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 intuitions to synergize the benefit.
MS4: Contribute towards the upliftment of the society.

2014 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 continous learning and carryout research and development in science, engineering and technology that support 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 support economic development of firms as well as society.

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

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

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

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

PO4 **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1 **Modern tool usage:** use the techniques, skills and modern engineering tools necessary for engineering practice.

PSO2 **Domain Knowledge:** work professionally in thermal, manufacturing and mechanical system areas including the design and realization of such systems with the use of computational tools.

MAPPING OF PEOs WITH POs AND PSOs

PEO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	3	3	3	2	2	2	2	1	1	2	2	2	2	3
PEO2	3	3	3	3	3	3	2	1	1	2	2	2	3	3
PEO3	3	3	3	2	2	1	2	3	1	2	1	2	2	2
PEO4	2	1	2	1	2	3	1	2	2	2	3	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

CURRICULUM BREAKDOWN STRUCTURE UNDER REGULATION 2014

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)	16	510	30
Engineering Sciences(ES)	14	510	26
Humanities and Social Sciences(HS)	8	255	14
Program Core(PC)	40	1455	73
Program Electives(PE)	10	270	18
Open Electives(OE)	5	135	9
Project(s)/Internships(PR)	7	360	12
Total			**182**

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B.E. DEGREE IN MECHANICAL ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14EGT11	Communicative English I	3	0	0	3	40	60	100	HS
14MAT11	Mathematics I	3	1	0	4	40	60	100	BS
14PHT11	Applied Physics	3	0	0	3	40	60	100	BS
14CYT11	Applied Chemistry	3	0	0	3	40	60	100	BS
14MET11	Basics of Civil and Mechanical Engineering	3	0	0	3	40	60	100	ES
14MEC11	Engineering Drawing	2	0	3	3	40	60	100	ES
14VEC11	Value Education	0	2	1	1	100	0	100	HS
	PRACTICAL								
14PHL11	Physical Sciences Laboratory I	0	0	3	1	100	0	100	BS
14MEL11	Basics of Civil and Mechanical Engineering Laboratory	0	0	3	1	100	0	100	ES
				Total	**22**				

CA – Continuous Assessment, ESE – End Semester Examination

CBS – Curriculum Breakdwon Structure

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B.E. DEGREE IN MECHANICAL ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – II

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14EGT21	Communicative English II	3	0	0	3	40	60	100	HS
14MAT21	Mathematics II	3	1	0	4	40	60	100	BS
14PHT21	Materials Science	3	0	0	3	40	60	100	BS
14CYT21	Environmental Science	3	0	0	3	40	60	100	BS
14CSC11	Problem Solving and Programming	3	0	3	4	40	60	100	ES
14EET11	Basics of Electrical and Electronics Engineering	3	0	0	3	40	60	100	ES
	PRACTICAL								
14PHL21	Physical Sciences Laboratory II	0	0	3	1	100	0	100	BS
14EEL11	Basics of Electrical and Electronics Engineering Laboratory	0	0	3	1	100	0	100	ES
				Total	**22**				

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CBS – Curriculum Breakdwon Structure

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CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – III

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14MAT31	Mathematics III	3	1	0	4	40	60	100	BS
14MET31	Engineering Mechanics	3	1	0	4	40	60	100	ES
14MET32	Engineering Thermodynamics	3	1	0	4	40	60	100	PC
14MET33	Fluid Mechanics and Hydraulic Machines	3	0	0	3	40	60	100	PC
14MET34	Manufacturing Technology	3	0	0	3	40	60	100	PC
14EET33	Electrical Drives and Industrial Electronics	3	0	0	3	40	60	100	ES
	PRACTICAL								
14MEL31	Fluid Mechanics and Hydraulic Machines Laboratory	0	0	3	1	100	0	100	PC
14MEL32	Manufacturing Technology Laboratory	0	0	3	1	100	0	100	PC
14EEL33	Electrical Engineering Laboratory	0	0	3	1	100	0	100	ES
				Total	**24**				

CA – Continuous Assessment, ESE – End Semester Examination

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B.E. DEGREE IN MECHANICAL ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – IV

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14MAT42	Statistics and Numerical Methods	3	1	0	4	40	60	100	BS
14MET41	Strength of Materials	3	1	0	4	40	60	100	PC
14MET42	Thermal Engineering	3	1	0	4	40	60	100	PC
14MET43	Kinematics of Machinery	3	1	0	4	40	60	100	PC
14MET44	Material Removal Processes	3	0	0	3	40	60	100	PC
14MET45	Engineering Materials and Metallurgy	3	0	0	3	40	60	100	PC
	PRACTICAL								
14MEL41	Thermal Engineering Laboratory	0	0	3	1	100	0	100	PC
14MEL42	Machining Process Laboratory	0	0	3	1	100	0	100	PC
14MEL43	Advanced Materials Testing Laboratory	0	0	3	1	100	0	100	PC
				Total	**25**				

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B.E. DEGREE IN MECHANICAL ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – V

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14MET51	Dynamics of Machinery	3	1	0	4	40	60	100	PC
14MET52	Design of Machine Elements	3	0	0	3	40	60	100	PC
14MET53	Metrology and Measurements	3	0	0	3	40	60	100	PC
14MET54	Operations Research	3	0	0	3	40	60	100	PC
14MEC51	Machine Drawing	3	0	3	3	40	60	100	PC
	Elective-I (Professional)	3	0	0	3	40	60	100	PE
	PRACTICAL								
14MEL51	CAD Laboratory	0	0	3	1	100	0	100	PC
14MEL52	Metrology and Dynamics Laboratory	0	0	3	1	100	0	100	PC
14EGL41	Communication Skills Laboratory	0	0	3	1	100	0	100	HS
				Total	**22**				

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CBS – Curriculum Breakdwon Structure

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B.E. DEGREE IN MECHANICAL ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – VI

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14GET61	Economics and Management for Engineers	3	0	0	3	40	60	100	HS
14MTT62	Fluid Power System	3	0	0	3	40	60	100	ES
14MET61	Heat and Mass Transfer	3	1	0	4	40	60	100	PC
14MET62	Design of Transmission Systems	3	0	0	3	40	60	100	PC
	Elective-II (Professional)	3	0	0	3	40	60	100	PE
	Elective-III (Open)	3	0	0	3	40	60	100	OE
	PRACTICAL								
14MEL61	Heat Transfer Laboratory	0	0	3	1	100	0	100	PC
14MEL62	CAM and Robotics Laboratory	0	0	3	1	100	0	100	PC
14MEL63	Mechatronics Laboratory	0	0	3	1	100	0	100	PC
				Total	**22**				

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B.E. DEGREE IN MECHANICAL ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – VII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14GET71	Total Quality Management	3	0	0	3	40	60	100	PC
14MET71	Finite Element Analysis	3	1	0	4	40	60	100	PC
14MET72	Industrial Engineering and Cost Analysis	3	0	0	3	40	60	100	PC
	Elective – IV (Professional)	3	0	0	3	40	60	100	PE
	Elective – V (Open)	3	0	0	3	40	60	100	OE
	Elective – VI (Open)	3	0	0	3	40	60	100	OE
	PRACTICAL								
14MEL71	Computer Aided Simulation and Analysis Laboratory	0	0	3	1	100	0	100	PC
14MEL72	Automobile Engineering and Fluid Power Laboratory	0	0	3	1	100	0	100	PC
14MEP71	Design and Fabrication Project	0	0	6	3	50	50	100	PR
				Total	**24**				

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B.E. DEGREE IN MECHANICAL ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2014 – 15 onwards)

SEMESTER – VIII

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	THEORY								
14GET81	Professional Ethics and Human Values	3	0	0	3	40	60	100	HS
	Elective – VII (Professional)	3	0	0	3	40	60	100	PE
	Elective – VIII (Professional)	3	0	0	3	40	60	100	PE
	Elective – IX (Professional)	3	0	0	3	40	60	100	PE
	PRACTICAL								
14MEP81	Project Work	0	0	18	9	100	100	200	PR
				Total	**21**				

CA – Continuous Assessment, ESE – End Semester Examination

CBS – Curriculum Breakdwon Structure

Total Credits: 182

LIST OF PROFESSIONAL ELECTIVES						
Course Code	**Course Title**	**Hours/Week**			**Credit**	**CBS**
		L	**T**	**P**		
SEMESTER V						
14CST35	Object Oriented Programming	3	0	0	3	ES
14MEE01	CAD/CAM/CIM	3	0	0	3	PE
14MEE02	Design for Manufacture and Assembly	3	0	0	3	PE
14MEE03	Refrigeration and Air Conditioning	3	0	0	3	PE
SEMESTER VI						
14MEE04	Design of Jigs, Fixtures and Press Tools	3	0	0	3	PE
14MEE05	Industrial Tribology	3	0	0	3	PE
14MEE06	Rapid Prototyping	3	0	0	3	PE
14MEE07	Industrial Automation	3	0	0	3	PE
SEMESTER VII						
14MTT52	CNC Technology	3	0	0	3	ES
14MEE08	Gas Dynamics and Jet Propulsion	3	0	0	3	PE
14MEE09	Manufacturing Information System	3	0	0	3	PE
14MEE10	Automobile Engineering	3	0	0	3	PE
SEMESTER VIII						
14GEE81	Entrepreneurship Development	3	0	0	3	HS
14MEE11	Advanced Structure of Materials	3	0	0	3	PE
14MEE12	Robotics	3	0	0	3	PE
14MEE13	Non Destructive Evaluation Techniques	3	0	0	3	PE
14MEE14	Computational Fluid Dynamics	3	0	0	3	PE
14MEE15	Composite Materials	3	0	0	3	PE
14MEE16	Fundamentals of Ergonomics	3	0	0	3	PE
14MEE17	Cryogenic Engineering	3	0	0	3	PE
14MEE18	Advanced Heat Transfer	3	0	0	3	PE
14MEE19	Instrumentation in Thermal Engineering	3	0	0	3	PE
14MEE20	Introduction to Aircraft Structures	3	0	0	3	PE
14MEE21	Quality Control and Reliability Engineering	3	0	0	3	PE

LIST OF OPEN ELECTIVES						
Course Code	**Course Title**	**Hours/Week**			**Credit**	**CBS**
		L	**T**	**P**		
SEMESTER VI						
14MEO01	Introduction to Aircraft Systems	3	0	0	3	OE
14MEO02	Renewable Energy Sources	3	0	0	3	OE
SEMESTER VII						
14MEO03	Energy Auditing and Energy Management	3	0	0	3	OE
14MEO04	Power Plant Engineering	3	0	0	3	OE
14MEO05	Maintenance Engineering	3	0	0	3	OE
14MEO06	Industrial Safety Engineering	3	0	0	3	OE

14EGT11 COMMUNICATIVE ENGLISH I

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Functional Grammar: Basics of Vocabulary - Parts of speech or Word Classes including Determiners - Prefixes and Suffixes - Homonyms and Homophones - Connectives - Compound Nouns. **Listening:** Introduction to Listening / Types of Listening – Extensive / Intensive Listening - Listening Activities. **Speaking:** Verbal and non verbal communication – An introduction to speech sounds, syllables & word stress – Speaking Activities. **Reading:** Introduction to Skimming and scanning as reading techniques - understanding discourse coherence – sequencing of sentences – Reading activities. **Writing:** Introduction to aspects of technical writing – writing definitions and descriptions- Letter Writing – Informal letters-Punctuation in Letter Writing

UNIT – II **9**

Functional Grammar: Concord - Tenses - Voice - Use of Articles and prepositions. **Listening:** Listening Comprehension – Cloze Test - Extensive listening – listening for general information. **Speaking:** Role Play – Situational Conversations. **Reading:** Reading newspaper articles – global understanding skills and ability to infer, extract gist and understand main ideas. **Writing:** Letter Writing - Formal letters, Writing a Profile about an organization—Punctuation (General).

UNIT – III **9**

Functional Grammar: Phrasal verbs - Clauses - Simple, Compound and Complex Sentences - Synonyms and Antonyms. **Listening:** Listening Comprehension – Cloze Text - Intensive listening – listening for specific information. **Speaking:** Describing Places, People, Technical Processes. **Reading:** Reading different types of texts – Understanding general and specific information. **Writing:** Paragraph Writing – Writing reviews on short films and videos - Offering suggestions and recommendations

UNIT – IV **9**

Functional Grammar: Conditional clauses (If clause) - Adjectives, Compound Adjectives and Degrees of Comparison. **Listening:** Listening to different accents, listening to speeches / presentations. **Speaking:** Describing Technical Processes and Machines and Gadgets - Telephone Skills. **Reading:** Reading Texts with focus on use of verbs and verb phrases. **Writing:** Writing e-mails –Transcoding - Using Charts, pictures and tables for interpretations.

UNIT – V **9**

Functional Grammar: Modals – Types of Sentences – Idioms and Phrases and proverbs - identifying odd words. **Listening:** Retrieval of factual information – listening to identify topic, context, function, speaker's opinion, attitude, etc. **Speaking:** Interviews - Personal and Telephonic - Giving impromptu talks, making presentations on given topics. **Reading:** Reading for structure and detail – finding key information in a given text and finding topic sentences. **Writing:** Designing and Making Posters – Writing Advertisements-Free writing on any given topic (Technical and topics on current affairs)

TOTAL : 45

TEXT BOOKS :

1. "Learn English – A Fun Book of Functional Language, Grammar and Vocabulary", McGraw Hill Education [India] Pvt. Ltd., Santanu Sinha Chaudhuri, 2013.

