FLUID DYNAMICS

General Course Information:

Course Code: ME-482-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:
1. Expose the students to the governing equations for fluid flow and
2. Introduce turbulence models used to solve the flow equation for turbulent flow.
3. Introduce the numerical methods used to solve the partial differential equations.

By the end of the course a student is expected to:
1. understand the governing equations for different fluid flow.
2. solve the fluid flow problem using CFD.
3. understand the basics of Finite Volume and Difference Methods.

Course Contents

UNIT-I

Introduction: Introduction to C.F.D., models of the flow, governing differential equations – continuity equation, momentum equation, energy equation, Navier- stokes equation, physical boundary conditions.

Mathematical behavior of governing equation: Classification of quasi linear partial differential equation, General method of determining the Classification of partial differential equation, hyperbolic, parabolic, elliptic equations.

UNIT-II

Heat conduction problem : Solution of One dimensional heat conduction through a pin fin by F.D.M solution of two dimensional heat conductional in a plate by F.D.M. Control volume formulation of the heat conduction problem and its solution. Discretization methods: Finite difference methods, difference equations, explicit & implicit approach, errors & analysis of stability. Basics of finite control volume method, errors & analysis of stability

UNIT-III

Heat conduction with convection & diffusion: Steady state one dimensional convection and diffusion, unwinding, exact solution, exponential scheme, hybrid scheme, power law scheme, Discretization equation for two dimensions & three dimensions, false diffusion

UNIT-IV

Fluid flow problem: Viscous incompressible flow, solution of the couette flow problem by F.D.M., calculation of the flow field using stream function –vorticity method numerical algorithms for solving complete navier stokes equation – MAC method; SIMPLE method.

Text and Reference Books:

- Versteeg, H. and Malalasekra, W., An Introduction to Computational Fluid Dynamics: The Finite Volume Method, Pearson Education, New Delhi (2008).
- Wendt, J. F., Computational Fluid Dynamics: An Introduction, Springer, New York (2009)
- Muralidhar, K and Sundararajan, T., Computational Fluid Flow and Heat Transfer, Narosa, New Delhi
- Jaluria, Y and Torrance, K.E., Computational Heat Transfer, Hemisphere Publishing Company, New York
- Patankar, S. V., Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Company, New York
- John David Anderson, Computational Fluid Dynamics: The Basics with Applications, Mc-graw hill education

ERGONOMICS ENGINEERING

General Course Information:

Course Code: ME-484-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:
1. Making the students understand the ergonomic principles in workplace design and work organisation.
2. Enabling the students to identify and evaluate the impact of various human factors to design of safe workplace environment.

By the end of the course a student is expected to:
1. Identify, explain and evaluate the impact of various personal attributes (anatomical, physiological and anthropometric) on proper, safe working practice.
2. Assess the effect of physical environment factors on comfort and performance.
3. Apply principles of good ergonomic design to work areas and equipment.
4. Apply various task analysis tools to posture measurement, lifting, lowering and carrying tasks.
5. Comprehend the need for information display and the ergonomic design of different display and control devices.

Course Contents

UNIT-I

General: Man in industrial work environments, Ergonomics as multidisciplinary fields, Importance and justification and ergonomics problems, Man-machine-environment system.

Anthropometry: Significance of human body measurement in design of equipment, Facilities, Work place and operation, Static and dynamic anthropometry, Anthropometric data.

UNIT-II

Task Analysis: Task description, Posture measurement, RULA & REBA analysis and evaluation, Lifting & lowering tasks, Lifting index, Lifting & carrying tasks, NIOSH lifting equation.

Biomechanics: Introduction to levers of Human Body, Ligaments & Tendons, Joints. Kinetics to include forces producing motion.

UNIT-III

Man-Environment Interface: Environmental factors of temperature, Humidity, Lighting and noise in industry, Effect of environmental factors on human performance, Measurement and mitigation of physical and mental fatigue, Basics of environment design for improved efficiency.

UNIT-IV

Design of Display and Control: Need for information display, Elements of information theory, Reaction time, Methods and types of displays, Design of audio and visual displays, Design of hand and foot operated control device, Design of human-computer interface.

