KONGU ENGINEERING COLLEGE
PERUNDURAI ERODE – 638 052
(Autonomous)

VISION

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

MISSION

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

QUALITY POLICY

We are committed to

- Providing value based quality education for the development of students as competent and responsible citizens.
- Contributing to the nation and beyond through research and development
- Continuously improving our services

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To be a centre of excellence for development and dissemination of knowledge in Mechanical Engineering for the Nation and beyond.

MISSION

Department of Mechanical Engineering is committed to

MS1: Establish itself as an excellent academic centre through expert pedagogical methods and modern laboratories to produce world class mechanical engineers.

MS2: Disseminate knowledge through seminar, conferences and continuing education programs.

MS3: Make tie-ups with industries, research centres and renowned intuition to synergize the benefit.

MS4: Contribute towards the upliftment of the society.

2011 REGULATIONS

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates of Mechanical Engineering will

PEO1: Practice Mechanical Engineering in the general stems of design, manufacture, service and allied engineering sectors.

PEO2: Habituate continuous learning and carryout research and development in science, engineering and technology that supports career growth.

PEO3: Exhibit ethical code of conduct in a professional manner to solve real-time multidisciplinary engineering problems.

PEO4: Demonstrate managerial and leadership capabilities that supports economic development of firms as well as society.

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3	PEO4
MS1	3	2	1	1
MS2	2	3	1	2
MS3	2	2	2	2
MS4	1	3	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)

Graduates of Mechanical Engineering will be able to

a. apply knowledge of mathematics, science and engineering

b. design and conduct experiments, as well as to analyze and interpret data

c. design a system, component, or process to meet desired needs within realistic constraints

d. function in multidisciplinary teams

e. identify, formulate and solve engineering problems

f. understand the professional and ethical responsibility

g. communicate effectively

h. understand the impact of engineering solutions in a global and societal context

i. recognize the need for and an ability to engage in continuous learning

j. use knowledge on contemporary issues

k. use the techniques, skills and modern engineering tools necessary for engineering practice

l. work professionally in thermal, manufacturing and mechanical system areas including the design and realization of such system with the use of computational tools

m. demonstrate knowledge and understanding of economics/financial management, project management and entrepreneurship skills

MAPPING OF PEOs WITH POs

PEO\PO	a	b	c	d	e	f	g	h	i	j	k	l	m
PEO1	3	3	3	2	2	2	2	2	2	2	2	3	3
PEO2	2	2	2	2	2	1	2	2	2	3	3	3	2
PEO3	2	2	2	2	3	2	2	2	2	2	2	3	1
PEO4	2	3	2	1	1	3	2	2	2	2	2	3	1

1 – Slight, 2 – Moderate, 3 – Substantial

CURRICULUM BREAKDOWN STRUCTURE UNDER REGULATION 2011

Curriculum Breakdown Structure(CBS)	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total number of credits
Basic Sciences(BS)	20.00	645	37
Engineering Sciences(ES)	13.51	465	25
Humanities and Social Sciences(HS)	3.24	90	6
Program Core(PC)	48.64	1710	90
Program Electives(PE)	8.1	990	15
Open Electives(OE)	-	-	-
Project(s)/Internships(PR)	6.48	135	12
Total			**185**

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B.E. DEGREE IN MECHANICAL ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11EL101	Technical English	3	0	0	3	50	50	100	BS
11MA101	Engineering Mathematics - I	3	1	0	4	50	50	100	BS
11PH101	Applied Physics	3	0	0	3	50	50	100	BS
11CY101	Applied Chemistry	3	0	0	3	50	50	100	BS
11CS101	Problem Solving and Programming	3	0	0	3	50	50	100	ES
11EE101	Basics of Electrical and Electronics Engineering	3	0	0	3	50	50	100	ES
	PRACTICAL								
11PH102	Physical Sciences Laboratory – I	0	0	3	1	50	50	100	BS
11CS102	Programming Laboratory	0	0	3	1	50	50	100	ES
				Total	**21**				

CA- Continuous Assessment, ESE- End Semester Examination
CBS – Curriculum Breakdown Structure

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(For the candidates admitted from academic year 2011-12 onwards)

SEMESTER – II

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11EL201	Communication Skills	3	0	0	3	50	50	100	BS
11MA201	Engineering Mathematics - II	3	1	0	4	50	50	100	BS
11PH201	Materials Science	3	0	0	3	50	50	100	BS
11CY201	Environmental Science	3	0	0	3	50	50	100	BS
11ME101	Basics of Civil and Mechanical Engineering	3	0	0	3	50	50	100	ES
11ME102	Engineering Drawing	2	0	3	3	50	50	100	ES
	PRACTICAL								
11PH202	Physical Sciences Laboratory -II	0	0	3	1	50	50	100	BS
11ME103	Engineering Practices Laboratory	0	0	3	1	50	50	100	ES
11EL202	Communication Skills Laboratory	0	0	3	1	50	50	100	BS
				Total	**22**				

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CURRICULUM
(For the candidates admitted from academic year 2011 – 12 onwards)

SEMESTER – III

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11MA301	Engineering Mathematics - III	3	1	0	4	50	50	100	BS
11ME301	Engineering Mechanics	3	1	0	4	50	50	100	ES
11ME302	Engineering Thermodynamics	3	1	0	4	50	50	100	PC
11ME303	Fluid Mechanics and Machinery	3	1	0	4	50	50	100	PC
11ME304	Manufacturing Technology	3	0	0	3	50	50	100	PC
11EE308	Electrical Drives	3	0	0	3	50	50	100	ES
	PRACTICAL								
11ME305	Fluid Mechanics and Machinery Laboratory	0	0	3	1	50	50	100	PC
11ME306	Manufacturing Technology Laboratory – I	0	0	3	1	50	50	100	PC
11EE309	Electrical Engineering Laboratory	0	0	3	1	50	50	100	ES
				Total	**25**				

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CURRICULUM
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SEMESTER – IV

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11MA401	Numerical Methods	3	1	0	4	50	50	100	BS
11ME401	Strength of Materials	3	1	0	4	50	50	100	PC
11ME402	Thermal Engineering	3	1	0	4	50	50	100	PC
11ME403	Kinematics of Machinery	3	1	0	4	50	50	100	PC
11ME404	Material Removal Processes	3	0	0	3	50	50	100	PC
11ME405	Engineering Materials and Metallurgy	3	0	0	3	50	50	100	ES
	PRACTICAL								
11ME406	Thermal Engineering Laboratory	0	0	3	1	50	50	100	PC
11ME407	Manufacturing Technology Laboratory – II	0	0	3	1	50	50	100	PC
11ME410	Advanced Materials Testing Laboratory	0	0	3	1	50	50	100	PC
				Total	**25**				

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CURRICULUM
(For the candidates admitted from academic year 2011 – 12 onwards)

SEMESTER – V

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11ME501	CAD/CAM/CIM	3	0	0	3	50	50	100	PC
11ME502	Dynamics of Machinery	3	1	0	4	50	50	100	PC
11ME503	Design of Machine Elements	3	1	0	4	50	50	100	PC
11ME504	Metrology and Measurements	3	0	0	3	50	50	100	PC
11ME505	Operations Research	3	1	0	4	50	50	100	PC
11ME506	Machine Drawing	3	0	3	4	50	50	100	PC
	PRACTICAL								
11ME507	CAD/CAM Laboratory	0	0	3	1	50	50	100	PC
11ME508	Metrology and Measurements Laboratory	0	0	3	1	50	50	100	PC
11ME509	Dynamics Laboratory	0	0	3	1	50	50	100	PC
				Total	**25**				

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CURRICULUM
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SEMESTER – VI

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11GE601	Economics and Management for Engineers	3	0	0	3	50	50	100	HS
11ME601	Heat and Mass Transfer	3	1	0	4	50	50	100	PC
11ME602	Design of Transmission Systems	3	1	0	4	50	50	100	PC
11ME603	Finite Element Analysis	3	1	0	4	50	50	100	PC
11ME604	Fluid Power System	3	0	0	3	50	50	100	PC
	Elective-I	3	0	0	3	50	50	100	PE
	PRACTICAL								
11ME605	Heat Transfer Laboratory	0	0	3	1	50	50	100	PC
11ME606	Computer Aided Simulation and Analysis Laboratory	0	0	3	1	50	50	100	PC
11ME607	Design and Fabrication Project	0	0	6	2	50	50	100	PR
				Total	**25**				

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CURRICULUM
(For the candidates admitted from academic year 2011 – 12 onwards)

SEMESTER – VII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11ME701	Industrial Automation	3	0	0	3	50	50	100	PC
11ME702	Industrial Engineering and Cost Analysis	3	0	0	3	50	50	100	PC
11ME703	Automobile Engineering	3	0	0	3	50	50	100	PC
11GE701	Total Quality Management	3	0	0	3	50	50	100	PC
	Elective – II	3	0	0	3	50	50	100	PE
	Elective – III	3	0	0	3	50	50	100	PE
	PRACTICAL								
11MT706	Mechatronics Laboratory	0	0	3	1	50	50	100	PC
11ME704	Automobile Engineering and Fluid Power Laboratory	0	0	3	1	50	50	100	PC
11ME705	Comprehension for Project Work Phase – I	0	0	3	1	50	50	100	PR
				Total	**21**				

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CURRICULUM
(For the candidates admitted from academic year 2011 – 12 onwards)

SEMESTER – VIII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
11GE801	Professional Ethics And Human Values	3	0	0	3	50	50	100	HS
11ME801	Power Plant Engineering	3	0	0	3	50	50	100	PC
	Elective - IV	3	0	0	3	50	50	100	PE
	Elective - V	3	0	0	3	50	50	100	PE
	PRACTICAL								
11ME802	Project Work	0	0	18	9	100	100	200	PR
				Total	**21**				

CA – Continuous Assessment, ESE – End Semester Examination
CBS – Curriculum Breakdown Structure

LIST OF ELECTIVES						
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**CBS**
DESIGN STREAM						
11ME011	Design of Jigs, Fixtures and Press Tools	3	0	0	3	PE
11ME012	Industrial Tribology	3	0	0	3	PE
11ME013	Composite Materials	3	0	0	3	PE
11ME031	Advanced Structure of Materials	3	0	0	3	PE
11ME014	Introduction to Aircraft Systems	3	0	0	3	PE
11ME015	Introduction to Aircraft Structures	3	0	0	3	PE
11ME016	Design For Manufacture And Assembly	3	0	0	3	PE
THERMAL STREAM						
11ME017	Computational Fluid Dynamics	3	0	0	3	PE
11ME018	Gas Dynamics and Jet Propulsion	3	0	0	3	PE
11ME019	Refrigeration and Air Conditioning	3	0	0	3	PE
11ME020	Advanced Heat and Mass Transfer	3	0	0	3	PE
11ME021	Turbo Machines	3	0	0	3	PE
11ME022	Energy Conservation in Thermal Equipments	3	0	0	3	PE
11ME023	Renewable Energy Sources	3	0	0	3	PE
MANUFACTURING & INDUSTRIAL STREAM						
11ME024	Rapid Prototyping	3	0	0	3	PE
11ME025	Maintenance Engineering	3	0	0	3	PE
11ME026	Non Destructive Evaluation Techniques	3	0	0	3	PE
11GE011	Entrepreneurship Development	3	0	0	3	PE
11ME027	Automation in Manufacturing	3	0	0	3	PE
11ME028	Quality Control and Reliability Engineering	3	0	0	3	PE
11ME029	Manufacturing Information System	3	0	0	3	PE
11ME030	Robotics	3	0	0	3	PE

11EL101 TECHNICAL ENGLISH

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **17**

Grammar and Vocabulary: Word formation with prefixes and suffixes – Synonyms and Antonyms – Verb Patterns – Tenses (simple and compound tenses) - Simple, Compound and Complex Sentences - Voice – Use of Conditionals - Comparative Adjectives (affirmative and negative) – Expanding Nominal compounds - Articles - Use of Prepositions – Identifying Odd Words – Acronyms.

MODULE – II **13**

Listening: Listening for General Content – Intensive Listening – Listening for Specific Information : Retrieval of Factual Information – Listening to Identify Topic, Context, Function, Speaker's Opinion, Attitude, etc. – Global Understanding Skills and Ability to infer, extract gist and understand main ideas – Note-taking: Guided and unguided- Listening to fill up gapped texts.

Writing: Introduction to the Characteristics of Technical Style - Writing Definitions and Descriptions - Paragraph Writing (topic sentence and its role, unity, coherence and use of cohesive expressions) - Process Description(use of sequencing connectives)– Comparison and Contrast - Classifying the data - analysing / interpreting the data – Personal letter - Formal letter writing (Inviting Guest Speakers, letter to the editor, letter for seeking practical training, and letter for undertaking project works in industries) – editing (punctuation, spelling and grammar) – Recommendations & Suggestions.

MODULE- III **15**

Reading: Exposure to different Reading Techniques - Reading for Gist and global meaning - Predicting the content - Skimming the text – Identifying the Topic Sentence and its role in each paragraph - Scanning - Inferring / identifying lexical and contextual meanings - Reading for structure and detail - Transfer of information / guided note-making - Understanding discourse coherence - Sequencing of sentences.

Speaking: Verbal and Non Verbal Communication - Pronunciation drills/ Tongue Twisters – Formal and Informal English - Oral practice – Developing Confidence - Introducing Oneself - Asking for or Eliciting Information - Describing Objects – Offering Suggestions and Recommendations – expressing opinions (agreement / disagreement.

TOTAL : 45

TEXT BOOK

1. "English for Engineers and Technologists", Combined Edition, Volume. I & II, Orient Longman, Oxford University Press, New Delhi, 2006.

REFERENCE BOOKS

1. Aysha Viswamohan, "English for Technical Communication", Tata McGraw-Hill, New Delhi, 2008.
2. Rizvi M Ashraf, "Effective Technical Communication", Fifth Edition, Tata McGraw- Hill, New Delhi, 2007.
3. Mark Ibbotson, "Cambridge English for Engineering", Cambridge University Press, New Delhi, 2009.
4. Rama Krishna Rao, A, "Learning English: A Communicative Approach" Orient Black Swan, Hyderabad, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Improve their vocabulary and appropriate usage of words in different academic and professional contexts.

CO2: Familiarize with different rhetorical functions of technical English.

CO3: Develop strategies that could be adopted while reading texts.

CO4: Speak effectively in English and career related situations.

CO5: Acquire knowledge in academic and professional writing.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1									2	3		1	
CO2									2	3			
CO3				2					2	3		1	
CO4									2	3			
CO5				1					1	3		1	

3 – Substantial, 2 – Moderate, 1 – Slight

11MA101 ENGINEERING MATHEMATICS – I

(Common to all Engineering and Technology branches)

3 1 0 4

MODULE – I **15**

Matrices: Linear independent and dependent of vectors – Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties of eigen values and eigen vectors (without proof) – Cayley – Hamilton theorem (without proof).

Diagonalisation: Similarity transformation (concept only) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Nature of quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

MODULE – II **15**

Differential Calculus: Curvature – Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature. Involutes and evolutes – Envelopes – Properties of envelopes and evolutes.

Functions of several variables: Functions of two variables – Partial derivatives – Total differential – Maxima and minima – Constrained maxima and minima – Lagrange's multiplier method – Jacobians.

MODULE - III **15**

Differential Equations: Linear differential equations of Second and higher order with constant coefficients when the R.H.S is e^{ax}, x^n, $n > 0$, Sinax, Cosax, $e^{ax}x^n$, $e^{\alpha x}$ Sinβx, $e^{\alpha x}$ Cosβx, x^n Sinαx and x^n Cosαx– Differential Equations with variable coefficients (Cauchy's form). Method of variation of parameters - Simultaneous first order linear equations with constant coefficients.

Applications of Differential Equations: Solution of specified differential equations connected with electric circuits, simple harmonic motion (Differential equations and associated conditions need to be given).

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Kandasamy. P, Thilagavathy. K and Gunavathy. K., "Engineering Mathematics For First Year B.E/B.Tech", Reprint Edition 2011, S.Chand and Co., New Delhi.
2. Veerarajan. T., "Engineering Mathematics, (for first year)", Reprint Edition 2011, Tata McGraw-Hill, New Delhi.

REFERENCE BOOKS

1. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, New Delhi, 2007.
2. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House, New Delhi, 2007.
3. Bali N.P and Manish Goyal, "Text Book of Engineering Mathematics", 3rd Edition, Laxmi Publications, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Solve engineering problems which needs matrix computations.

CO2: Utilize the geometrical aspects of differential calculus and extremal problems which arise in function of several variables.

CO3: Apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3		1	2							1	
CO2	3	3										1	
CO3	3	3		1	2							1	

3 – Substantial, 2 – Moderate, 1 – Slight

11PH101 APPLIED PHYSICS

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Acoustics : Classification of sound – Characteristics of musical sound – Weber-Fechner law – Absorption Coefficient – Reverberation – Reverberation time – Sabine's formula (growth & decay) – Factors affecting acoustics of buildings (reverberation time, loudness, focusing, echo, echelon effect, resonance and noise) and their remedies.

Ultrasonics : Introduction – Production – Magnetostriction effect – Magnetostrictive generator - Inverse piezoelectric effect - Piezoelectric generator - Detection of ultrasonics - Properties – Cavitation - Industrial applications – drilling, welding, soldering and cleaning – SONAR - Non destructive testing – Ultrasonic pulse echo system - Medical applications – A, B and C Scan displays – Ultrasonic imaging technique.

MODULE – II **15**

Lasers: Introduction – Principle of spontaneous emission and stimulated emission - Population inversion, Pumping, Einstein's Coefficients (A&B) - Types of lasers – Nd:YAG, CO_2, Semiconductor lasers: Homojunction and Heterojunction – Laser Applications – Industrial applications – Laser welding, Laser cutting, Laser drilling – Holography – Construction and reconstruction of images.

Fiber Optics & Applications: Principle – Classification based on materials, Modes of propagation, Refractive index profile - Crucible-crucible technique of fiber fabrication - Light sources for fiber optics – Detectors - Fiber optical communication links - Losses in optical fibers – Fiber optic sensors – Temperature, displacement, voltage and magnetic field measurement.

MODULE - III **15**

Quantum Physics and Applications: Black body radiation – Planck's theory (derivation)– Deduction of Wien's displacement law and Rayliegh – Jean's Law from Planck's theory – Compton effect – Theory and experimental verification - Matter waves – Uncertainty principle - Experimental verification – Schroedinger's wave equations – Time independent and time dependent equation – Physical Significance of wave function – Particle in a box (One dimensional) - Optical microscope – Limitations of optical microscopy - Scanning electron microscope - Transmission electron microscope.

TOTAL : 45

TEXT BOOKS

1. Avadhanalu M N and Kshirsagar P G, "A Text Book of Engineering Physics", S.Chand & company Ltd, New Delhi, 2007.
2. Palanisamy P K, "Engineering Physics", Scitech Publications, Chennai, 2008.

REFERENCE BOOKS

1. Gaur R K and Gupta S L , "Engineering Physics", Dhanpat Rai and Sons, New Delhi, 2006.
2. Rajendran V, "Engineering Physics", Prentice Hall of India, New Delhi, 2008.
3. Rajagopal K, "Textbook of Engineering Physics", Part I, PHI Learning Pvt. Ltd., New Delhi, 2008.
4. Personick S D, "Fibre Optics, Technology and Applications", Khanna Publishers New Delhi, 1987.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: get an insight into design of acoustically good buildings and applications of laser in engineering and technology.

CO2: gain basic knowledge in Fiber optic concepts and fiber optic communication link.

CO3: understand the applications of quantum physics to optical and electrical phenomena.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	1									2		
CO2	2	1									2		
CO3	2	1									2		

3 – Substantial, 2 – Moderate, 1 – Slight

11CY101 APPLIED CHEMISTRY

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Water: Introduction - Sources of water - impurities in water - Types of water - Water quality standards - Water quality parameters (Discussion not required) - Hardness of water- Expression of hardness - Units of hardness –Estimation of Hardness of water by EDTA method – Determination of alkalinity - Disadvantages of using hard water - Boiler troubles due to hard water - scale and sludge formation – Boiler corrosion – caustic embrittlement- priming and foaming-Softening of water- External treatment methods - Lime soda, zeolite and demineralization process (principle, process, advantages and disadvantages only) Internal treatment process - colloidal, carbonate, calgon and phosphate conditioning (brief discussion only) - desalination by reverse osmosis method. **Electrochemistry:** Introduction - Cells – Representation of a galvanic cell - EMF measurements and its applications – Electrode potential - Nernst Equation – Reference electrodes (hydrogen and calomel electrodes) – Electrochemical series and its applications – Conductometric titrations (strong acid Vs strong base only) - Batteries – Lead acid and Ni-Cd batteries.

MODULE – II **15**

Corrosion and Its Control: Introduction – Mechanism of dry and wet corrosion – galvanic corrosion - concentration cell corrosion – Galvanic series - Factors influencing rate of corrosion – corrosion control methods - Sacrificial anode and impressed current cathodic method – Corrosion inhibitors - Protective coatings - classifications - Pretreatment of metal surface - Metallic coating -electroplating and electrolessplating (General discussion) - Hot dipping (Tinning and galvanising) - Nonmetallic coating - surface conversion coating (phosphate coating and anodized coating) - Organic coating - paints – constituents and their function – Special paints (Fire retardant, temperature indicating, water repellant and luminescent paints) **Combustion:** Introduction – Calorific Values – Gross and net – Theoretical calculation of minimum air for combustion (Theoretical aspects only) – flue gas analysis – Orsat's method - Explosive range and Spontaneous Ignition Temperature.

MODULE - III **15**

Fuels: coal – proximate and ultimate analysis – their importance – metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel - refining of petroleum - Straight run, cracked and polymer petrol – Manufacture of synthetic petrol - polymerization (thermal and catalytic methods) - Hydrogenation of coal (Fisher Tropsch and Bergius methods) - knocking - octane number – improving octane number by additives – Diesel – cetane number – Gaseous fuels (Water gas, producer gas and biogas)

Polymers: Introduction – Nomenclature of polymers – functionality – polymerization - types – addition, condensation and co-polymerization with examples – Effect of polymer structure on properties (strength, plastic deformation, crystallinity and chemical resistance) - plastics – types (thermo and thermosetting plastics) - individual polymers - Polyethylene, polypropylene, PVC, Teflon, Bakelite and epoxy resin (preparation, properties and uses only) - Compounding of plastics-Fabrication of plastics (compression, injection and extrusion moulding methods) – conducting polymers

TOTAL : 45

TEXT BOOK

1. Jain PC and Monica Jain, "Engineering Chemistry", 15th Edition, Dhanpat Rai publication Co., New Delhi, 2008.

REFERENCE BOOKS

1. Dara S.S., "A Text Book of Engineering Chemistry", S.Chand & Co. Ltd., New Delhi, 2006.
2. Sharma B.K., "Engineering Chemistry", Krishna Prakasan Media (P) Ltd., Meerut, 2001.
3. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill, New Delhi, 2008.
4. Krishnamurthy N., "Engineering Chemistry", 2nd Edition, PHI Learning private Limited, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: acquire basic knowledge of water treatment.
CO2: understand the principles of electrochemistry, electrochemical cells, Emf series and energy storing devices.
CO3: understand the types and prevention methods of corrosion
CO4: understand the developments in polymers and plastics

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3										2		
CO2	3										2		
CO3	3										2		
CO4	3										2		

3 – Substantial, 2 – Moderate, 1 – Slight

11CS101 PROBLEM SOLVING AND PROGRAMMING

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Basics: Evolution of computers- Generations of computers- Classification of computers- Applications of computers-Hardware - Software-Information Technology-Internet Problem-Solving Techniques- Program Control Structures-Programming Paradigms and Languages-Generations of Programming Languages.

Problem Solving: Introduction – Problem Solving Aspects- Top-Down Design-Implementation of Algorithms-Program Verification- Efficiency of Algorithms- Analysis of Algorithms- Fundamental algorithm- Factorial Computation - Generation of Fibonacci Sequence.

MODULE – II **15**

C Fundamentals and Arrays: Introduction to C – C programming structure – C character set – Identifiers – keywords. Data types – Constants – variables- Operators – Expressions – Library functions Managing Input and Output – formatted input and output. Control statements – Decision making and branching – Looping structures- Arrays – One dimensional array – Two dimensional arrays – Multidimensional arrays. Character arrays and strings.

MODULE - III **15**

Functions, Structures and Files: Functions - User defined functions: declaration, definition function call and parameter passing mechanisms – Recursion –Array and Functions - User defined data types –typedef - Structures – Unions –File operations in C- Introduction to pointer –Pointer Declaration and Initialization-Accessing a Variable through a pointer-Difference between array and Pointers.

TOTAL : 45

TEXT BOOKS

1. Kamthane, Ashok N. “Computer Programming”, Pearson Education, New Delhi, 2007.
2. Dromey, R.G., “How to solve it by Computers”, Pearson Publishers, New Delhi, 2007.

REFERENCE BOOKS

1. Gottfried Byron S, “Programming with C”, Second Edition, Tata McGraw-Hill, New Delhi, 2006.
2. Kanetkar Yashavant P., “Let us C”, Fifth Edition, BPB publications, New Delhi, 2005.
3. Schildt Herbert, “The Complete Reference C”, Fourth Edition, Tata McGraw-Hill, New Delhi, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Outline the changes in hardware and software technologies with respect to evolution of computers and programming languages

CO2: Apply fundamental principles of problem solving techniques

CO3: Develop programs using basic programming principles of C language

CO4: Design simple applications using structured programming techniques and file concepts

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	1	1		1				2		1		
CO2	3	2	2		3					1			
CO3		3			3						2		
CO4		3			3								
CO5													

3 – Substantial, 2 – Moderate, 1 – Slight

11EE101 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to Civil, Mechanical, Chemical, Food Technology, Computer Science and Information Technology branches)

3 0 0 3

MODULE – I **15**

Electrical Systems: Kirchhoff's Laws – Resistors in series and Parallel, Voltage and Current division Rule, Mesh Analysis of Simple Resistive networks – Introduction to AC Circuits – Sinusoidal Voltage, Current, R.M.S and Average value. Power System: Introduction- Structure of electric power system- Transmission and Distribution systems – Various levels of Transmission and Distribution Voltages..