REFERENCE BOOKS :

1. Raman, Meenakshi and Sangeetha Sharma, "Technical Communication: Principles and Practice", Oxford University Press, New Delhi, 2011.
2. Regional Institute of English, "English for Engineers", Cambridge University Press, New Delhi, 2006.
3. Rizvi, Ashraf M., "Effective Technical Communication", Tata McGrawHill, New Delhi. 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: speak clearly, confidently, comprehensibly, and communicate with others using appropriate communicative strategies

CO2: write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide range of vocabulary, organizing their ideas logically on a topic

CO3: read different genres of texts adopting various reading strategies

CO4: listen/view and comprehend different spoken discourses / excerpts in different accents

CO5: use language effectively and accurately acquiring vocabulary from real-life context

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						1			2	3		2		
CO2						1			1	3		1		
CO3						1			1	3		2		
CO4						1			2	3		2		
CO5						2			2	3		2		

1 – Slight, 2 – Moderate, 3 – Substantial

14MAT11 MATHEMATICS I

(Common to all Engineering and Technology branches)

3 1 0 4

Pre-requisites: Basics concepts of matrices, Basic idea of differentiation, Knowledge of differential equations

UNIT – I **9**

Matrices: Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors (without proof) – Cayley-Hamilton Theorem (Statement and Applications) - Similarity transformation (concept only) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of quadratic forms – Reduction of a quadratic form to canonical form by orthogonal transformation.

UNIT – II **9**

Functions of Several Variables: Functions of two variables – Partial derivatives – Total differential – Taylor's Series expansion –Maxima and Minima – Constrained maxima and minima – Lagrange's multiplier method – Jacobians – Properties.

UNIT – III **9**

Ordinary Differential Equations of First Order: Solutions of equations in separable form – Exact differential equations – Integrating factors – Linear first order differential equations – Bernoulli's equation – Clairaut's equation.

UNIT – IV **9**

Ordinary Differential Equations of Higher Order: Linear differential equations of second and higher order with constant coefficients – Particular Integrals for the types: e^{ax} – cos(ax) / sin(ax) – x^n – $e^{ax}x^n$, $e^{ax}\sin(bx)$ and $e^{ax}\cos(bx)$ – $x^n\sin(ax)$ and $x^n\cos(ax)$ – Linear differential equations with variable coefficients: Euler-Cauchy's equation – Legendre's equation.

UNIT – V **9**

Applications of Ordinary Differential Equations: Method of variation of parameters – Simultaneous first order linear equations with constant coefficients – Simple harmonic motion – Deflection of beams – Electric circuits (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 2014, S.Chand and Co., New Delhi.
2. Veerarajan T., "Engineering Mathematics, (for first year)", Reprint Edition 2013, Tata McGraw-Hill, New Delhi.

REFERENCE BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, New Delhi, 2011.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", 4th Edition, Narosa Publishing House, New Delhi, Reprint 2014.
3. Bali N.P. and Manish Goyal, "Text Book of Engineering Mathematics", 8th Edition, Laxmi Publications, New Delhi, 2011.
4. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2011.
5. Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2010.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: solve engineering problems which needs matrix computations
CO2: solve extremal problems which arise in function of several variables
CO3: identify the appropriate method for solving first order ordinary differential equations
CO4: classify and find the solution of ordinary differential equations of higher order
CO5: apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1								1		
CO2	3											1		
CO3	3	3	1	1								1		
CO4	3	3	1	1								1		
CO5	3	3	2	1								1		

1 – Slight, 2 – Moderate, 3 – Substantial

14PHT11 APPLIED PHYSICS

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Properties of Matter: Elasticity – Hooke's law – Modulus of elasticity (qualitative) – Stress-strain diagram – Poisson's ratio – Bending moment – Depression of a cantilever (theory) – Derivation of Young's modulus of the material of the beam – Uniform and non-uniform bending – I-shaped girders. **Thermal Physics:** Modes of heat transfer – Thermal conductivity – Derivation of rectilinear flow of heat along a bar – Radial and cylindrical heat flow – Conduction through compound media (series and parallel).

UNIT – II **9**

Acoustics: Classification of sound – Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption coefficient and its determination –Factors affecting acoustics of buildings and their remedies. **Ultrasonics:** Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acoustic grating – Cavitation – Industrial applications – Drilling, welding, soldering and cleaning – Non destructive testing – Ultrasonic pulse echo system.

UNIT – III **9**

Laser and Applications: Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Derivation of Einstein's coefficients (A&B) – Types of lasers – Nd:YAG laser, CO_2 laser, Semiconductor lasers: homojunction and heterojunction – Laser Applications – Industrial applications: laser welding, laser cutting, laser drilling – Holography – Construction and reconstruction of images.

UNIT – IV **9**

Fiber Optics and Applications: Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index, modes and materials) – Crucible-crucible technique for fiber fabrication – Sources (LED and LASER) and detectors (p-i-n photodiode and avalanche photodiode) for fiber optics - Fiber optical communication links – Losses in optical fibers – Fiber optic sensors – Temperature and displacement sensors.

UNIT – V **9**

Quantum Physics and Applications: Black body radiation – Planck's theory (derivation) – Compton effect (theory) – Matter waves – Uncertainty principle (qualitative) – Schroedinger's wave equations – Time independent and time dependent wave equations – Physical significance of wave function – Particle in a box (One dimensional) – Electron microscopes – Scanning electron microscope – Transmission electron microscope.

TOTAL : 45

TEXT BOOKS:

1. Tamilarasan K and Prabu K, "Engineering Physics-I", Tata McGraw Hill Education Private Limited, New Delhi, 2014.

REFERENCE BOOKS:

1. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai and Sons, New Delhi, 2009.
2. Uma Mukherji, "Engineering Physics", Narosa Publishing House, New Delhi, 2011.
3. Laud B.B., "Lasers and non- linear optics", New Age International (P) Limited Publishers, New Delhi, 1996.
4. Ajoy Ghatak and Thyagarajan K., "Introduction to Fiber Optics", Cambridge University Press, New York, USA, 2000
5. Mehta and Neeraj, "Applied Physics for Engineers", Prentice-Hall of India Private Limited, New Delhi, 2011.
6. Douglas Brandt and Douglas C. Giancoli, "Physics for Scientists and Engineers", Prentice-Hall of India Private Limited, New Delhi, 2000.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Infer the extensive properties of matter and heat conduction in metal.
CO2: Demonstrate acoustically good buildings and non-destructive testing using ultrasonic waves.
CO3: Employ the laser in engineering and technology.
CO4: Sketch the principle of fiber optics and fiber optic communication link.
CO5: Interpret the concepts of quantum physics to optical phenomena and electrons in a metal.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2		1		1	2	2		1		
CO2	3	2		2		1		1	2	2		1		
CO3	3	2		2		1		1	2	2		1		
CO4	3	2		2		1		1	2	2		1		
CO5	3	2		2		1		1	2	2		1		

1 – Slight, 2 – Moderate, 3 – Substantial

14CYT11 APPLIED CHEMISTRY

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Water: Introduction - Sources of water - Impurities in water - Types of water - Water quality standards - Water quality parameters (Brief discussion only) - 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 - 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

UNIT – II **9**

Electrochemistry: Introduction – Electrolytic and Electrochemical Cells – Representation of a galvanic cell - Reversible and Irreversible cells - EMF and its determinations – 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 battery, NICAD, Lithium battery, Lithium Sulphur battery) – Proton exchange membrane cells.

UNIT – III **9**

Corrosion and Its Control: Introduction – Mechanism of chemical and electrochemical corrosion – galvanic corrosion - concentration cell corrosion – Galvanic series - Factors influencing rate of corrosion – corrosion control methods - Sacrificial anode and impressed current cathodic protection methods – Corrosion inhibitors - Protective coatings - classifications - Pretreatment of metal surface - Metallic coating -electroplating and electrolessplating (General discussion) - Hot dipping (Tinning and galvanising) - Non-metallic 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)

UNIT – IV **9**

Fuels: Coal and its varieties – proximate and ultimate analysis – their significance – metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel - refining of petroleum – Manufacture of synthetic petrol – Cracking - Polymerization - Hydrogenation of coal (Fisher Tropsch and Bergius methods) - knocking - octane number – improving octane number by additives – Diesel – cetane number – Gaseous fuels (Water gas and LPG).

Combustion: Introduction – Calorific Values – Gross and Net Calorific Values – Dulong's formula (simple problems)- Flue gas analysis by Orsat's method - Explosive range and Spontaneous Ignition Temperature

UNIT – V **9**

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

TOTAL : 45

TEXT BOOKS:

1. Palanisamy P.N, Geetha A, Manjula Rani K, "Applied Chemistry", 2nd Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2013.
2. Jain P C and Monica Jain, "Engineering Chemistry", 15th Edition, Dhanpat Rai Publication Co., New Delhi, 2008.

REFERENCE BOOKS:

1. Sharma B.K., "Engineering Chemistry", Krishna Prakasan Media (P) Ltd., Meerut, 2001.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill, New Delhi, 2008.
3. 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: Get the basic knowledge of water quality parameters and treatment methods
CO2: Obtain the principles of electrochemical cells, EMF series and energy storing devices
CO3: Acquire the knowledge of the types and prevention methods of corrosion
CO4: Know the concepts and developments in combustion and various types of fuels.
CO5: Understand the knowledge about the types of polymers, plastics and moulding methods

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2	1			1		3		3		
CO2	3	2		2	1			1		3		3		
CO3	3	2		2	1			1		3		3		
CO4	3	2		2	1			1		3		3		
CO5	3	2		2	1			1		3		3		

1 – Slight, 2 – Moderate, 3 – Substantial

14MET11 BASICS OF CIVIL AND MECHANICAL ENGINEERING

(Common to all Engineering and Technology branches)

3 0 0 3

PART-A: CIVIL ENGINEERING

UNIT – I **5**

Introduction: History of civil engineering - Role and Functions of civil engineer - Fields of civil engineering

UNIT– II **5**

Building Materials: Introduction – Properties and applications of Construction Materials – bricks – stones – sand – cement – mortar- concrete – steel – glass-wood –plastics- ceramics -rubber- FRP – Non ferrous materials - Geosynthetics – Smart materials.

UNIT – III **4**

Sub Structure: Soil **–** classification- bearing capacity- foundation -function- requirements- types-failures -remedial measures- machine foundation

UNIT – IV **4**

Super Structures: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering- damp proofing- weathering course

UNIT – V **4**

Interior design and Landscaping: History of Interior design-Importance of Interior design- Basic elements of Interior design. Landscape Architecture-Elements of Landscaping- Green Engineering

PART-B: MECHANICAL ENGINEERING

UNIT – I **5**

Thermal Science: Laws of thermodynamics and their applications – Principle of operation of Steam, Diesel, Hydro-electric and Nuclear power plants - Classification of internal combustion engines and their working principles – Components of basic Vapour Compression Refrigeration system.

UNIT – II **4**

Fluid Science: Properties of fluids – Classification of hydraulic turbines, working principle of Pelton turbine – Applications of steam and gas turbines. Classification of pumps, working principle of centrifugal and reciprocating pump

UNIT – III **4**

Mechanics and Materials: Classification of engineering materials - Mechanical properties of engineering materials- Definition and importance of stress and strain - Definition and importance of centre of gravity and moment of inertia.

UNIT – IV **5**

Mechanical Components And Their Applications: Basic principles and applications of power transmission systems such as belt, rope, chain and gear drives – Function and principles of coupling, clutch, brake, flywheel and governor

UNIT – V **5**

Manufacturing Technology: Principle and applications of Metal forming process – Foundry, Forging. Principle and applications of Metal Joining process – Welding, Soldering and Brazing, Basics of CAD/CAM/CIM.

TOTAL : 45

TEXT BOOKS:

1. Palanichamy M.S., "Basic Civil Engineering", Tata McGraw-Hill, New Delhi, 2006.
2. Pravin Kumar, "Basic Mechanical Engineering", Pearson Publishers, New Delhi, 2013.

REFERENCE BOOKS:

1. Rangawala S.C., "Engineering Materials" Charotor Publishing House(P) Ltd., Anand, 2013.
2. Punmia B.C., Ashok Kumar Jain, Arun Kumar Jain, "Building Construction," Laximi Publications (P) Ltd., NewDelhi, 2005.
3. Shanmugam G., "Basic Mechanical Engineering", Tata McGraw-Hill, New Delhi, 2005.
4. Venugopal K. and Prabhu Raja V., "Basic Mechanical Engineering", 6th Edition, Anuradha Publishers, Kumbakonam, 2005.
5. https://www.youtube.com/watch?v=WH2vSp_p56k
6. https://www.acs.org/content/acs/en/greenchemistry/what-is-green-chemistry/principles/12-principles-of-green-engineering-html
7. https://www.youtube.com/watch?v=on-_oUajNso

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: know the various functions of Civil Engineer and to identify the suitable construction materials

CO2: demonstrate the various elements of sub-structure and super-structure

CO3: apply the elements of interior design and landscaping in Civil Engineering

CO4: demonstrate an understanding of basic concepts in thermal engineering, fluid mechanics and material properties

CO5: demonstrate an understanding of principles and applications of mechanical power transmission components and basic manufacturing process

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2	1	2	1		2		2		
CO2	3	2	2		2	1	2			2		2		
CO3	3	2	2		2	1	2			2		2		
CO4	3	2	2		2	1	2			2		2		
CO5	3	2	2		2	1	2			2		2		

1 – Slight, 2 – Moderate, 3 – Substantial

14MEC11 ENGINEERING DRAWING

(Common to all Engineering and Technology branches)

2 0 3 3

Pre-requisites: Basic knowledge in practical geometry construction and mathematics

UNIT – I **9**

General Principles of Orthographic Projection: Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Projections of Points, Lines and Planes. 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.

UNIT – II **9**

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

UNIT – III **9**

Sectioning 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.