Text and Reference Books:

- Bridger, R.S., Introduction to Ergonomics, McGraw Hill (2008).
- Sanders, M. and McCormick E., Human Factors in Engineering & Design, McGraw Hill
- Maynard, H. B., Industrial Engineering Hand Book, McGraw Hill
- David, A., Practice & Management of Industrial Ergonomics, Prentice Hall
- Singleton, W. T., Introduction to Ergonomics, WHO, Geneva

RAPID PROTOTYPING

General Course Information:

Course Code: ME-486-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Study the concept of rapid prototyping, its benefits and applications.
2. Study the various liquid, powder and solid material based technologies in Rapid Prototyping.
3. Design solid models and converting it to STL file format required for part generation.
4. Focus on the various issues related to RP parts.
5. Study the concept of rapid tooling and apply reverse engineering for generating RP parts.

By the end of the course a student is expected to:

1. Understand the concept of rapid prototyping, its benefits and applications.
2. Understand the various liquid, powder and solid material based technologies in Rapid Prototyping.
3. Design solid models and converting it to STL file format required for part generation.
4. Understand the various issues related to RP parts.
5. Understand the concept of rapid tooling and apply reverse engineering for generating RP parts.

Course Contents

UNIT-I

Introduction to RP: Need & Development of RP systems, RP process chain, Impact of Rapid prototyping and Tooling on Product Development, Benefits, Digital prototyping, Virtual prototyping.

RP Applications: Design, Concept Models, Form & fit checking, Ergonomic Studies, Functional testing, Requesting Price quotes, CAD data verification, Rapid Tooling, Rapid manufacturing, Science & Medicine, Archeology, Paleontology & forensic Science, miniaturization.

UNIT-II

Liquid and Solid Based Rapid Prototyping Systems: Stereo lithography Apparatus, Fused deposition Modeling, Laminated object manufacturing, 3D printing: Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

Powder Based Rapid Prototyping Systems: Selective Laser Sintering, Direct Metal Laser Sintering, 3D Printing, Laser Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes, materials, products, advantages, applications and limitations.

UNIT-III

Data Processing for Rapid Prototyping: Process planning for rapid prototyping, CAD model preparation, Data Requirements & geometric modeling techniques: Wire frame, surface and solid modeling data formats - Data interfacing, Tessellation of surfaces, STL file generation Defects in STL files and repairing algorithms, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation.

Issues of Rapid Prototyping parts: Accuracy issues in Rapid Prototyping, Strength of RP Parts, Surface roughness problem in Rapid Prototyping, Part deposition orientation and issues like accuracy, surface finish, build time, support structure, cost, material, color, dimensional accuracy, stability, machine-ability, environmental resistance, operational properties.

UNIT-IV

Rapid Tooling: Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect, Fabrication processes, Applications, Rapid tooling techniques such as laminated metallic tooling, direct metal laser sintering, vacuum casting, use of Rapid tooling for injection mold.

Reverse Engineering: Introduction to reverse engineering, integration of reverse engineering and rapid prototyping,
use of RP for reverse engineering.

Text and Reference Books:

- Rapid Prototyping: Principle and Applications, Rafiq I Noorani, Wiley & Sons, 2006
- Rapid prototyping: Principles and applications, Chua C.K., Leong K.F., and Lim C.S., Yes Dee Publishing Pvt. Ltd, Third edition,2010.
- Rapid Prototyping And Engineering Applications, Frank W. Liou, CRC Press, Special Indian Edition, 2007.
- Journey from Rapid Prototyping to Rapid Manufacturing , Somnath Chattopadhyaya, LAP Lambert Academic Publishing,,2011.
- Rapid Prototyping Technology: Selection and Application, Kenneth G. Cooper, Cooper Cooper, Marcel Dekker Inc, 1st Edition, 2001.

COMPUTER INTEGRATED MANUFACTURING

General Course Information:

Course Code: ME-488-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand the basic concepts of automation and control systems.
2. Learn mechanisms of robots and material handling.
3. Gain knowledge about quality standards and manufacturing systems.
4. Learn product design, process planning and product planning.

By the end of the course, a student is expected to:

1. Describe the automation and computer control systems.
2. Explain about the mechanics of robots and material handling.
3. Explain quality control charts used in manufacturing systems.
4. Use the computers in Product design, process and production planning.