Electrical Machines: DC Machines Construction, Principle of Operation, Basic Equation and Applications of: DC Generators (EMF equation), DC Motors (Torque equation).

MODULE – II **15**

AC Machines: Single Phase Transformer- Construction and Working Principle of Three Phase Induction Motors- Single Phase Induction Motors: Split Phase and Capacitor Start Motors.

Semiconductor Devices and Applications: Semiconductors and Junction Diodes : Distinction between Conductors, Semiconductors and Insulators – Properties of Semiconductors – PN Junction Diode- Rectifiers and Filters- Zener Diodes – Zener Diode Voltage Regulator– LEDs. Junction Transistors: Principle of Operation – CE,CB and CC Configurations – Static Characteristics – CE Transistor as an Amplifier – Characteristics and Applications of SCR and UJT.

Digital Electronics: Introduction– Binary Number Systems and Conversions – Binary Addition and Subtraction -Logic Gates and Truth tables.

MODULE - III **15**

Digital Electronics: Boolean Algebra: Basic laws and Demorgan's theorem – Simplification of Boolean Functions —Full Adder and Full Subtractor – Flip-Flops: RS,JK,D and T – Counter: 4 Bit Binary Ripple Counter.

Linear IC'S: OPAMPs: – Ideal Characteristics –Applications of OP-Amps: Inverting and Non-Inverting Amplifier, Voltage Follower, Adder and Subtractor.

Fundamentals of Communication Engineering: Introduction – Need for Modulation – Amplitude Modulation – Frequency Modulation – Comparison of AM & FM Communication Systems (Block Diagram approach): Radio, TV: Standards, Transmitter and Receiver- Satellite and Optical Fibre Communication

Powersupplies (Block Diagram Approach) : Regulators, UPS and SMPS

TOTAL : 45

TEXT BOOKS

1. Hughes Edward., Smith Mckenzie., Hiley John and Brown Keith., "Electrical and Electronic Technology", 9th Edition, Pearson Education, New Delhi.
2. Muthusubramanian, Salivahanan R.S. and Muraleedharan K.A., "Basic Electrical, Electronics and Computer Engineering", Tata McGraw-Hill, New Delhi, 2007.

REFERENCE BOOKS

1. Millman and Halkias, "Integrated Electronics", Tata McGraw-Hill, New Delhi, 1998.
2. Kennedy, David, "Electronic Communication Systems", Tata McGraw – Hill, New Delhi, 2000.
3. Gayakward, Ramakant A. "Op-Amps and Linear Integrated Circuits", Pearson Education, New Delhi, 2002.
4. Metha, V.K and Rohit Mehta, "Principles of Power System", S. Chand & Company Ltd., New Delhi, 2006.
5. Smarajit Ghosh, "Electrical and Electronics Engineering", Second Edition, Prentice Hall of India, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Develop a basic understanding of the concept of electrical systems

CO2: Illustrate the construction and working of different types of electric machines

CO3: Gain basic knowledge of analog and digital electronics

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2	2									1	
CO2	3	1										1	
CO3	3											1	

3 – Substantial, 2 – Moderate, 1 – Slight

11PH102 PHYSICAL SCIENCES LABORATORY – I

(Common to all Engineering and Technology branches)

0 0 3 1

PART-A: APPLIED PHYSICS LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. (a) Particle size determination using Diode Laser.
   (b) Determination of Laser parameters – Wavelength and angle of divergence.
   (c) Determination of acceptance angle in an optical fiber.
2. Determination of thickness of a thin wire – Air wedge method.
3. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
4. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
5. Determination of dispersive power of a prism using spectrometer.
6. Determination of Young's modulus of the material – non uniform bending.

PART-B: APPLIED CHEMISTRY LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. Estimation of Total, Temporary and Permanent hardness of water by EDTA method.
2. Estimation of Ca^{2+} and Mg^{2+} hardness separately by EDTA method.
3. Estimation of Alkalinity of a water Sample.
4. Conductometric titration - Mixture of acids.
5. Estimation of Hydrochloric acid using PH meter.
6. Estimation of Ferrous ion by Potentiometric titration.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: perform experiments on fibre, laser, optics, ultrasonic wave and carey Faster's bridge.

CO2: understand the concepts of numerical aperture, acceptance angle, wavelength, dispersive power, interference, velocity, compressibility and specific resistance.

CO3: get a basic idea about the analysis of hardness, amount of Ca^{2+} and Mg^{2+}, presence of alkalinity in water.

CO4: get a basic idea about the handling of instruments like pH meter and conductivity meter for the estimation of unknown concentration of acids.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1		3									1		
CO2		3									1		
CO3		3									1		
CO4		3									1		

3 – Substantial, 2 – Moderate, 1 – Slight

11CS102 PROGRAMMING LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

A) APPLICATION PACKAGES

1. To create an advertisement using word
2. To illustrate the concept of mail merging using word
3. To create a spread sheet to analyse the marks of the students of a class and also to create appropriate charts using excel
4. To create the presentation for the department using power point
5. To create the presentation for digital computers using power point

B) C PROGAMMING (ANY TWO PROGRAMS IN EACH SECTION)

6. Simple programs using decision making and branching:
   a. Program to find biggest of three numbers
   b. Design of simple menu driven calculator
   c. Program to find the roots of the quadratic equation
   d. Program to convert the given decimal number to binary
   e. Program to print the prime numbers between 100 to 500
   f. Program to print the electricity bill in a specified format applying specified rules
7. Programs using arrays:
   a. Program to find the biggest number in the array
   b. Menu driven program to insert and delete a specified element from the array
   c. Program to arranged the elements of the array in ascending order
   d. Program to merge given two one dimensional arrays and to remove the duplicates
   e. Program for multiplication of two matrices
8. String manipulations:
   a. Program to find the length of the string, copy one string to another and compare two strings, concatenate two strings without using library functions.
   b. Program to check whether the given string is a palindrome or not without reversing
   c. Program to find the occurrence of a substring in a main string and replace the substring by another string.
   d. Arranging the list of names in alphabetical order
   e. Program to count the number of occurrences of vowels, consonants, words, white spaces and special characters in the given statement.
9. Functions:
   a. Program to swap the contents of two variables using functions (Pass by address and pass by reference)
   b. Program to print the Fibonacci series using recursive function
   c. Program to print the average and standard deviation of the elements of the one- dimensional array using function.
   d. Program to print the transpose of a matrix using functions
   e. Menu driven program to perform string operations using functions
10. Structures and file operations:
    a. Define a structure to store the student details viz., Roll no, name, marks in three subjects, total, avg and class obtained. Read the first three fields and write your logic to calculate the total, average and class obtained for ten students. Print the results in the order of ran obtained.
    b. Structure based program to print the pay slip of an employee.
    c. Program using files to copy the contents of one file to another

REFERENCES / MANUALS/SOFTWARE:

Software requirements

Operating System : Windows / Linux

Compiler : C compiler

Packages: MS office or Equivalent

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Utilize the features of MS office package to create documents, presentation and reports

CO2: Write and execute programs to illustrate decision making and branching

CO3: Develop programs using 1D and 2D arrays

CO4: Create programs for manipulating strings

CO5: Demonstrate the use of functions and structures to develop applications

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1											3		
CO2	3	2			2								
CO3	3	2			2								
CO4	3	2			2								
CO5	3	1			3								

3 – Substantial, 2 – Moderate, 1 – Slight

11EL201 COMMUNICATION SKILLS

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Focus on language: Cause and effect expressions - indicators of purpose and function - connectives -imperatives - modal verbs - infinitives and gerunds - reporting verbs - homonyms - commonly confused (mispronounced and misspelt) words - phrasal verbs - British and American Vocabulary.- rules for writing SI [system international] units - concord.

MODULE – II **15**

Listening: Listening practice - Radio / TV news - documentaries - listening to short and long conversations in different domains of activity/ live speech - new inventions, products, announcements, casual conversation, and academic lectures.

Writing: Formal letter writing (letter of application - job application) , Business (calling for quotation, placing orders , letter of complaint) - structure of memorandum and technical reports (reports on visits made to industries, report on an accident in the factory, meeting report) – notices - agenda - instructions - e-mails - Preparing Checklist- note taking and note making.

MODULE- III **15**

Speaking: Communication – accuracy, fluency, appropriateness – levels of formality – oral practice activities related to professional skills – role play using different functions (persuasion, negotiation, giving directions and guidance) – conversational etiquette (greetings, making requests, permission, accepting, denying, declining, politeness strategies, turn-taking, body language) – making speeches – describing people, place, things and events.

Reading: Reading comprehension – guided note- making – providing a suitable title - identifying main points, supporting ideas – evaluating the style (argumentative / descriptive etc) – drawing inferences separating facts from opinions – interpreting text in different genres.

TOTAL : 45

TEXT BOOK

1. Department of Science and Humanities, Anna University, Chennai. “English for Engineers and Technologists”, Combined Edition Volumes (I & II), Orient Longman, Oxford University Press, New Delhi, 2006.

REFERENCE BOOKS

1. Kiranmai. Dutt P, Geetha Rajeevan and Prakash, C. L. N., “A Course in Communication Skills”, Cambridge University Press, New Delhi, 2007.
2. Meenakshi Raman and Sangeetha Sharma, “Technical Communication”, Oxford University Press, New Delhi, 2006.
3. Sangeetha Sharma and Binod Mishra, “Communication Skills for Engineers and Scientists”, PHI Learning, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Improve their vocabulary and appropriate usage of words.

CO2: Familiarize with different rhetorical functions of technical English.

CO3: Speak effectively in English in real-life and career-related situations.

CO4: Acquire knowledge in academic and professional writing.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1									2	3		1	
CO2									2	3			
CO3									1	3			
CO4				1					1	3		1	

3 – Substantial, 2 – Moderate, 1 – Slight

11MA201 ENGINEERING MATHEMATICS – II

(Common to all Engineering and Technology branches)

3 1 0 4

MODULE – I **15**

Multiple Integrals: Double integration in Cartesian coordinates – Change of order of integration – Area between two curves – Area as double integrals – Triple integration in Cartesian coordinates –Volume as Triple integrals (Simple problems only). **Vector Calculus**: Gradient, divergence and curl – Line, surface integral (Concept Only) and volume integrals (Concept Only) – Green's, Gauss divergence and Stoke's theorems (without proof) – Verification of the above theorems and evaluation of integrals using them (Simple problems only).

MODULE – II **15**

Analytic Functions: Functions of a complex variable – Analytic functions – Necessary conditions and Sufficient conditions (excluding proof) – Cauchy– Riemann equations — Properties of analytic function (Statement only) – Harmonic functions – Construction of Analytic functions – Conformal mapping: $w = z + a$, az, $\frac{1}{z}$ - Bilinear transformation.

Complex Integration: Cauchy's theorem (without proof) – Cauchy's integral formula – Taylor and Laurent's series (without proof) – Singularities – Classification – Cauchy's residue theorem (Statement only) – Contour integration – circular and semi-circular contours (excluding poles on real axis).

MODULE – III **15**

Laplace Transforms: Conditions for existence – Transform of elementary functions –Basic properties – Derivatives and integrals of transforms – Transforms of derivatives and integrals – Initial and final value theorems – Transform of unit step function – Transform of periodic functions.

Inverse Laplace transforms: Inverse Transform of elementary functions – Partial fraction method – Convolution theorem (without proof) – Solution of linear ODE of second order with constant coefficients.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Kandasamy. P, Thilagavathy. K and Gunavathy. K, "Engineering Mathematics For First Year B.E/B.Tech", Reprint Edition 2011, S.Chand and Co., New Delhi.
2. Veerarajan. T., "Engineering Mathematics, (for first year), Reprint Edition 2011, Tata McGraw-Hill New Delhi.

REFERENCE BOOKS

1. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, New Delhi, 2007.
2. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", Third Edition, Narosa Publishing House, New Delhi, 2007.
3. Bali. N.P and Manish Goyal, "Text Book of Engineering Mathematics", Third Edition, Laxmi Publications, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify problems involving vectors, double and triple integrals

CO2: measure the knowledge of analytic functions.

CO3: evaluate complex integrals which are extensively applied in engineering.

CO4: adapt Laplace transforms to solve practical problems.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3		1	2							1	
CO2	3											1	
CO3	3	3		1	2							1	
CO4	3	3		1	2							1	

3 – Substantial, 2 – Moderate, 1 – Slight

11PH201 MATERIALS SCIENCE

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Crystal Physics: Introduction – Lattice – Unit cell – Crystal systems – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal imperfections : Point, line and surface imperfections.

Conducting Materials: Conductors – Classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – Carrier concentration in metals.

MODULE – II **15**

Semiconducting Materials: Intrinsic semiconductor – Carrier concentration derivation – Extrinsic semiconductors – Carrier concentration derivation in n-type and p-type semiconductors – Hall effect – Determination of Hall coefficient – Applications – Semiconductor devices – Solar cells – LDR.

Magnetic and Dielectric Materials: Types of magnetic materials – Domain theory – Hysteresis – Soft and hard magnetic materials – Magnetic devices – Transformer core – Magneto optical recording – Dielectric constant – Qualitative study of polarization – Frequency and temperature dependence of polarization – Dielectric loss – Dielectric breakdown – Uses of dielectric materials (capacitor and transformer) – Ferro electric materials.

MODULE- III **15**

Smart Materials : Metallic glasses: Preparation, properties and applications - Shape memory alloys (SMA): Characteristics, properties, applications, advantages and disadvantages of SMA – Superconductors: Properties – Types of superconductors – BCS theory of superconductivity(Qualitative) – High T_c superconductors – Applications of superconductors – SQUID – cryotron – magnetic levitation.

Nano Materials: Synthesis: Lithographics – Vapour phase physical and chemical deposition methods – Colloidal and solgel methods – Properties of nanoparticles and applications – Carbon nanotubes: Structure – Properties – Fabrication by Laser ablation – Applications.

TOTAL : 45

TEXT BOOKS

1. Kittel. Charles, “Introduction to Solid State Physics”, Seventh Edition, John Wiley & sons, Singapore, 2007.
2. Poole. Charles P and Ownen. Frank J., “Introduction to Nanotechnology”, Wiley India, 2007. (For Module III).

REFERENCE BOOKS

1. Pillai. S O, “Solid State Physics”, Fifth Edition, New Age International, New Delhi, 2003.
2. Rajendran. V, “Engineering Physics”, Prentice Hall of India, New Delhi, 2008.
3. Palanisamy. P K, “Engineering Physics – II”, SciTech publications (India), Chennai 2008.
4. Raghavan. V, “Materials Science and Engineering: A first course”, Fifth Edition, Prentice Hall of India, New Delhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: gain basic knowledge in concepts like crystal physics, conducting and superconducting materials

CO2: understand the concepts of semiconducting materials, devices, magnetic and dielectric materials

CO3: acquire basic knowledge of Smart materials, Nano materials and its applications

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		1		1						2		
CO2	3		1		1						2		
CO3	3		3		1						3		

3 – Substantial, 2 – Moderate, 1 – Slight

11CY201 ENVIRONMENTAL SCIENCE

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Introduction to Environmental Studies and Natural Resources: Introduction to Environmental Science – Forest resources: Use and over-exploitation, deforestation, case studies. – Water resources: Use and over-utilization of surface and ground water, dams - benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture - effects of modern agriculture, fertilizer and pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, case studies – Land resources: Land as a resource – Conservation Practices - Role of an individual in conservation of natural resources. **Ecosystems:** Concept of an ecosystem – Structural features – Functional attributes (Food chain and Food web only) – Introduction, types, characteristic features, structure and functions of the (a) Forest ecosystem (b) Aquatic ecosystems (ponds, rivers and oceans). **Biodiversity:** Introduction to Biodiversity – Definition - genetic, species and ecosystem diversity – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic, option values and ecosystem service value– Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife – Endangered and endemic species of India – In-situ and Ex-situ conservation of biodiversity.

MODULE – II **15**

Pollution: Definition – Causes, effects and control measures of: (a) Air pollution - Climate change, global warming, acid rain, ozone layer depletion (b) Water pollution (c) Soil pollution (d) Radioactive Pollution - Solid waste Management - Disaster management: floods, earthquake, cyclones and landslides - Role of an individual in prevention of pollution - Case studies. **Water Treatment methods**: Treatment of Water for Domestic Supply (Screening, Aeration, Sedimentation with Coagulation, Filtration and Disinfection methods) - Break point chlorination –Estimation of dissolved oxygen, BOD and COD - Bacteriological examination of water - Sewage treatment (Primary, Secondary & Tertiary methods) - Miscellaneous methods of Sewage treatments (Oxidation Ponds, Aerated Lagoons, Oxidation ditch, Anaerobic Lagoons, Septic tanks) – Methods of Sewage treatment by activated sludge process – Introduction to industrial waste water treatment using Reverse Osmosis Technology- Self purification of Natural Waters - Membrane Technology for wastewater treatment - Activated carbon in pollution abatement of wastewater.

MODULE- III **15**

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 - case studies – Environmental ethics - Issues and possible solutions - Wasteland reclamation – Consumerism and waste products – Environment Production 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. **Human Population and the Environment:** Introduction - Population growth - Variation of population based on age structure - Variation among nations – 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.

TOTAL : 45

TEXT BOOK

1 Anubha Kaushik, and Kaushik C P, "Environmental Science and Engineering", Third Edition: 2008, (Reprint 2010), New Age International (P) Ltd, New Delhi.

REFERENCE BOOKS

1 B.K.Sharma, **"** Industrial Chemistry",Tenth Edition, Krishna Prakashan Media(P) Ltd,Meerut-250001(UP), India.

2 B Uppal M M revised by S C Bhatia, "Environmental Chemistry", Sixth Edition Khanna Publishers, New Delhi, 2002.

3 Trivedi R.K. and Goel P. K., "Introduction to Air Pollution", Techno-Science Publications, Jaipur, 2003.

4 Masters. Gilbert M, "Introduction to Environmental Engineering and Science", Second Edition, Pearson Education, New Delhi, 2004.

5 Miller, T.G., "Environmental Science", Wadsworth Publishing Co.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: appreciate the importance of conservation of resources and our role in maintaining the clean environment.

CO2: develop an understanding of ecological balance and preservation of biodiversity

CO3: acquiring the awareness about the different types of pollution and know about the impact of population explosion.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	1			2							3		
CO2	1			2							3		
CO3	3			2							3		

3 – Substantial, 2 – Moderate, 1 – Slight

11ME101 BASICS OF CIVIL AND MECHANICAL ENGINEERING

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **7**

Construction Materials: Introduction – Civil Engineering – Materials – bricks – stones – sand – cement – concrete – steel sections – Site selection for foundations – Bearing capacity – loads – Types of foundations – requirements.

MODULE – II **7**

Elements of Structures: Superstructure – brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Types of Bridges and Dams.

MODULE - III **8**

Elements of Surveying: Surveying – Objects – types – classification – principles – measurements of distances – Determination of areas –Building area calculation – illustrative examples – Basics of Interior and Landscaping.

PART–B: BASIC MECHANICAL ENGINEERING

MODULE – I **7**

Metal Forming and Joining Processes:

Foundry: Introduction- patterns – molding –casting - cupola furnace.

Forming: Introduction-Classification- Rolling, extrusion, and drawing.

Welding: Introduction-Classification - TIG, MIG welding, Gas welding, soldering and brazing.

Machining process: Introduction-Classification – lathe and drilling machines.

MODULE – II **8**

Boilers and Power Plants:

Steam Boilers: Introduction-Classification- Working Principle of Cochran boiler, Babcock and Wilcox boiler- Benson boiler - Boiler Mountings and accessories.

Power Plants: Classification of power plants – working principle of steam, Diesel, Hydro-electric and Nuclear Power plants- Merits and Demerits.

MODULE – III **8**

IC Engines, Refrigeration and Air-conditioning:

IC Engines: Classification-components - Working principle of Petrol and Diesel Engines- Four stroke and two stroke cycles- Comparison of four stroke and two stroke engines. Working principle of carburetor, fuel pump and multi point fuel injector.

Refrigeration and Air Conditioning System: Terminology of Refrigeration and Air conditioning, Properties of refrigerant - Principle of vapour compression and absorption system - Layout of typical domestic refrigerator - Window and Split type room Air conditioner.

TOTAL : 45

TEXT BOOKS

1. Palanichamy, M S., "Basic Civil Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. Shanmugam, G, "Basic Mechanical Engineering", 4th Edition, Tata McGraw-Hill, New Delhi, 2011.

REFERENCE BOOKS

1. Rao, M.S., "Basics of Civil Engineering", Dhanpat Rai and Co, New Delhi, 2006.
2. Venugopal, K and Prabhu Raja, V, "Basic Mechanical Engineering", Sixth Edition, Anuradha Publishers, Kumbakonam, 2005.
3. Rao, P N, "Manufacturing Technology: Foundry, Forming And Welding", Tata McGraw-Hill, New Delhi, 2008.
4. Rajan, T.S, "Basic Mechanical Engineering, 3rd Edition, New Age International Publishers, NewDelhi, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: select the suitable construction materials and foundation required for a building
CO2: recall the various elements of the super structure
CO3: point out the various elements of surveying and landscaping
CO4: demonstrate the ability to describe the basics of metal forming and joining processes.
CO5: demonstrate the knowledge on patterns, molding, casting, rolling, extrusion, drawing, TIG, MIG welding, gas welding, soldering and brazing.
CO6: describe basics of boilers and power plants.
CO7: explain the working principle of steam, Diesel, Hydro-electric and Nuclear power plants.
CO8: demonstrate the working of IC engines, Refrigeration and Air-conditioning systems.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2	2	2	2	1							2
CO2	3	2	2	2	2	1							2
CO3	3	2	2	2	2	1							2
CO4	3				2			1				3	
CO5	3				2			3				2	
CO6:	3				2			1				3	
CO7:	3				3			2				3	
CO8:	3				2			1				3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME102 ENGINEERING DRAWING

(Common to all Engineering and Technology branches)

2 0 3 3

Concepts (Not for Exam)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

MODULE – I **15**

Projections of Points, Lines, Planes and Solids:

General principles of orthographic projection – First angle projection – Layout of views – Projection of points, located in all quadrant and straight lines located in the first quadrant – Determination of true lengths and true inclinations and location of traces – Projection of polygonal surface and circular lamina inclined to both reference planes.

Projections of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

MODULE – II **15**

Sectioning and development of solids:

Sectioning of solids- prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cone with cutout, perpendicular and inclined to the horizontal axis.

15

MODULE- III

Isometric projection and Perspective projection :

Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones

Conversion of isometric projection into orthographic projection.

Perspective projection of prisms, pyramids and cylinders by visual ray method.

TOTAL: 45

TEXT BOOKS

1. Venugopal K. and Prabhu Raja V. "Engineering Graphics", New Age International (P) Limited, New Delhi, 2008.
2. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD", Tata McGraw Hill, New Delhi, 2008.

REFERENCE BOOKS

1. Bhatt N.D, "Engineering Drawing", 46th Edition, Charotar Publishing House, Anand, 2003.
2. Gopalakrishnana K.R., "Engineering Drawing", Volume. I & II, Subhas Publications, Bangaluru, 2006.
3. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw-Hill, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: prepare elementary sketches of 2D and 3D objects with correct interpretation and mark dimensions properly.

CO2: draw multi-view orthographic and other projections including isometric, sectional, true and perspective.

CO3: read, understand, interpret drawings and communicate effectively.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3				2				3				
CO2	3				2				2				
CO3	3				2				2				

1 – Slight, 2 – Moderate, 3 – Substantial

11PH202 PHYSICAL SCIENCES LABORATORY – II

(Common to all Engineering and Technology branches)

0 0 3 1

PART - A: APPLIED PHYSICS LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. Determination of band gap of a semiconductor material.
2. Determination of wavelength of mercury spectrum – spectrometer grating.
3. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
4. Determination of hysteresis loss in a ferromagnetic material.
5. Determination of Young's modulus of the material – uniform bending.
6. Determination of viscosity of liquid – Poiseuille's method.

PART - B: APPLIED CHEMISTRY LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS /EXERCISES

1. Estimation of Chloride in a given water sample.
2. Determination of Dissolved Oxygen in a sample of water / sewage.
3. Estimation of Chromium in Industrial waste water.
4. Estimation of Ferrous ion in rust solution.
5. Estimation of percentage of Copper present in brass.
6. Estimation of ferric ion by Spectrophotometeric method.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: perform experiments on semiconductor, thermal conductivity, optics, elasticity and viscosity of liquids.

CO2: demonstrate the understanding of wave length, band gap, thermal conductivity, Young's modulus, and viscosity.

CO3: gain knowledge to find band gap of semiconductors, thermal conductivity of a bad conductor, wave length of various colors in mercury, spectrum using grating, Young's modulus of a material and viscosity of a liquid.

CO4: estimate the different water quality parameters (Chloride, DO) and also to estimate the metals like Cr, Ferrous iron and Copper for industrial applications.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2					1					3		
CO2	1					1					2		
CO3	2					1					2		
CO4	2					1					3		

3 – Substantial, 2 – Moderate, 1 – Slight

11ME103 ENGINEERING PRACTICES LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

PART-A: CIVIL & MECHANICAL

LIST OF EXPERIMENTS

1.FITTING

Tools & Equipments – Practice in Filing and Drilling.