UNIT – IV **9**

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

UNIT – V **9**

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

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: gain knowledge on international standards of drawings and to draw the different types of projections for points, lines and planes
CO2: draw the different projections of 3D primitive objects like cube, cone, cylinder, etc.
CO3: draw sections of solids including prisms, pyramids, cylinders and cones
CO4: understand the concepts of development of surfaces of simple and truncated solids
CO5: draw the isometric and perspective projections for the given object

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3		2	1				2		2		
CO2	3	2	3		2	1				2		2		
CO3	3	2	3		2	1				2		2		
CO4	3	2	3		2	1				2		2		
CO5	3	2	3		2	1				2		2		

1 – Slight, 2 – Moderate, 3 – Substantial

14VEC11 VALUE EDUCATION

(Common to all Engineering and Technology branches)

0 2 1 1

UNIT – I **6**

Philosophy of Life Science: Life – Purpose of life (four stages of life) – Philosophy of life (who am 'I') – Law of nature (cause of the life and body) – Content of the Life (five sheaths) – Goal of life. Five duties in life.

Methodology: Life and messages of spiritual and national leaders– The forgotten hero, etc.

Project report: Complementing with happiness - Every soul is potentially divine

UNIT – II **6**

Human Values-Moral foundation: Truth, forgiveness, compassion, endurance, humility, non violence, moderate diet, non stealing, self purification, self discipline, self study, content, cleanliness, honesty, and totality in faith– Good habits – Attitude forming for Individual peace.

Practical Methods: Personal experience with above characters, Puranic Stories - Self resolve diary maintenance

UNIT – III **6**

Social Values: Family – Family System - Greatness of women – World brotherhood (vasudeiva kudumbagam) – Glorious Bharath - Bharathian systems - Past –Present – Future - Team spirit - Goal setting – Economics – Education – Politics – Responsibilities of people – Preserving natural resources.

Methodology: Preparing an album on glorious Bharath Past, Present and Future Plans. Goal setting - Management Games. Team Spirit - Yogic Games.

UNIT – IV **6**

Development of Mental Prosperity: Prosperity of mind – Functions of mind - Obstacles of mind - Practical method to perfect mind is yoga – Types – Uses – Precaution – Contradiction – Kriyas - Asanas – Pranayamas – Meditative techniques.

Methodology: Asana - Pranayama – Cyclic meditation – Nada anu sandhana – Meditation – Yogic games for memory. Album on asanas , pranayama and mantra.

UNIT – V **6**

Maintenance of Physical Health: Human body – Structure - Ten Systems of the body as per modern science. Five elements - Harmonious relationship – Life force – Conserving vitality & health through natural life – Pranic food and its importance – Uses of herbs - Right way of cooking to preserve nutrients - Cause of the disease – Acute and chronic - Disease - Life and death.

Methodology: Natural food making, traditional millet dishes. Asanas, pranayamas, cleansing procedures, Quiz on healthy living, Uses of herbs or kitchen garden.

TOTAL : 30

TEXT BOOK:

1. "Value Education", compiled by Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar, Pollachi, for Kongu Engineering College.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the purpose and value of life
CO2: exhibit positive human values
CO3: understand social values
CO4: take steps to develop mental and physical health

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3				3		
CO2						3		3				3		
CO3						3		3				3		
CO4						3		3				3		

1 – Slight, 2 – Moderate, 3 – Substantial

14PHL11 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:

1. Determination of Young's modulus of a given material using uniform bending.
2. Determination of thermal conductivity of bad conductor using Lee's disc arrangement.
3. Determination of velocity of ultrasonic waves in liquid and compressibility of liquid using ultrasonic interferometer.
4. (a) Particle size determination using diode laser.

(b) Determination of wavelength of laser

5. Determination of specific resistance of a given coil of wire using Carey Foster bridge.
6. Determination of wavelength of Hg spectrum using spectrometer and grating.

Demonstration

1. Measurement of efficiency of a solar cell
2. Non destructive testing
3. Tyndall effect

PART-B: APPLIED CHEMISTRY LABORATORY
(Any five experiments)

LIST OF EXPERIMENTS:

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 the given water sample.
4. Conductometric titration - Mixture of acids.
5. Estimation of Hydrochloric acid using pH meter.
6. Estimation of Ferrous ion by potentiometric titration.

Demonstration

1. Distillation system
2. RO water treatment system
3. UV Spectrophotometer

REFERENCES / MANUALS / SOFTWARE:

1. Physics Laboratory Manual –Dr.K.Tamilarasan and Dr.K.Prabu
2. Chemistry Laboratory Manual- Dr.P.N.Palanisamy, P.Manikandan, A.Geetha and K.Manjularani

TOTAL : 45

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Describe the basics of modulus of elasticity, thermal conductivity, ultrasonics and compressibility of water, laser parameters, specific resistance of electrical conductors, and interference and diffraction of light waves.

CO2: Operate thebasic measuring devices, travelling microscope, Lee's disc arrangement, ultrasonic interferometer, Carrey Foster bridge and spectrometer, and to measure the related physical parameters.

CO3: Analyze the hardness, amount of Ca^{2+} and Mg^{2+} ions, and presence of alkalinity in water.

CO4: Employ the instruments like pH meter, conductivity meter and potentiometer for the estimation of unknown concentration of acids and ferrous ion.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		3			1	1	2	2		2		
CO2	3	2		3			1	1	2	2		2		
CO3	3	2		3			1	1	2	2		2		
CO4	3	2		3			1	1	2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL11 BASICS OF CIVIL AND MECHANICAL ENGINEERING LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS:

1. To prepare a square or rectangular shaped two identical MS plates by cutting and filing operations
2. To prepare a square/rectangular/circular/trapezoidal/Vshaped projection and its counterpart formating from the given square or rectangular MS plates.
3. To carryout drilling, tapping and assembly on the given MS plates.
4. To carryout thread forming on a GI and PVC pipes and cut to the required length.
5. To use various pipe fitting accessories and prepare water leak proof water line from overhead tank.
6. To prepare a T/L/Lap joint from the given wooden work pieces.
7. To prepare a plywood box/tray to the given dimensions.
8. To prepare a leak proof sheet metal tray/box/funnel to the given dimensions.
9. Cutting of MS plates by gas cutting method and arc weld joining by Lap/Butt/T joint method
10. Preparing a simple PVC window/door frame assembly.
11. Preparing a simple memento or similar articles using wood/sheet metal
12. Preparing innovative articles involving waste metals.

TOTAL : 45

REFERENCES / MANUALS / SOFTWARE:

1. Introduction to basic manufacturing processes and workshop technology by Rajender Singh, New Age International (P) Limited, 2006.
2. Elements of Workshop Technology by S.K.Hajra Choudhury, Media Promoters, 2009.

COURSE OUTCOMES:

On completion of the course the students will be able to

CO1: demonstrate knowledge on safety and adhere to safety features

CO2: mark the given dimensions accurately and execute cutting and joining operations

CO3: select methods and tools and execute the given experiments

CO4: finish the job to the requirements and quantify the accuracy

CO5: plan and complete simple and innovative articles

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2		2	2	1		2	2		2		
CO2	3	1	2		2	2	1		2	2		2		
CO3	3	1	2		2	2	1		2	2		2		
CO4	3	1	2		2	2	1		2	2		2		
CO5	3	1	2		2	2	1		2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial

14EGT21 COMMUNICATIVE ENGLISH II

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Functional Grammar: Sentences – Affirmative / Negative – Asking questions in the simple present – Using reference words - Cause and Effect expressions. **Listening:** Listening practice - listening to different types of conversation and answering questions - listening to Audio texts and completing cloze exercises. **Speaking:** Opening a conversation and getting acquainted with people. **Reading:** Reading excerpts from a novel, itinerary, magazine and news paper articles. **Writing:** Formal Letter writing – Job Application Letter – CV and Resume – Writing Instructions

UNIT – II **9**

Functional Grammar: Sentences – Interrogative & WH questions - SI units – Numerical Adjectives

Listening: Listening to situation based dialogues – listening to short and long conversations in different domains of activity. **Speaking** : Conversation practice in real life situations, describing places, narration, introducing ideas. **Reading:** Reading historic writing – biographical writing – Non fictional book extracts and news feeds. **Writing:** Filling Forms – Academic Writing - Basics of Business Writing – Calling for Quotation, Placing Orders, Letter of Complaint

UNIT – III **9**

Functional Grammar: Sentences – Imperative – Gerunds & Infinitives - Commonly confused words. **Listening:** Understanding the structure of conversations - Listening to academic lectures and live speech – advertisements and announcements. **Speaking:** Giving and Justifying opinions – apologizing – extempore. **Reading:** Reading Blogs - Website articles – e-mails. **Writing:** e-mails – Tweets – Texting and SMS language

UNIT – IV **9**

Functional Grammar: Transformation of Sentences – Simple, Compound and Complex - Vocabulary (single word substitute) – conjunctions - reporting verbs – Direct and Indirect speech. **Listening:** Listening to a telephone conversation, viewing of model interviews (face–to–face, telephonic and video conferencing). **Speaking:** Giving instructions – Role play – Interviews. **Reading:** Reading job advertisements and profile of the company concerned **Writing:** Writing Reports - Preparing a Check list

UNIT – V **9**

Grammar: Analyzing sentence structures in a given short passage - Identifying parts of speech in a given short passage. **Listening:** Viewing a model group discussion and reviewing the performance of each participant – identifying the characteristics of a good listener – casual conversation. **Speaking:** Group discussion skills – initiating, turn taking and concluding the discussion. **Reading:** Making notes from long passages or any form of written materials – providing a suitable title – identifying main points, supporting points. **Writing:** Email writing – Effective use of email.

TOTAL: 45

TEXT BOOKS :

1. Dr. Elango et al. "Resonance: English for Engineers and Technologists", Foundation, Chennai, 2013.

REFERENCE BOOKS:

1. Anderson, Paul V., " Technical Communication **:** A Reader–Centered Approach", Cengage.
2. Muralikrishna and Sunita Mishra, "Communication Skills for Engineers", Pearson, New Delhi, 2011.
3. Sharma, Sangeetha 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: speak effectively, express their opinions clearly, initiate and sustain a discussion and also negotiate using appropriate communicative strategies

CO2: write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing

CO3: read different genres of texts, infer implied meanings and critically analyze and evaluate them for ideas as well as for method of presentation

CO4: listen and comprehend different spoken excerpts critically and infer unspoken and implied meanings

CO5: use functional grammar for improving employment oriented skills

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2			2	3		2		
CO2						1			1	3		1		
CO3						2			1	3		2		
CO4						1			2	3		2		
CO5						1			1	3		1		

1 – Slight, 2 – Moderate, 3 – Substantial

14MAT21 MATHEMATICS II

(Common to all Engineering and Technology branches)

3 1 0 4

Pre-requisites: Basic ideas of integration, Basic ideas of vectors and complex numbers

UNIT – I **9**

Multiple Integrals: Double integration in Cartesian coordinates – Change of order of integration – Area between two curves – Triple integration in Cartesian coordinates –Volume as Triple integrals (Simple problems only).

UNIT – II **9**

Vector Calculus: Gradient of a scalar point function – Directional derivative – Divergence of a vector point function – Curl of a vector – Irrotational and Solenoidal vectors – Line Integral, Surface integral and Volume integral (Concept only) – Green's, Stoke's and Gauss divergence theorems (Statement only) – Verification of the above theorems and evaluation of integrals using them (Simple problems only).

UNIT – III **9**

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

UNIT – IV **9**

Complex Integration: Cauchy's theorem and Cauchy's integral formula (Statement and applications) – Taylor's and Laurent series – Singularities – Classification – Cauchy's Residue theorem (Statement only) – Contour integration – circular and semi-circular contours (excluding poles on real axis).

UNIT – V **9**

Laplace Transform: 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 transform of elementary functions – Partial fraction method – Convolution theorem (Statement only) – 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 2014, S.Chand and Co., New Delhi.
2. Veerarajan T., "Engineering Mathematics", (for first year), Reprint Edition 2013, Tata McGraw-Hill, New Delhi.

REFERENCE BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, New Delhi, 2011.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", 4th Edition, Narosa Publishing House, New Delhi, Reprint 2014.
3. Bali N.P. and Manish Goyal, "Text Book of Engineering Mathematics", 8th Edition, Laxmi Publications, New Delhi, 2011.
4. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2011.
5. Kreyszig E., "Advanced Engineering Mathematics", 10th Edition, John Wiley Sons, 2010.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Solve problems involving double and triple integrals.
CO2: Apply the concept of vectors in engineering problems.
CO3: Have a clear idea about functions of complex variables and analytic function which are widely used in study of fluid and heat flow problems.
CO4: Evaluate complex integrals which is extensively applied in engineering.
CO5: Handle Laplace transforms to solve practical problems.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1								1		
CO2	3	3	1	1								1		
CO3	3	3										1		
CO4	3	3	1	1								1		
CO5	3	3	1	1								1		

1 – Slight, 2 – Moderate, 3 – Substantial

14PHT21 MATERIALS SCIENCE

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Crystal Physics: Crystalline and amorphous solids – Lattice – Unit cell – Crystal systems – Bravais lattice – Lattice planes – Miller indices – Derivation of '*d*' spacing in cubic lattice – Atomic radius – Coordination number– Packing factor for SC, BCC, FCC and HCP structures – Crystal imperfections: Point and line imperfections.

UNIT – II **9**

Conducting Materials: Conductors – Classical free electron theory of metals – Electrical and thermal conductivities – 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.

UNIT – III **9**

Semiconducting Materials: Intrinsic semiconductor – Carrier concentration derivation – Electrical conductivity and band gap (theory) – Extrinsic semiconductors – Carrier concentration derivation in n-type and p-type semiconductors – Hall effect – Determination of Hall coefficient – Applications –Solar cell – LDR.