Course Contents

UNIT-I

Automation: Basic Elements of Automated Systems, Levels of Automation, Hardware Components of Automation.

Control Systems: Evolution of Computer Process Control, Capabilities of Computer control, Types of Computer Process Control.

UNIT-II

Robotics: Common Robot Configurations, Robot Control Systems, End Effectors, Robot Applications.

Material Handling: Automated Guided Vehicles, Conveyors, Cranes and Hoists.

UNIT-III

Manufacturing Systems: Automated Production Lines, Automated Assembly Systems, Cellular Manufacturing, Flexible Manufacturing Systems.

Quality Control: Statistical Process Control Charts, Six Sigma, Taguchi Methods, ISO 9000.

UNIT-IV

Product Design: Applications of Computers in Design, CAD System Hardware, CAM, CAD/CAM, and CIM.

Process and Production Planning: Computer Aided Process Planning (CAPP), Concurrent Engineering, Material Requirement Planning.

Text and Reference Books:

- Automation, Production Systems and Computer Integrated Manufacturing. Groover M.P, Prentice Hall of India.
- CAD/CAM – Groover M.P, Zimmers E.W, Prentice Hall of India.
- Approach to Computer Integrated Design and Manufacturing Nanua Singh, John Wiley

SEMINAR

General Course Information:

Course Code: ME-402-P Course Credits: 2.0 Mode: Practical Contact Hours: 04 hours per week Examination Duration: 03 hours	**Course Assessment Methods (Internal: 100):** Internal continuous assessment of 100 marks on the basis of report writing, presentation and viva voce in practical classes by the team of panel of faculty members.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Impart the technical knowledge of the current topics of Mechanical Engineering
2. Improves the presentation and communication skills
3. Overall improvement in their technical skills

By the end of the course a student is expected to:

1. Gain the knowledge in recent development in the field of Mechanical Engineering.
2. Learnt report writing and presentation skills
3. Develop technical skills along with overall development

Contents

The topic of the technical presentation will be related to the current research & development in the field of Mechanical Engineering. Each student is required to submit a report on the topic of seminar as per the guidelines decided by the department from time to time. During the semester, each student is required to give a presentation before the class and course coordinator and the faculty members assigned by chairperson.

MAJOR PROJECT

General Course Information:

Course Code: ME-404-P Course Credits: 7.0 Mode: Practical Contact Hours: 14 hours per week Examination Duration: 03 hours	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Objectives and Outcomes:

The objectives of this course are to:
1. Provide more weightage for project work
2. Generate innovative ideas for the solution of identified problems or improvement in the existing system of mechanical engineering field.
3. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

By the end of the course a student is expected to:
1. Analyze and identify the problems in the mechanical systems.
2. Select and apply proper modern tools.
3. Find solution for problems.
4. Make use of the benefits of team work.

LAB CONTENT

Project involving design/ fabrication/ testing computer simulation/ case studies etc. which is commenced in VIIth Semester, will be completed in VIIIth Semester. The student will be required to demonstrate his ideas/design/development in front of the committee constitute of a project coordinator, project guide and senior teachers of the department.
The student will be required to submit three copies of his/her project report to the office of the concerned department for record (one copy each for the deptt. Office, Project guide and University/College library).

List of Open Elective offered by Mechanical Engineering Department to other Engineering Departments

V Semester

Subject Area	Course Code	Course Name	L	T	P	Credits
OE-1	OE-ME-391-L	Industrial Engineering	4	-	-	4.0

VI Semester

Subject Area	Course Code	Course Name	L	T	P	Credits
OE-2	OE-ME-392-L	Material Science	4	-	-	4.0

VII Semester

Subject Area	Course Code	Course Name	L	T	P	Credits
OE-3	OE-ME-491-L	Computer Aided Design and Manufacturing	4	-	-	4.0

INDUSTRIAL ENGINEERING

General Course Information:

Course Code: OE-ME-391-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:
1. Impart the knowledge of different types of plant layout and material handling
2. Familiarize with the concept of work study and method study
3. Impart the knowledge of work measurement and value engineering
4. Familiarize with the concept of ergonomics and intellectual property rights