Making Vee Joints, Square, dovetail joints, Key Making.

2. PLUMBING

Tools & Equipments - Pipe connection for a bath room, Pipe connection for multi-storey building,

Pipe connection with different components like valves, tap, coupling, union, reducers, elbows etc.

Plumbing work with metal, PVC and flexible hoses (Threading, joining of pipes)

3.CARPENTRY

Tools and Equipments- Planning practice. Making Half Lap, dovetail, Mortise & Tenon joints, a mini model of a single door window frame.

Making of Pen stand, Box, etc. from plywood. (Use of modern power tools for cutting)

4.SHEET METAL

Tools and equipments - Fabrication of a small cabinet, Rectangular Hopper, etc.

5.WELDING

Tools and equipments - Arc and Gas welding of butt joint, Lap Joint and Tee Fillet.

REFERENCES / MANUALS / SOFTWARE:

1. Suyambazhahan, S, "Engineering Practices Laboratory Manual", PHI Learning, NewDelhi, 2010.

2. John, K. C., "Mechanical Workshop Practice", Second Edition, PHI Learning, NewDelhi, 2009.

PART-B: ELECTRICAL & ELECTRONICS

1. Safety aspects of Electrical wiring.
2. Wiring circuit for a lamp using single and two way switches (stair case).
3. Wiring circuit for fluorescent lamp.
4. Study of Electronic components and equipment – Resistor-colour coding, measurement of AC Signal parameter (Peak-Peak, RMS Value, Frequency and Power factor) using CRO
5. Assembling electronic components on a small PCB (Etching, Fabrication and Testing)
6. Measurement of earth resistance and insulation resistance of an electrical equipment
7. Study of Telephone, FM radio & Transducers.
8. Study of Mixie, Iron box, Ceiling & Table Fans.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the functions of different tools used in fitting, carpentry, sheet metals and welding.

CO2: prepare different types of joints in metal pieces, sheet metals and wooden pieces.

CO3: plan and fabricate simple models.

CO4: utilize the basic laboratory equipment

CO5: build the layout of domestic wiring circuits and troubleshoot it.

CO6: estimate Earth Resistance, assemble electronic components in PCB and understand operation of various domestic appliances

Mapping of COs with POs

COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2							2			1		
CO2	2							3			2		
CO3	3							2			2		
CO4	3		1		3						2	3	
CO5	3	2			2	3						3	
CO6	3					2						3	

1 – Slight, 2 – Moderate, 3 – Substantial

11EL202 COMMUNICATION SKILLS LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS

English Lab

1. Listening Comprehension
   Listening to instructional software packages in the communication laboratory, using them, understanding the mechanics of language like grammar, listening to native speakers' presentation, and developing oral communication by imitating the model dialogues. Listening for specific information – listening to improve pronunciation – Listening and typing – Filling the blanks – TV programmes and News.
2. Reading comprehension and vocabulary:
   Reading for getting information and understanding; scanning, skimming and identifying topic sentences – reading for gaining knowledge, looking for transitions, understanding the attitude of the writer – Filling the blanks – Cloze exercises – vocabulary building – Comprehension.
3. Speaking:
   Group discussion; verbal and non-verbal communication; speaking on situational topics – maintaining eye contact, speaking audibly, clearly and with confidence – Common errors in English
   Conversations – face-to-Face conversation – Telephone Conversation – Roll play.
4. Writing Skills:
   Writing job application: resume, applications for jobs, making complaint letters – Projects: report writing – editing and proof reading – research paper and translating numerical data from charts and diagrams into verbal communication.

Career Lab

1. Letter Writing / Resume / Report preparation:
   Structuring Letter Writing / Resume / Report preparation / E-Mail
2. Presentation skills
   Elements and structure effective presentation – presentation tools – voice Modulation – Body language – Video samples
3. Group Discussion
   Structure of Group Discussion – Strategies in GD – Team work – Video Samples
4. Interview skills
   Kinds of Interview- corporate culture – video samples
5. Soft Skills
   Time management – stress management – assertiveness – case study

Communication Software Package:

a. Presentation Skills
b. Interview Skills
c. Group Discussion
   - From Globarena Software

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Write, read and listen English effectively
CO2: Communicate efficiently in English in real life and career related situations
CO3: Demonstrate good presentation skill.
CO4: Use the modern communication software package to enhance the soft skills

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1				2					2	3		1	
CO2				2					2	3		1	
CO3				2					2	3		1	
CO4									2	3			

3 – Substantial, 2 – Moderate, 1 – Slight

11MA301 ENGINEERING MATHEMATICS – III

(Common to all Engineering and Technology branches)

3 1 0 4

MODULE – I **15**

Fourier Series: Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Change of interval - Parseval's Identity - Harmonic analysis.

MODULE - II **15**

Partial Differential Equations: Formation – By elimination of arbitrary constants and arbitrary functions – Standard types– Lagrange's linear equation- Linear partial differential equations of second order with constant coefficients.

Applications of Partial Differential Equations: Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded).

MODULE - III **15**

Fourier transform: Fourier integral theorem (Statement only) – Fourier transform pair – Properties – Transforms of simple functions – Sine and Cosine transforms – Convolution theorem and Parseval's identity (Statement only).

Z-transform: Elementary properties – Transforms of simple functions - Inverse Z – transform(Partial Fraction Method and Residue method) – Convolution theorem (Statement Only) – Solution of Difference Equations.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., "Engineering Mathematics", Volume - III, S. Chand & Co, New Delhi, 2008.
2. Veerarajan, T., "Engineering Mathematics", Tata McGraw-Hill, New Delhi, Reprint 2010.

REFERENCE BOOKS

1. Grewal, B.S., "Higher Engineering Mathematics", Thirty Sixth Edition, Khanna Publishers, New Delhi, 2007.
2. Wylie, C. Ray and Barrett, Louis, C., "Advanced Engineering Mathematics", Sixth Edition, McGraw-Hill, New York, 2004.
3. Andrews, L. A. and Shivamoggi, B. K., "Integral Transforms for Engineers and Applied Mathematicians", Macmillan, New York, 2004.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: utilize Fourier series to solve engineering problems.

CO2: formulate and solve higher order partial differential equations.

CO3: interpret the basic knowledge of Fourier transforms and Z-transforms in engineering field.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3		1	2							1	
CO2	3	3		2	2							1	
CO3	3	3		1	2							1	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME301 ENGINEERING MECHANICS

(Common to Civil, Mechanical and Mechatronics Engineering)

3 1 0 4

MODULE – I **15**

Statics of Particles and Rigid Bodies: Introduction - Laws of Mechanics – Parallelogram and triangular Law of forces – Principle of transmissibility- Coplanar Forces – Resolution and Composition of forces -Free body diagram- Equilibrium of a particle- Forces in space -Vectorial representation of forces- Equilibrium of a particle in space. Moments – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar component of moments – Varignon's theorem– Equivalent systems of forces – Single equivalent force. Types of supports and their reactions – requirements of stable equilibrium – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Simple Trusses, Types-Method of joints-Zero – force members, Method of sections- virtual work.

MODULE - II **15**

Friction: Surface Friction – Laws of dry friction – Sliding friction – Static and Kinetic friction–ladder friction – Wedge friction – Rolling resistance – Belt friction.

Properties of Surfaces and Solids: Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle areas from integration – T section, I section, Angle section, Hollow section from primary simpler sections – second moments of plane area – Parallel axis theorem and Perpendicular axis theorem- Rectangle, triangle, circle from integration - T section, I section, Angle section, Hollow sections – Polar moment of inertia – Principle Moment of inertia of plane area-Principle axis of inertia- Mass moment of inertia – Derivation of mass moment of inertia for prism, cylinder and sphere from first principle – Relation to area moments of inertia.

MODULE - III **15**

Dynamics of Particles and Rigid Body: Rectilinear motion of particles - Relative motion – Curvilinear motion – Newton's law – Energy and momentum Equation of particles – Impulse – Impact of elastic bodies – Motion of connected particles. Kinematics of Rigid body, Kinetic equation of motion, Translation, Rotation about a fixed axis- General plane motion.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Rajasekaran, S, and Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House, New Delhi, 2008.
2. Beer, F. P and Johnson, E. R., "Vector Mechanics for Engineers- Statics and Dynamics", Eighth Edition, Tata McGraw-Hill, New Delhi, 2007.

REFERENCE BOOKS

1. Shames, Irving H., "Engineering Mechanics: Statics and Dynamics", Fourth Edition, Pearson Education Asia, Singapore, 2003.
2. Hibbeller, R. C., "Engineering Mechanics", Volume - I: Statics, Volume - II: Dynamics, Pearson Education Asia, Singapore, 2006.
3. Timoshenko, Stephen and Young, D. H., "Engineering Mechanics", Tata McGraw-Hill, New Delhi, 2006.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: analyze forces and their moments in terms of vector components and formulate static equilibrium equations for mechanical systems

CO2: predict the effect of dry friction for various applications

CO3: determine the centroid, centre of gravity and moment of inertia of geometrical shapes and solids respectively

CO4: apply different principles to study the motion of a body and develop their constitutive equations

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3	2	2							2	
CO2	3	3	3	2	2							2	
CO3	3	3	3	2	2							2	
CO4	3	3	3	2	2							2	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME302 ENGINEERING THERMODYNAMICS

3 1 0 4

MODULE – I **15**

Laws of Thermodynamics: Basic concepts - concept of continuum, micro, macroscopic approach, thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

Second law of thermodynamics – Kelvin - Planck and Clausius statements of second law. Reversibility and irreversibility. Carnot cycle, reversed carnot cycle, refrigerator-heat pump-efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy – Carnot theorem, absolute entropy, Basic concepts of availability.

MODULE - II **15**

Concept of Steam Formation and Gas Laws: Properties of pure substances – Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, p-v, p-T, T-v, T-s, h-s diagrams, pvT surface, thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes. Standard Rankine cycle, Reheat and regenerative cycle -Problems.

Concept of ideal and real gases, Properties of ideal and real gases, equation of state, Avagadro's law, Vander Waal's equation of states, compressibility, compressibility chart. Dalton's law of partial pressure, Gas mixtures.

MODULE – III **15**

Thermodynamic Relations and Psychrometry: Exact differentials, TdS relations, Maxwell relations, Clausius Clapeyron equation, Joule Thomson Coefficient.

Psychrometry-properties of atmospheric air and calculations of air vapour mixtures. Psychrometric charts. Psychrometric process – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling, problems.

Lecture : 45, Tutorial : 15, TOTAL : 60

(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart are permitted)

TEXT BOOKS

1. Nag. P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2007.
2. Cengel, "Thermodynamics: An Engineering Approach", Tata McGraw-Hill, New Delhi, 2003.

REFERENCE BOOKS

1. Rajput, R K., "Engineering Thermodynamics", Lakshmi Publications, New Delhi, 2007**.**
2. Arora. C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
3. Holman. J.P., "Thermodynamics", McGraw-Hill, New York, 2000.
4. Ballaney. P.L., "Thermal Engineering", Khanna Publishers, New Delhi, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: apply the knowledge of basic concepts and laws of thermodynamics

CO2: solve the problems relating to thermodynamic properties of steam and gases

CO3: apply thermodynamic relations in physical problems and attain the familiarity with various psychrometric processes

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2			3		2		2	2	3	3	
CO2	3	3			3		2		2	2	3	3	
CO3	3	3			3		2		2	2	3	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME303 FLUID MECHANICS AND MACHINERY

(Common to Mechanical and Mechatronics)

3 1 0 4

MODULE – I **15**

Basic Concepts and Fluid Kinematics: Properties of fluids – Classification of fluids- Fluid statics: concept of fluid static pressure- pressure measurement by manometers- Buoyancy and equilibrium of floating bodies

Fluid Kinematics - Lines of flow - Types of flow - Velocity field and acceleration - continuity equation - control volume analysis of mass - Equation of streamline - stream function – velocity potential function – Introduction to flow visualization techniques

MODULE – II **15**

Fluid Dynamics and Viscous Flow: Fluid dynamics - Equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube - Dimensional analysis - Buckingham's π theorem- applications - similarity laws and models

Viscous flow - Shear stress, pressure gradient relationship - laminar flow between parallel plates and circular tubes – Hydraulic and energy gradient – flow through pipes - Darcy weisback's equation – pipe roughness friction factor- minor losses - flow through pipes in series and in parallel - power transmission- Boundary layer flows, boundary layer thickness, boundary layer separation - drag and lift coefficients.

MODULE – III **15**

Fluid Machines: Impact force – work done – Efficiency on stationary, moving flat and curved vanes due to moving water jet - Euler's equation for turbo machines - Construction of velocity vector diagrams - head and specific work components of energy transfer - degree of reaction- Pelton wheel – Francis turbine - Kaplan turbine - working principles - velocity triangles - work done.

Centrifugal pump: classifications, working principle, velocity triangles, Work done - Reciprocating pump: classification, working principle, Basic principles of indicator diagram – Work saved by air vessels and performance curves - cavitations in pumps - working principles of gear ,vane and Monobloc pumps

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Cengel, Yunus A. and Cimbala, John M., "Fluid Mechanics", Tata McGraw- Hill, New Delhi, 2nd Edition, 2010.

REFERENCE BOOKS

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Fifth Edition, Laxmi publications, New Delhi, 2010
2. Som, S.K. and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", Second Edition, Tata McGraw-Hill, New Delhi, 2nd Edition, 2007.
3. Kumar, K.L., "Engineering Fluid Mechanics", Seventh Edition, Eurasia Publishing House, New Delhi, 2005.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: recognize the type of fluid flow and its properties occurring in a particular physical system and analyse the problems in static and kinematic state

CO2: apply fundamental knowledge of mathematics to model and analyze the fluid flow problems in dynamic state

CO3: infer the working of various pumps, turbines and analyze the performance of various fluid machines

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	2	3								2	
CO2	3	3	3	3								2	
CO3	3	2	3	3								2	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME304 MANUFACTURING TECHNOLOGY

3 0 0 3

MODULE – I **15**

Foundry Technology & Bulk Forming Processes: Design of pattern - Core making - Moulding sand - Melting furnaces - Special casting processes - Shell, Investment, Die casting, Full mould process - centrifugal casting, Design of gating – Risering and solidification – Defects in casting - Testing and Inspection of casting.
Cold and hot working - Forging, Rolling, Extrusion..

MODULE - II **15**

Sheet Metal Forming, Conventional Welding and Special Welding: Sheet metal forming- Blanking, Piercing, Punching, trimming, Shaving, Nibbling, Notching - Stretch forming - Embossing and coining – Principle of rod, wire and tube drawing – deep drawing processes.
Classification - Arc Welding - Machines - Electrode types - Specification - Carbon Arc, TIG, MIG, Atomic hydrogen, Submerged Arc - welding, Gas welding - Special welding - Laser, electron beam, Plasma Arc, Ultrasonic, Electro slag and Friction welding - Defects in weld - Testing and Inspection – Thermal welding - Brazing and soldering.

MODULE - III **15**

Metal and Plastic Forming Processes: Special forming processes _ Hydro forming – rubber pad forming - Metal spinning _ Introduction to explosive forming, Magnetic pulse forming, peen forming and super plastic forming.
Working principles and typical applications of - Injection moulding – Plunger and screw machines - Compression moulding - Transfer moulding – Typical industrial applications – Introduction to Blow moulding – Rotational moulding – Film blowing – Extrusion - Thermo forming – Bonding of thermoplastics.

TOTAL : 45

TEXT BOOKS

1. Hajra Choudhry, A.K. and Hajra Choudhry, H.K., "Elements of Workshop Technology", Volume - I, Media Promoters and Publishers, Mumbai, 2007.
2. Sharma, P.C., "A Text book of Production Technology", S.Chand & Company Ltd., New Delhi, 1996.
3. Kalpakjain. Serope., "Manufacturing Engineering and Technology**"** Addison-Wesley**,** 2006.

REFERENCE BOOKS

1. DeGarmo, "Materials and Processes in Manufacturing", Eight Edition, Prentice Hall of India, New Delhi, 1998.
2. Surender Kumar and Goutam Sutradhar, "Design and manufacturing - An Integrated Approach", Oxford & IBH Publishers, New Delhi, 1998.
3. HMT, "Production Technology", Tata McGraw- Hill, 2003.
4. Chapman, WAJ "Workshop Technology Arnold Publisher –New Delhi 1989.
5. Rao, P.N., "Manufacturing Technology: Foundry, Forming, and Welding" Tata Mcgraw Hill – New Delhi 2002

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the foundry and bulk forming processes.
CO2: examine the sheet metal forming processes and conventional & special welding processes.
CO3: distinguish between the metal and plastic forming processes.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	1	1	1	1	1	1		1	2	1	1	1	
CO2	1		2	1	1	1		1	2	1	2	1	
CO3				1	1	1	1	2	3	1	1	1	

1 – Slight, 2 – Moderate, 3 – Substantial

11EE308 ELECTRICAL DRIVES

3 0 0 3

MODULE - I **15**

Drive Motor Characteristics: Basic Elements – Types of Electric Drives – Factors influence the choice of electrical drives – Heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors - Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Simple problems.

MODULE - II **15**

Braking and Starting Methods: Braking of Electrical motors: DC motors: Shunt, series and compound – AC motors: Single phase and Three phase induction motors - Types of DC Motor starters: Two point starter, Three point starter, Four point starter – Typical control circuits for shunt and series motors – Types of AC motors starters: stator resistance starter, DOL starter, Y-Δ starter and Auto transformer starter, rotor resistance starter.

MODULE - III **15**

Speed Control of DC and AC Motors: Speed control of DC series and shunt motors: Armature and field control, Ward-Leonard control system – Speed control using controlled rectifiers and DC choppers – Speed control of three phase induction motors: Voltage control, frequency control voltage / frequency control and slip power recovery scheme – Speed control using inverters and AC voltage regulators.

TOTAL: 45

TEXT BOOKS

1. Theraja, B. L. and Theraja, A. K., "A Text Book of Electrical Technology", Volume. II, Twenty Third Edition, S. Chand and Co, New Delhi, 2002.
2. Pillai, S. K., "A First Course on Electric Drives", Wiley Eastern Limited, New Delhi, 1998.

REFERENCE BOOKS

1. Dubey, G. K., "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 1995.
2. Nagrath, I. J. and Kothari, D. P., "Electrical Machines", Tata McGraw-Hill, New Delhi, 1998.
3. Vedam Subrahmaniam., "Electric Drives: Concepts and Applications", Tata McGraw-Hill, New Delhi, 2001.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: perform steady state analysis on the common electric drives configuration.

CO2: select suitable braking and starting methods

CO3: apply various speed control techniques for AC and DC motors

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		3										
CO2	2				2								
CO3	2		2		2								

3 – Substantial, 2 – Moderate, 1 – Slight

11ME305 FLUID MECHANICS AND MACHINERY LABORATORY

(Common to Civil, Mechanical and Mechatronics)

0 0 3 1

LIST OF EXPERIMENTS

1. Determination of co-efficient of discharge for venturimeter
2. Determination of co-efficient of discharge for orifice meter
3. Study on impact of jet on flat plate (normal / inclined)
4. Study on friction losses in pipes
5. Study on minor losses in pipes
6. Study on performance characteristics of Pelton turbine (constant head method)
7. Study on performance characteristics of Francis turbine (constant head method)
8. Study on performance characteristics of Kaplan turbine (constant head method)
9. Study on performance characteristics of Centrifugal pump
10. Study on performance characteristics of reciprocating pump.
11. Study on performance characteristics of submersible pump.
12. Study on performance characteristics of Jet pump.
13. Study on performance characteristics of Gear pump

REFERENCES / MANUALS / SOFTWARE:

1. Cengel, Yunus A. and Cimbala, John M., "Fluid Mechanics", Tata McGraw- Hill, New Delhi, 2nd Edition, 2010.
2. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Fifth Edition, Laxmi publications, New Delhi, 2010.
3. Som, S.K. and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", Second Edition, Tata McGraw-Hill, New Delhi, 2nd Edition, 2007.
4. Lab Manuals

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: compile empirical and experimental data of fluid flow through written and oral reports

CO2: determine the co-efficient of discharge and frictional losses in the pipe lines

CO3: analyze the performance and determine characteristics of different types of turbines and pumps

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3		3					2	2		2	
CO2	3	3		3					2	2		2	
CO3	3	3		3					2	2		2	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME306 MANUFACTURING TECHNOLOGY LABORATORY - I

0 0 3 1

LIST OF MOULD MAKING

1. Making of mould by using split patterns like coupling etc.
2. Making of mould by using Mould with loose – piece patterns like gear etc.
3. Making of mould with core.
4. Fabrication of tray by using sheet metal components.
5. Fabrication of funnel by using sheet metal components.
6. Making of different welding joints by using horizontal and vertical welding.
7. Making of different welding joints by using Gas cutting and gas welding
8. Making of different welding joints by using special welding techniques.
9. Making of square / rectangular rod by hand forging.

REFERENCES / MANUALS/SOFTWARE

1. Sharma P.C., "A Text book of Production Technology", S. Chand & Co, New Delhi, 1996.
2. Hajra Choudhry, A.K. and Hajra Choudhry, H.K., "Elements of Workshop Technology", Volume - I, Media Promoters and Publishers, Bombay, 2007.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: make sand moulds using standard pattern.
CO2: prepare sheet metal components of various shapes.
CO3: demonstrate the welding and forgings skills.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	2	1		1		1	2	2	1	1	1	1
CO2	2		1		2		1	1	2	1	2	1	1
CO3	1		1	1	1		1	1	1	1		1	1

1 – Slight, 2 – Moderate, 3 – Substantial

11EE309 ELECTRICAL ENGINEERING LABORATORY

0 0 3 1

LIST OF EXPERIMENTS

1. Study of DC and AC Starters
2. Load test on DC Shunt motor
3. Load test on DC Series motor
4. O.C.C and Load characteristics of DC Shunt generator
5. Speed control of DC shunt motor (Armature, Field control)
6. Load test on single phase transformer
7. O.C and S.C Test on a single phase transformer
8. Load test on three phase slip ring Induction motor
9. Speed control of three phase squirrel cage Induction Motor
10. Load test on single phase Induction Motor

REFERENCES:

Laboratory manual

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: conduct performance test on various types of DC machines and differentiate between their characteristics.

CO2: apply various speed control methods of DC motor.

CO3: determine the efficiency of transformer.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	1	2	3						1		
CO2	2	3	1	2	3						1		
CO3	2	3	1	2	3						1		

3 – Substantial, 2 – Moderate, 1 – Slight

11MA401 NUMERICAL METHODS

(Common to all Engineering and Technology branches except ECE & CSE)

3 1 0 4

MODULE - I **15**

Linear Algebraic Equations: Method of false position - Newton's method - Solution of linear system of equations by Gaussian elimination and Gauss - Jordan methods – Iterative methods: Gauss Jacobi and Gauss – Seidel methods.

Interpolation: Newton's forward and backward difference formulae – Bessel's formula - Lagrange's interpolation formula - Newton's divided difference formula.

MODULE - II **15**

Numerical Differentiation: Differentiation Using Newton's forward , backward and divided difference interpolation formula - Single step Methods - Taylor Series, Euler and Modified Euler methods - Fourth order Runge-Kutta method for solving first order equations - Multistep methods – Milne's and Adam's predictor and corrector methods.

Numerical Integration: Trapezoidal rule – Simpson's 1/3 – Double integrals using Trapezoidal and Simpson's rules.

MODULE - III **15**

Boundary Value Problems in PDE: Finite difference approximations to partial derivatives - Two dimensional Laplace equations - Poisson equations – One dimensional heat equation by implicit and explicit methods – One dimensional wave equation.

Lecturer: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS

1. Kandasamy, P., Thilakavathy, K. and Gunavathy, K., "Numerical Methods", S.Chand & Co, New Delhi, reprint 2010.
2. Venkatraman, M. K, "Numerical Methods", National Publishing Company, Chennai, 2000.

REFERENCE BOOKS

1. Balagurusamy, E., "Numerical Methods", Tata McGraw-Hill, New Delhi, 1999.
2. Jain, M. K., Iyengar, S. R. K. and Jain, R. K., "Numerical Methods for Scientific and Engineering Computation", Fourth Edition, New Age International (P) Ltd., New Delhi, 2006.
3. Sankara Rao, K., "Numerical Methods for Scientists and Engineers", Second Edition, Prentice Hall India, New Delhi, 2004.
4. Thangaraj, P, "Computer – Oriented Numerical Methods", Prentice Hall of India, New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: discuss the various methods of solving linear algebraic and transcendental equations.

CO2: estimate the intermediate values using interpolation concepts.

CO3: interpret the knowledge of numerical differentiations and integration

CO4: apply various numerical techniques in solving complex partial differential equations.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3		1	2							1	
CO2	3	3										1	
CO3	3	3		1	2							1	
CO4	3	3		1	2							1	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME401 STRENGTH OF MATERIALS

(Common to Mechanical and Mechatronics)

3 1 0 4

MODULE – I **15**

Stress, Strain, and Deformation of Solids Analysis of State of Stress: Rigid and deformable bodies- Stability, Strength and Stiffness- Tensile, compressive and shear stresses, strain. Poisson's ratio - lateral stress. Deformation of simple and compound bars- Relation between elastic constants- Thermal stresses- Strain Energy in uniaxial loads- gradually applied load, suddenly applied load and impact load.

Biaxial state of stress- thin cylinders and shells- Deformation in thin cylinders and spherical shells- Thick cylinders, Lame' s equation- compounding of thick cylinders-Biaxial stresses at a point- stresses on inclined planes- principal planes and stresses- Mohr's circle for biaxial stress. Maximum shear stress.