UNIT – IV **9**

Magnetic and Superconducting Materials: Magnetic materials - Types of magnetic materials (qualitative) – Domain theory – Hysteresis – Soft and hard magnetic materials – Applications - Transformer core – Magneto optical recording – Superconductors – Properties – Types of superconductors – BCS theory of superconductivity (qualitative) – Josephson effect - Applications of superconductors – SQUID – Cryotron – Magnetic levitation. **Dielectric Materials:** Dielectric constant – Qualitative study of polarization – Frequency and temperature dependence of polarization – Dielectric loss – Dielectric breakdown – Uses of dielectric materials (capacitor) – Ferro electric materials (qualitative).

UNIT – V **9**

Smart Materials: Metallic glasses: Preparation (Melt spinning method only), properties and applications – Shape memory alloys (SMA): Characteristics and applications. **Nano Materials:** Low dimensional structures (quantum dot, wire and well) – Features of nano materials – Synthesis: top down and bottom up approaches – Ball milling and lithographic methods – Physical and chemical vapor phase depositions – Sol gel method – Carbon nanotubes: Structures – Properties – Fabrication by laser ablation – Applications.

TOTAL : 45

TEXT BOOKS:

1. Tamilarasan K. and Prabu K., "Engineering Physics-II", Tata McGraw Hill Education Private Limited, New Delhi, 2014.

REFERENCE BOOKS:

1. Mehta and Neeraj, "Applied Physics for Engineers", Prentice-Hall of India Private Limited, New Delhi, 2011.
2. Raghavan V., "Materials Science and Engineering: A first course", 5th Edition, Prentice-Hall of India, New Delhi, 2009.
3. Poole Charles P. and Ownen Frank J., "Introduction to Nanotechnology", Wiley India, 2007.
4. William Fortune Smith and Javad Hashemi, "Foundations of Materials Science and Engineering", McGraw-Hill Education, 2006, New Delhi.
5. Pillai S.O., "Solid State Physics", 5th Edition, New Age International, New Delhi, 2003.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Explain the various crystal systems and crystal defects.
CO2: Comprehend the theory of conducting materials.
CO3: Classify the types of semiconducting materials and to illustrate the device applications.
CO4: Summarize the theory and applications of magnetic, superconducting and dielectric materials.
CO5: Outline the properties and applications of smart materials and nano materials.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2		1		1	2	2		1		
CO2	3	2		2		1		1	2	2		1		
CO3	3	2		2		1		1	2	2		1		
CO4	3	2		2		1		1	2	2		1		
CO5	3	2		2		1		1	2	2		1		

1 – Slight, 2 – Moderate, 3 – Substantial

14CYT21 ENVIRONMENTAL SCIENCE

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

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.

UNIT – II **9**

Ecosystems: Concept of an ecosystem – Components of an ecosystem - Structural and functional features – Functional attributes (Food chain and Food web only) –Ecological Succession- Introduction, types, characteristic features, structure and functions of the (a) Forest ecosystem (b) Aquatic ecosystems (ponds, rivers and oceans). **Biodiversity:** Introduction – Classification: genetic, species and ecosystem diversity – Bio geographical classification of India- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic, option values and ecosystem service value – Biodiversity at global, national and local level- Hotspots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – In-situ and Ex-situ conservation of biodiversity.

UNIT – III **9**

Environmental 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 - 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 - Sewage treatment (Primary, Secondary & Tertiary methods) – Introduction to industrial wastewater treatment using Reverse Osmosis Technology- Membrane Technology for wastewater treatment - Activated carbon in pollution abatement of wastewater.

UNIT – IV **9**

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation– Environmental ethics - Wasteland reclamation – 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 – Value Education – HIV / AIDS – Women and Child welfare – Role of Information Technology in Environment and human health – Case studies.

UNIT – V **9**

Green Chemistry for Sustainable Future: Water the greenest solvent – Role of catalyst – Biopolymers – Biofertilizers – Principle and applications of green chemistry. **Food and Human Health:** Introduction – Classification and applications of carbohydrates, amino acids, proteins, lipids and vitamins – Food additives – Balanced food – Minerals rich, carbohydrates rich and proteins rich – Chemistry of soft drinks – Oils and fats – Simple tests for identification of adulterants in food stuffs – Impacts of fluoride and arsenic on human health – Fluoride and arsenic removal methods – Significance of iodine, iron and calcium content in human health.

TOTAL : 45

TEXT BOOKS:

1. Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K., "Environmental Science", Pearson Education, New Delhi, Revised Edition 2014.
2. Anubha Kaushik, and Kaushik C.P., "Environmental Science and Engineering", 4th multicolour Edition, New Age International (P) Ltd., New Delhi, 2014.

REFERENCE BOOKS:

1. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses", 2005, University Grands Commission, Universities Press India Private Limited, Hyderguda, Hyderabad.
2. Uppal M.M. revised by Bhatia S.C., "Environmental Chemistry", 6th Edition, Khanna Publishers, New Delhi, 2002.
3. Bahl B.S. and Arun Bahl, "Advanced Organic Chemistry", 3rd Edition, S. Chand & Co., New Delhi, 2005.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: know the types of natural resources and the individual role in conserving the resources
CO2: understand the ecological balance and the preservation of biodiversity
CO3: gain the knowledge of the various types of pollution and the waste water treatment methods
CO4: attain the knowledge of various social issues and impact of population explosion on environment
CO5: know about the green chemistry for sustainable future, food and human health

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2			2	3	1		3		3		
CO2	2	1	2			2	3	1		3		3		
CO3	2	1	2			2	3	1		3		3		
CO4	2	1	2			2	3	1		3		3		
CO5	2	1	2			2	3	1		3		3		

1 – Slight, 2 – Moderate, 3 – Substantial

14CSC11 PROBLEM SOLVING AND PROGRAMMING

(Common to all Engineering and Technology branches)

3 0 3 4

UNIT – I **9**

Introduction to Computer and Problem Solving: Overview of computers – Applications of computers-Characteristics of computer - Basic computer Organization – Number System - Problem solving: Planning the computer program – Algorithms - Flowcharts – Pseudo codes – Structuring the logic - Top-Down design.

UNIT – II **9**

Case Study on Problem Solving: Algorithm, Flowchart and Pseudo code for the problems: Exchanging the values of two variables – Finding the biggest number - Counting – Summation of numbers – Factorial computation – Generation of Fibonacci Sequence - Summation of series – Base Conversion - Reversing the digits of an Integer.

UNIT – III **9**

Introduction to C and Control Statements: Overview of C – Basic structure of a C Program – Executing a C Program – C Character set – Tokens – Keywords and Identifiers – Constants – Variables – Data types - Storage classes - Managing Input and Output operations – Operators and Expressions - Decision making and Branching - Looping – break and continue statements.

UNIT – IV **9**

Arrays, Strings and Functions: Arrays – One dimensional and Two dimensional arrays - Handling of character strings: Declaring and initializing string variables – String handling functions - Library functions – User defined functions: Elements of User defined Functions – nesting of functions – passing arrays to function – passing strings to functions - recursion.

UNIT – V **9**

Structures, Unions and Pointers: Structure definition – Structure declaration – Accessing a structure member- Structure initialization – Array of Structures - Arrays within structures –Structures within Structures – Structures and Functions , Unions. Understanding pointers – Accessing address of a variable – Declaring pointer variables – Initialization of pointer variables – accessing a variable through its pointer – Pass by value vs. Pass by pointers.

Lecture: 45, Practical: 45, TOTAL: 90

REFERENCE BOOKS:

1. Dromey R.G., "How to Solve it by Computer", Pearson Education, 2009.
2. Balagurusamy E., "Fundamentals of Computing and Programming", Tata McGraw-Hill Education Pvt. Ltd, 2010.
3. Stephen G. Kochan, "Programming in C", 3rd Edition, Pearson Education, 2005.
4. Yashavant P. Kanetkar, " Let Us C", BPB Publications, 2011.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: apply fundamental principles of problem solving techniques
CO2: develop algorithm, flowchart and pseudo code to provide solutions to problems
CO3: develop programs using basic programming principles of C language
CO4: implement modular programming concepts using functions
CO5: design simple applications using arrays, structures and pointers

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	2		1										
CO2	2	3	2	1	1									
CO3	1	2	2	2						1				
CO4		2	2	2						1				
CO5		1	1	2										

1 – Slight, 2 – Moderate, 3 – Substantial

14EET11 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT- I **9**

Introduction to Power Systems: Introduction: Electric Potential, Current, Power and Energy. Generation of Electrical Energy: Sources of Energy - Renewable and Non Renewable - Power Generation: Thermal, Hydro and Nuclear Power plants - Solar and Wind (schematic arrangement and operation) Power plants - Structure of Electric Power System - Transmission and Distribution Voltages. Electrical Safety Aspects - Phase-Neutral - Earthing: Need for Earthing and Types - Domestic Wiring (Simple and staircase) - Energy Conservation and Sustainability.

UNIT - II **9**

DC Circuits and AC Circuits: Resistance: Resistors in Series and Parallel - Network Reduction - Voltage and Current Division Rule - Ohm's Law- Kirchhoff's Laws - Mesh Analysis of Simple Resistive Networks.

Single phase systems: Alternating (Sinusoidal) Voltage and Current, R.M.S and Average Value, Power Factor, Form Factor and Peak Factor - AC Series Circuits (RL, RC & RLC). Three phase Systems (Qualitative only): Star and Delta Connected Systems - Line and Phase Voltage/Current - Three Phase Power Measurement by Two Wattmeter Method.

UNIT - III **9**

Electrical Machines: DC Machines: Construction, Principle of Operation of DC Motor-Torque Equation, Types and Applications. AC Machines: Construction and Working Principle of AC Generator , Single Phase Transformer, Three Phase Induction Motor and Single Phase Induction Motor (Split Phase and Capacitor Start Induction Motor) - Applications.

UNIT - IV **9**

Basic Electronics: PN Junction Diode - Operation of Rectifiers (Half wave, Full wave - Bridge Rectifiers with waveforms) and Filters - Zener Diodes - Zener Diode as Voltage Regulator - IC Voltage Regulators (78XX & 79XX) - Transistors: Types - Operation of NPN Transistor - Transistor as an Amplifier - Operation and Characteristics of SCR - UPS and SMPS (Block Diagram approach).

UNIT - V **9**

Digital Electronics: Introduction – Binary Number Systems and Conversions - Binary Addition and Subtraction - Logic Gates and Truth tables - Boolean Algebra - Basic Laws and Demorgan's theorem - Simplification of Boolean Functions - Full Adder and Full Subtractor - Flip Flops - Counters: Asynchronous Binary Ripple Counter .

TOTAL: 45

TEXT BOOKS:

1. Prasad P.V., Sivanagaraju S. and Prasad R., "Basics of Electrical and Electronics Engineering", 1st Edition, Cengage Learning, 2013.
2. Muthusubramanian R. and Salivahanan S., "Basics of Electrical and Electronics Engineering", 1st Edition ,Tata McGraw Hill, 2009.

REFERENCE BOOKS:

1. Jegathesan V., Vinoth Kumar K. and Saravanakumar R., "Basic Electrical and Electronics Engineering", 1st Edition, Wiley India, 2011.
2. Sukhija M.S. and Nagsarkar T.K., "Basics of Electrical and Electronics Engineering", 1st Edition ,Oxford University Press, 2012.
3. Smarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", 2nd Edition, PHI Learning, 2007.
4. Edward Hughes, Ian McKenzie Smith, Dr. John Hiley and Keith Brown, "Electrical and Electronics Technology", 8th Edition, Pearson Education, 2012.
5. http://www.nptelvideos.in/2012/11/basic-electrical-technology.html
6. http://nptel.kongu.edu/Basic%20Courses%20I%20&%20II/Others/BEL/index.html

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: analyze the DC and AC circuits
CO3: interpret the construction and working of different types of electric machines
CO4: discuss the basic electronic components
CO5: distinguish analog and digital electronics

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2													
CO2	3	2	1											
CO3	2													
CO4	2													
CO5	3	1												

1 – Slight, 2 – Moderate, 3 – Substantial

14PHL21 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:

1. Determination of band gap of a semiconductor material using post office box.
2. Determination of dispersive power of a prism using spectrometer.
3. Determination of viscosity of liquid - Poiseuille's method.
4. Determination of thickness of a thin wire – air wedge method.
5. Determination of AC frequency using Melde's string experiment.
6. Determination of hysteresis loss in a ferromagnetic material.

Demonstration

1. Thin film deposition using RF magnetron sputtering technique
2. Synthesis of nano-particles
3. Phase change memory materials - RW CD / DVD

PART - B: APPLIED CHEMISTRY LABORATORY

(Any five experiments)

LIST OF EXPERIMENTS:

1. Estimation of Chloride in the given water sample.
2. Determination of Dissolved Oxygen in the given wastewater sample.
3. Estimation of Ferrous ion in the given solution.
4. Estimation of Copper in the given solution by Iodometric method.
5. Estimation of Chromium (Cr^{6+}) in the wastewater.
6. Estimation of copper content of the given solution by EDTA method.

Demonstration

1. Turbidity measurement using Nephelometer
2. COD analyzer
3. Dissolved Oxygen measurement using DO analyzer

TOTAL : 45

REFERENCES / MANUALS / SOFTWARE:

1. Physics Laboratory Manual –Dr.K.Tamilarasan and Dr.K.Prabu
2. Chemistry Laboratory Manual- Dr.P.N.Palanisamy, P.Manikandan, A.Geetha and K.Manjularani

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: describe **t**he basics of band gap of semiconductors, dispersive power of a prism, viscosity of liquids, interference of light, AC frequency and hysteresis of ferromagnetic materials.