By the end of the course a student is expected to:
1. Understand importance of different types of plant layout and material handling
2. Understand importance ofwork study and method study
3. Understand importance of work measurement and value engineering
4. Understand importance of ergonomics and intellectual property rights

Course Contents

UNIT-I

Plant Layout: Objectives of Good Plant Layout, Importance of Plant Layout, Types of Plant Layout, Advantages and Limitations of Different Types of Plant Layouts

Material Handling: Function of Material Handling, Principles of Material Handling, Material Handling Devices, Relation between Plant Layout and Material Handling

UNIT-II

Work Study: Definition and Concept of Work Study, Need of Work Study, Advantages of Work Study, Techniques of Work Study, Work Study and Management, Work Study and Productivity

Method Study: Objectives and Procedure of Method Study, Process Chart Symbols, Flow Diagram, String Diagram, Therblig, Multiactivity Charts

UNIT-III

Work Measurement: Objectives of Work Measurement, Basic Procedure for Time Study, Difference between Time Study and Motion Study, Various Time Estimates and Production Standard, Level of Performances, Allowances, Various Time Recording Techniques in Time Study

Value Engineering: Types of Values, Concept of Value Engineering, Phases of Value Engineering Studies, Application of Value Engineering

UNIT-IV

Ergonomics: Concept of Ergonomics, Objectives of Ergonomics, Man Machine System Interface, Anthropometry, Ergonomics and Safety, Ergonomics and Fatigue

Intellectual Property Rights: Intellectual Property Rights, Patents, Trade Marks, CopyRights, Law of Contract

Text and Reference Books:

- Industrial Engineering and Management by Hicks, Tata McGraw Hill, New Delhi
- Work study and Ergonomics by Suresh Dalela and Saurabh, Standard Publishers
- Motion and time study by R. Bernes, John-Wiley & Sons
- Ergonomics at work by D.J. Oborne, John Wiley & Sons
- Techniques of Value Analysis and Engineering by Miles, McGraw Hill

MATERIAL SCIENCE

General Course Information:

Course Code: OE-ME-392-L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Understand structure-properties properties relationship
2. Understand the mechanical behavior of materials, phase & phase diagram, heat treatment, failure of materials & their protection, applications of recent materials.
3. Develop intuitive understanding of the subject to present a wealth of real world engineering examples to give students a feel of how material science is useful in engineering practices.

By the end of the course a student is expected to:

1. Analyze the Structure of materials at different levels, basic concepts of crystalline materials.
2. Explain the concept of phase & phase diagram & understand the basic terminologies associated with metallurgy. Construction and identification of phase diagrams and reactions.
3. Understand and suggest the heat treatment process & types.
4. Explain features, classification, applications of newer class materials like smart materials, piezoelectric materials, biomaterials, composite materials etc.

Course Contents

UNIT-I

Crystallography: Review of crystal structure, space lattice, crystal planes and crystal directions, co-ordination number, number of atoms per unit cell, atomic packing factor,.

Imperfection in metal crystals: Crystal imperfections and their classifications, point defects, line defects, edge & screw dislocations, surface defects, volume defects & effects of imperfections on metal properties.

UNIT-II

Solid solutions and phase diagram: Introduction to single and multiphase solid solutions and types of solid solutions, importance and objectives of phase diagram, systems, phase and structural constituents, cooling curves, unary & binary phase diagrams, Gibbs's phase rule, Lever rule, eutectic and eutectoid systems, peritectic and peritectoid systems, iron carbon equilibrium diagram and TTT diagram.

Heat Treatment: Principles, purpose, classification of heat treatment processes, annealing, normalizing, stress relieving, hardening, tempering, carburizing, nitriding, cyaniding, flame and induction hardening, Allotropic transformation of iron and steel, Properties of austenite, ferrite, pearlite, martensite.

UNIT-III

Deformation of Metal: Elastic and plastic deformation, mechanism of plastic deformation, twinning, conventional and true stress strain curves for polycrystalline materials, yield point phenomena, strain ageing, work hardening, Bauschinger effect, season cracking, Recovery, re-crystallization and grain growth.

Failures of metals: Failure analysis, fracture, process of fracture, types of fracture, fatigue, characteristics of fatigue, fatigue limit, mechanism of fatigue, factors affecting fatigue.