MODULE - II **15**

Transverse Loading on Beams, Stresses in Beams and Deflection of Beams: Beams – types and transverse loading on beams- shear force and bending moment in beams- cantilevers, simply supported and overhanging beams-Point of contraflextures. Theory of simple bending – analysis of stress-load carrying capacity .Stress distribution of simple beams –circular, rectangular, 'I' section, 'T' section and channel sections.

Elastic curve of neutral axis of the beam under normal loads – Evaluation of beam deflection and slope. Double integration method- Macaulay's method- Area moment theorems for computation of slopes and deflection in beams.

MODULE – III **15**

Columns and Torsion on Circular Shafts: Columns: End condition- Equivalent length of column – Eulers's equation – Slenderness ratio – Rankine formula for columns.

Torsion – circular shaft- Shear stress distribution- hollow and solid circular section. Torsional rigidity- stepped shaft – Twist and torsional stiffness-compound shafts-shafts fixed at both ends and simply supported. Torsion on springs – Whal's factor of springs stresses in helical springs under torsion loads-stiffness and deflection of springs under axial load.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Rajput, R.K., "Strength of Materials", S.Chand & Co, New Delhi, 2007.
2. Popov, E.P., "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 2006.

REFERENCE BOOKS

1. Timoshenko, S.P., "Elements of Strength of Materials", Tata McGraw-Hill, New Delhi, 2006.
2. Sadhu Singh, "Strength of Materials", Khanna Publishers, New Delhi, 2006.
3. Beer F. P. and Johnson R, "Mechanics of Materials", Third Edition, McGraw-Hill Book Co, 2002.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: examine stress and strain relationship for simple and compound bars

CO2: evaluate biaxial stresses and deformations of thin, thick cylinders and spherical shells

CO3: construct shear force and bending moment diagrams to predict the bending stresses, shearing stresses and deflections of beams

CO4: estimate strengths of columns, springs and shafts

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3	3	2							2	
CO2	3	3	3	3								2	
CO3	3	3	3	3	2							2	
CO4	3	3	3	3								2	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME402 THERMAL ENGINEERING

3 1 0 4

MODULE – I **15**

Gas Power Cycles and Internal Combustion Engines: Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure and air standard efficiency- Actual and theoretical PV diagram of four stroke engines- Actual and theoretical PV diagram of two stroke engines.

Classifications of IC engine, IC engine components and functions - Valve timing diagram and port timing diagram - Ignition systems, Lubrication system and cooling system - Performance calculation. Knocking and Detonation. Exhaust gas analysis, pollution control norms. Pollution Control Methods – Catalytic converters, EGR and SCR - Recent developments in IC Engines – HCCI, Lean burn, GDI, Stratified Charge and VVT Engines

MODULE - II **15**

Steam Boilers, Nozzles, Turbines: Classification of boilers – Fire tube and Water tube boilers - Steam Boilers Cycles – High Pressure and Super Critical Boilers – Boiler Testing- Fluidised Bed Boilers – CFBC and PFBC boilers.

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Impulse and reaction principles, compounding, velocity diagrams for simple turbines, speed regulations-governors and nozzle governors.

MODULE – III **15**

Air Compressor, Refrigeration and Air-Conditioning: Classification and working principle of reciprocating air compressor, work of compression with and without clearance. Volumetric efficiency, Isothermal efficiency and isentropic efficiency of reciprocating air compressors. Multistage air compressor and inter cooling – work of multistage air compressor, various types of rotary compressors

Vapour compression Refrigeration cycle – super heat, sub cooling, performance calculations. Working principle of vapour absorption system. Ammonia – water, Lithium bromide – water systems – Performance calculation of VARS- Cooling load calculations. Concept of RSHF, GSHF, ESHF, Air conditioning systems.

Lecture : 45, Tutorial : 15, TOTAL : 60

(Use of standard steam tables, Mollier diagram, Psychometric chart and Refrigerant property tables are permitted)

TEXT BOOKS

1. Rudramoorthy, R., "Thermal Engineering", First Edition Tata McGraw-Hill, New Delhi, 2010.
2. Sarkar, B.K, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2007

REFERENCE BOOKS

1. Rajput, R K., "Thermal Engineering", Lakshmi Publications, New Delhi, 8th Edition, 2010**.**
   Kothandaraman. C.P., Domkundwar. S and Domkundwar. A.V., "A Course in Thermal Engineering", Dhanpat Rai & Sons, New Delhi, 2010.
2. Ganesan, V., "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, New Delhi, 2010.
3. Arora, C.P., "Refrigeration and Air Conditioning", Third Edition, Tata McGraw-Hill, New Delhi, 2010.

COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: demonstrate the understanding of air standard cycles and their applications to IC engines
- CO2: identify the types of boilers and perform steam power cycle calculations
- CO3: analyze the steam nozzles and turbines by applying the knowledge of velocity diagrams
- CO4: assess the performance of air compressors with knowledge acquired on working of compressors.
- CO5: solve problems on refrigeration and air-conditioning cycles by understanding the physical processes.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		3		3		2		2		2	3	
CO2	3		3		3		2		2		2	3	
CO3	3		3		3		2		2		2	3	
CO4	3		3		3		2		2		2	3	
CO5	3		3		3		2		2		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME403 KINEMATICS OF MACHINERY

(Common to Mechanical and Mechatronics Engineering)

3 1 0 4

MODULE – I **15**

Basics of Mechanisms and Synthesis: Terminology and Definitions –Kinematics of Links, Pairs and Chains -Degree of Freedom Mobility-Kutzbach criterion-Grashoff's law-Kinematic Inversions of 4-bar chain and slider crank chains-Mechanical Advantage-Transmission angle-Description of common Mechanisms-Single, double and offset slider mechanisms - Quick return mechanisms. Straight line generators-Design of Crank-rocker Mechanisms. Displacement, velocity and acceleration - analysis in simple mechanisms - Graphical Method velocity and acceleration polygons kinematic analysis of simple mechanisms- Displacement, velocity and acceleration – instantaneous centre method Coincident points – Introduction - Coriolis component.

MODULE - II **15**

Kinematics of CAM: Classifications - Terminology-Displacement, Velocity and acceleration diagrams-Uniform Velocity, Simple harmonic, Uniform acceleration retardation and Cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion - High speed cams - circular arc and tangent cams - Standard cam motion - Pressure angle and undercutting.

MODULE – III **15**

Kinematics of Gears and Gear Trains: Spur gear Terminology and definitions-Gear materials-Fundamental Law of toothed gearing and involute gearing-Length of arc of contact and approach-Length of path of contact-Inter changeable gears-gear tooth action – Terminology - Interference and undercutting-Non standard gear teeth- Basics of Helical, Bevel, Worm, Rack and Pinion gears. Gear trains-Parallel axis gear trains -Epicyclic gear trains-velocity ratio-Differentials-Applications

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Rattan, S. S., "Theory of Machines" Third Edition, Tata McGraw-Hill, New Delhi, 2009.
2. Shigley, J. E and Uicker, J. J., "Theory of Machines and Mechanisms", Third Edition, McGraw-Hill, New York, 2006.

REFERENCE BOOKS

1. R.S.Khurmi, J.K.Gupta, "Theory of Machimes", S.Chand & Co., New Delhi, 14th Edition.
2. Rao, J. S and Dukkipati, R. V., "Mechanism and Machine Theory", Wiley Eastern Limited, New Delhi, 1992.
3. Bevan, Thomas, "Theory of Machines", C B S Publishers & Distributors, New Delhi, 2003
4. Ballaney P L, "Theory of Machines", Khanna Publishers, New delhi, 2003.
5. Ghosh A, Mallik AK, "Theory of Mechanisms & Machines", Third Edition, Affiliated Est -West Press Pvt Limited, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: classify the different types of mechanisms and analyze its velocity and acceleration

CO2: assess the displacement, velocity and acceleration of CAM mechanisms with various motions and develop the CAM profile

CO3: perceive the nomenclature of various gears and estimate the speed and torque in various gear trains

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3	3								2	
CO2	3	3	3	3								2	
CO3	3	3	3	3								2	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME404 MATERIAL REMOVAL PROCESSES

3 0 0 3

MODULE – I **15**

Theory of Metal Cutting and Centre Lathe: Single point cutting tool-tool geometry, nomenclature and tool signature - theory of metal cutting - orthogonal and oblique metal cutting, chip formation, cutting tool materials, tool wear, tool life, cutting fluids, machinability index. Lathe machine: Centre lathe, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation.

MODULE - II **15**

Machine Tools and Abrasive Processes: Reciprocating machine tools: shaper, planer, and slotter. Milling: types, milling cutters. Hole making operations: Drilling, reaming, boring, tapping - Sawing machine: hack saw, band saw, circular saw. Broaching machines: broach construction – push, pull, surface and continuous broaching machines - Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding, surface grinding, centreless grinding – honing, lapping, super finishing, polishing and buffing.

MODULE – III **15**

Unconventional Machining Processes: Principle of operations – Advantages and disadvantages – applications: Abrasive Jet machining process (AJM), Water Jet machining process (WJM), Ultrasonic machining process (USM), Electric Discharge machining process (EDM), Laser Bean machining process (LBM) Chemical machining process (CHM) and Electro Chemical machining process (ECM).

TOTAL : 45

TEXT BOOKS

1. Serope Kalpakjian, Steven R. Schmid, "Manufacturing Process for Engineering Materials", 4th Edition, Pearson Education, 2003.
2. Hajra Choudhry, A.K. and Hajra Choudhry, H.K., "Elements of Workshop Technology", Volume - II, Media Promoters and Publishers, Bombay, 2007.

REFERENCE BOOKS

1. Rao P.N., "Manufacturing Technology: Metal cutting and Machine Tools", Tata McGraw-Hill, 2003.
2. HMT, "Production Technology", Tata McGraw-Hill, New Delhi, 1998
3. Kibbe, Richerd R., Neely, John E., Merges, Roland O. and White, Warren J., "Machine Tool Practices", Prentice Hall of India, New Delhi, 2003.
4. Sharma P.C., "A Text book of Production Technology", S. Chand & Co, New Delhi, 1996.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the mechanisms of cutting processes and operations of lathe

CO2: demonstrate the different operations in other machine tools

CO3: illustrate Principles and working of unconventional machining processes

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2				1	1		1	3	1	2	1	1
CO2	2	1	1	1	1	1		1	2	1	2	1	1
CO3	3			1			1	2	1	1		1	1

1 – Slight, 2 – Moderate, 3 – Substantial

11ME405 ENGINEERING MATERIALS AND METALLURGY

3 0 0 3

MODULE – I **14**

Constitution of Alloys and Phase Diagrams: Ferrous Metals: Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams,lever rule, Isomorphous, eutectic, peritectic, eutectoid and peritectoid reactions, Iron – Iron carbide equilibrium diagram. Classification of steels and cast iron microstructure, properties and application.Ferrite and austenite stabilizers.

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels – HSLA - maraging steels – Gray, White, malleable, spheroidal - Graphite - alloy cast irons.

MODULE - II **14**

Non Ferrous Alloys and Non-Metallic Materials: Copper and Copper alloys – Brass, Bronze and Cupronickel – Aluminum and Al-Cu – precipitation strengthening treatment – Bearing alloys.

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK and PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics – Properties and applications of Al_2O_3, SiC, Si_3N_4, PSZ and Sialon – Fibre and particulate reinforced composites.

MODULE – III **17**

Heat Treatment and Testing of Mechanical Properties: Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalising,quenching, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

Mechanism of plastic deformation,dislocation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and Charpy, fatigue and creep test-Case studies.

TOTAL : 45

TEXT BOOKS

1. Rajan T.V,Sharma ”Heat Treatment Principles and Techniques” Prentice Hall of India Pvt., Ltd., New Delhi, 2010.
2. Avner, Sydney H., “Introduction to Physical Metallurgy”, McGraw-Hill, New York, 2000.

REFERENCE BOOKS

1. Budinski, Kenneth G. and Budinski, Michael K., “Engineering Materials”, Fourth Indian Reprint, Prentice-Hall of India, New Delhi, 2002.
2. Callister, William D., “Material Science and Engineering”, John Wiley and Sons, New York, 1997.
3. Dieter, George E., “Mechanical Metallurgy”, McGraw-Hill, New York, 1961.
4. Raghavan.V., “Materials Science and Engineering”, Prentice Hall of India Pvt., Ltd., New Delhi, 2006.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the constitution of ferrous alloys with phase diagrams

CO2: identify the structure, composition and properties of non-ferrous and non-metallic materials

CO3: understand the types of heat treatment processes with suitable transformation diagram.

CO4: demonstrate the mechanical tests such as tensile, compression, hardness, impact tests

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	1		1	1	1	2	2	2	3		1	1
CO2	3	1	1	1	1		1	1	2	2		1	
CO3	1	1	1	1			1	1	2	2	1	1	
CO4	3	2	2	2	1	1	2	1	3	3	2	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

11ME406 THERMAL ENGINEERING LABORATORY

0 0 3 1

LIST OF EXPERIMENTS

1. Valve timing and Port timing diagrams
2. Determination of Flash and Fire Point of standard fuels using open and closed cup apparatus
3. Determination of Viscosity of standard oils using Redwood and Say bolt viscometer
4. Performance test on single cylinder diesel engines by mechanical and electrical loading
5. Performance and emission test on Twin cylinder diesel engine by electrical loading
6. Heat balance test on single cylinder diesel engines by mechanical and electrical loading
7. Performance and Morse test on multi cylinder petrol engine using hydraulic loading.
8. Emission test on single cylinder Diesel and petrol engine using Exhaust gas analyser
9. Performance test on multistage reciprocating air compressor
10. Performance and Heat balance test on Boiler
11. Performance test on Steam turbine, Condenser and Cooling Tower
12. Study on Biomass Gasifier.
13. Performance test on dual fuel engine

REFERENCES / MANUALS/SOFTWARE:

1. Rudramoorthy. R., "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2010.
2. Lab Manuals

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: test the liquid fuel properties
CO2: examine the performance and plot heat balance sheet for internal combustion engines
CO3: carry out performance test on air compressors, boilers, condenser and cooling tower

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3		2	1	2	2				3	
CO2	3	3	3		2	1	2	2				3	
CO3	3	3	3		2	1	2	2				3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME407 MANUFACTURING TECHNOLOGY LABORATORY - II

0 0 3 1

LIST OF EXPERIMENTS

1. Metal Cutting experiments - Cutting force measurement.
2. Making a gear and key way on the work piece by using milling machine.
3. Prepare good surface finish on the flat and circular metal by using grinding machine.
4. Produce hole making process on the flat and circular metal by using drilling machine.
5. Make the various operations in centre lathe.
6. Gear manufacturing – Gear milling, Gear hobbing.
7. Reciprocating machine experiments-Shaper/planner, slotter.

REFERENCES / MANUALS/SOFTWARE

1. Sharma P.C., "A Text book of Production Technology", S. Chand & Co, New Delhi, 1996.
2. Hajra Choudhry, A.K. and Hajra Choudhry, H.K., "Elements of Workshop Technology", Volume - II, Media Promoters and Publishers, Bombay, 2007.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: measure various cutting forces in machining operation.

CO2: operate lathe, milling machines, drilling machines and shaping machines etc.

CO3: prepare few mechanical components using machine tools.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	1	2	1	1	2	2	3	2	3	1	
CO2		3	2	2	2	1	1	2	3	2	3	2	1
CO3		3	2	2	2	1	1	3	3	2	3	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

11ME410 ADVANCED MATERIALS TESTING LABORATORY

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

Strength of Materials

1. Tension test on a mild steel rod.
2. Double shear test on Mild steel and Aluminium rods.
3. Torsion test on mild steel rod.
4. Impact test on metal specimen (Izod and Charpy Test).
5. Fatigue Test on metal specimen (Cyclic loading)
6. Deflection test on Cantilever beam.
7. Compression test on helical springs.
8. Deflection Test on Simply Supported Beams (Aluminium, Steel, Wood).
9. Tensile test on composite Material Plate using Tensometer
10. Tensile test on Mild Steel under high temperature using Tensometer

Metallurgy Lab

1. Sand sample preparation(Green sand and Dry sand mould)
2. Determination of permeability, compressive strength, shear strength.
3. Sieve analysis – Determination of AFS fine mess number
4. Microstructure of low carbon, eutectoid steel
5. Microstructure of Grey cast-iron & SG iron
6. Microstructure of copper alloys.
7. Hardness measurement – Vickers Hardness, Rockwell Hardness, Brinell Hardness
8. Jominy End Quench Test
9. Microstructure of aluminum alloys.

REFERENCES / MANUALS/SOFTWARE:

1. Rajput, R.K., "Strength of Materials", S.Chand & Co, New Delhi, 2007.
2. Rajan T.V,Sharma "Heat Treatment Principles and Techniques" Prentice Hall of India Pvt., Ltd., New Delhi, 2010.
3. Raghavan.V., "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., New Delhi, 2006.
4. Avner, Sydney H., "Introduction to Physical Metallurgy", McGraw-Hill, New York, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the mechanical testing on materials and components.

CO2: understand the mechanical behavior of structural elements.

CO3: identify the microstructure of various metals and alloys.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	2	2	1	2	1	2	2	3	1	2	1	
CO2	2	2	2	1	2	1	2	1	3	1	2	1	
CO3	2	2	2	1	2	1	2	2	3	1	2	1	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME501 CAD/CAM/CIM

3 0 0 3

MODULE – I **15**

CAD: The Design process and role of CAD – Introduction to computer graphics - Output primitives – Bresenham's line and circle drawing algorithms– Parametric equations for line and circle – 2D & 3D transformations – Translation – Scaling – Rotation – Homogeneous coordinate - Hidden line – Surface algorithms – Shading and Coloring, RGB, HSV, HLS – UCS, WCS - Solid modeling – CSG and B-rep Techniques - Parametric modeling

MODULE – II **15**

CAM: CNC Technology, Classification- contouring – interpolators-open loop and closed loop system- CNC controller- Structural members of CNC machines- Function of ball screws-ATC, feed back Devices- Fundamentals of part programming – Manual programming- Canned cycle and subroutines – APT language programs – ISO standards for coding – G codes and M-codes, CL data and tool path simulation- Code generation from 3D solid models using software.

MODULE – III **15**

CIM: Definition- CIM Wheel- role of G.T in CAD/CAM integration - part families - classification and coding - DCLASS and MICLASS and OPITZ coding systems- cellular manufacturing. Process planning - variant approach and generative approaches - CAPP and CMPP process planning systems. Shop floor control-factory data collection system -automatic identification methods- Bar code technology-automated data collection system. FMS-components of FMS - types -FMS workstation -material handling and storage systems- FMS layout -application and benefits. Communication fundamentals-local area networks -topology -LAN implementations - network management and installations.

TOTAL : 45

TEXT BOOKS

1. Radhakrishnan, P. and Subramanian S., "CAD/CAM/CIM", New Age International Publishers, New Delhi, 2002.
2. Zeid, Ibrahim, Sivasubramanian "CAD/CAM Theory and Practice", Tata McGraw Hill, New Delhi, Special Indian Edition, Second Edition 2009.

REFERENCE BOOKS

1. Groover, M.P., ''Automation, Production System and Computer Integrated Manufacturing'', Prentice-Hall of India, New Delhi, 2007.
2. Bedworth, David, "Computer Integrated Design and Manufacturing", Tata McGraw-Hill, New Delhi, 1991.
3. Hearn, Donald and Baker, M Pauline, "Computer Graphics", Prentice Hall Inc, New Delhi, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Generate output primitives using algorithms and models with visual realism concepts
CO2: Identify the different features of CNC machines and write the part programming
CO3: Integrate the basic elements of FMS,GT,CAPP and computer networks

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3		2	3			3	2		3	3	
CO2	2	3		2	3			3	2		3	3	
CO3	2	3		2	3			3	2		3	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME502 DYNAMICS OF MACHINERY

(Common to Mechanical and Mechatronics)

3 1 0 4

MODULE – I **15**

Force Analysis and Balancing of Masses: Static Force Analysis - Free body diagrams - conditions of two, three and four force members. Inertia forces and D'Alembert's principle- - Crank shaft Torque Analysis - Fly wheels- turning moment diagrams and fluctuation of energy of reciprocating engine mechanisms, coefficient of fluctuation of energy and speed, weight of flywheel required. Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines – Introduction to Balancing of radial engine – Direct and reverse crank method.

MODULE – II **15**

Free and Forced Vibration: Basic features of vibratory systems- types- Single degree of freedom system- Transverse vibration of beams- Natural frequency by energy method, Dunkerly's method-Critical speed-damped free vibration of single degree freedom system-Types of damping- free vibration with viscous damping, Critically damped system, under damped system. Torsional systems; Natural frequency of two and three rotor systems. Response to periodic forcing - Harmonic Forcing - Forcing caused by unbalance - Support motion-Logarithmic decrement-magnification factor – Force transmissibility and amplitude transmissibility - Vibration isolation.

MODULE - III **15**

Vibration Measurements, Governors and Gyroscopic: Vibration Measurement Scheme – Transducers - Different types of Pickups - Exciters, Frequency Measurement Instruments - FFT Spectrum Analyzer - Introduction to vibration monitoring techniques.

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors –Characteristics - Effect of friction - Controlling Force - other Governor mechanisms. Gyroscopes - Gyroscopic forces and Torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes

Lecture: 45, Tutorial: 15 TOTAL: 60

TEXT BOOKS

1 Rattan, S.S.," Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2008.
2 Abdul Sheffif," Theory of Machines", Dhanpat Rai Sons., New Delhi, 1987.

REFERENCE BOOKS

1 Bevan, Thomas, "Theory of Machines", CBS Publishers and Distributors, New Delhi, 2002.
2 Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, New York, 2006.
3 Meirovitch, "Elements of Mechanical Vibrations", Tata McGraw Hill
4 Rao S. S. "Mechanical Vibrations ", 4th Edition, Pearson Education Pte. Ltd..

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: estimate inertia force, torque for reciprocating mechanisms and parameters of flywheel

CO2: analyze the static and dynamic unbalance of revolving and reciprocating masses

CO3: determine the natural frequencies of free and forced vibration and infer various vibration measurement techniques

CO4: evaluate the characteristics of different types of governors

CO5: construct the effect of reactive gyroscopic couple and evaluate the couple

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3	2	2							2	
CO2	3	3	3	2	2							2	
CO3	3	3	3	2	2							2	
CO4	3	3	3	2	2							2	
CO5	3	3	3	2	2							2	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME503 DESIGN OF MACHINE ELEMENTS

3 1 0 4

MODULE – I **15**

Steady Stresses and Variable Stresses in Machine Members: Introduction to the design process – factors influencing machine design, selection of materials based on mechanical properties – Direct, Bending and torsion stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – factor of safety – theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations.

MODULE – II **15**

Design of Shafts, Couplings and Fasteners and Welded Joints: Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys and key ways. Design of rigid and flexible couplings – Introduction to gear and shock absorbing couplings – design of knuckle joints. Threaded fasteners. Design of bolted joints – riveted joints - including eccentric loading. Design of welded joints for pressure vessels and structures – theory of bonded joints.

MODULE – III **15**

Design of Springs, Bearings and I.C Engine components: Design of helical and leaf Springs Theory of disc and torsional springs under constant loads and varying loads.

Design of bearings – Preloading sliding contact and rolling contact types, - Cubic mean load – Design of journal bearings – Mckees equation – calculation of bearing dimensions. Design of flywheels involving stresses in rim and arm.

Design of I.C Engine components-cylinder, piston, connecting rod.

Lecture: 45, Tutorial: 15, TOTAL: 60

(Approved Design Data Book is Permitted in the End Semester Examination)

TEXT BOOKS

1. Bhandari, V.B., "Design of Machine Elements", Tata McGraw-Hill, New Delhi, 2003.
2. Shigley, J.E and Mischke C. R., "Mechanical Engineering Design", McGraw-Hill International Editions, New York, 2008.

REFERENCE BOOKS

1. Norton, R.L., "Design of Machinery", Tata McGraw Hill, New Delhi, 2004.
2. Orthwein W., "Machine Component Design", Jaico Publishing Co, Bombay, 2003.
3. Ugural, A.C., "Mechanical Design – An Integral Approach, McGraw Hill Book Co, New Delhi, 2004.
4. Spotts, M.F., and Shoup, T.E., "Design and Machine Elements" Pearson Education, New Delhi, 2004.
5. Juvinall, R.C., and Marshek K.M., "Fundamentals of Machine Component Design", Third Edition, John Wiley & Sons, New Delhi, 2002.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Design the mechanical elements subjected to steady and variable stresses.

CO2: Design and analyze bolted joints, shafts, couplings, knuckle joints and welded joints.

CO3: Design and analyze coil and leaf springs, bearings, flywheels and IC engine components.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	2	3		3				2		2	3	
CO2	2	2	3		3				2		2	3	
CO3	2	2	3		3				2		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME504 METROLOGY AND MEASUREMENTS

3 0 0 3

MODULE – I **15**

Concept of Measurement and Measurement of Physical Properties: Basic concept of measurements – Generalized measurement system-Units and standards of measurements, calibration; Types of inputs, order of instruments, - static characteristics-sensitivity, linearity, readability, range, precision and accuracy, error, hysteresis etc., dynamic response; Sources of errors-systematic and random errors-correction, standardization & Interchangeability.

Measurement of Force, torque, power:-mechanical, pneumatic, hydraulic and electrical transducer-Flow measurement**:** special methods – Temperature: bimetallic strip, pressure thermometers, thermocouples, thermister and RTD – pyrometer.