CO2: operate the instruments like post office box, air wedge arrangement, Melde's string apparatus and hysteresis arrangement, and to measure the related parameters

CO3: estimate the amount of DO and chloride in a given water sample

CO4: determine the amount of chromium, ferrous ion and copper in waste water

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		3			1	1	2	2		2		
CO2	3	2		3			1	1	2	2		2		
CO3	3	2		3			1	1	2	2		2		
CO4	3	2		3			1	1	2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial

14EEL11 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS:

1. Control of incandescent and fluorescent lamp by simple and stair-case wiring
2. Resistor color coding and verification of Ohm's Law and Kirchhoff's Laws
3. Measurement of real power, reactive power, power factor and impedance of RC, RL and RLC circuits.
4. Measurement of Earth's resistance
5. Load test on DC shunt motor
6. Performance characteristics of single phase Transformer
7. Load test on single phase induction motor.
8. Verification of basic logic gates and their truth tables.
9. Implementation of Half wave and Full wave Rectifier with simple Capacitor Filter
10. Study of Mixie, Ceiling Fan and Vacuum Cleaner

TOTAL : 45

REFERENCES / MANUALS / SOFTWARE:

- Lab Manuals

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: create a basic electrical connections for domestic applications
CO2: test basic electrical machines like transformer and DC motors
CO3: construct and analyze basic electronic circuits
CO4: measure the various electrical parameters of the circuit
CO5: explain the working of various domestic appliances

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3							1	2			1		
CO2	3	2						1	2			1		
CO3	3	2						1	2			1		
CO4	2	2						1	2			1		
CO5	2							1	2			1		

1 – Slight, 2 – Moderate, 3 – Substantial

14MAT31 MATHEMATICS III

(Common to all Engineering and Technology Branches)

3 1 0 4

UNIT – I **9**

Fourier Series: Dirichlet's conditions – General Fourier series – Change of interval - Odd and even functions – Half range Sine series – Half range Cosine series – Harmonic analysis.

UNIT – II **9**

Partial Differential Equations: Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Lagrange's linear equation – Homogeneous linear partial differential equations of higher order with constant coefficients.

UNIT – III **9**

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 (excluding insulated edges).

UNIT – IV **9**

Fourier Transform: Fourier Integral theorem (without proof) – Fourier transform pair – Properties – Transforms of simple functions – Fourier Sine and Cosine transforms – Convolution theorem and Parseval's identity (Statement and applications only).

UNIT – V **9**

Z - Transform: Definition – Elementary properties – Z-transform of some basic functions – Inverse Z-transform – Partial fraction method – Residue method – Convolution theorem – Applications of Z-transforms – Solution of difference equations.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics, Volume - III", Reprint Edition, S.Chand & Co., New Delhi, 2014.
2. Veerarajan T., "Transforms and Partial Differential Equations", 3rd Reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.

REFERENCE BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Reprint Edition, Narosa Publishing House, New Delhi, 2014.
3. Bali N.P. and Manish Goyal, "A Text Book of Engineering Mathematics", 9th Edition, Laxmi Publications, New Delhi, 2014.
4. Ramana B.V., "Higher Engineering Mathematics", 11th Reprint, Tata McGraw Hill Publishing Company, New Delhi, 2010.
5. Erwin Kreyzig, "Advanced Engineering Mathematics", 10th Edition, Wiley & Co, 2011.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: expand a function in terms of Fourier series and apply it for solving engineering problems
CO2: model and solve higher order partial differential equations
CO3: apply the methods of solving PDE in practical problems
CO4: gain knowledge on Fourier transforms
CO5: handle problems in Z transforms and apply it to solve difference equations

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1								1	2	1
CO2	3	3	1	1								1	2	1
CO3	3	3	1	1								1	2	1
CO4	3	3	1	1								1	1	
CO5	3	3	1	1								1	1	

1 – Slight, 2 – Moderate, 3 – Substantial

14MET31 ENGINEERING MECHANICS

(Common to Mechanical, Mechatronics and Automobile branches)

3 1 0 4

Pre-requisites: Mathematics I & II, Applied Physics.

UNIT – I **9**

Statics of Particles: Introduction –Laws of Mechanics – Parallelogram and triangular Law of forces – Principle of transmissibility – Coplanar Forces – Resolution and Composition of force -Free body diagram–Equilibrium of a particle in plane – Forces in space - Vectorial representation of forces–Equilibrium of a particle in space.

UNIT – II **9**

Statics of Rigid Bodies: 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 – Trusses: Method of joints- Method of sections, Equilibrium of Rigid bodies in three dimensions.

UNIT – III **9**

Properties of Surfaces and Solids: Determination of Areas and Volumes – First moment of area and Centroid of sections – T section, I section, Angle section, Hollow section from primary simpler sections – Second moment of plane areas – Parallel axis theorem and Perpendicular axis theorem—T section, I section, Angle section, Hollow sections – Polar moment of inertia – Product of inertia- Principal Moment of inertia of plane area- Mass moment of inertia – Relation to area moments of inertia.

UNIT – IV **9**

Friction and Kinematics of Particles: Surface Friction – Laws of dry friction – Sliding friction – Static and Kinetic friction– Ladder friction – Wedge friction – Belt friction. Rectilinear motion of particles- Displacement, velocity and acceleration, their relationship – Relative motion- Curvilinear motion – Projectile motion.

UNIT – V **9**

Dynamics of Particles and Rigid Body: Newton's law, Work - Energy and Impulse - Momentum equations of particles – Impact of elastic bodies. Kinematics of Rigid body -Translation, Rotation about a fixed axis–General plane motion- Kinetics of rigid body.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Rajasekaran S. and Sankarasubramanian G., "Fundamentals of Engineering Mechanics", 3rd Edition, Vikas Publishing House, Noida, 2009.
2. Beer F.P., Johnston E.R., Cornwell P. and Maurek D., "Vector Mechanics for Engineers: Statics and Dynamics", 10th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2012.

REFERENCE BOOKS:

1. Shames Irving H., "Engineering Mechanics: Statics and Dynamics", 4th Edition, Pearson Education Asia, New Delhi, 2014.
2. Hibbeller R.C., "Engineering Mechanics Statics and Dynamics", 11th Edition, Pearson Education Asia, Noida, 2015.
3. Timoshenko S.P., Young D.H., Sukumar Pati, Rao J.V., "Engineering Mechanics", 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.
4. http://nptel.ac.in/courses/122104015/
5. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-050-engineering-mechanics-i-fall-2007/index.htm

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: represent the forces in vector components (both 2D and 3D) and apply equilibrium conditions

CO2: calculate the moment produced by various force systems and develop static equilibrium equations for rigid body system

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

CO4: comprehend the effect of dry friction and its applications

CO5: apply the different principles to study the motion of a body and analyse their constitutive equations

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2		2							2	3	3
CO2	3	3	2		2							2	3	3
CO3	3	3	2		2							2	3	3
CO4	3	3	2		2							2	3	3
CO5	3	3	2		2							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MET32 ENGINEERING THERMODYNAMICS

(Common to Mechanical and Automobile branches)

(Use of standard Steam table with Mollier diagram and Psychometric chart are permitted)

3 1 0 4

Pre-requisites: Mathematics I & II, Applied Physics.

UNIT – I **9**

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

UNIT – II **9**

Second Law, Entropy and Availability: Second law of thermodynamics – Kelvin–Planck and Clausius statements of second law. Carnot cycle, Heat engine, reversed Carnot cycle – efficiency, Refrigerator, Heat pump – COP. Reversibility and irreversibility. Thermodynamic temperature scale, Inequality of Clausius. Concept of entropy, entropy of ideal gas, principle of increase of entropy – Carnot's theorem, absolute entropy, Basic concepts of availability.

UNIT – III **9**

Properties of Pure Substance: Properties of pure substances –Thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, p-v, p-T, T-s, h-s diagrams, pvT surface. Thermodynamic properties of steam. Calculations of work done and heat transfer in non-flow and flow processes.

UNIT – IV **9**

Ideal and Real Gases and Thermodynamic Relations: Concept of ideal and real gases, Properties of ideal and real gases, equation of state, Avogadro's law, Van der Waals equation of state, Compressibility and compressibility chart. Dalton's law of partial pressure - Gas mixtures. Exact differentials, TdS equations, Maxwell's equations, Clausius- Clapeyron equation, Joule-Kelvin coefficient.

UNIT – V **9**

Psychrometry: Psychrometry-Properties of atmospheric air, calculations of properties of air-vapour mixtures. Psychrometric charts. Psychrometric processes – Sensible heat exchange processes. Latent heat exchange processes. Adiabatic mixing, evaporative cooling-Problems.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Nag P.K., "Engineering Thermodynamics", 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.
2. Rajput R.K., "Engineering Thermodynamics", 4th Edition, Lakshmi Publications, New Delhi, 2012.

REFERENCE BOOKS:

1. Arora C.P., "Thermodynamics", Tata McGraw Hill Publishing Company, New Delhi, 2003.
2. Cengel Y., "Thermodynamics: An Engineering Approach", 7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2011.
3. Holman J.P., "Thermodynamics", McGraw-Hill, New York, 2000.
4. Ballaney P.L., "Thermal Engineering", 24th Edition, Khanna Publishers, New Delhi, 2000.
5. http://nptel.ac.in/courses/112105123/
6. http://nptel.ac.in/courses/114105029/
7. https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008/video-lectures/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: gain the capability of problem solving in thermodynamic processes
CO2: acquire the knowledge on second law of thermodynamics and entropy concept
CO3: solve the problems related to thermodynamic properties of pure substances
CO4: recognize the concept of real and ideal gases and applications of thermodynamic relations in physical problems
CO5: apply the psychrometric concepts in various processes

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2					2		2	2	3
CO2	3	3	3	3	2					2		2	2	3
CO3	3	3	3	3	2					2		2	2	3
CO4	3	3	3	3	2					2		2	2	3
CO5	3	3	3	3	2		3			2		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MET33 FLUID MECHANICS AND HYDRAULIC MACHINES

(Common to Mechanical, Mechatronics and Automobile branches)

3 0 0 3

Pre-requisites: Physics, Mathematics I & II, Basics of Mechanical Engineering.

UNIT – I **9**

Fluid Properties and Fluid Statics: Fluid Definition and Classification – Properties of fluids: Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Compressibility, Bulk Modulus, Capillary and Surface Tension – Fluid statics: Concept of fluid static pressure – Pascal's law –Absolute and Gauge pressures – Manometers: Types and Pressure measurement.

UNIT – II **9**

Fluid Kinematics and Fluid Dynamics: Fluid Kinematics: Types of fluid flow – Continuity equation in two and three dimensions – Velocity and Acceleration of fluid particle – Velocity potential function and Stream function. Fluid dynamics: Euler's equation along a streamline –Bernoulli's equation and applications – Venturi meter, Orifice meter and Pitot tube.

UNIT – III **9**

Viscous Flow, Flow through Pipes and Dimensional analysis: Viscous flow: Shear stress, pressure gradient relationship – Flow of viscous fluid through circular pipe – Flow through pipes: Loss of head due to friction – Minor head losses – Hydraulic gradient and Total energy lines – Flow through pipes in series and in parallel – Power transmission through pipes. Dimensional analysis: Buckingham's π theorem.

UNIT – IV **9**

Hydraulic Turbines: Impact force – work done – Efficiency of stationary, moving flat and curved vanes due to moving water jet – Construction of velocity vector diagrams – Degree of reaction – Pelton wheel – Francis turbine – Kaplan turbine – working principles – velocity triangles – work done.

UNIT – V **9**

Hydraulic Pumps: Centrifugal pump: classifications, working principle, velocity triangles, Work done. Reciprocating pump: classification, working principle- Basic principles of indicator diagram, cavitations in pumps.

TOTAL: 45

TEXT BOOKS:

1. Bansal R.K., "Fluid Mechanics and Hydraulic Machines", 9th Edition, Laxmi Publications, New Delhi, 2015.
2. Rajput R.K., "A Text Book of Fluid Mechanics" 5th Edition, S.Chand & Company Ltd., New Delhi, 2012.

REFERENCE BOOKS:

1. Som S.K., Biswas G., "Introduction to Fluid Mechanics and Fluid Machines", 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007.
2. Kumar K.L., "Engineering Fluid Mechanics", 7th Edition, Eurasia Publishing House, New Delhi, 2005.
3. Frank M. White., "Fluid Mechanics", 7th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2009.
4. https://www.smartzworld.com/notes/fluid-mechanics-hydraulic-machinery-notes-pdf-fmhm-notes-pdf/
5. http://nptel.ac.in/courses/112105182/
6. http://nptel.ac.in/courses/112104117/
7. http://www.nptelvideos.in/2012/11/fluid-mechanics.html

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the fluid flow properties
CO2: solve the problems related to kinematics and dynamics of fluid flow
CO3: calculate the energy losses in flow through pipes
CO4: design the velocity triangle by various hydraulic machines
CO5: estimate the work done by the various pumps

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2								2	2	2
CO2	3	3	3	2								2	2	2
CO3	3	2	3	2								2	2	2
CO4	3	3	3	2								2	2	2
CO5	3	3	3	2								2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MET34 MANUFACTURING TECHNOLOGY

3 0 0 3

Pre-requisites: Basics of Mechanical Engineering.

UNIT – I **9**

Foundry Technology: Casting processes**:** Pattern: Types, Material, Allowances – Moulding Sand: Preparation, Properties –Cores: Types and Applications– Heating and Pouring – Solidification and Cooling – Pure metal – Alloys – Solidification time – Shrinkage – Directional solidification – Design – Runner – Riser – Gate. **Special Casting Processes:** Expendable mold casting processes – Shell molding – Vacuum molding – Expanded polystyrene process – Investment casting, Plastic mold and Ceramic mold casting, Permanent mold casting process –Die casting – Centrifugal casting – Types, Defects in casting.

UNIT – II **9**

Metal Forming Processes: Bulk deformation process –Principles of extrusion, rolling and drawing– Forging processes: open, impression and closed die forging - Types: Upset and Heading – Swaging and Radial, Roll forging – Sheet metal operations: Shearing, Blanking, Punching, Slotting, Perforating, Notching, Trimming, Shaving – Bending operations – Bending allowances - Flanging- Hemming- Seaming and Curling, Ironing, Coining, Embossing.