UNIT-IV

Creep & Corrosion: Definition and concept, creep curve, mechanism of creep, impact of time and temperature on creep, creep fracture, creep testing and prevention against creep. Corrosion: Mechanism and effect of corrosion, prevention of corrosion.

Plastic, Composite and Ceramics: Polymers, formation of polymers, polymer structure and crystallinity, polymers to plastics types, reinforced particles-strengthened and dispersion strengthened composites. Ceramic materials: Types of ceramics, properties of ceramic, ceramic forming techniques, mechanical behavior of ceramic.

Text and Reference Books:

- Elements of Material Science and Engineering: VanVlack, Wesley Pub. Comp.
- Material Science - Narula, Narula and Gupta. New Age Publishers
- Material Science & Engineering –V. Raghvan, Prentice Hall of India Pvt. Ltd, New Delhi
- A Text Book of Material Science & Metallurgy – O.P. Khanna, Dhanpat Rai & Sons
- Material Science and Engineering-An Introduction - Callister; W.D., John Wiley & Sons., Delhi.
- Engineering Materials: Kenneth G. Budinski, Prentice Hall of India, New Delhi

COMPUTER AIDED DESIGN AND MANUFACTURING

General Course Information:

Course Code: OE-ME-491 -L Course Credits: 4.0 Contact Hours: 4 hours/week Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Objectives and Outcomes:

The objectives of this course are to:

1. Provide the basic overview of CAD/CAM and 3D modeling approaches.
2. Provide an understanding about the types of geometric transformation and mathematical representation of curves.
3. Impart knowledge of mathematical representations of surfaces and solids.
4. Expose the students about computer assisted part programming for CNC machines.

By the end of the course a student is expected to:

1. Understand the scope and applications of CAD/CAM and geometric modeling techniques.
2. Understand the basic overview of geometric transformations and curves.
3. Understand the representation schemes of the surfaces and solids.
4. Understand the part programming and able to generate CNC part programmes.

Course Contents

UNIT-I

Introduction and Geometric modeling: Historical developments, product life cycle, CAD/CAM systems, scope of CAD/CAM, CAD/CAM applications, 3D modeling approaches, types of geometric modeling, coordinate systems, sketching and sketch planes, basic features of a CAD/CAM system (extrusion, revolution, hole, cut, sweep, loft, fillet, chamfer, rib, shell, draft, patterns spiral and helix), feature based modeling, parametric modeling, datum features, geometric constraints, modeling operations, heterogeneous modeling, modeling strategies, master model, system modes, model viewing.

UNIT-II

Transformations: Introduction, transformation of points and line, 2-D translation, rotation, reflection, scaling, homogeneous representation, concatenated transformation, mapping of geometric models, 3-D scaling, shearing, rotation, reflection and translation, combined transformations.

UNIT-III

Curves, surfaces and solids: Cubic-Spline curve, Bezier curve and B-Spline curve, plane surface, ruled surface, surface of revolution, tabulated cylinder, bi-cubic surface, Bezier surface, B-Spline surface, geometry and topology, Solid models and representation schemes, boundary representation, constructive solid geometry, sweep representation

UNIT-IV

CNC Technology: Introduction, types of NC systems, NC machine tools, principle of operation of CNC, advantages and limitations of CNC systems, Direct numerical control (DNC) and its application, NC part programming, coordinate systems, NC programming languages, G & M codes, Part program for simple parts.

Text and Reference Books:

1. Zeid, I., "CAD/CAM", McGraw Hill, 2008.
2. Groover and Zimmer, "CAD/ CAM", Prantice Hall.
3. Rogers, D. F. and Adams, J. A., "Mathematical Elements for Computer Graphics", McGraw Hill.
4. Radhakrishnan, P. and Kothandaraman, C. P., "Computer Graphics & Design", Dhanpat Rai Publication", 2nd edition, 2005.
5. Krishnamoorathy, C. S. and Rajeev, J. S., "Computer Aided Design (Software and Analysis Tools)", Narosa Publication House, 2nd edition, 2005.
6. Kundra T. K., Rao P. N. and Tiwari N. K, "Numerical Control and Computer Aided Manufacturing", McGraw Hill.