MODULE – II **15**

Length, Angle and Form Measurement: Length measurement- mechanical and electrical transducers; Vibration and acceleration transducers; mechanical, electrical and pneumatic comparators, Slip gauges and classification, limit gauges – strain gauge – types – measurement circuits – gauge factor – gauge design.

Angular measurements: Sine bar, optical bevel protractor, angle Decker – Taper measurements. Tool makers microscope.

Measurement of screw threads-Thread gauges, floating carriage micrometer-measurement of gears-tooth thickness-constant chord and base tangent method-Gleason gear testing machine – radius measurements-surface finish, straightness, flatness and roundness measurements.

MODULE – III **15**

Advances in Metrology: Surface roughness/surface finish measurement, flatness, roundness; Interferometer and optical flat in measurement.

Precision instruments based on laser principles- laser interferometer-application in linear, angular measurements and machine tool metrology.

Coordinate Measuring Machine (CMM) - Constructional features – types, applications – digital devices- computer aided inspection.

Demonstration of modern measurement system in industrial applications.

TOTAL : 45

TEXT BOOKS

1. Tayal, A. K, “Instrumentation and Mechanical Measurements”, Galgotia Publications, New Delhi, 2006.
2. Jain, R. K., “Engineering Metrology”, Khanna Publishers, New Delhi, 2007.

REFERENCE BOOKS

1. Beckwith, T. G, and Buck, N. Lewis., “Mechanical Measurements”, Addison Wesley, New York, 1991.
2. Gupta, S.C., “Engineering Metrology”, Dhanpat Rai Publications, New Delhi, 1984.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the knowledge of measurement systems and their characteristics.

CO2: demonstrate the knowledge on linear and angular measurements including form and surface measurements

CO3: illustrate the knowledge on modern measurement tools and methods.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	2	1	2	1	1	2	1	1	1	3	3
CO2	1	3	2	1	2	1	1	2	1	1	2	3	3
CO3	1	3	2	1	2	1	1	2	1	1	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

11ME505 OPERATIONS RESEARCH

(Common to Mechanical and Mechatronics branches)

3 1 0 4

MODULE – I **15**

Linear and Network Models: The phases of OR study – formation of an L.P model- graphical solution – simplex algorithm – artificial variables technique– Big M method, two phase method. Transportation problems- VAM – MODI technique- Assignment problems – sequencing problems.

Shortest route – minimal spanning tree - maximum flow models – project network- CPM and PERT network-critical path scheduling.

MODULE – II **15**

Inventory and Queuing Models: Types of Inventory- EOQ – Deterministic inventory problems – Price breaks - Stochastic inventory problems- selective inventory control techniques.

Queuing models – queuing systems and structures – notation–parameter – single server and multiserver models – Poisson input – exponential service – constant rate service – infinite population.

MODULE – III **15**

Replacement Models and Metaheuristics: Replacement of items that deteriorate with time-value of money changing with time-not changing with time-optimum replacement policy-individual and group replacement.

Introduction to design of experiments-ANOVA. The nature of metaheuristics-Genetic Algorithms- Simulated Annealing- Tabu Search-Ant colony optimization-Particle swarm optimization-Memetic Algorithms- Case studies.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Taha, Hamdy A., "Operation Research: An introduction", Pearson Education, Ninth Edition, 2010.
2. Hiller, Frederick. S. and Lieberman, Gerald. J., "An introduction to Operations research- concepts and cases", Tata McGraw Hill (SIE) Eighth Edition, 2005.

REFERENCE BOOKS

1. Winston Wayne.L., "Operations Research Applications and Algorithms", Fourth Edition, Thomson learning, 2007.
2. Hira and Gupta "Problems in Operations Research: Principles and Solutions", S.Chand and Co, Reprint 2007.
3. Panneerselvam.R, "Operations Research", Prentice Hall of India, 2007
4. Eiben, A.E. and Smith, J.E., "Introduction to Evolutionary Computing", Springer, 2008.
5. Godfrey C.Onwubolu, "New Optimization Techniques in Engineering", Springer, 2004.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: formulate and solve Linear programming problems and sequencing problems
CO2: construct networks and analyze optimality for various applications
CO3: categorize inventory models and solve for optimality
CO4: perceive queuing characteristics and solve problems
CO5: recommend the optimum replacement period for capital equipment's and items that fails
CO6: utilize metaheuristics techniques and design of experiments for solving industrial problems

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	2	3	2						3	2	
CO2	3	3	2	3	2						3	2	
CO3	3	3	2	3	2						3	2	
CO4	3	3	2	3	2						3	2	
CO5	3	3	2	3	2						3	2	
CO6	3	3	2	3	2						3	2	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME506 MACHINE DRAWING

3 0 3 4

MODULE –I **10**

Machine Drawing Conventions; Introduction graphic language classification of drawing, principal of drawing, Code of Practice for Engineering Drawing, BIS specifications for machine drawing, lines, scales, section dimensioning, standard abbreviation, – Limits , fits and Tolerance, Tolerance built up, machining tolerance – gauge tolerance. Machining symbols (Dimensional and Geometrical tolerance), Surface finish, drawing conventions. Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.

MODULE –II **10**

Drawing of Machine Elements and simple parts: Orthographic projections: principle of first angle projection, orthographic views from isometric views of machine parts / components.

Drawing of sectional views: keys, cotters and joints, Coupling, Bearings, Crankshaft, Pulley, Piston and Connecting rod, Cotter and Knuckle joint, bolts and nuts.

MODULE –III **10**

Assembly Drawing of Machine Elements: Assembly drawing with sectioning and bill of materials from given detailed drawings of assemblies: Lathe Tail stock, Machine vice, Pedestal bearing, screw jacks, Stuffing box, Cross heads, piston assembly, Machine Vices Plummer block and safety valve.

Lecture : 30, Practical : 30, TOTAL : 60

TEXT BOOKS

1. N. D. Bhatt and V. M. Panchal . "Machine Drawing", 45th Edition, Charotar Publishing House Pvt. Limited, Anand, Gujarat, 2010.
2. K. L. Narayana and P. Kannaiah, "Machine Drawing", 3rd Edition, New Age International Publishers limited, New Delhi, 2010.

REFERENCE BOOKS

1. N Sidheswar, P Kannaiah, V.V.S. Sastry. "Machine Drawing", Tata-Mcgraw Hill Education, Chennai, 2004.
2. K.R. Gopalakrishna. "Machine Drawing", Subhas Publications, New Delhi, 2007.
3. K. C. John, "Text Book of Machine Drawing", Pentice Hall of India, New Delhi, 2009.
4. Goutam Pohit and Goutam Ghosh. "Machine Drawing", Pearson EducationChennai, 2010.
5. P.S.G. Design Data Book, Coimbatore, 2001.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: apply the knowledge of geometric dimensioning and tolerancing.

CO2: draft the orthographic and sectional views of machine components

CO3: Interpret the detailed and assembly drawings of various mechanical components

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3			1	2		2	3			3	2	
CO2	3			1	2		2	3			3	2	
CO3	3			1	2		2	3			3	2	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME507 CAD/CAM LABORATORY

0 0 3 1

LIST OF EXPERIMENTS

COMPUTER AIDED DESIGN (CAD) 18

Objective:

To learn and obtain the knowledge in creating a model by utilizing the softwares.

1 3D Part modeling – protrusion, cut, sweep, draft, loft, blend, rib
2 Editing – Move, Pattern, Mirror, Round, Chamfer
3 Assembly – creating assembly from parts – assembly constraints
4 Conversion of 3D solid model to 2D drawing - different views, sections, isometric view and dimensioning
5 Introduction to Surface Modeling
6 Introduction to File Import, Export – DXF, IGES, STL, STEP
7 3D modeling of machine elements like Flanged coupling, screw jack etc.
8 Mass property calculations and interference check

COMPUTER AIDED MANUFACTURING (CAM) 18

Objective:

To learn and develop the skill in creating a component by utilizing the Automated Machines.

MANUAL PART PROGRAMMING (Using G and M Codes) in CNC lathe

9 Part programming for Linear and Circular interpolation.
10 Part programming using standard canned cycles for Turning.

MANUAL PART PROGRAMMING (using G and M codes) in CNC milling

11 Part programming for Linear and Circular interpolation and Contour motions.
12 Part programming involving canned cycles for Drilling, Peck drilling, and Boring

SIMULATION AND NC CODE GENERATION 9

13 NC Code generation using CAD / CAM softwares - Post processing for standard CNC Controls like FANUC, Simens etc.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

Pro-E Wildfire 3.0

CATIA V5R12

Master CAM

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: develop solid models of machine components and their assembly.
CO2: generate and simulate the manual part programs using G& M codes.
CO3: perform simple machining operations in CNC machine

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3		3	3				2	1	3	2	
CO2	2	3		3	3				2	1	3	2	
CO3	2	3		3	3				2	1	3	2	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME508 METROLOGY AND MEASUREMENTS LABORATORY

0 0 3 1

LIST OF EXPERIMENTS (Any 12 experiments)
(Use slip gauges for calibration of length measuring instruments)

LIST OF EXPERIMENTS /EXERCISES

1. Calibration of Vernier / Micrometer; static characteristic study. Measurement of Components like V block etc.,.
2. Calibration of Internal micrometer and bore gauge; static characteristic study. Measurement of components.
3. Calibration of Dial Gauge; static characteristic study; Use of dial gauge as measuring device and comparator.
4. Calibration of Gear Tooth Vernier; static characteristics study; Measurement of gear tooth thickness.
5. Calibration of LVDT and characteristic study; Use of LVDT as electronic comparator
6. Measurement/checking of Taper Angle using Bevel Protractor / Sine bar / Tool Makers Microscope.
7. Measurement of straightness and flatness using autocollimator.
8. Measurement/checking of thread parameters using tool maker's microscope/thread gauges
9. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical).
10. Calibration and characteristics study of dead weight pressure gauge
11. Dynamic characteristics study of glass thermometer- a first order instrument;
12. Use of CMM in metrology- Tracing the profile of a component and measurement of dimensions
13. Machine alignment test (Lathe and special machines) like parallel and perpendicularity test.
14. Use of Sampling Inspection & Control charts for Quality control.
15. Measurement of Force and torque(study experiment)
16. Measurement of Vibration / Shock(Demonstration experiment)
17. Study on measurement of light, sound, humidity, DBT, WBT, etc.
18. Temperature measurement using thermo couples, RTD etc.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Jain, R. K., "Engineering Metrology", Khanna Publishers, New Delhi, 2007.
2. Tayal, A. K, "Instrumentation and Mechanical Measurements", Galgotia Publications, New Delhi, 2006.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: calibrate the instruments and analyze their characteristics
CO2: demonstrate the knowledge/skill in the measurement of length, angle and form and surface measurement.
CO3: demonstrate the knowledge/skill in the measurement of light, sound, vibration and temperatures

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	2	1	2	1	1	2	1	1	1	3	3
CO2	1	3	2	1	2	1	1	2	1	1	2	3	3
CO3	1	3	2	1	2	1	1	2	1	1	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

11ME509 DYNAMICS LABORATORY

0 0 3 1

LIST OF EXPERIMENTS / EXERCISE:

1. Determine the mass moment of inertia of a block using turning table apparatus.
2. Determine the natural frequency of given spring using spring mass system.
3. a) Generation of cam profile with roller flower using cam analysis machine.
   b) Generation of cam profile with knife edge flower using cam analysis machine.
4. Determine the characteristics of governor using universal governor apparatus. (Porter, Proell and Watt governor set up)
5. Determine the loss of couple due to friction using gyroscopic couple apparatus.
6. Determine the efficiency of worm gear box using speed reducer apparatus.
7. Determine the moment of inertia of connecting rod and flywheel by oscillating method.
8. Determine the natural frequency of undamped torsional vibration of single rotor and single node system.
9. Determine the transmissibility ratio of given eccentric mass in vibration table.
10. Determine the natural and critical frequency of given shaft using whirling of shaft apparatus.
11. Determine the natural frequency of simply supported beam.
12. Dynamic balancing of rotating masses.

REFERENCES / MANUALS/SOFTWARE:

1. Rattan, S.S.," Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2008.
2. P.L.Ballaney,"Theory of Machines with Mechanism", Khanna Publishers, Delhi, 2001
3. Sadhu Singh., "Theory of Machines" Pearson Education, New Delhi, 2006.
4. Bevan, Thomas, "Theory of Machines", CBS Publishers and Distributors, New Delhi, 2002.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: plot and analyze cam profile with different followers and calculate mass moment of inertia of the components.

CO2: interpret characteristics of different governors, worm gear box and gyroscope.

CO3: identify system response, natural frequency and resonance for free, forced and torsional vibrations systems.

CO4: carry out dynamic balancing of masses and calculate whirling speed of the shaft.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	3		3	1			2		2	3	
CO2	2	3	3		3	1			2		2	3	
CO3	2	3	3		3	1			2		2	3	
CO4	2	3	3		3	1			2		2		

1 – Slight, 2 – Moderate, 3 – Substantial

11GE601 ECONOMICS AND MANAGEMENT FOR ENGINEERS

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Economics – Basics Concepts and Principles – Demand and Supply – Law of demand – Determinants of demand, Law of supply – market Equilibrium – National Income – Circular Flow of Economic activities and Income –National Income and its measurement techniques – Inflation – Causes of Inflation – Controlling Inflation –Business Cycle .

MODULE – II **15**

Forms of business – Management Functions: Planning, Organizing, Staffing, Leading and Controlling- Managerial Skills - Levels of Management - Roles of manager.

Marketing – Core Concepts of Marketing, Four P's of Marketing, New product development, Product Life Cycle, Pricing Strategies and Decisions. Operations Management – Resources – Site selection, Plant Layout, Steps in Production Planning and Control – EOQ Determination

MODULE – III **15**

Accounting Principles – Financial Statements and its uses – Time value of Money – Depreciation methods — Break Even Analysis – Capital budgeting techniques – Introduction to FDI, FII, Mergers & Acquisition.

TOTAL : 45

TEXT BOOKS

1. Geetika, Plyali Ghosh, Purba Roy Choudhury, "Managerial Economics", 1st Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Jeff Madura, "Fundamentals of Business", Cengage Learning Inc, India, 2007.

REFERENCE BOOKS

1. Stanley L. Brue and Campbell R Mcconnell, "Essentials of Economics", Tata McGraw-Hill, New Delhi, 2007.
2. S.P.Jain, K.L.Narang, Simi Agrawal, "Accounting for Management", First Edition, Tata McGraw-Hill, New Delhi, 2009

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: estimate market equilibrium and interpret national income calculation and inflation issues
CO2: categorize the forms of business and analyse the functions of management
CO3: appraise marketing and operations management decisions
CO4: interpret financial and accounting statements

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
CO1	1	1	2			3		2	2	2	3	2
CO2		1	2			2	2	2	2	2	3	2
CO3	1	2	1			2		2	2	2	3	2
CO4	2	2				2		2	2	2	3	2

3 – Substantial, 2 – Moderate, 1 – Slight

11ME601 HEAT AND MASS TRANSFER

3 1 0 4

MODULE – I **17**

Conduction and Convection Heat Transfer: Fourier's Law of Conduction - General Differential equation of Heat Conduction in Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems –Critical radius of insulation - Composite Systems – Conduction with Internal Heat Generation – Plane wall and Cylinder – Extended Surfaces – Unsteady Heat Conduction – Principle of Lumped Heat Analysis – Use of Heisler's Chart. Basic Concepts – Convective Heat Transfer Coefficients – Forced Convection – External Flow – Flow over flat Plates, Cylinders and Spheres – Laminar and Turbulent Flow - Internal Flow –– Flow over Bank of tubes – Free Convection – Flow over Vertical Plate, Horizontal Plate, Cylinders and Spheres – Free convection in porous media – Mixed convective flow – Heat transfer in high speed flow.

MODULE – II **13**

Phase Change Heat Transfer and Heat Exchangers: Boiling – Pool boiling and Film boiling – Condensation – Dropwise and Filmwise Condensation - Correlations in boiling and condensation- Transpiration and film cooling – Heat pipe – Non gravitational condensation. Heat Exchangers – Types of heat exchangers – LMTD Analysis – Effectiveness – NTU Analysis – Overall Heat Transfer Coefficient – Fouling Factors – Theory of Compact Heat Exchangers.

MODULE – III **15**

Radiation Heat Transfer, Special Heat Transfer Processes and Mass Transfer:

Basic laws of radiation – Concept of Black body – Absorptivity, Reflectivity and Transmissivity – Grey body radiation - Shape Factor Algebra – Radiosity and Irradiation - Electrical Analogy for parallel plates – Radiation Shields –Introduction to Gas Radiation. Special heat transfer processes – Cooling of electronic equipments – Heat transfer in Circulating Fluidized Bed Boiler – Bio Heat transfer – Cardiovascular system – Ablative and Cryosurgical Procedures – Cryopreservation – Therapeutic Hyperthermia and Hypothermia. Mass transfer – Diffusion Mass Transfer - Convective Mass Transfer and Correlations –- Heat and Mass Transfer Analogy.

Lecture : 45, Tutorial : 15, TOTAL : 60

(Use of approved Heat and Mass Transfer Data book is permitted in the end semester examination)

TEXT BOOKS

1. Holman, J.P "Heat Transfer" Tata McGraw-Hill, New Delhi, 2010.
2. Nag. P.K, "Heat and Mass Transfer", Tata McGraw-Hill, New Delhi, 2008.

REFERENCE BOOKS

1. William M. Kays, Michael E. Crawford, Bernhard Weigand, "Convective Heat and Mass Transfer", McGraw-Hill International edition, 2004.
2. Ghoshdastidar .P.S, "Heat Transfer", Oxford Press, New Delhi, 2008.
3. Yunus Cengel, "Heat and Mass Transfer", Tata McGraw-Hill, 2006.
4. Sachdeva, R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, New Delhi, 2010.
5. http://en.wikipedia.org/wiki/bioheat_transfer

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: solve the physical problems in conduction and convection heat transfer

CO2: identify the phase change heat transfer process and apply necessary correlations in the design of heat exchanging equipment.

CO3: demonstrate an understanding of radiation heat transfer and special heat transfer processes with respect to practical applications.

CO4: apply mass transfer correlations to real time problems and correlate them with heat transfer phenomenon

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2	3		3		2	1	2		2	3	
CO2	3	2	3		3		2	1	2		2	3	
CO3	3	2	3		3		2	1	2		2	3	
CO4	3	2	3		3		2	1	2		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME602 DESIGN OF TRANSMISSION SYSTEMS

3 1 0 4

MODULE – I **15**

Belt & Chain Drives, Spur & Helical Gears: Classification of belt drives, Selection of V belts and pulleys – selection of Flat belts and pulleys - Wire ropes and pulleys – Selection of Transmission chains and Sprockets.

Gear Terminology-Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects - Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces and stresses. Estimating the size of the helical gears.

MODULE – II **15**

Design of Bevel, Worm gears, power screws: Straight bevel gear- terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits- terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Design of power screws.

MODULE – III **15**

Design of Gear Boxes and Design of Clutches and Brakes: Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box -Constant mesh gear box. – Design of multi speed gear box.

Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-internal and external shoe brakes.

Lecture : 45, Tutorial : 15, TOTAL : 60

(*Use of PSG Design Data Book is permitted in the end semester Examinations)*

TEXT BOOKS

1. Shigley, J.E and Mischke C. R., "Mechanical Engineering Design", McGraw-Hill International Editions, New York, 2008.
2. Bhandari, V.B., "Design of Machine Elements", Tata McGraw-Hill, New Delhi, 2009.

REFERENCE BOOKS

1. Maitra, G.M. and Prasad L.V., "Hand book of Mechanical Design", Second Edition, Tata McGraw-Hill, New Delhi, 1985.
2. Juvinall, R.C. and Marshek K.M., "Fundamentals of Machine Component Design", Third Edition, John Wiley & Sons, New York, 2002.
3. Prabhu, T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2005,
4. Norton, R.L., "Design of Machinery", McGraw-Hill Book co, New York, 2004.
5. Hamrock, B.J., Jacobson B. and Schmid S.R., "Fundamentals of Machine Elements", McGraw-Hill Book Co., New York, 1999.

STANDARDS

1 IS 4460 : Parts 1 to 3 : 1995, Gears – Spur and Helical Gears – Calculation of Load Capacity
2 IS 7443 : 2002, Methods of Load Rating of Worm Gears
3 IS 15151: 2002, Belt Drives – Pulleys and V-Ribbed belts for Industrial applications – PH, PJ, PK, Pl and PM Profiles : Dimensions
4 IS 2122 : Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission : Part 1 Flat Belt Drives.
5 IS 2122: Part 2: 1991, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 2 V-Belt Drives.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Design and analyze the chain drives, belt drives, spur gear and helical gear drives for various applications.
CO2: Design and analyze bevel gear, worm gear and power screw for different applications.
CO3: Design and analyze the multi speed gear box, clutches and braking systems for industrial application

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	2	3		3				2		2	3	
CO2	2	2	3		3				2		2	3	
CO3	2	2	3		3				2		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME603 FINITE ELEMENT ANALYSIS

3 1 0 4

MODULE – I **15**

Introduction: Historical background – Matrix approach –Coordinates, Numerical simulation, and Gauss Elimination based Solvers. –FEA General procedure –Discretization of the domain, -Interpolation –Weighted residual method – Ritz method – Introduction of stiffness method.

MODULE – II **15**

One Dimensional Problems and Two Dimensional Problems: 1D Finite element modeling – Linear and Quadratic element-shape functions— Galerkin method -structural–Heat Transfer and flow in 2D: Fin Pin -Galerkin approach for beam.

2D Finite element modeling–shape function for CST element – potential energy approach- Plane Strain and Plane Stress - Solid Mechanics Problems.

MODULE – III **15**

Axis symmetric Continuum and Numerical Integration: Axis symmetric formulation – Elemental Equations- Connectivity and Assembly-Imposition of Boundary Conditions- Applications to cylinders under internal or external pressures– Applications to plane trusses.

The four node quadrilateral – Shape functions – Sub-parametric, Iso-parametric; Elements – Numerical integration - Stiffness integration – Stress calculations.

Lecture : 45, Tutorial : 15, TOTAL : 60

TEXT BOOKS

1. Rao, S.S., "The Finite Element Method in Engineering", Pergamon Press, New York, 1989.
2. J. N. Reddy, "An Introduction to the Finite Element Method", 2nd Edition, McGraw-Hill, Inc., New York, 1993.

REFERENCE BOOKS

1. T. R. Chandrupatla and A. D. Belegundu, "Introduction to Finite Elements in Engineering", 2nd Edition, Prentice Hall, New Jersey, 2007.
2. Hutton, David V., "Fundamentals of Finite Element Analysis". McGraw-Hill, New York, 2004.
3. Logan, D.L., "A First course in the Finite Element Method", Third Edition, Thomson Learning, New York, 2002.
4. Cook, Robert D., Malkucs, David. S, and Plesha Michael E, "Concepts and Applications of Finite Element Analysis", Fourth Edition, John Wiley & Sons, New York, 2003.
5. Zienkiewicz, O.C. and Taylor R.L., "The Finite Element Methods", Volume. I: The Basic Formulation And Linear Problems, Fifth Edition, Butterworth Heineman, London, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: utilize the variational formulation methods, weighted residual method and basics of finite element formulation for engineering problems.

CO2: derive finite element equations and solve the real time 1D and 2D structural and thermal problems.

CO3: solve and analyze the engineering problems using axisymmetric and parametric elements.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	3	2	3				2		2	3	
CO2	2	3	3	2	3				2		2	3	
CO3	2	3	3	2	3				2		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME604 FLUID POWER SYSTEM

(Common to Mechanical and Mechatronics Engineering)

3 0 0 3

MODULE – I **17**

Fundamentals of Hydraulic System: Basics of fluid power system – Advantages of Fluid power systems – Fluid properties – Pascal's Law and applications– Hydraulic pumps – Gear, Vane and Piston pumps, Sizing of Pumps, Pump Performance, Characteristics and Selection. Control valves – Direction control valves – Three way valve, Four way valve, Check valve and shuttle valve –Actuation mechanism – Pressure control valves – Pressure relief, Pressure Reducing, Counter balance, Sequencing and Unloading Valves – Flow control valves – types – Proportional Valves – Servo valves- Hydraulic Power pack construction– Fluid power symbols.

MODULE – II **13**

Fundamentals of Pneumatic System: The perfect Gas laws – Compressors – piston, screw and vane compressor – Fluid conditioning Elements –Filter, Regulator and Lubricator unit, Pneumatic silencers, Aftercoolers, Air dryers – Air control valves – Fluid power actuators – Cylinders and Motors – types – Cushioning mechanism – Sizing of Actuators – Hydrostatic transmission system – Basic pneumatic circuits – Electrical controls for Fluid power circuits – Introduction to Fluid logic devices and applications – PLC applications in Fluid power circuit.

MODULE – III **15**

Industrial Circuits and Maintenance of Fluid Power System: Circuit design methodology – Cascade method – Industrial circuits – Speed control circuits – Regenerative cylinder circuits – Pump unloading circuit –Double pump circuit – Counter balance valve circuit – Hydraulic cylinder sequencing circuit (using pressure sequence valve) – Automatic cylinder reciprocating circuit – Cylinder synchronizing circuits – Fail safe circuits – Accumulator – types and application circuits – Pressure intensifier circuits – Sealing devices – types and materials – Installation, Maintenance and trouble shooting of Fluid Power systems – Safety considerations and Environmental issues in Fluid power system.

TOTAL: 45

TEXT BOOKS

1. Esposito Anthony, "Fluid Power with Applications", Pearson Education Inc., New York, 2003.
2. Majumdar, S.R., "Oil Hydraulic Systems – Principles and Maintenance", Tata McGraw-Hill, New Delhi, 2006.