UNIT – III **9**

Plastic Forming Processes: Properties of polymer melts – Extrusion – Production of sheet and film – Fiber and Filament production – Coating processes Injection molding – Compressions and Transfer molding – Blow molding – Rotational molding – Thermoforming.

UNIT – IV **9**

Welding Technology: Physics of welding – Features of a fusion welded joint – Working Principles of Arc welding – Resistance welding – Electron beam – Laser beam – Electro slag – Thermit welding – Solid state welding – Weld quality weldability.

UNIT – V **9**

Powder Metallurgy: Characterization of engineering powders – Production of metallic powders – Conventional pressing and sintering – Alternative pressing and Sintering techniques – Design consideration in PM – Product of PM

TOTAL: 45

TEXT BOOKS:

1. Serope Kalpakjian, Steven R. Schmid, "Manufacturing Process for Engineering Materials", 5th Edition, Pearson Education, 2009.
2. Mikell P. Groover, "Fundamentals of Modern Manufacturing Materials, Processes and Systems", 5th Edition, Wiley India, 2012.

REFERENCE BOOKS:

1. DeGarmo S., "Materials and Processes in Manufacturing", 11th Edition, John Wiley & Sons, New Delhi, 2011.
2. Sharma P.C., "A Text Book of Production Technology: Manufacturing Process", 7th Edition, S.Chand & Co. Ltd., New Delhi, 2007.
3. Sharma P.C., "A Text Book of Production Engineering", 11th Edition, S.Chand & Co. Ltd., New Delhi, 2008.
4. http://nptel.ac.in/courses/112104195/
5. http://nptel.ac.in/courses/112107145/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: find the suitable casting process for the given component
CO2: perform basic calculation to fabricate sheet metal components
CO3: identify appropriate technique for the fabrication of polymeric components
CO4: demonstrate the principle involved in several welding techniques
CO5: know the importance of powder metallurgy components

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	1				1	1		3	1	3
CO2	3	3	2	2					1			2		3
CO3	2	1	1	1	2		1			1		3	2	2
CO4	3	1			1					1		2	1	3
CO5	2	1			1					1		2		2

1 – Slight, 2 – Moderate, 3 – Substantial

14EET33 ELECTRICAL DRIVES AND INDUSTRIAL ELECTRONICS

(Common to Mechanical and Chemical branches)

3 0 0 3

Pre-requisites: Materials Science, Basics of Electrical and Electronics Engineering.

UNIT – I **9**

Electrical Drives and Motor Characteristics: Basic Elements of Drive – Types of Electric Drives – Factors Influence the Choice of Electrical Drives– Classification of Load Torques and Classes of Duty – Selection of Power Rating for Drive Motors. Torque Equation of DC Machine – Speed-Torque Characteristics of DC Motors-Series, Shunt and Compound Motors – Torque Equation and Speed-Torque Characteristics of Three Phase Induction Motors.

UNIT – II **9**

Motor Starting and Braking Methods: Types of D.C Motor Starters – Two Point Starter, Three Point Starter, Four Point Starter – Types of AC Motor Starters – Stator Resistance Starter, DOL Starter, Y-Δ Starter, Auto Transformer Starter and Rotor Resistance Starter. Braking of Electrical Motors – DC Motors: Shunt, Series and Compound – AC Motors: Three Phase Induction Motors.

UNIT – III **9**

Power Electronics: SCR:- Principle of Operation, Static and Dynamic Characteristics, Phase Angle Control – Single Phase Half wave and Full wave Controlled Rectifiers – Three phase Voltage Source Inverters – 120° and 180° Mode-Basics of PWM Inverters – Chopper Operation (Step-Up and Step-Down)- Introduction to Harmonics

UNIT – IV **9**

Conventional and Solid State Speed Control of DC Drives: Speed Control of DC Series and Shunt Motors – Armature and Field Control, Ward-Leonard Control System – Controlled Rectifiers Fed DC Drive and Chopper Based DC Drive (First and Second Quadrant Operation) – Selection of DC Drives for Cranes and Paper Mill.

UNIT – V **9**

Conventional and Solid State Speed Control of AC Drives: Speed Control of Three Phase Induction Motor – Voltage Control, Voltage / Frequency Control, Slip Power Recovery Scheme – Inverter and AC Voltage Controller Based Induction Drives – Selection of AC Drives for Textile Mill and Cement Mill.

TOTAL: 45

TEXT BOOKS:

1. Dubey G.K, "Fundamentals of Electrical Drives", 2nd Edition, Narosa Publishing House, New Delhi, 1995, Reprint – 2013
2. M.D.Singh, K.B.Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007, Reprint – 2013.

REFERENCE BOOKS:

1. Vedam Subrahmaniam, "Electric Drives: Concepts and Applications", Tata McGraw Hill Publishing Company, New Delhi, 2nd Edition, 2001, Reprint – 2012.
2. Pillai, S. K, "A First Course on Electric Drives", 2nd Edition, Wiley Eastern Limited, New Delhi, 1998, Reprint-2007.
3. Bose B.K., "Power Electronics and Motor Drives", 1st Edition, Academic Press, 2006.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: categorize and explain the operation of electrical drives
CO2: classify and interpret the operation of starting and braking methods of AC and DC machines
CO3: categorize and explain the working principle of converters
CO4: choose the appropriate speed control techniques for AC and DC motor drives
CO5: select the suitable AC and DC drives for industrial applications

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3											1		1
CO2	3											1		
CO3	3											1		
CO4	3				2							2		
CO5	3	1										2		1

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL31 FLUID MECHANICS AND HYDRAULIC MACHINES LABORATORY

(Common to Mechanical and Automobile branches)

0 0 3 1

LIST OF EXPERIMENTS / EXERCISES:

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

TOTAL: 45

REFERENCES / MANUALS / SOFTWARE:

1. Bansal R.K., "Fluid Mechanics and Hydraulics Machines", 9th Edition, Laxmi Publications, New Delhi, 2012.
2. Som S.K., Biswas G., "Introduction to Fluid Mechanics and Fluid Machines", 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: perform empirical investigation and quantitative assessment of important mechanics of fluid.
CO2: demonstrate the performance characteristics of hydraulic machinery
CO3: find the co-efficient of discharge and frictional losses in open and closed flows

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2		1		3	2		2	2	3
CO2	3	3	3	1	2		1		3	2		2	2	3
CO3	3	3	3	1	2		1		3	2		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL32 MANUFACTURING TECHNOLOGY LABORATORY

0 0 3 1

Pre-requisites: Basics of Mechanical Engineering, Materials Science.

LIST OF EXPERIMENTS / EXERCISES:

1. Making a mould by using solid patterns.
2. Making a mould by using split patterns.
3. Making a mould by using Mould with loose – piece patterns.
4. Making a mould with core (Hollow objects).
5. Producing different weld joints by using horizontal and vertical position of Arc welding operations.
6. Producing different weld joints by using Gas welding operations.
7. Gas cutting and spot welding operations.
8. Making square rod by hand forging operation.
9. Making rectangular rod by hand forging operation.
10. Producing plastic components by injection moulding operations.
11. Dismantling and assembling of a bicycle.

TOTAL: 45

REFERENCES / MANUALS / SOFTWARE:

1. Sharma P.C., "A Text book of Production Technology", 7th Edition, S.Chand & Co, New Delhi, 2007.
2. Hajra Choudhry S.K., Bose S.K., Hajra Choudhry A.K., Roy Nirjhar, "Elements of Workshop Technology", 12th Edition, Volume - II, Machine Tools, Media Promoters and Publishers Pvt. Ltd., Bombay, 2007.
3. Lab Manual.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: prepare moulds and fabricate castings using foundry tools
CO2: demonstrate and fabricate different types of components using welding processes
CO3: demonstrate and fabricate various components using casting and forging processes
CO4: demonstrate and fabricate various components using sheet metal operations
CO5: give demonstration on dismantling and mantling of a bicycle

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2		1			3	3		1		1
CO2	3	2	1	1	1	1			3	3		1	1	2
CO3	3	2	2	1		1			3	3		1		1
CO4	3	2	2	1	1				3	3		1	1	2
CO5	3	2		2	2	1			3	3		1	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

14EEL33 ELECTRICAL ENGINEERING LABORATORY

0 0 3 1

Pre-requisites: Basics of Electrical and Electronics Engineering.

LIST OF EXPERIMENTS / EXERCISES:

1. Study of DC and AC Starters
2. Load Test on DC Series Motor
3. Open Circuit Characteristics and Load Characteristics of DC Shunt Generator
4. Speed Control of DC Shunt Motor (Armature control and Field control)
5. Speed Control of Three Phase Squirrel Cage Induction Motor
6. Load Test on Three Phase Slip Ring Induction Motor
7. Steady State and Switching Characteristics of SCR.
8. Operational Analysis of Choppers (Step Up and Step Down)
9. Conversion of AC to DC Voltage using Single Phase Controlled Rectifier.
10. Analysis of IGBT Based Three Phase Inverter (120◦ & 180◦ Mode Operation).

TOTAL : 45

REFERENCES / MANUALS / SOFTWARE:

1. Singh M.D. and Kanchandani, "Power Electronics", 2nd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2006.
2. Lab Manual.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: compare the operation of various types of starters
CO2: classify the rotating machines based on their performance curves
CO3: evaluate the methods of speed control in rotating machines
CO4: analyze the characteristics of power electronic devices
CO5: categorize the various power electronics converters and their operation

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3								3			1		
CO2	3	1							3			1		
CO3	3				2				3			1		2
CO4	3	2	1						3			1		
CO5	3	2							3			1		

1 – Slight, 2 – Moderate, 3 – Substantial

14MAT42 STATISTICS AND NUMERICAL METHODS

(Common to Mechanical, Mechatronics and Automobile Engineering)

3 1 0 4

UNIT – I **9**

Testing of Hypothesis: Large sample tests – Z-test for single mean and difference of means – Small sample tests – Student's t-test for significance of means – F-test for comparison of variances – Chi-square test for goodness of fit and independence of attributes.

UNIT – II **9**

Design of Experiments: Analysis of variance – One way classification – Completely Randomized Design – Two way classifications – Randomized Block Design – Three way classifications – Latin Square Design.

UNIT – III **9**

Solution to Algebraic and Transcendental Equations: Method of false position – Newton-Raphson method – Solution of linear system of equations – Direct methods: Gauss elimination method and Gauss - Jordan method – Iterative methods: Gauss Jacobi and Gauss-Seidel methods.

UNIT – IV **9**

Interpolation: Interpolation with equal intervals: Newton's forward and backward difference formulae – Interpolation with unequal intervals: Lagrange's interpolation formula – Newton's divided difference formula. **Numerical Differentiation and Integration**: Differentiation using Newton's forward, backward and divided difference interpolation formulae – Numerical integration: Trapezoidal rule – Simpsons $1/3^{rd}$ rule.

UNIT – V **9**

Numerical Solution of First order Ordinary Differential Equations: Single step methods**:** Taylor series method – Euler method – Modified Euler method – Fourth order Runge-Kutta method – Multi step methods: Milne's predictor corrector method – Adam's Bashforth method.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Manish Goyal, "Statistics and Numerical Methods", 1st Edition, Laxmi Publications, New Delhi, 2010.
2. Veerarajan T., "Probability, Statistics and Random Processes", Reprint Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.
3. Kandasamy P., Thilakavathy K. and Gunavathy K., "Numerical Methods", Reprint Edition, S.Chand & Co, New Delhi, 2014.

REFERENCE BOOKS:

1. Walpole R.E., Myers R.H., Myers S.L. and Ye K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2012.
2. Johnson R. and Gupta C.B., "Miller and Freund's Probability and Statistics for Engineers", 11th Edition, Pearson Education, Asia, 2011.
3. Sankara Rao K., "Numerical Methods for Scientists and Engineers", 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
4. Jain M.K., Iyengar S.R.K. and Jain R.K., "Numerical Methods for Scientific and Engineering Computation", 6th Reprint, New Age International Pvt. Ltd., New Delhi, 2014.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Identify large and small samples and apply suitable tests for getting required results
CO2: Handle design of experiments problems
CO3: Solve algebraic and transcendental equations numerically where analytical methods fail to give solution
CO4: Gain knowledge in the concept of interpolation
CO5: Understand the concept of numerical differentiation and integration and apply numerical techniques for solving first order ordinary differential equations

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		1	1							1	1	1
CO2	3	3		1	1							1	1	1
CO3	3	3		1	1							1		
CO4	3	3		1	1							1		
CO5	3	3		1	1							1	1	1

1 – Slight, 2 – Moderate, 3 – Substantial

14MET41 STRENGTH OF MATERIALS

(Common to Mechanical, Mechatronics and Automobile branches)

3 1 0 4

Pre-requisites: Engineering Mechanics, Mathematics I & II.

UNIT – I **9**

Stress, Strain, and Deformation of Solids: 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.

UNIT – II **9**

Analysis of State of Stress: Biaxial state of stress – thin cylinders and shells – Deformation in Thin cylinders and spherical shells. Thick Cylinder – Lame's Equation. Biaxial stresses at point – stresses on inclined planes – Principal planes and stresses – Mohr's circle for biaxial stress- Maximum shear stress.

UNIT – III **9**

Transverse Loading on Beams and Stresses in Beams: Beams – types and transverse loading on beams-shear force and bending moment in beams – cantilevers, simply supported and overhanging beams-Point of contra flexures. Theory of simple bending – analysis of stress- load carrying capacity.

UNIT – IV **9**

Deflection of Beams and Columns: 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. Columns: End condition –Equivalent length of column – Euler's equation – Slenderness ratio – Rankine's formula for columns.