REFERENCE BOOKS

1. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGraw-Hill, New Delhi, 2006.
2. Sullivan James A., "Fluid Power - Theory and Applications", Fourth Edition, Prentice Hall International, New Jersey, 1998.
3. Pippenger, John and Hicks, Tyler, "Industrial Hydraulics", Third Edition, Tata McGraw-Hill, New Delhi, 1987.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify fluid power components and their symbols as used in the industry
CO2: interpret the functions and operations of hydraulic components
CO3: build basic circuits using pneumatic components
CO4: design, construct, test, install, maintain and trouble shoot the fluid power circuits for engineering applications in a safe manner

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3		3							2	
CO2	3	3	3		3							2	
CO3	3	3	3		3							2	
CO4	3	3	3	3	3	2						2	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME605 HEAT TRANSFER LABORATORY

0 0 3 1

LIST OF EXPERIMENTS /EXERCISES

HEAT TRANSFER

1. Thermal conductivity measurement by guarded plate method.
2. Thermal conductivity of pipe insulation by using lagged pipe apparatus.
3. Thermal conductivity of Insulating powder by using a spherical apparatus.
4. Natural convection heat transfer from a vertical cylinder.
5. Forced convection inside tube.
6. Heat transfer from Pin-Fin (Natural & Forced convection modes)
7. Determination of Stefan-Boltzmann constant.
8. Determination of emissivity of a grey surface.
9. Effectiveness of Parallel/Counter flow heat exchanger.
10. Performance Test on Air Blower.
11. Heat transfer studies on CFB riser.
12. Performance test on evacuated solar tubes.
13. Study on cooling towers.

REFRIGERATION AND AIR CONDITIONING

14. Determination of COP of a refrigeration system.
15. Experiments on air-conditioning system.

REFERENCES / MANUALS/SOFTWARE:

1. Sachdeva, R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, New Delhi, 2007.
2. Holman, J.P "Heat and Mass Transfer" Tata McGraw-Hill, New Delhi, 2000.
3. Ghoshdastidar .P.S, "Solutions Manual of Heat Transfer", Oxford University Press, 2005
4. Lab Manuals

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: perform conduction, convection and radiation experiments to find the dependent variables

CO2: calculate the co-efficient of performance of refrigeration and air-conditioning systems and interpret their results

CO3: examine a heat exchanger through its effectiveness calculation

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	2		3		2					3	
CO2	3	3	2		3		2					3	
CO3	3	3	2		3		2					3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME606 COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY

0 0 3 1

LIST OF EXPERIMENTS:

1. Stresses and Deflections of different types of beams with various types of loads.
2. Deflections of different types of truss with point of loads.
3. Application of plane stress and plane stain conditions.
4. Deflection of Springs
5. Axis Symmetric Application
6. Heat conduction and convection applications
7. Thermo-structural Analysis
8. Contact of Two Bodies
9. Harmonic Response of a Two-Mass-Spring System
10. Modal Analysis of a Cyclic Symmetric Annular Plate
11. Bimetallic Layered Cantilever Plate with structural Loading

REFERENCES / MANUALS/SOFTWARE:

1. Cook, Robert D.., Malkucs, David. S, and Plesha Michael E, "Concepts and Applications of Finite Element Analysis", Fourth Edition, John Wiley & Sons, New York, 2003.
2. Rao, S.S., "The Finite Element Method in Engineering", Pergamon Press, New York, 1989.
3. ANSYS Software.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: know the basic working knowledge of analysis tools.

CO2: solve the 1D and 2D structural and thermal problems with various boundary conditions.

CO3: solve the coupled field, modal and harmonic response analysis for multiple degree of freedom systems.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3		3	2	1			2		3	3	
CO2	2	3		3	2	1			2		3	3	
CO3	2	3		3	2	1			2		3	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME607 DESIGN AND FABRICATION PROJECT

0 0 6 2

The objective of this project is to understand the features of design tool and its implementation techniques towards fabricating the same.

The students in convenient groups of not more than 3 members have to take engineering oriented task for design and fabrication. Every project work shall have a guide who is the member of the faculty of the institution and if possible with an industry guide also.

The task chosen may be small machine elements (Example-screw jack, coupling, machine vice, cam and follower, governor etc), attachment to machine tools, tooling (jigs, fixtures etc), small gear box, automotive appliances, agricultural implements, simple heat exchangers, small pumps, hydraulic /pneumatic devices etc.

The students are required to design and fabricate the chosen task in the college and demonstrate its working apart from submitting the project report. The report should contain assembly drawing, parts drawings, process charts relating to fabrication.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify the problem from literature collection and real life situation.

CO2: demonstrate the knowledge and skill in design, development, fabrication and testing by way of carrying out the project model.

CO3: plan, organize and execute the project and complete in time.

CO4: write project reports and publish technical papers

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3	2	3	3	3	3	3	3	2	3	3
CO2	3	3	3	2	3	3	3	3	3	3	2	3	3
CO3	3	3	3	2	3	3	3	3	3	3	2	3	3
CO4	3	3	3	2	3	3	3	3	3	3	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

11ME701 INDUSTRIAL AUTOMATION

3 0 0 3

MODULE – I **15**

Mechatronics Design: Sensors for mechatronic system: Pressure, Temperature, Displacement, Photo electric. Building blocks of Mechanical, Electrical, Fluid & Thermal systems, Hydraulic systems. Introduction to Micro-Mechatronic system-principle-Component design - Micro actuation - Micro robot-Micropump-Application of micromechatronic components. Case studies of mechatronics system: Pick and Place robot, Engine management system, Car park barrier and Automatic washing machine.

MODULE – II **15**

Microprocessor and its Interfacing: Organization of 8085-Instruction set-Addressing modes- Interfacing I/O devices - 8255 programmable peripheral devices (PPI)- 8253 programmable interval timer – 8279 keyboard and display interfacing – 8237 programmable DMA controller – Interfacing A/D and D/A converters.

MODULE – III **15**

Programmable Logic Controller: Introduction - Architecture of PLC- I/O module – Distributed I/O modules – programmable devices – programming of PLC-Timer, Counter and relays-shift registers – master and jump controls – Data handling – Selection of PLC- Maintenance and trouble shooting of PLC.

TOTAL : 45

TEXT BOOKS

1. Bolton, W, "Mechatronics", Second Edition, Pearson Education, New Delhi, 2003.
2. Goankar, Ramesh, "Microprocessor Architecture. Programming and Applications with the 8085", Fifth Edition, Penram International Publishing, Bombay, 2002.
3. Petruzella, Frank D, "Programmable Logic Controllers", Second Edition, McGraw-Hill, New York, 1998.

REFERENCE BOOKS

1. Mathur, Aditya P., "Introduction to Microprocessor", Third Edition, Tata McGraw- Hill, New Delhi, 2003.
2. Tai-Ran-Hsu, "MEMS and Micro Systems Design", Tata McGraw-Hill, New Delhi, 2006.
3. Bradley, D. A., Dawson, D., Buru, N.C. and. Loader, A.J, "Mechatronics", Chapman and Hall, London, 1993.
4. Mahadik, Nitaigour Premchand., "Mechatronics", Tata McGraw-Hill, New Delhi, 2003.
5. Histand, Michael B. and Alciatore, David G., "Introduction to Mechatronics and Measurement Systems", McGraw-Hill, New York, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: establish the systems concepts involving electrical, electronics, mechanical and computer for an industrial automation.

CO2: program for various problems using microprocessor based systems

CO3: understand the operations of logic controllers

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2		3	1	3		2	1	2	1	2	3	
CO2	2		3	1	3		2	1	2	1	2	3	
CO3	2		3	1	3		2	1	2	1	2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME702 INDUSTRIAL ENGINEERING AND COST ANALYSIS

3 0 0 3

MODULE – I **15**

Productivity and Work Study: Industrial Engineering – Role of Industrial Engineering - System concept of production-Types of production system-flow, job, batch and project-Productivity-Factors affecting productivity-Productivity measures-Productivity improvement techniques-Business Process Reengineering (BPR).

Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – Principles of motion economy-Work measurement - Techniques of work measurement - Time study – computation of standard time-Work sampling - Synthetic data - Predetermined motion time standards-Job Evaluation, Merit Rating-Ergonomics and Safety.

MODULE – II **15**

Forecasting and Facility Planning: Need for forecasting-demand patterns-Forecasting models- Judgemental Techniques, Time series analysis, moving average, exponential smoothing, Regression and correlation method-Forecast error-costs and accuracy of forecasts.

Facility location-factors influencing plant location-single and multi facility location problems-Minimax, Gravity and Euclidean – Distance location problem. Capacity planning, Plant layout-Layout classification-Layout Design Procedures-CRAFT, ALDEP, CORELAP-Material handling systems-unit load concept-material handling principles-Types of material handling equipments and its selection.

MODULE – III **15**

Value Engineering: Value engineering – Function, aims, procedure. Make or buy decision, Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods. Methods of comparison of alternatives – present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

TOTAL : 45

TEXT BOOKS

1. Telsang, Martand., "Industrial Engineering and Production Management", S. Chand and Company, New Delhi, Second Revision Edition, 2006.
2. Panneerselvam.R., "Production and Operations Management", Prentice-Hall of India, 2007.

REFERENCE BOOKS

1. Buffa, Elwood S., and Sarin, Rakesh K., "Modern Production and Operations Management", Eighth Edition, John Wiley and Sons, New York, 2003.
2. Chary, S.N., "Production and Operations Management", McGraw Hill, Fourth edition, New Delhi, 2009.
3. Nair, N.G., "Production and Operations Management", Tata McGraw-Hill, New Delhi, 2002.
4. Chase,Jacobs and Aquilano "Operations Management for Competitive Advantage", Tenth Edition, Tata McGraw-Hill, New Delhi, 2004.
5. ILO, "Introduction to work study", Geneva.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: exhibit various industrial engineering concepts and re-engineering tools

CO2: perform different forecasting techniques and demonstrate the concepts for design of layout

CO3: demonstrate the concepts of cash flow models and value engineering

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	1	2	2	2	2	1	1	1	2	2	3	3
CO2	3	1	2	2	2	2	1	1	1	2	2	3	3
CO3	3	1	2	2	2	2	1	1	1	2	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

11ME703 AUTOMOBILE ENGINEERING

3 0 0 3

MODULE – I **14**

Engine Auxiliary Systems: Types of Automobiles - Vehicle Construction – Chassis – Frame and Body –Engine types, Components of Engine – Functions and Materials – Turbo Chargers. Electronic Engine Management System.

Fuel supply System: Carburetion and Simple carburetor - Electronically controlled gasoline fuel injection system – Mono-point and Multi - Point Fuel Injection Systems (MPFI). Diesel engine fuel supply system-Types, Electronically controlled diesel fuel injection system - Unit injector system, Rotary distributor type and CRDi.

Construction and Operation of Lead Acid Battery - Electrical systems –Lighting system – Starting Motor and Drives.

MODULE – II **17**

Transmission Systems: Clutch – Types and Construction – Gear Boxes, Manual and Automatic – Selector mechanism – Over Drives – Transfer Box -Fluid flywheel-Torque converters – Propeller shaft – Slip Joint – Universal Joints – Differential and Rear Axle – Hotchkiss Drive and Torque Tube Drive. **Steering Systems** Wheels and Tyres – Wheel Alignment Parameters - Types of Front Axle - Steering geometry- mechanism and steering linkages, Steering gear box and types – Power Steering.

MODULE – III **13**

Brakes, Suspension Systems: Hydraulic and Pneumatic Braking Systems – Types and Construction - Antilock Braking System, Suspension systems – Types and Construction. **Alternative Energy Sources:** Properties and applications of Natural Gas, LPG, Biodiesel, Bioethanol, Gasohol and Hydrogen in Automobiles - Electric and Hybrid Vehicles - Fuel Cells.

Emission Control & Safety: Global Standards, Indian norms for Petrol & Diesel vehicles, Safety measures in automobiles.

TOTAL : 45

TEXT BOOKS

1. Kirpal Singh., "Automobile Engineering", Volume. I & II, Eleventh Edition, Standard Publishers, New Delhi, 2008.
2. Crouse, William H and Anglin, Donald L., "Automotive Mechanism", Ninth Edition, Tata McGraw-Hill, New Delhi, 2003.

REFERENCE BOOKS

1. Newton, K., Steeds, W and Garet, T K., "Motor Vehicles", Butterworth Publishers, Burlington, 1989.
2. Srinivasan. S., "Automotive Mechanics", Second Edition, Tata McGraw-Hill, New Delhi, 2003.
3. Heitner, Joseph., "Automotive Mechanics", Second Edition, East-West Press, New Delhi, 1999.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: illustrate the automobile engine auxiliary system, fuel supply systems and electrical systems

CO2: demonstrate the working of components used in transmission and steering systems.

CO3: describe the construction and working principle of braking system in automobile

CO4: expose the knowledge on alternate fuels, emission control and safety measurements in automobile

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3					1	2			2		3	
CO2	3					1	2			2		3	
CO3	3					1	2			2		3	
CO4	3					1	2	3		2		3	

1 – Slight, 2 – Moderate, 3 – Substantial

11GE701 TOTAL QUALITY MANAGEMENT

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Quality Systems: Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs, Basic concepts of Total Quality Management, Historical Review. Need for ISO 9000 and Other Quality Systems, ISO 9000:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, Introduction to TS 16949, QS 9000, ISO 14000, ISO 18000, ISO 20000, ISO 22000.

MODULE – II **15**

TQM Principles: Principles of TQM, Leadership – Concepts, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation. Customer satisfaction – Customer Perception of Quality, Customer Complaints, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits. Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts.

MODULE – III **15**

TQM Tools: The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools, Poka Yoke. Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

TOTAL :45

TEXT BOOKS

1. Besterfield, Dale H. et al., "Total Quality Management", Third Edition, Pearson Education, 2008
2. Subburaj Ramasamy, "Total Quality Management", Tata McGraw Hill, New Delhi, 2007.

REFERENCE BOOKS

1. Feigenbaum. A.V, "Total Quality Management", Tata McGraw Hill, New Delhi, 1999.
2. Suganthi, L and Samuel A Anand., "Total Quality Management", PHI Learning, New Delhi.
3. Evans James R. and Lindsay William M., "The Management and Control of Quality", Seventh Edition, South-Western (Thomson Learning), 2007.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: illustrate the evolution and basic concepts of TQM
CO2: interpret various ISO standards and their implementation procedures
CO3: apply the principles of TQM and its elements in real time scenario
CO4: adapt quality tools and techniques to implement TQM at the work place

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1						2	2	3	2	2	2	2	
CO2						3	3	3	3	2	2	2	
CO3					2	3	2	3	3	3	2	2	
CO4	3	2	2	2	2	1		2	2	2	3	3	

3 – Substantial, 2 – Moderate, 1 – Slight

11MT706 MECHATRONICS LABORATORY

0 0 3 1

LIST OF EXPERIMENTS

1. Measurement of speed using servo motor controller.
2. Measurement of displacement using LVDT and Capacitive transducer.
3. Measurement of temperature using RTD and thermocouple sensors.
4. Measurement of force using load cell.
5. 8 Bit addition, subtraction, multiplication, division of two 8 bit numbers using microprocessor kit
6. Arrange a series of numbers in ascending and descending orders using microprocessor kit
7. Sum of N numbers and factorial of N numbers using microprocessor kit
8. Interfacing a microprocessor with stepper motor control
9. Construction of ladder programming for Boolean operations.
10. Linear actuation of pneumatic cylinder with timer and counter using PLC.
11. Sequential operation of a pneumatic cylinder using PLC
12. Speed control of a DC motor using PLC.

REFERENCES / MANUALS/SOFTWARE:

1. Sensors like speed sensor, displacement sensor, temperature sensor and force sensor.
2. Microprocessor kit.
3. PLC Interfacing module.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: measure the speed, displacement, temperature and load using sensor

CO2: interface various physical devices with microprocessor for real time applications

CO3: perform automation using PLC programming

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2		2	3	2	1			2			1	
CO2	2		2	3	2	1			2			1	
CO3	2		2	3	2	1			2			1	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME704 AUTOMOBILE ENGINEERING AND FLUID POWER LABORATORY

0 0 3 1

AUTOMOBILE ENGINEERING LABORATORY

LIST OF EXPERIMENTS:

1. Study of Automobile Components and its Functions.
2. Study of Petrol and Diesel Fuel Injection systems.
3. Study of multicylinder engine.
4. Dismantling and Assembly of Carburetors and clutches.
5. Dismantling and Assembly of Gear Boxes.
6. Dismantling and Assembly of Differential.
7. Dismantling and Assembly of Braking systems.
8. Dismantling and Assembly of Suspension systems.
9. Wheel alignment: measuring and adjustment of castor, camber, king-pin inclination, toe-in and toe-out.
10. Test on fuel pump.
11. Study on electrical systems.

REFERENCES / MANUALS/SOFTWARE:

1. Kirpal Singh "Automobile Engineering", Volume. I & II, 11th Edition, Standard Publishers, New Delhi, 2008.
2. Crouse, William H and Anglin, Donald L. "Automotive Mechanism", Ninth Edition, Tata McGraw-Hill, New Delhi, 2003.

FLUID POWER LABORATORY

LIST OF EXPERIMENTS

1. Design and testing of speed control circuits – Meter in, Meter out
2. Design and testing of Electro-hydraulic circuit with pressure sequence valve
3. Speed control of hydraulic motor
4. Circuits with logic controls – AND valve and OR valve
5. Sequential circuit design with pneumatic timers
6. Circuits with multiple cylinder sequences - Pneumatic control
7. Circuits with multiple cylinder sequences - Electrical control
8. Circuits with multiple cylinder sequences - PLC control
9. Simulation of basic hydraulic and pneumatic circuits using fluid power simulation software
10. Proportional control of Pressure and Flow in hydraulic Circuits

REFERENCES / MANUALS/SOFTWARE:

1. Fluid Power lab manual
2. "Hydraulic power pack – Instruction Manual", Mansco Fluidtek Private Ltd., Coimbatore.
3. "Automation studio exercise circuits", Janatics Ltd., Coimbatore.
4. "Pneumatics", Basic level TP101 text book, Fifth Edition, Festo Ltd., 1999.
5. "Electro Pneumatics", Basic level TP201 Text Book, Festo Ltd., Tenth Edition, 1990.
6. "Programmable Logic Controller", Basic level TP301 text book, Seventh Edition, Festo Ltd, 1995.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify the basic components of automobiles and analyze the fuel supply, braking, suspension and electrical systems in engines

CO2: dismantle and assemble the various elements in transmission system like clutch, gear box, propeller shaft and differential unit.

CO3: evaluate the wheel alignment parameters in automobiles

CO4: design and simulate the hydraulic and pneumatic circuits for various applications

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1					3		2	2				3	
CO2					3		2	2				3	
CO3					3		2	2				3	
CO4		3	3		3		2	2				3	

1 – Slight, 2 – Moderate, 3 – Substantial

11GE801 PROFESSIONAL ETHICS AND HUMAN VALUES

(Common to all Engineering and Technology branches)

3 0 0 3

MODULE – I **15**

Introduction to Human Values and Engineering Ethics: Understanding: Morals- Values-Ethics– Honesty – Integrity – Work Ethic – Service Learning – Civic Virtue –caring – Sharing– Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality- Senses of 'Engineering Ethics' - variety of moral issues - 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.

MODULE – II **15**

Safety, Responsibilities and Rights: Meaning of Engineering experimentation - engineers as responsible experimenters - codes of ethics for engineers - a balanced outlook on law - the challenger case study. 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 – discrimination- Intellectual Property Rights (IPR)

MODULE - III **15**

Global Ethical Issues and Codes : 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. etc.

TOTAL: 45

TEXT BOOKS

1. Martin Mike and Schinzinger Roland., "Ethics in Engineering", Tata McGraw-Hill, New Delhi,2003.
2. Govindarajan M, Natarajan S, and Senthil Kumar V. S., "Engineering Ethics", Prentice HallofIndia, NewDelhi, 2004.

REFERENCE BOOKS

1. Fleddermann, Charles D., "Engineering Ethics", Pearson Education/Prentice Hall, New Jersey, 2004.
2. Harris, Charles E., Protchard, Michael S. and Rabins,Michael J., "Engineering Ethics: Concepts and Cases", Wadsworth Thompson Learning, United States, 2000.
3. Seebauer Edmund G and Barry Robert L., "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: examine the various aspects of human values

CO2: develop as responsible experimenters particularly with reference to safety

CO3: apply appropriate code of ethics to evaluate the probable consequences of actions

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1						3		3		2		3	
CO2	1	2	2	2		2	2	3	3	2		3	
CO3				1		2	1	3	3			3	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME801 POWER PLANT ENGINEERING

3 0 0 3

MODULE – I **15**

Steam and Gas Turbine Power Plants: Energy Scenario and Environmental issues of present day power generation.

Steam Power Plant: Rankine Cycle – Performance – Thermodynamic analysis of cycles -Layout of Steam Power Plant - High Pressure and Super Critical Boilers – Fluidised Bed Boilers – Boiler Trial - Fuel and Ash Handling, Pulveriser, Stokers, Dust Collectors and Cooling towers- comparative analysis of combined heat and power cycles - Thermionic steam power plant – Binary cycle.

Gas turbine Power Plant: Gas turbine cycles – Thermodynamic analysis of cycles - Reheating – Regeneration and Intercooling - Layout of Gas Turbine Power Plant - Binary and combined cycle - IGCC

MODULE –II **18**

Other Power Generating Techniques:

Nuclear Power Plant: Layout - Types of Reactors - Radioactivity – Fission process – Reaction rates – Diffusion theory, elastic scattering and slowing down – criticality calculations – Critical heat flux - Global Standards in Waste Disposal and nuclear safety - Nuclear Treaty

Diesel Power Plant: Layout - Selection of Engine

Hydel Power Plant: Layout - Selection of Turbines -Micro Hydel developments.

MHD Power Generation, Solar thermal and PV- WECS – Biomass -Geo thermal –OTEC- Micro fuel cells & Portable power

MODULE –III **12**

Power Plant Economics: Cost of Electric Energy – Load Duration Curves-Fixed and operating Costs – Energy Rates – Types of Tariffs – Economics of load sharing, Comparison, Selection and economics of various power plants, Energy Auditing for Thermal Power Plant – Waste Heat Recovery Techniques.

TOTAL: 45

(Use of standard thermodynamic tables, Mollier diagram are permitted)

TEXT BOOKS

1. Arora, S.C and Domkundwar, S., "A Course in Power Plant Engineering", Dhanpat Rai, New Delhi, 2004.
2. Rajput, R.K., "Power Plant Engineering", Laxmi Publications, New Delhi, 2005.

REFERENCE BOOKS

1. Nagpal, G.R., "Power Plant Engineering", Khanna Publishers, New Delhi, 1998.
2. Nag P.K., "Power Plant Engineering", Tata McGraw-Hill, New Delhi, 2006.
3. Rai, G.D., "Introduction to Power Plant Technology", Khanna Publishers, New Delhi, 1995.
4. Wood, A.J., Wollenberg, B.F., "Power Generation, operation and control", John Wiley, New York,1984

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify various components and their functions in steam power plant and gas turbine power plant

CO2: plot the layout with their working process of nuclear, diesel, hydel and non-conventional power plants

CO3: Estimate electric energy cost and utilization of thermal energy effectively through energy auditing

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		2	2	3		2	2	2			3	
CO2	3		2	2	3		2	2	2			3	
CO3	3		2	2	3		2	2	2			3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME802 PROJECT WORK

0 0 18 9

The objective of the project work is to enable the students in convenient groups of not more than 3 members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Six periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field work as assigned by the guide and also to present in periodical seminars on the progress made in the project.

The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify, conceptualize and define engineering problems that needs to be solved.
CO2: identify and refer literature
CO3: identify and apply suitable solution methodology as well as research tools used in solving engineering problems.
CO4: plan, carry out and control project activities like design, development, fabrication, experimentation, analytical, simulation work etc.,
CO5: present the project work in the form of oral presentation, report/thesis and technical paper publication

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3	3	3	3	3	3	3	3	2	3	3
CO2	3	3	3	3	3	3	3	3	3	3	2	3	3
CO3	3	3	3	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	2	3	3
CO5	3	3	3	3	3	3	3	3	3	3	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

11ME011 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

(Common to Mechanical and Mechatronics branches)

3 0 0 3

MODULE – I **15**

Purpose Types and Functions of Jigs and Fixtures: Tool design objectives - Production devices - Materials used in Jigs and Fixtures – Types of Jigs - Types of Fixtures-Mechanical, pneumatic and hydraulic actuation-Analysis of clamping force-Tolerance and error analysis. Drill bushes –different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs-Automatic drill jigs-Rack and pinion operated. Air operated Jig components. Design and development of Jigs for given components. lathe, milling and broaching fixtures- Grinding, planning and shaping fixtures assembly, Inspection and welding fixtures- Modular fixtures. Design and development of fixtures for given component.