UNIT – V **9**

Torsion on Circular Shafts and Coiled Helical Springs: Torsion of circular shaft – Shear stress distribution – hollow and solid circular section. Torsional rigidity – stepped shaft – Twist and torsional stiffness - Torsion on springs – Wahl'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", 4th Edition, S.Chand & Co, New Delhi, 2012.
2. Bansal R.K., "Strength of Materials", 4th Edition, Lakshmi Publications, New Delhi, 2014.

REFERENCE BOOKS:

1. Timoshenko S.P., "Elements of Strength of Materials", 10th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2010.
2. Sadhu Singh, "Strength of Materials", 11th Edition, Khanna Publishers, New Delhi, 2014.
3. Popov E.P., "Engineering Mechanics of Solids", 2nd Edition, Prentice-Hall of India, New Delhi, 1998.
4. https://ocw.mit.edu/courses/mechanical-engineering/2-001-mechanics-materials-i-fall-2006/index.htm
5. http://nptel.ac.in/courses/112107147/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: Estimate the stress, strain and strain energy relations for simple and compound bars
CO2: analyze the biaxial state of stresses in thin, thick cylinders and spherical shells
CO3: plot the shear force and bending moment diagrams and analyze the bending stresses in beams
CO4: estimate the slope and the deflection of beams and the strengths of the columns
CO5: design and analyze the torsional behavior of shafts and springs

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2		2		1			2	3	3
CO2	3	3	3	3	2		2		1			2	3	3
CO3	3	3	3	3	2		2		1			2	3	3
CO4	3	3	3	3	2		2		1			2	3	3
CO5	3	3	3	3	2		2		1			2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MET42 THERMAL ENGINEERING

(Use of standard Steam table with Mollier diagram, Psychrometry chart, Refrigeration and Air-conditioning data book are permitted)

3 1 0 4

Pre-requisites: Applied Physics

UNIT – I **9**

Internal Combustion 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.

UNIT – II **9**

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

UNIT – III **9**

Steam Boilers, Nozzles and Turbines: Classification of boilers – Fire tube and Water tube boilers – Rankine Cycle. Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow. Steam turbines- Impulse and reaction principles, compounding, velocity diagrams for simple turbines, Governing of turbines– Types.

UNIT – IV **9**

Air Compressor: 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, Screw compressor.

UNIT – V **9**

Refrigeration and Air-Conditioning: Vapour compression Refrigeration system – super heat, sub cooling, performance calculations. Working principle of vapour absorption system –Types – NH_3-H_2O and LiBr-H_2O systems. Air conditioning systems, Working principle of Air Handling Unit (AHU), Cooling load calculations – Concept of RSHF, GSHF, ESHF

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Rajput R.K., "Thermal Engineering", 10th Edition, Lakshmi Publications, New Delhi, 2017**.**
2. Kothandaraman C.P., Domkundwar S., Domkundwar A.V., "A Course in Thermal Engineering", 6th Edition, Dhanpat Rai & Sons, New Delhi, 2010.

REFERENCE BOOKS:

1. Ballaney P.L., "Thermal Engineering", 24th Edition, Khanna Publishers, New Delhi, 2014**.**
2. Mahesh M. Rathore, "Thermal Engineering", 1st Edition, Tata McGraw Hill Publishing Company, New Delhi, 2010.
3. Ganesan V., "Internal Combustion Engines", 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2017.
4. Arora C.P., "Refrigeration and Air Conditioning", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2010.
5. http://nptel.ac.in/courses/114105029/
6. https://ocw.mit.edu/courses/aeronautics-and-astronautics/16-540-internal-flows-in-turbomachines-spring-2006/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify the components of IC engine and its various subsystems
CO2: understand the working of gas power cycles and their applications
CO3: recognize the types of boilers, steam nozzles and turbines and their performance behaviour
CO4: acquire the knowledge on working and performance of air compressors
CO5: solve problems on refrigeration and air-conditioning systems by understanding the various thermodynamic processes

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	1	3			2		2	2	3
CO2	3	3	3	2	2	3	3		1	2		2	2	3
CO3	3	3	3	2	2	3	3		1	2		2	2	3
CO4	3	3	3	2	2	2	3		1	2		2	2	3
CO5	3	3	3	2	2	3	3		2	2		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MET43 KINEMATICS OF MACHINERY

(Common to Mechanical and Mechatronics branches)

3 1 0 4

Pre-requisites: Engineering Mechanics, Engineering Drawing.

UNIT – I **9**

Basics of Mechanisms: Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle. Description of common Mechanisms – Quick return mechanisms – Ratchets and escapements – Indexing Mechanisms – Rocking Mechanisms.

UNIT – II **9**

Kinematics of Mechanisms: Velocity and Acceleration of simple mechanisms: Analytical solution for slider crank mechanism- Velocity analysis using instantaneous centre method- Klien's construction for slider crank mechanism, oscillating cylinder and swivel bearing mechanisms - Velocity and Acceleration of simple mechanisms by relative velocity method- Coincident points –Coriolis Acceleration component.

UNIT – III **9**

Kinematics of Cam: Cams- Types of cams and followers, displacement, velocity and acceleration curves for uniform velocity, uniform acceleration and retardation, SHM and cycloidal curves. Layout of profile of plate cams of above-types with reciprocating and oscillating followers like knife – edge follower, roller and flat faced followers. High speed cams – circular arc and tangent cams – Standard cam motion – Pressure angle and undercutting.

UNIT – IV **9**

Kinematics of Gears and Gear Trains: Theory of Gearing – gear nomenclature, law of gearing, tooth forms, minimum number teeth, length of arc of contact, contact ratio and interference. Gear trains – types, velocity and torque calculation- Parallel axis and epicyclic gear trains.

UNIT – V **9**

Gyroscope: Angular velocity, Acceleration, Gyroscopic couple – Gyroscopic effect on Naval ships, Stability of an automobile- Rigid disc at an angle fixed to a rotating shaft.

Lecture: 45, Tutorial: 15, TOTAL: 60

TEXT BOOKS:

1. Rattan S.S., "Theory of Machines" 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.
2. Shigley J.E., Uicker J.J., "Theory of Machines and Mechanisms", 4th Edition, Oxford University Press, 2014.

REFERENCE BOOKS:

1. Rao J.S., Dukkipati R.V., "Mechanism and Machine Theory", 2nd Edition, New Age International Pvt. Ltd., Publishers, New Delhi, 2014.
2. Bevan Thomas, "Theory of Machines", 3rd Edition, C B S Publishers & Distributors, New Delhi, 2005.
3. Ballaney P.L., "Theory of Machines", 3rd Edition, Khanna Publishers, New Delhi, 2004.
4. http://nptel.ac.in/courses/112104121/1
5. http://freevideolectures.com/Course/2359/Kinematics-of-Machines

COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: design and analyze the various mechanisms
- CO2: analyze and draw the velocity and acceleration diagrams of mechanisms
- CO3: plot and analyze the profile of various cam mechanisms for different applications
- CO4: solve and evaluate the kinematics aspects of gears and gear trains
- CO5: solve and analyze gyroscopic effects for various applications

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	2							2	3	2
CO2	2	3	3	3	2							2	3	2
CO3	1	2	2		2							2	3	2
CO4	2	2	3	1								2	3	2
CO5	3	3	3		1							2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MET44 MATERIAL REMOVAL PROCESSES

3 0 0 3

Pre-requisites: Manufacturing Technology, Basics of Mechanical Engineering.

UNIT – I **9**

Theory of Metal Cutting: Introduction – Mechanics of chip formation – Chip morphology – Single point cutting tool nomenclature –Tool signature – Forces in orthogonal cutting- Tool wear and Failure – Tool life – Surface finish and Surface integrity – Machinability – Cutting tool materials – Coated cutting tools – Cutting fluids.

UNIT – II **9**

Machine Tools: Lathe machine: Centre lathe, Various operations, Taper turning methods, Thread cutting methods, Special attachments, Machining time and Power estimation. Special purpose lathe. Automatic, semi-automatic lathes

UNIT – III **9**

Machining Process: 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.

UNIT – IV **9**

Abrasive Processes: Grinding wheel – Specifications and Selection, Types of grinding process – Cylindrical grinding, Surface grinding, Centreless grinding – Honing, Lapping, Super finishing, Polishing and Buffing.

UNIT – V **9**

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 Beam 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", 5th Edition, 14th Impression, Pearson Education, 2014.
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", 3rd Edition, Tata McGraw Hill Publishing Company, 2013.
2. Sharma P.C., "A Text Book of Production Technology: Manufacturing Process", 5th Edition, S.Chand & Company Ltd., New Delhi, 2007.
3. Richerd R. Kibbe, Warren T. White, Roland O. Meyer, Kelly Curran, Jon Stenerson, "Machine Tool Practices", 10th Edition, Pearson Education, 2014.
4. http://nptel.ac.in/downloads/112105127/
5. http://nptel.ac.in/courses/112104195/
6. http://nptel.ac.in/courses/112107145/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: deliver the concept of metal cutting principles and tool life
CO2: know the various working principles and applications of lathe
CO3: know the various working of milling, drilling and broaching
CO4: become familiar with surface finishing processes
CO5: demonstrate the basic concepts of unconventional machining process

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1			2							3	1	2
CO2	3	2			2							2	2	2
CO3	3	2			2							3	2	2
CO4	2				2							3	2	2
CO5	3	2			1							2	1	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MET45 ENGINEERING MATERIALS AND METALLURGY

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Applied Physics, Materials Science

UNIT – I **9**

Constitution of Alloys: 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 irons, microstructure, properties and applications. Ferrite and austenite stabilizers.

UNIT – II **9**

Phase Diagrams and Non Ferrous Alloys: Effect of alloying additions on steel Manganese (Mn), Silicon (Si), Chromium (Cr), Molybdenum (Mo),Vanadium (V), Titanium (Ti) and Tungsten (W) - stainless and tool steels – HSLA maraging steels – Gray, White, malleable, spheroidal – Graphite - alloy cast irons. Copper and Copper alloys –Brass, Bronze and Cupronickel –Aluminum and Aluminum -Copper –precipitation strengthening treatment.

UNIT – III **9**

Non -Metallic Materials: Polymers – types of polymer, commodity and engineering polymers –Glass transition and melting temperature of polymers – Structures, Properties and applications of Polyethylene (PE), Polypropylene (PP), Polystyrene (PS), Polyvinylchloride (PVC), Poly methyl metha acrylate (PMMA), Polyethylene terephthalate (PET), Polycarbonate (PC), Polyamide (PA), Polyimide (PI), Polyamide-imide (PAI), Poly phenylene oxide (PPO), Polyphenylene sulfide (PPS), Polyether ether ketone (PEEK), Poly tetra fluro ethylene (PTFE) - Urea and Phenol Formaldehydes –Engineering Ceramics –Properties and applications of Alumina (Al_2O_3), Silicon carbide (SiC), Silicon nitride ($Si_3.N_4$), Partially stabilized zirconia (PSZ) and Sialon – Glass annealing – Fibre and particulate reinforced composites.

UNIT – IV **9**

Heat Treatment: Definition – Full annealing, stress relief, recrystallisation and spheroidizing –normalising, quenching, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on Time Temperature Transformation (TTT) diagram, Critical Cooling Rate (CCR) – Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburising, nitriding, cyaniding, carbonitriding – Flame and Induction hardening.

UNIT – V **9**

Testing of Mechanical Properties: 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.

TOTAL: 45

TEXT BOOKS:

1. Rajan T.V., Sharma, "Heat Treatment Principles and Techniques", 2nd Edition Prentice Hall of India Pvt., Ltd., New Delhi, 2012.
2. Avner Sydney H., "Introduction to Physical Metallurgy", 2nd Edition, McGraw-Hill, New York, 2009.

REFERENCE BOOKS:

1. Budinski Kenneth G., Budinski Michael K., "Engineering Materials: Properties and Selection", 9th Edition, 4th Indian Reprint, Prentice-Hall of India, New Delhi, 2009.
2. Callister William D., "Material Science and Engineering", 4th Edition, John Wiley and Sons, New York, 2012.
3. Dieter George E., "Mechanical Metallurgy", 3rd Edition, McGraw-Hill, New York, 2013.
4. Raghavan V., "Materials Science and Engineering", 5th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
5. Premamoy Ghosh, "Polymer Science and Technology-Plastics, Rubber, blends and Composites", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.
6. http://nptel.ac.in/courses/113106032/
7. http://www.vssut.ac.in/lecture_notes/lecture1424355321.pdf

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the structure, composition and properties of metals, alloys and non-metals
CO2: identify the phase diagram of various materials
CO3: present the applications of heat-treatment
CO4: demonstrate the mechanical testing of materials
CO5: identify and select suitable materials for various engineering applications

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1				2	2			2		3		2
CO2	3	2	1	1	1	2	2				1	3	1	2
CO3	2	2	1		1	1	1					2	1	2
CO4	2	2	1		2	1	1			1		3	1	3
CO5	2	2	2	2		2	1		1	1	1	3	1	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL41 THERMAL ENGINEERING LABORATORY

(Use of standard Steam table with Mollier chart is permitted)

0 0 3 1

Pre-requisites: Mathematics I & II

LIST OF EXPERIMENTS / EXERCISES:

1. Draw a valve timing and port timing diagram for four stroke and two stroke engines.
2. Determination of flash and fire point of given fuels using open and closed cup apparatus.
3. Determination of viscosity of given oils using redwood and say bolt viscometers.
4. Performance test on single cylinder diesel engines by mechanical, hydraulic, eddy current and electrical loading.
5. Performance test on twin cylinder diesel engine by electrical loading.
6. Heat balance test on single cylinder diesel engines by mechanical, hydraulic, eddy current and electrical loading.
7. Performance and morse test on multi cylinder petrol engine using hydraulic loading.
8. Retardation test on internal combustion engine.
9. Emission test on single cylinder diesel and petrol engines using exhaust gas analyzer.
10. Performance test on multistage reciprocating air compressor.
11. Performance and heat balance test on boiler.
12. Performance test on steam turbine, condenser and cooling tower.