MODULE – II **15**

Press Working Terminologies and Elements of Dies and Strip Lay Out: Press working terminology-Presses and press accessories-Computation of capacities and tonnage requirements. Elements of progressive combination and compound dies: Die block-die shoe. Bolster plate-punch plate-punch holder-guide pins and bushes – strippers – knockouts-stops –pilots-Selection of standard die sets strip lay out-strip lay out calculations

MODULE – III **15**

Design and Development of Dies: Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies – development of bending dies-forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

(Use of approved design data book is permitted)

TOTAL : 45

TEXT BOOKS

1. Hoffman, Edward G., "Jigs & Fixture Design", Thomson – Delmar Learning, Singapore 2004.
2. Donaldson. C., "Tool Design", Tata McGraw-Hill, 1986

REFERENCE BOOKS

1. Kempster., "Jigs & Fixtures Design", The English Language Book Society", 1978
2. Joshi, P.H., "Jigs & Fixtures", Second Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2004.
3. Hiram E Grant, " Jigs and Fixture" Tata McGraw-Hill, New Delhi, 2003.
4. "Fundamentals of Tool Design", CEEE Edition, ASTME, 1983.
5. "Design Data Handbook", PSG College of Technology, Coimbatore.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: illustrate the principles of jigs and fixtures design, locating principles, locating elements and clamping devices
CO2: interpret the principles, functions and terminologies in press work, elements of dies and strip layout
CO3: design the dies for forging, extrusion, casting and plating with realistic constraints

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3	3	3	2						2	
CO2	3	3	3	3	3	2						2	
CO3	3	3	3	3	3	2						2	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME012 INDUSTRIAL TRIBOLOGY

3 0 0 3

MODULE – I **15**

Surfaces, Friction and Wear: Topography of Engineering surfaces- Contact between solids - Sources of sliding Friction – Friction Characteristics of metals - Friction of non metals- Friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction – Stick slip motion. Types of wear - Simple theory of Sliding Wear Mechanism - Adhesive and Abrasive wear - Corrosive wear - Surface Fatigue wear - Brittle Fracture - Wear of Ceramics and Polymers.

MODULE – II **15**

Lubrication Types and Film Lubrication Theory: Types and properties of Lubricants - Testing methods - Hydrodynamic Lubrication – Fluid film in simple shear - Viscous flow between very close parallel plates - Reynolds Equation for film Lubrication - Solid Lubrication- Hydrostatic Lubrication – Aerostatic Bearings.

MODULE – III **15**

Journal Bearings and Materials for Bearings: Journal bearings –Bearing geometry– Pressure distribution – Load capacity – Friction force – Coefficient of friction – Lubricant flow rate – Practical and operational aspects of journal bearings- Thermal effects in bearings – The Sommerfield diagram – Surface treatments – Reduction of friction – Wear resistant coatings - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings

TOTAL: 45

TEXT BOOKS

1. Gwidon W.Stachowiak, Andrew W.Batchelor., “Engineering Tribology” Butterworth-Heinmann, 2001.
2. Cameron, A., “Basic Lubrication theory ", New Age international Publishers, 1987.

REFERENCE BOOKS

1. Williams, J.A., “Engineering Tribology”, Oxford University Press, New Delhi, 1994.
2. Halling. J, “Principles of Tribology”, Macmillan India Ltd., New Delhi, 1975.
3. Neale, M.J., "Tribology Handbook", Butterworth- Heinemann, U.K., 1995.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the surface topography and apply the basic theories of friction and wear on different materials.
CO2: articulate different theories of lubrications for bearing application
CO3: design and analyze the industrial bearings

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	3		3				2		2	3	
CO2	2	3	3		3				2		2	3	
CO3	2	3	3		3				2		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME013 COMPOSITE MATERIALS

3 0 0 3

MODULE – I **12**

Introduction, Lamina Constitutive Equations and Manufacturing: Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Q_{ij}), Typical Commercial material properties, Rule of Mixtures. Specially Orthotropic Lamina – Transformation Matrix, Transformed Stiffness. Manufacturing: Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes. Case studies.

MODULE – II **15**

Flat Plate Laminate Constitute Equations and Lamina Strength Analysis: Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates.

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure. Case studies.

MODULE – III **18**

Thermal Analysis and Analysis of Laminated Flat Plates: Assumption of Constant Coefficient of Thermal expansion. Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates. Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies. Case studies.

TOTAL: 45

(Use of approved handbook is permitted)

TEXT BOOKS

1. Gibson, R.F., "Principles of Composite Material Mechanics", Second Edition, McGraw-Hill, New York, 1994.
2. Hyer, M.W., "Stress Analysis of Fiber Reinforced Composite Materials", McGraw-Hill, New York, 1998.

REFERENCE BOOKS

1. Daniel, Issac M. and Ishai, Ori, "Engineering Mechanics of Composite Materials", Oxford University Press, Oxford, 2007.
2. Mallick, P.K., "Fiber – Reinforced Composites: Materials, Manufacturing and Design", Marcel Dekker Inc, New York, 1993.
3. Halpin, J.C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1984.
4. Agarwal, B.D. and Broutman, L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the concepts, fabrication and mechanical behaviour of fiber reinforced composite materials.
CO2: perform and analyze the problems involving reinforced laminate design.
CO3: carry out thermo-mechanical and dynamical analysis on the laminated composites

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	3	3		3			1			3	2	
CO2	2	3	3		3			1			3	2	
CO3	2	3	3		3			1			3	2	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME031 ADVANCED STRUCTURE OF MATERIALS

3 0 0 3

MODULE – I **15**

Elasticity: Theory of stresses. Infinitesimal and finite strains. Strain-displacement relationships. Compatibility. Stress-strain relationship. Elastic constants. Stress and displacement functions. Plane problems in Cartesian and polar coordinates– boundary conditions, representations of three dimensional stress of a tension – generalized Hooke's law – St.Vennant's principle – Plane strain, plane stress – Airy's stress function. Elements of plasticity failure and yield criteria, flow rule, velocity field. Plastic stress-strain relations- incremental plasticity.

Shear Centre: Location of shear centre for various sections – shear flow.

MODULE – II **15**

Unsymmetrical Bending and Stresses Due to Rotation: Stresses and deflection in beams subjected to unsymmetrical loading – Kern of a section. Curved flexural members - circumferential and radial stresses – deflection and radial curved beam with re-strained ends – closed ring subjected to concentrated load and uniform load – chain link and crane hooks. Stresses due to rotation – Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness – allowable speed.

MODULE – III **15**

Beams On Elastic Foundation and Curved Beams And Contact Stresses: Infinite beam subjected to concentrated load – Boundary Conditions – Infinite beam subjected to a distributed load segment – Triangular load – Semi infinite beam subjected to loads at the ends and concentrated load near the ends – Short beams.

Analysis of stresses in beams with large curvature – Stress distribution in curved beams – Stresses in crane hooks and C clamps – Contact Stresses – Hertz equation for contact stresses – applications to rolling contact elements.

TOTAL: 45

(Use of approved data book is permitted)

TEXT BOOKS

1 Timoshenko.S, "Strength of Materials", Third Edition. CPS Publishers, 2004

2 Den-Hartog, "Advanced Strength of Materials", Dover Publications, New York, 1987.

REFERENCE BOOKS

1 Timoshenko and Gaodler, "Theory of Elasticity", Tata McGraw-Hill, 1985

2 Wang,C.T "Applied Elasticity", Pergaman Press, New York, 1987

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand and demonstrate the stress strain relations based on elastic and plastic theory.

CO2: estimate the stresses and deflection of structural members due to unsymmetrical bending and stresses on rotational component

CO3: design of beams on elastic foundation, curved members and estimation of contact stress

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3		3				2		2	3	
CO2	3	3	3		3				2		2	3	
CO3	3	3	3		3				2		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME014 INTRODUCTION TO AIRCRAFT SYSTEMS

(Common to Mechanical and Mechatronics Engineering branches)

3 0 0 3

MODULE – I **15**

Introduction to Aircrafts and Aircraft Systems: Basic components of an Aircraft, Structural members, Aircraft Axis System, Aircraft Motions, Control surfaces and High lift Devices.

Types of Aircrafts - Lighter than Air/Heavier than Air Aircrafts Conventional Design Configurations based on Power Plant Location, Wing vertical location, intake location, Tail Unit Arrangements, Landing Gear Arrangements. Unconventional Configurations-Biplane, Variable Sweep, Canard Layout, Twin Boom Layouts, Span loaders. Advantages and disadvantages of these Configurations.

Types of Aircraft Systems - Mechanical Systems

MODULE – II **15**

Basic Principles of Flight: Aerofoil Nomenclature, Types of Aerofoil, Wing Section- Aerodynamic Center, Aspect Ratio.

Significance of speed of Sound, Air speed and Ground Speed, Properties of Atmosphere, lifting surfaces-lift and drag, angle of attack, Pressure Distribution over a wing section, centre of pressure and its effects.

Generation of Lift, Drag, Pitching moments, Types of Drag, Lift curve, Drag Curve, Lift/Drag Ratio Curve, Factors affecting Lift and Drag.

MODULE – III **15**

Stability and Control: Degree of Stability- Lateral, Longitudinal and Directional Stability, Controls of Aircraft. Taxying, Landing, Gliding and Turning.

Aircraft Performance and Maneuvers: Taking off, climbing, Power Curves, Maximum and minimum speeds of horizontal flight, Effects of Changes of Engine Power, Effects of weight on performance, Effects of Altitude on Power Curves, Forces acting on a Aeroplane during a Turn, Correct and incorrect Angles of Bank, Aerobatics, Inverted Maneuvers, Maneuverability.

TOTAL: 45

TEXT BOOKS

1. Kermode A.C, "Mechanics of Flight", Fifth Edition, Pearson Education, New Delhi.
2. Shevell, "Fundamentals of Flight", Second Edition, Pearson Education, New Delhi.

REFERENCE BOOKS

1. Anderson, Dave "Introduction to Flight",
2. Ian Moir, "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", Allan Seabridge
3. Delp Frank, and Kroes, Michael J. and Watkins, William A., "Aircraft Maintenance & Repair", Sixth Edition, Glencoe & McGraw-Hill, 1993.
4. Hurst, Dale, "Aircraft Structural Maintenance", Second Edition, Avotek publishers, 2006.
5. Schaufele, Roger D., "The Elements of Aircraft Preliminary Design", Aries Publications, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: apply engineering technologies to design vehicles and aircrafts
CO2: perceive the concept of stability related to aircraft
CO3: analyze the use of aerofoil in aircraft and its effect related to different maneuvers

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	2	3	3	3	2						1	
CO2	2	2	3	3	3	2						1	
CO3	2	2	3	3	3	2						1	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME015 INTRODUCTION TO AIRCRAFT STRUCTURES

3 0 0 3

MODULE – I **12**

Overview of the Aircraft Design Process, Aircraft Loads, Aircraft Structures Description: Introduction, Phases of Aircraft Design, Aircraft Conceptual Design Process, Conceptual Stage, Preliminary Design, Detailed Design, Design Methodologies. Airworthiness-Definition, Airworthiness Regulations, Regulatory Bodies, Type certification, General Requirements, Requirements Related to Aircraft Design covers- Performance and Flight Requirements, Airframe Requirements, Landing Requirements, Fatigue and Failsafe requirements, Emergency Provisions, Emergency Landing requirements. Aerodynamic Loads, Inertial Loads, Loads due to engine, Actuator Loads, Maneuver Loads, VN diagrams, Gust Loads, Ground Loads, Ground conditions, Miscellaneous Loads. Types of Structural members of Fuselage and wing section and empennage Ribs, Spars, Frames, Stringers, Longeron, Splices, Types of structural joints, Type of Loads on structural joints.

MODULE – II **15**

Aircraft Materials and properties, Static and Fatigue Failures: Introduction, Basic construction, Material forms-Metallic materials and forms. Alloy designations. Mechanical Properties- strength, static, stress strain curves, Fatigue properties, crack growth,. Breif review of Principal stresses, principal strains, Mohr's circle for stress and strain. **(not for exam)** Fatigue Failures, Fatigue theory, Introduction to Low cycle Fatigue, Stress Life and Strain Life Techniques, Mean stress effects, Multi-axial Effects, Isothermal and Thermomechanical Fatigue, Introduction to high cycle fatigue.

MODULE– III **18**

Box Beams, Buckling of Thin Sheets, Aircraft Structural Joints, Advanced materials, Vibrations and Flutter: Box Beams-Introduction, Shear flow due to shear, Shear flow due to torsion-Bredt Baths, Single and Multicell Boxes.

Buckling of thin sheets, Buckling of flat plate in compression and shear, Buckling of curved plates in compression and shear, buckling of stiffened panels-post buckling, effective width, Concept of diagonal tension, buckling under combined loads. Introduction to Fasteners, Splices, and Eccentric joints-Bolt Group Analysis, Welded joints, Bonded joints, Lug Analysis, Tension Fitting and clips. Introduction to Comp Materials, Matrices, Fibers, Forms, Characteristics of composite materials. Study of Vibration and Flutter.

TOTAL: 45

Use of approved Data book is permitted in the end semester examination.

TEXT BOOKS

1. Daniel P.Raymer, "Aircraft Design-A Conceptual Approach", 6th Edition, AIAA Education, series,
2. Michael Niu, "Airframe Structural Design", 2nd Edition by Conmilit Press, 1988,.

REFERRENCE BOOKS

1. Michael Niu, "Airframe Stress Analysis and Sizing", 3rd Edition, Conmilit Press, 1999,
2. T. H. *G.* Megson, "Aircraft Structures for Engineering Students", Third Edition, Butterworth-Heinemann,
3. Roger D. Schaufele, "The Elements of Aircraft Preliminary Design", Aries Publications, 2000
4. Filippo De Florio, "An Introduction to Aircraft Certification; A Guide to Understanding Jaa, Easa and FAA", Butterworth-Heinemann
5. http://www.aero.org/
6. http://www.rl.af.mil/rrs/resources/griffiss_aeroclub/aircraft.html
7. http://en.wikipedia.org/wiki/Tesla_turbine
8. http://ameslib.arc.nasa.gov/randt/1999/aero/aero.html
9. http://www.ctas.arc.nasa.gov/project_description/pas.html
10. http://www.moog.com/noq/_acoverview__c463/
11. http://www.dcmt.cranfield.ac.uk/aeroxtra/e339.htm
12. http://www.aeromech.usyd.edu.au/structures/as/acs1-p4.htm
13. http://www.av8n.com/how/htm/xref.html
14. http://www.aviation-history.com/video.html

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: apply fundamentals of engineering science to make proper assumptions, analyse stresses developed over the various aircraft structures.

CO2: design and analyze the structural members aircraft and select proper materials

CO3: select, configure, and synthesize the structural components into assemblies using engineering science fundamentals.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2	3		3				1		2	3	
CO2	3	2	3		3				1		2	3	
CO3	3	2	3		3				1		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME016 DESIGN FOR MANUFACTURE AND ASSEMBLY

(Common to Mechanical and Mechatronics branches)

3 0 0 3

MODULE – I **15**

DFM Guidelines and Geometric Tolerance: General design principles for manufacturability - strength and mechanical factors - Geometric tolerances – Tolerance analysis - Worst case method - Assembly limits –Design and Manufacturing Datum – Conversion of design datum into manufacturing datum -Tolerance stacks- Process capability – Principal materials - Selection of materials and processes - Design - Possible solutions - Evaluation method.

MODULE – II **15**

DFA Guidelines and Machining Considerations: General design guidelines for manual assembly – Assembly efficiency – Effects of part symmetry, part thickness and weight on handling time – Types of manual assembly methods – Application of DFA methodology- Design for high speed automatic assembly and robot assembly – Design for machining – Single point and multipoint cutting tools – Choice and Shape of work material – Accuracy and surface finish - Reduction of machined area- Design for clampability - Design for accessibility.

MODULE – III **15**

Design for Injection molding and Casting: Injection molding Materials - The molding cycle – Molding systems and molds – Cycle time and mold cost estimation – Estimation of optimum number of cavities – Design guidelines for injection molding - Die casting alloys –The die casting cycle, Determination of number of cavities and appropriate machine size in die casting – Design principles for die casting – Sand casting alloys – Sand cores - Design rules for sand castings - Identification of uneconomical design - Modifying the design.

TOTAL : 45

TEXT BOOKS

1 Boothroyd, G, "Product Design for Manufacture and Assembly", New York, CRC Press, London, 2002.

2 Peck, Harry., "Design for Manufacture", Pitman Publications, London 1983.

REFERENCE BOOKS

1. Otto, Kevien and Wood, Kristin, "Product Design". Pearson Publication, New Delhi, 2004.
2. Matousek, "Engineering Design: A Systematic Approach", Blackie & Son Ltd., Glasgow, 1974.
3. Bralla, "Design for Manufacture Handbook", McGraw Hill, New York, 1999.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: perceive the basics of manufacturability and materials selection

CO2: appraise various concepts in design and assembly

CO3: develop a solution, related to die casting, molding and all other foundry related problems

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3	3	3	2	1					2	
CO2	3	3	3	3	3	2	1					2	
CO3	3	3	3	3	3	2	1					2	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME017 COMPUTATIONAL FLUID DYNAMICS

3 0 0 3

Prerequisite: Fundamental Knowledge of partial differential equations, Heat Transfer and Fluid Mechanics

MODULE – I **15**

Fundamentals of CFD and Finite Difference Method: Basics of computational fluid dynamics – Governing equations – Continuity, Momentum and Energy equations – General transport equation – Physical boundary conditions – Discretization – Mathematical behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations – Time averaged Navier Stokes equation. Finite Difference Method – Taylor's series – Forward, Central and Backward differences – Explicit Method – Implicit Method – Tridigonal matrix – ADI Method - Solution methodology for parabolic and elliptic equations – Stability analysis - Errors

MODULE – II **15**

Finite Volume Method (FVM): Finite volume formulation for steady state One and Two -dimensional diffusion problems. One dimensional unsteady heat conduction through Explicit, Crank – Nicholson and fully implicit schemes.

Steady state one-dimensional convection and diffusion – Central, Upwind differencing schemes-, Hybrid, Power-law, QUICK Schemes - properties of discretization schemes – Conservativeness, Boundedness, Transportiveness

MODULE – III **15**

Turbulence Modeling and Grid Generation: Turbulence – Transition flow – Effect of turbulence on Time averaged Navier Stokes equation – Characteristics of simple turbulent flow – Free turbulent flow – Flat plate boundary layer – Pipe flow – Turbulence models – Mixing length model - K-$\in$ Models – Reynolds stress equation model – Algebraic stress model. Grid generation – Grid transformation – Staggered grid - Pressure and Velocity correction – SIMPLE algorithm – Flow and heat transfer analysis on simple components like nozzle, diffuser, pipe flow etc. using FLUENT package.

TEXT BOOKS **TOTAL : 45**

1. Anderson, John D, "Computational Fluid Dynamics: Basic with Applications", Tata McGraw Hill, New Delhi, 1995.
2. Versteeg, H., and Malalasekera, W., "An Introduction to Computational Fluid dynamics: A Finite Volume Approach", Addison Wesley Longman Limited,2007.

REFERENCE BOOKS

1. Ghoshdastidar, P.S., "Computer Simulation of Fluid Flow and Heat Transfer", Tata McGraw-Hill, New Delhi, 1998.
2. Anderson, D.A., Tannehill J.C. and Pletcher, R.H., "Computational Fluid Mechanics and Heat Transfer ", Hemisphere Publishing Corporation, New York, USA, 1997.
3. Abbott, M.B., Bosco, D.R., "Computational Fluid Dynamics: An Introduction for Engineers", Longman Singapore Publishers Limited, 1997
4. Niyogi, Prodip., Chakrabarty, S.K., and Laha, M.K. "Introduction to Computational Fluid Dynamics", Pearson Education, New Delhi, 2005.
5. Muralidhar, K. and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2011.

COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: derive the governing equations and identify the type of partial differential equation.
- CO2: solve the heat transfer and fluid flow problems with finite difference method.
- CO3: apply the finite volume method for convection and diffusion problems.
- CO4: assess the different schemes in finite volume method
- CO5: demonstrate an understanding of turbulence models
- CO6: perform grid transformation and calculate the flow field variables and their corrections

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		3	2	3		2		2		3	3	
CO2	3		3	2	3		2		2		3	3	
CO3	3		3	2	3		2		2		3	3	
CO4	3		3	2	3		2		2		3	3	
CO5	3		3	2	3		2		2		3	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME018 GAS DYNAMICS AND JET PROPULSION

3 0 0 3

MODULE – I **15**

Fundamentals and Flow Through Variable Area Ducts: Energy and momentum equations for compressible fluid flows, stagnation state, velocity of sound, critical states, Mach number, critical Mach number, reference velocities, various regions of flow, Mach cone, Mach angle, effect of Mach number on compressibility - Isentropic flow through variable area ducts, T-s and h-s diagrams for nozzle and diffuser flows, area ratio as a function of Mach number, mass flow rate through nozzles and diffusers, effect of friction in flow through nozzles

MODULE – II **15**

Flow Through Constant Area Ducts and Normal Shock: Flow in constant area ducts with friction – Fanno curves and Fanno flow equation, variation of flow properties, variation of Mach number with duct length –Flow in constant area ducts with heat transfer -Rayleigh line and Rayleigh flow equation, variation of flow properties, maximum heat transfer- Governing equations of normal shock, variation of flow parameters across the normal shock, Prandtl - Meyer equation, impossibility of shock in subsonic flows.

MODULE – III **15**

Jet Propulsion: Aircraft propulsion – types of jet engines – energy flow through jet engines, study of turbojet engine components – diffuser, compressor, combustion chamber, turbine and exhaust systems, performance of turbo jet engines – thrust, thrust power, propulsive and overall efficiencies, thrust augmentation in turbo jet engine, ram jet and pulse jet engines

Rocket propulsion – rocket engines thrust equation – effective jet velocity specific impulse – rocket engine performance, solid and liquid propellants, comparison of different propulsion systems

TOTAL: 45

(Use of approved gas tables is permitted in the End Semester examination)

TEXT BOOKS

1. Yahya, S.M., "Fundamental of Compressible Flow", Third Edition, New Age International (p) Ltd., New Delhi, 2010.
2. Rathakrishnan, E, "Gas Dynamics", Third Edition, Prentice Hall of India, New Delhi, 2010.

REFERENCE BOOKS

1. Ganesan, V., "Gas Turbines", Third Edition, Tata McGraw-Hill, New Delhi, 2010.
2. Cohen. H., Rogers, R.E.C and Sravanamutoo, "Gas Turbine Theory", Fifth Edition, Addison Wesley Ltd., New York, 2009.
3. Oosthuizen, Patrich. H. and Carscallen, William E., "Compressible Fluid Flow", McGraw-Hill, New York, 1997.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate an understanding of basic concepts of compressible flow and flow behavior in nozzles and diffusers

CO2: solve the problems in flow associated with friction, heat transfer and normal shock.

CO3: assess the performance of jet and rocket engines by acquiring broad knowledge in propulsion systems

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		2		3		2				2	3	
CO2	3		2		3		2				2	3	
CO3	3		2		3		2				2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME019 REFRIGERATION AND AIR CONDITIONING

3 0 0 3

MODULE - I **15**

Refrigeration Cycle and Refrigerants: Review of thermodynamic principles of refrigeration. Carnot refrigeration cycle – Air Refrigeration cycles - Bell Coleman and Bootstrap Cycles - Vapour compression refrigeration cycle – multistage and multiple evaporator systems – cascade system – COP comparison. . Refrigerants – properties – selection of refrigerants, Eco friendly Refrigerants, Cycling controls.

MODULE - II **15**

Air Conditioning Systems and System Components: Cooling load calculation- working principles of – Centralised Air conditioning systems, Split, Ductable split, Packaged Air conditioning, VAV & VRV Systems. Duct Design by equal friction method, Indoor Air quality concepts. Compressors – reciprocating and rotary - Types of condensers, evaporators, cooling towers – Functional aspects. Duct Design (elementary treatment).

MODULE- III **15**

Psychrometry and Unconventional Refrigeration Cycles: Psychrometric processes use of psychrometric charts – Grand and Room Sensible Heat Factors – bypass factor – air washers, requirements of comfort air conditioning, summer and Winter Air conditioning. Vapour Absorption system – Ejector jet, Steam jet refrigeration, thermo electric refrigeration. APPLICATIONS – ice plant – food storage plants – milk – chilling plants.

TOTAL : 45

Refrigeration And Air Conditioning Data Book is permitted in the End Semester Examination

TEXT BOOKS

1. Prasad, Manohar., "Refrigeration and Air Conditioning", New Age International (P) Ltd., New Delhi, 2003.
2. Arora, C.P., "Refrigeration and Air Conditioning", Tata McGraw Hill, New Delhi, 1988.

REFERENCE BOOKS

1. Roy, J. Dossat., "Principles of Refrigeration", Wiley Eastern Ltd., New Delhi, 2000.
2. Jordan, R C and Priester, G B., "Refrigeration and Air Conditioning", Prentice Hall of India, New Delhi, 1985.
3. Stoecker, Wilbert F and Jones, Jerold W., "Refrigeration and Air Conditioning", Tata McGraw-Hill, New Delhi, 1982.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: analyze the refrigeration cycles and gain knowledge on refrigerants.

CO2: assess air quality, design duct system and perform cooling load calculations for air conditioning systems

CO3: select specific components for air conditioning system with extensive knowledge.

CO4: solve problems using psychrometric chart and demonstrate an understanding of special refrigeration processes with their applications

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		3		3		2		2		2	3	
CO2	3		3		3		2		2		2	3	
CO3	3		3		3		2		2		2	3	
CO4	3		3		3		2		2		2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME020 ADVANCED HEAT AND MASS TRANSFER

3 0 0 3

MODULE I **15**

Conduction and Radiation Heat Transfer: One dimensional study and transient heat transfer equations and boundary conditions, 2D, 3D heat conduction equations-varying thermal conductivity-Analytical and semianalytical solutions, - Lumped Analysis-Heisler's chart, extended surface-geometric non linear heat transfer-Bessel function.

Conduction with moving boundaries, Radiation in gases and vapour. Gas radiation and radiation heat transfer in enclosures containing absorbing and emitting media – interaction of radiation with conduction and convection.

MODULE II **15**

Turbulent Forced Convective Heat Transfer: Momentum and Energy Equations, Turbulent Boundary Layer Heat Transfer, Mixing length concept, Turbulence Model – K Є Model, Analogy between Heat and Momentum Transfer – Reynolds, Colburn, Prandtl Turbulent flow in a Tube, High speed flows.

Phase Change Heat Transfer And Numerical Analysis Of Heat Exchanger

Condensation with shear edge on bank of tubes, Boiling – pool and flow boiling, Heat exchanger, Є – NTU approach and design procedure, compact heat exchangers.

MODULE III **15**

Mass Transfer and Heat Transfer Correlations for Thermal Equipments: Mass Transfer, Vaporization of droplets, combined heat and mass transfer, Heat Transfer Correlations in various applications like I.C. Engines, Compressors & turbines.

TOTAL: 45

Heat and Mass Transfer Data Book is permitted in the End Semester Examination

TEXT BOOKS

1. P.K. Nag, "Heat Transfer", Tata McGraw-Hill, 2002
2. Incropera F.P. and DeWitt. D.P., "Fundamentals of Heat & Mass Transfer", John Wiley & Sons, 1996.

REFERENCES BOOKS

1. Ozisik. M.N., "Heat Transfer – Basic Approach", McGraw-Hill Co., 1985
2. Schlichting, Gersten, "Boundarylayer Theory", Springer, 2000
3. Rohsenow. W.M., Harnett. J.P., and Ganic. E.N., "Handbook of Heat Transfer Applications", McGraw-Hill, NY1985
4. Anthony F. Mills, "Basic Heat and Mass Transfer", Irwin Publishers

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: analyze steady and transient heat conduction and radiation problems

CO2: examine radiative heat transfer in absorbing and emitting media

CO3: deduce momentum and energy equations for boundary layer intercepted problems using different analogies

CO4: design heat exchangers by understanding the principles of heat transfer phenomenon.

CO5: apply the mass transfer and heat transfer correlations to real time problems

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		3		3		2			2	2	3	
CO2	3		3				2			2	2	3	
CO3	3		3		3		2			2	2	3	
CO4	3		3				2			2	2	3	
CO5	3		3		3		2			2	2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME021 TURBO MACHINES

3 0 0 3

MODULE – I **15**

Centrifugal Fans and Blowers: Types - stage and design parameters - flow analysis in impeller blades - volute and diffusers, losses, characteristic curves and selection, fan drives and fan noise. Construction details, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

MODULE – II **15**

Centrifugal and Axial Flow Compressor: Stage Construction details, impeller flow losses, slip factor, diffuser analysis, losses and performance curves. Velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done simple stage design problems and performance characteristics.

MODULE – III **15**

Axial and Radial Flow Turbines: Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics.

TOTAL: 45

TEXT BOOK

1. Yahya, S.H., "Turbines, Compressors and Fans", Tata McGraw-Hill Publishing Company, 1996.

REFERENCE BOOKS

1. Bruneck, "Fans", Pergamom Press, 1973.
2. Earl Logan, Jr., "Hand book of Turbomachinery", Marcel Dekker Inc., 1992.
3. Dixon, S.I., "Fluid Mechanics and Thermodynamics of Turbomachinery", Pergamon Press, 1990.
4. Shepherd, D.G., Principles of Turbomachinery", Macmillan, 1969.
5. Stepanpff, A.J., "Blowers and Pumps", John Wiley and Sons Inc. 1965.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: gain the knowledge in centrifugal fans and blowers

CO2: understand the construction, working principle and performance characteristics of centrifugal and axial flow compressor

CO3: quantify the design steps and performance characteristics of axial and radial flow turbines

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3		2		3		2				2	3	
CO2	3		2		3		2				2	3	
CO3	3		2		3		2				2	3	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME022 ENERGY CONSERVATION IN THERMAL EQUIPMENTS

3 0 0 3

MODULE – I **17**

Energy Scenario and Instruments for Energy Auditing: Energy Scenario – world and India. Energy Resources Availability in India - Energy consumption pattern. Energy conservation potential in various Industries and commercial establishments - Energy intensive industries – an overview. Energy conservation and energy efficiency – needs and advantages - Energy auditing – types, methodologies, barriers. Role of energy manager – Energy audit questionnaire – Energy Conservation Act 2003. Instrument characteristics – sensitivity, readability, accuracy, precision, hysteresis - Error and calibration. Measurement of flow, velocity, pressure, temperature, speed, Lux, power and humidity. Analysis of stack, water quality, power and fuel quality.

MODULE - II **16**

Energy Conservation in Thermal Utilities: Boilers - Thermic Fluid Heaters – Furnaces - Waste Heat Recovery Systems - Thermal Storage - Steam traps – refractories – optimum insulation thickness – insulation – piping design.

MODULE - III **12**

Financial Management : Investment – need, appraisal and criteria, financial analysis techniques – break even analysis – simple pay back period, return on investment, net present value, internal rate of return, cash flows, DSCR, financing options, ESCO concept.

TOTAL: 45

TEXT BOOKS

1. Trivedi, PR, Jolka KR, "Energy Management", Commonwealth Publication, New Delhi, 1997
2. Guide book for National Certification Examination for Energy Managers and Energy Auditors

REFERENCE BOOKS

1. Hamies, "Energy Auditing and Conservation; Methods Measurements: Management and Case study", Hemisphere, Washington, 1980
2. Smith, CB "Energy Management Principles", Pergamon Press, New York, 1981
3. Handbook on Energy Efficiency, TERI, New Delhi, 2001
4. Write, Larry C, "Industrial Energy Management and Utilization", Hemisphere Publishers, Washington, 1988.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the energy consumption pattern, energy auditing procedures and energy auditing instrument characteristics.

CO2: interpret energy conservation opportunities in thermal utilities

CO3 carry out financial calculations related to retrofitting of thermal utilities.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	1	2	3	1	2	2	2	2	3	3	2
CO2	3	3	2	2	2	1	2	2	2	2	1	3	2
CO3							2		2			3	3

1 – Slight, 2 – Moderate, 3 – Substantial

11ME023 RENEWABLE ENERGY SOURCES

(Common to Mechanical and Mechatronics branches)

3 0 0 3

MODULE- I **15**

Solar Energy and Wind Energy: Solar Radiation – Measurements of solar Radiation and sunshine – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – solar Cells – PV Systems – PV Applications.Wind Energy- Sources and potentials, horizontal and vertical axis windmills, performance characteristics- Wind Energy Storage – Applications – Hybrid systems

MODULE- II **15**

OTEC, Tidal, Geothermal Energy and New Energy Sources: Tidal energy – Wave energy – Data, Technology options – Open and closed OTEC Cycles – Small hydro, turbines – Geothermal energy sources, power plant and environmental issues Hydrogen - generation, storage, transport and utilization – Applications - power generation and transport – Fuel cells – technologies, types – economics in power generation

MODULE- III **15**

Bio – Energy and Direct Energy Conversion: Biomass, Source, Composition, Technology for utilization– Biomass direct combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio diesel production and economics - combustion characteristics of bio-gas and utilization for cooking.

Need for DEC, principles of DEC. Thermo-electric generators, MHD generators, principles, dissociation and ionization, hall effect, magnetic flux, MHD accelerator, electron gas dynamic conversion, economic aspects. Faraday's laws, thermodynamic aspects, selection of fuels and operating conditions.

TOTAL:45

TEXT BOOKS

1. G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 1999.
2. Kothari D.P. et. al., "Renewable Energy Sources and Emerging Technologies", Prentice Hall of India Pvt. Ltd. 2008

REFERENCES BOOKS

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 1996.
2. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 1986
3. G.N. Tiwari, "Solar Energy – Fundamentals Design, Modelling & applications", Narosa Publishing House, New Delhi, 2002.
4. L.L. Freris, "Wind Energy Conversion systems", Prentice Hall, UK, 1990.
5. S.P. Sukhatme, "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: examine the working and applications of solar and wind energy systems

CO2: perceive the concept of OTEC, tidal, geothermal energy and fuel cell technologies

CO3: build knowledge on bio-energy production and direct energy conversion techniques

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	3	3	1	2		2			2	2	3	
CO2	3	2	3	1	2		2			2	2	3	
CO3	3	2	3	1	2		2			2	2	3	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME024 RAPID PROTOTYPING

3 0 0 3

MODULE – I **15**

Introduction to Rapid Prototyping and Methods: Need for the time compression in product development, History of RP systems, Survey of applications, Growth of RP industry and classification of RP systems. Fusion Deposition Modeling: Principle, Process parameters, Path generation, Applications. Solid Ground Curing: Principle of operation, Machine details, Applications. Stereolithography Systems Principle, Process parameters, Process details, Data preparation, Data files and Machine details, Applications. Selective Laser Sintering - Types of machines, Principle of operation, Process parameters, Data preparation for SLS, Applications. Laminated Object Manufacturing Principle of operation, LOM materials, Process details, Applications.

MODULE – II **15**

Concept Modelers and Rapid Tooling: Concept Modelers - Principle, Thermo jet printer, Sander's model market, 3-D printer, Genisys Xs printer, JP system 5, Object Quadra System. Laser Engineered Net Shaping (Lens) – principle – applications. Indirect Rapid Tooling - Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, etc. Direct Rapid Tooling - Direct AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Pro Metal, Sand casting tooling, Laminate tooling, soft tooling vs hard tooling.

MODULE – III **15**

Software for Rapid Prototyping: STL files, Overview of Solid view, Magics, mimics, magics communicator, etc. Internet based softwares, Collaboration tools. Rapid Manufacturing -Process Optimization - Factors influencing accuracy, Data preparation errors, Part building errors, Errors in finishing, Influence of part build orientation. Allied Processes - Vacuum Casting, Surface Digitizing, Surface Generation from point cloud, Surface modification, data transfer to solid models.

TOTAL:45

TEXT BOOKS

1. Pham, D. T. and Dimov, S. S., "Rapid Manufacturing", Verlag, London, 2001.
2. Chua.C.K., Leong. K.F and Lim. C.S., “Rapid Prototyping: Principles and Applications”, Second Edition, World Scientific Publishing Co. Private Ltd, 2003.

REFERENCE BOOKS

1. Wohlers, Terry., "Wohlers Report 2006", Wohlers Associates, 2006.
2. Ghosh, Amitabha., “Rapid Prototyping” East West Press, New Delhi, 1997.
3. Jacobs, Paul. F., "Stereo Lithography and other RP & M Technologies", SME, New York, 1996.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand and apply the concepts of rapid prototyping parameters in manufacturing systems.

CO2: demonstrate and conceptualize manufacturing processes and systems through direct and indirect rapid tooling systems

CO3: demonstrate the ability to explain software used in RPT

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2	1		1	2	1	1	2	3	1	3	1	1
CO2	2			1	1	1		2	3	1	3	1	
CO3	1		2	2	2	1	2	3	3	1	3	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

11ME025 MAINTENANCE ENGINEERING

(Common to Mechanical and Mechatronics branches)

3 0 0 3

MODULE – I **15**

Principles and Practices of Maintenance Planning, Condition Monitoring: Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics-Condition Monitoring – Cost comparison with and without CM – On-load testing and off-load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis-Case studies.

MODULE – II **15**

Maintenance Policies – Préventive Maintenance-Failures Analysis: Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM- Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location-Case studies.

MODULE – III **15**

Repair Methods for Basic Machine Elements, Material Handling Equipment: Repair methods for beds, slide ways, spindles, gears, lead screws and bearings –Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.

TOTAL: 45

TEXT BOOKS

1. Srivastava, S.K., "Industrial Maintenance Management", S. Chand & Co., New Delhi, 2011.
2. Bhattacharya, S.N., "Installation, Servicing and Maintenance", S. Chand & Co., New Delhi, 2010.

REFERENCE BOOKS

1. White, E.N., "Maintenance Planning", I Documentation, Gower Press, 2002.
2. Garg, M.R., "Industrial Maintenance", S. Chand & Co., New Delhi, 2004.
3. Higgins, L.R., "Maintenance Engineering Handbook", Seventh Edition, McGraw Hill, New York, 2008.
4. Armstrong, "Condition Monitoring", BSIRSA, 1988.
5. Davies, "Handbook of Condition Monitoring", Chapman &Hall, London, 1998.
6. "Advances in Plant Engineering and Management", Seminar Proceedings - IIPE, 1996.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: organize maintenance planning and judge condition monitoring of machine elements
CO2: assess preventive maintenance policies and failure analysis through TPM
CO3: propose repair methods for basic machine elements and material handling equipment

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2	2			3						2	
CO2	3		2			3						2	
CO3	3	2	2			3						2	

3 – Substantial, 2 – Moderate, 1 – Slight

11ME026 NON DESTRUCTIVE EVALUATION TECHNIQUES

3 0 0 3

MODULE – I **18**

Introduction, Liquid Penetrant and Magnetic Particle Testing: NDT and its importance – NDT vs. Destructive Testing – Visual Examination – Basic Principles, optical aids used and applications.

Liquid Penetrant – Principles, Procedure for Penetrant testing, Penetrant testing methods, Post emulsification, properties of liquid penetrant,sensitivity, applications and Limitations – Standards.

Magnetic Particle Testing - Principles, Magnetizing techniques, Procedures, Equipments, Sensitivity, applications and Limitations – Standards. Case studies.

MODULE – II **15**

Ultrasonic Testing: Properties of sound beam, Transducers, inspection methods, Techniques for normal and angle beam inspection, Flaw characterization – equipments, methods of display – A- Scan- B- Scan -C- Scan – Immersion testing – application, advantages and limitations- standards.

Radiography: Electromagnetic radiation sources- X-ray production & gamma ray sources, properties, radiation-attenuation and effects in film, Exposure charts – radiographic imaging – inspection techniques- applications and limitations – safety in industrial radiography- neuron radiography- standards. Case studies.

MODULE – III **12**

Eddy Current: Principles, Instrumentation, Techniques, Probe, Sensitivity, Advanced Test Methods, applications & Limitations – Standards.

Other Techniques: Acoustic Emission Testing- Principle, Techniques, Instrumentations, Applications and Standards, Homography Thermography - Principles, Equipments, Techniques, Applications and Standards, Leak testing-methods , detection and standards.

Selection of NDT Methods: Defects in material – Selection of NDT and Instrumentation – Some case studies.

TOTAL:45

TEXT BOOKS

1. Raj, Baldev., Jayakumar T. and Thavasimuthu, M., “Practical Non Destructive Testing”, Second Edition, Narosa Publishing House, New Delhi, 2002.
2. Shull, Peter J., “Non Destructive Evaluation: Theory, Techniques and Applications”, Marcel Dekkar, Inc, New York, USA, 2002.

REFERENCE BOOKS

1. Raj, Baldev and Venkatraman, B., “Practical Radiology”, Narosa Publishing House, New Delhi, 2004.
2. Hull, Barry and John, Vernon., “Non Destructive Testing”, Macmillan, London, 1988.
3. Brichan, D., “Non Destructive Testing”, Oxford Press, London, 1975.
4. ASM Handbook, “Non Destructive Evaluation and Quality Control”, Vol. 17.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the need and importance of non-destructive evaluation techniques.

CO2: apply the principles, procedures and main aspects involved in various ndt techniques

CO3: select appropriate testing technique for analyzing defects in materials

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2			3	2		1	3	3	1	3	1	
CO2	3	2		1	3			3	3	1	3	1	
CO3	3	3	3	1	3			3	3	1	3	1	

1 – Slight, 2 – Moderate, 3 – Substantial

11GE011 ENTREPRENEURSHIP DEVELOPMENT

(Common to all Engineering and Technology branches except Civil Engg.)

3 0 0 3

MODULE – I **15**

Entrepreneurship Concepts: Meaning and Concepts of Entrepreneurship – Definition and Characteristics of an Entrepreneur – Entrepreneurial Process – The scope of Entrepreneurship in India. Entrepreneurial Motivation – Factors creating Entrepreneurship – Classification of Entrepreneurs – Intrapreneurship - Barriers to Entrepreneurship – Creativity, Innovation & Entrepreneurship - Role of Entrepreneurship in Economic Development.

MODULE – II **15**

Business Plan: Business Planning Process – Idea generation, Environmental Scanning, Feasibility Analysis, Drawing Functional Plan - Marketing Plan – Production/Operations Plan –Organizational Plan – Financial Plan – Human Resource Plan – Project Report Preparation , Evaluation, Control and Review.

MODULE – III **15**

Managing a Small Business: Sources of Finance - Institutions Supporting Entrepreneurs - EDPs. Small Scale Industry – The Strengths and Weaknesses of Small Business - Growth strategies – Sickness - Evaluation, Symptoms, Causes and Assessment – Rehabilitation of Sick Industries.

TOTAL :45

TEXT BOOKS

1. Madhurima Lall and Shikha Sahai, " Entrepreneurship", Excel Books, New Delhi, 2006
2. S.S.Khanka, " Entrepreneurial Development", S.Chand & Company Ltd, 2005

REFERENCE BOOKS

1. Robert D Hisrich, Michael P Peters and Dean A Shepherd, "Entrepreneurship", Sixth Edition, Tata McGraw Hill, New Delhi, 2009.
2. Mary Coulter, "Entrepreneurship in Action", Second Edition, Prentice Hall of India, New Delhi, 2005.
3. Jain P.C., "Handbook for New Entrepreneurs", Oxford University Press, Oxford, 2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate knowledge of entrepreneurship concepts

CO2: plan various aspects of business activities

CO3: manage to start and run small business.

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	1			1		3	3	3		3			3
CO2	1			1		3	3	3		3			3
CO3	1			1		3	3	3		3			3

1 – Slight, 2 – Moderate, 3 – Substantial

11ME027 AUTOMATION IN MANUFACTURING

3 0 0 3

MODULE – I **15**

Introduction Types and Strategies of Automation and Automated Flow Lines: Introduction types and strategies of automation - Pneumatic and hydraulic components circuits. Automation in machine tools. Mechanical feeding and tool changing and machine tool control transfer the automation. Automated flow lines- methods of work part transport transfer -Mechanical buffer storage control function, design and fabrication consideration-Analysis of Automated flow lines- General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

MODULE-II **15**

Assembly System and Line Balancing: Assembly system and line balancing - Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines. Automated material handling - Types of equipment, functions, analysis and design of material handling systems conveyor systems, automated guided vehicle systems. Automated storage systems - Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

MODULE-III **15**

Adaptive Control Systems: Adaptive control systems - Introduction, adaptive control with optimization, Adaptive control with constraints, Application of A.C. in machining operations. Use of various parameters such as cutting force, temperatures, vibration and acoustic emission.
Business process Re-engineering - Introduction to BPE logistics, ERP, Software configuration of BPE, concurrent Engineering, Techniques of Rapid prototyping.

TOTAL: 45

TEXT BOOKS

1. Mikell P Groover, "Automation, Production systems and computer aided manufacturing", 3rd Edition, Prentice Hall, New Delhi, 2010.
2. Radhakrishnan, P., "Computer Numerical Control Machines", New Central Book Agencies, Kolkata, 2007.

REFERENCE BOOKS

1. Yoram Korem., "Computer control of Manufacturing systems", Mc Graw Hill, 1986.
2. Ibrahim Zeid, R. Sivasubramanian, "CAD/ CAM, Theory & Practice", Tata McGraw Hill Publications, New Delhi, 2010.
3. Chris McMahon, Jimmie Browne, "CAD/CAM Principles, Practice and Manufacturing Management", Pearson Education, Chennai, 2010
4. P. Radhakrishan, S. Subramanyan, V. Raju, "CAD/CAM/CIM", New Age International Publishers,New Delhi, 2010.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify and understand the elements of automation in manufacturing

CO2: ascertain and recognize the assembly lines, process and balancing methods

CO3: design and apply the adaptive control with optimization constraints and rpt techniques in manufacturing

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	2			2	1	1		1	3	1	1	1	
CO2	1	1	1	1	1			1	3	1	1	1	1
CO3	1		1	2	1	1	1	1	3	1	1	1	

1 – Slight, 2 – Moderate, 3 – Substantial

11ME028 QUALITY CONTROL AND RELIABILITY ENGINEERING

3 0 0 3

MODULE I **15**

Introduction and Process Control for Variables and Attributes: Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC, Quality assurance,Quality control: Quality cost-Variation in process- causesof variation –Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and σ chart -process capability – process capability studies and simple problems. Six sigma concepts.

Control chart for attributes –control chart for non conformities– p chart, np chart and 100 p chart – C and U charts, State of control and process out of control identification in charts, pattern study.

MODULE II **15**

Acceptance Sampling: Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

MODULE III **15**

Reliability Engineering: Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves. Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

TOTAL: 45

Use of approved statistical table permitted for the examination.

TEXT BOOKS

1. Douglas.C.Montgomery, " Introduction to Statistical quality control" John wiley 4th edition2001
2. L.S.Srinath, "Reliability Engineering", Affiliated East west press, 1991.

REFERENCES

1. John.S. Oakland. "Statistical process control", Elsevier, 5th edition, 2005
2. Connor, P.D.T.O., " Practical Reliability Engineering", John Wiley, 1993
3. Grant, Eugene .L "Statistical Quality Control", McGraw-Hill, 1996
4. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.
5. R.C.Gupta, "Statistical Quality control", Khanna Publishers, 1997.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: plot the appropriate control chart for variables/attributes and analyze the results.

CO2: identify and demonstrate the consumer and producer's risk in sampling inspection

CO3: exhibit the knowledge on fundamental concepts of reliability

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1	3	2	1	3	3	1	2	1	1	1	2	3	3
CO2	3	2	1	3	3	1	2	1	1	1	2	3	3
CO3	3	2	1	3	3	1	2	1	1	1	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

11ME029 MANUFACTURING INFORMATION SYSTEM

3 0 0 3

MODULE - I **13**

Introduction to Evolution of Order Policies: Introduction – The evolution of order policies from MRP to MRP II, the role of production organization, operation control. Database – Terminologies – Entities and attributes – Data models, schema and subschema – Data Independence – ER Diagram – Trends in database.

MODULE - II **18**

Designing Database and Structure: Designing database – Hierarchical model – Network approach – Relational Data model – Concepts, Principles, Key, relational operations – functional dependence – Normalisation, types – Query languages. Manufacturing consideration – The product and its structure, Inventory and process flow – Shop floor control-Data structure and procedure – various model – the order scheduling module, input / output analysis module, the stock status database – the complete IOM database.

MODULE - III **14**

Information System for Manufacturing: Introduction– Parts oriented production information system – concepts and structure – computerized production scheduling, online production control systems, Computer based production management system, computerized manufacturing information system – case study.

TOTAL: 45

TEXT BOOK

1. Luca G. Sartori, "Manufacturing Information Systems", Addison Wesley Publishing Company, 1988.

REFERENCE BOOKS

1. Date. C.J., "An Introduction to Database systems". Narosa Publishing House, 1997.
2. Orlicky.G., "Material Requirements Planning", McGraw-Hill Publishing Co., 1975.
3. Kerr.R, "Knowledge based Manufacturing Management", Addison Wesley, 1991.

Web Reference:

www.ist.osu.edu.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand and demonstrate the utilization of resources in ERP & MRP

CO2: analyze the problems in network, inventory and data structure analysis

CO3: validate knowledge on computerized production scheduling and its related management systems

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1			1		3		2	2	2	1	2	3	1
CO2	3	2	1		3		2	2	2	1	2	3	1
CO3	1	2	1		3		2	2	2	1	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

11ME030 ROBOTICS

3 0 0 3

MODULE I **15**

Fundamentals of Robot and System Analysis: Robot Definition – Basic Components of Robot –Anatomy – Laws of Robotics – Classification – Robot Degree of Freedom – Work Envelope – Joint Notations – Dynamic Performance – Functions and Specification of Robot Systems – Robot Applications – Robot Drive Systems – Mechanical, Electrical, Hydraulic and Pneumatic Actuators – Features, Applications and Comparison of all these Actuators – Robot End Effectors and Classifications – Gripper Mechanisms and Force analysis – Other Types of Grippers – Gripper Selection and design

MODULE II **15**

Sensory Devices and Machine Vision: Transducers – Requirements of a sensor – Types of sensors – Principles and Applications – Non Optical and Optical Position sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders), Range Sensing Techniques (Triangulation Principle, Structured Lighting Approach, Laser Range Meters), Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors (Binary Sensors, Analog Sensors), Slip Sensors – Introduction to Machine Vision – Sensing and Digitizing the data, Image Processing and Analysis – Training and Vision Systems – Robotic Applications

MODULE III **15**

Kinematics, Programming and Artificial Intelligence: Introduction to Manipulator Kinematics – Forward and Inverse Kinematics – Forward and Inverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) –Problems – Programming Methods – Teach Pendant Programming, Lead through programming Methods, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End Effector commands, and Simple programs – Introduction to Artificial Intelligence – Goals – AI Techniques – An Approach for Implementing Robotics in Industries – Various Steps; Safety Considerations for Robot Operations – Future Applications

TOTAL: 45

TEXT BOOKS

1. M.P.Groover, "Industrial Robotics – Technology, Programming and Applications", McGraw-Hill, 2001
2. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin "Robotic Engineering", Prentice-Hall India. 2005

REFERENCE BOOKS

1. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 1987
2. S.K.Saha., "Introduction to Robotics", Tata McGraw-Hill, 2005
3. James G.Kermas., "Robot Techology Fundamentals", Vikas Publishing House, 1999

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the concepts, functions, configurations and drive system of robot.

CO2: select and apply the sensors for various applications and carryout image processing

CO3: analyze the robot kinematics, programming, applications of robots with artificial intelligence

Mapping of COs with POs

COs/POs	a	b	c	d	e	f	g	h	i	j	k	l	m
CO1			2	2			2	2	2	1	3	3	
CO2			2	2			2	2	2	1	3	3	
CO3			2	2			2	2	2	1	3	3	

1 – Slight, 2 – Moderate, 3 – Substantial