TOTAL: 45

REFERENCES / MANUALS / SOFTWARE:

1. Rajput R.K., "Thermal Engineering", 9th Edition, Lakshmi Publications, New Delhi, 2014**.**
2. Lab Manual.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: analyze the characteristics of the fuels
CO2: examine the working of internal combustion engines and analyze their performances and heat balance curves
CO3: test the emission standards in engines
CO4: experimentation on steam boiler, steam turbine, condenser and cooling tower in order to determine the performance parameters
CO5: test and plot the performance curves on multistage air compressor.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	3	3			2		2	2	3
CO2	3	3	3	3	2	3	3			2		2	2	3
CO3	3	3	3	3	2	3	3			2		2	2	3
CO4	3	3	3	3	2	3	3			2		2	2	3
CO5	3	3	3	3	2	3	3			2		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL42 MACHINING PROCESS LABORATORY

0 0 3 1

Pre-requisites: Manufacturing Technology

LIST OF EXPERIMENTS / EXERCISES:

1. Perform facing, plain turning and step turning operations in centre lathe
2. Perform knurling and taper turning operations in centre lathe
3. Perform external thread cutting operations in centre lathe
4. Perform eccentric turning and bush turning operations in centre lathe
5. Drill and tap on the flat metal plate by using drilling and taping tools
6. Perform various milling operations by using milling machine
7. Grind the flat and circular metal work piece using grinding machines
8. Obtain a dovetail and key way shape using shaping machines
9. Prepare a curved surface (convex) in a flat metal work piece using slotting machines
10. Make a spur gear using hobbing machines

TOTAL : 45

REFERENCES / MANUALS / SOFTWARE:

1. Sharma P.C., "A Text Book of Production Technology", 7th Edition, S. Chand & Co., New Delhi, 2007.
2. Hajra Choudhry S.K., Bose S.K., Hajra Choudhry A.K., Roy Nirjhar, "Elements of Workshop Technology", 12th Edition, Volume - II, Machine Tools, Media Promoters and Publishers Pvt. Ltd., Bombay, 2007.
3. Lab Manual

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate various machining operations using machine tools
CO2: fabricate different types of components for industrial applications
CO3: ensure the quality of finished product

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1		1	1	1	3	1	1		3	3		3	3	2
CO2	1	1	1	2	3	1	1		3	3		3	3	2
CO3	1	1	2	2	3	1	1		3	3		3	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL43 ADVANCED MATERIALS TESTING LABORATORY

(Common to Mechanical and Automobile branches)

0 0 3 1

Pre-requisites: Material Science

LIST OF EXPERIMENTS / EXERCISES:

METALLURGY LABORATORY

1. Preparation and determination of compressive strength shear strength of green sand and dry sand.
2. Sieve analysis – Determination of AFS fineness number.
3. Microstructure of low carbon, eutectoid steel.
4. Microstructure of Grey cast-iron and spheroidal cast iron.
5. Microstructure of copper and aluminum alloys.
6. Rockwell and Brinell hardness measurement for different materials.

STRENGTH OF MATERIALS LABORATORY

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. Deflection test on cantilever beam and simply supported beam (Aluminium, Steel and Wood).
6. Test on Helical springs (open and closed coil)

TOTAL: 45

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", 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2012.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: examine and analyse microstructure various metals and alloys
CO2: demonstrate the preparation and testing of molding sands
CO3: perform mechanical testing of materials and components
CO4: identify and analyse the mechanical behavior of structural components like beam

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	2	2	1	1	3	2	1	2	2	2
CO2	2	1	1	1	1	1		1	3	2		2		2
CO3	2	1	1	1	2	1		1	3	2	1	2	2	2
CO4	3	2	2	2	1	2	1	1	3	2	1	2	1	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MET51 DYNAMICS OF MACHINERY

3 1 0 4

Pre-requisites: Basic of Engineering Mechanics, Kinematics of Machinery, Strength of Materials.

UNIT – I **9**

Force Analysis: Static Force Analysis, Free body diagrams, conditions of two, three and four force members. Inertia forces and D'Alembert's principle–Inertia force Analysis in Reciprocating Engines –Crank shaft Torque. Fly wheels–turning moment diagrams and fluctuation of energy of reciprocating engine mechanisms, coefficient of fluctuation of energy and speed, weight of flywheel required.

UNIT – II **9**

Balancing: Static and dynamic balancing–Balancing of rotating masses –Balancing a single cylinder Engine –Balancing Multi-cylinder Engines–Balancing of radial engine–Direct and reverse crank method.

UNIT– III **9**

Governors and Gyroscopic: Governors–Types–Centrifugal governors–Gravity controlled and spring controlled centrifugal governors–Characteristics–Effect of friction–Controlling Force. Gyroscopes –Gyroscopic couples –Gyroscopic effects in Automobiles, ships and aeroplanes.

UNIT – IV **9**

Free 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.

UNIT – V **9**

Forced Vibration: Response to periodic force–Harmonic Force–Force caused by unbalance–Support motion-Logarithmic decrement-magnification factor–Vibration isolation and transmissibility.

Lecture:45, Tutorial:15, TOTAL: 60

TEXT BOOKS:

1. Brar J.S., Bansal R.K., "A text book of Theory of Machines" 5th Edition, Laxmi Publication Pvt. Ltd., New Delhi, 2015.
2. Rattan S.S., "Theory of Machines", 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.

REFERENCE BOOKS:

1. Sadhu Singh, "Theory of Machines", 2nd Edition, Pearson Education, New Delhi, 2006.
2. Bevan Thomas, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, New Delhi, 2005.
3. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", 4th Edition, McGraw-Hill, New York, 2010.
4. http://nptel.ac.in/courses/112104114/
5. http://www.springer.com/la/book/9783540899396
6. http://opencourses.emu.edu.tr/course/view.php?id=68

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: solve and analyze the static and dynamic forces acting on different mechanism
CO2: solve and plot the static and dynamic balancing of various mechanical systems
CO3: solve and analyze the governors and gyroscopic for various applications
CO4: evaluate, analyze and demonstrate the free vibrations for different applications
CO5: evaluate, analyze and demonstrate the problems in forced vibrations for different applications

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	1		2	1		1		2		2
CO2	3	3	3	3	1		2	1		1		2		2
CO3	3	3	3	3	1		2	1		1		2		2
CO4	3	3	3	3	1		2	2		1		2		2
CO5	3	3	3	3	1		2	2		1		2		2

1 – Slight, 2 – Moderate, 3 – Substantial

14MET52 DESIGN OF MACHINE ELEMENTS

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Engineering Mechanics, Strength of Materials.

UNIT – I **9**

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

UNIT – II **9**

Design of Shafts and Couplings: 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.

UNIT– III **9**

Design of Fasteners and Welded Joints: Threaded fasteners – Design of bolted joints including eccentric loading – Design of welded joints – Axially loaded unsymmetrical welded joints - Eccentric load in the plane of welds - Welded joint subjected to bending moment and twisting moment.

UNIT – IV **9**

Design of Springs and Levers: Design of helical and leaf Springs Theory of disc and torsional springs under constant loads and varying loads – Concentric springs – Belleville springs (Theory only) – Design of levers.

UNIT – V **9**

Design of Bearings and Flywheels: Design of bearings-Preloading, design of rolling contact bearings -cubic mean load-Design of journal bearings-McKee's equation-calculation of bearing dimensions, Design of flywheels. Solid disc-flywheel-rimmed flywheel-stresses in rimmed flywheel.

TOTAL: 45

Use of PSG Data book is permitted

TEXT BOOKS:

1 Bhandari V.B., "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill, New Delhi, 2013.

2 Shigley J.E. and Mischke C.R., "Mechanical Engineering Design", 10th Edition, McGraw Hill International Education, New York, 2015.

REFERENCE BOOKS:

1 Norton R.L., "Design of Machinery", 5th Edition, Tata McGraw Hill, New Delhi, 2013.

2 Spotts M.F., Shoup T.E. and Lee E. Horn Berger, "Design and Machine Elements", 8th Edition, Pearson Education, 2003.

3 Juvinall R.C. and Marshek K.M., "Fundamentals of Machine Component Design", 5th Edition, John Wiley & Sons, New Delhi, 2011.

4 http://nptel.ac.in/courses/112105124/

5 http://opencourses.emu.edu.tr/course/view.php?id=60

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: design and specify the shape of the machine components subjected to steady stress and variable stress

CO2: design and specify the shafts , couplings, keys and knuckle joint for different applications

CO3: design and specify the screw fasteners and welded joints for different applications

CO4: design and specify the helical, leaf springs and levers for different applications

CO5: design and select the bearing, prediction of their life and design of flywheels for different applications

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	1		2	1			2	1	2
CO2	3	3	3	2	2	1		2	1			2	1	2
CO3	3	3	3	3	2	1		2	1			2	1	2
CO4	3	3	3	2	2	1		2	1			2	1	2
CO5	3	3	3	2	2	1		2	1			2	1	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MET53 METROLOGY AND MEASUREMENTS

Pre-requisites: Fundamental concepts of measurements, units and standards.

3 0 0 3

UNIT – I **9**

Concept of Measurement: Basic concept of measurement–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, numerical problem, standardization & Interchangeability.

UNIT – II **9**

Length and Angular Measurements: 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, optical flat.

UNIT– III **9**

Form Measurements: 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

UNIT – IV **9**

Computer Aided Inspection: 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 for industrial applications.

UNIT – V **9**

Measurement of Physical Properties: 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.

TOTAL: 45

TEXT BOOKS:

1. Anand K. Bewoor, Vinay A. Kulkarani, "Metrology and Measurement", 1st Edition, McGraw Hill Publishing Co. Ltd., 2014.
2. Tayal A.K., "Instrumentation and Mechanical Measurements", 2nd Edition, Galgotia Publications, New Delhi, 2013.

REFERENCE BOOKS:

1. Beckwith, Marangoni, Lienhard, "Mechanical Measurement", 6th Edition, Pearson Education, 2006.
2. Gupta I.C., "Engineering Metrology", 7th Edition, Dhanapa Rai Publication, 2012.
3. Rajput R.K., "Mechanical Measurements and Instrumentation", 2nd Edition, S.K.Kataria & Sons Publishers, New Delhi, 2012.
4. http://nptel.ac.in/courses/112106138/
5. http://annauniversityweb.com/me6504-metrology-and-measurements-lecture-notes/
6. https://drive.google.com/file/d/0B5_-VqecjfqpeUJFemtsM2VrN3M/view
7. http://www.rejinpaul.com/2015/06/me6504-metrology-and-measurements-syllabus-notes-question-banks-with-answers-regulation-2013.html

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate knowledge on basic measurement system, units and its characteristics
CO2: carry out linear and angular measurements using various instruments
CO3: demonstrate and carry out form measurements using various instruments
CO4: demonstrate knowledge on modern measurement methods like CMM, lasers and digital devices
CO5: demonstrate knowledge on applications of metrology in measuring various physical properties like force, power, torque, temperature and flow

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	1	2	1	1	2	1	2	1	1	3	3
CO2	2	1	2	2	2	1	1	2	2	2	1	2	3	3
CO3	2	1	2	2	2	1	1	2	2	2	1	2	3	3
CO4	2	1	2	2	2	1	1	2	2	2	1	2	3	3
CO5	2	1	2	2	2	1	1	2	2	2	1	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MET54 OPERATIONS RESEARCH

(Common to Mechanical, Mechatronics and Automobile branches)

3 0 0 3

Pre-requisites: Mathematics I, Mathematics II, Statistics and Numerical Methods

UNIT – I **9**

Linear Models: Introduction-Phases of OR study – Formation of LPP - Canonical form of LPP- Solutions to LPP: Graphical Solution, Simplex Algorithm, Artificial Variables Technique – Big M method, Two Phase method.

UNIT – II **9**

Transportation, Assignment problems and Sequencing problems: Transportation-Mathematical formulation-Basic Feasible solutions-NWC, LCM, VAM. Optimality test – MODI technique. Assignment problems- Mathematical formulation – Hungarian Algorithm. Sequencing Problems- n jobs 2 machine, n jobs 3 machine, n jobs m machine and 2 jobs n machine problems.

UNIT– III **9**

Network models: Shortest route – minimal spanning tree - maximum flow models-Project Management: Construction of networks- activity and event based diagrams, PERT- CPM-problems – Cost analysis and crashing of networks.

UNIT – IV **9**

Inventory Models: Types of Inventory- EOQ – Deterministic inventory models – Price break problems – stochastic inventory models- multi item deterministic models- selective inventory control techniques.

UNIT – V **9**

Queuing and Replacement Models: Queuing models – queuing systems and structures – notations–parameter – single server and multiserver models – Poisson input – exponential service – constant rate service – infinite population. Replacement Models**:** Replacement of Items due to deterioration with and without time value of Money -Individual and group replacement policy.

TOTAL: 45

TEXT BOOKS:

1. Vohra N.D., "Quantitative Techniques in Management", 4th Edition, McGraw Hill Education, 2009.
2. Gupta P.K. and Hira D.S., "Operations Research", 7th Edition, S.Chand and Company Ltd., New Delhi, 2014.

REFERENCE BOOKS:

1. Taha, Hamdy A., "Operation Research: An Introduction", 9th Edition, Pearson Education, 2014.
2. Hiller Frederick S. and Lieberman Gerald J., "An Introduction to Operations Research", 9th Edition, McGraw-Hill Science, 2011.
3. Panneerselvam R., "Operations Research", 2nd Edition, PHI Learning, 2009.
4. http://nptel.ac.in/courses/112106134/
5. http://www.maths.adelaide.edu.au/matthew.roughan/notes/OORII/03lecture_notes.html

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: formulate and solve linear programming problems
CO2: develop solutions to transportation and assignment problems
CO3: evaluate optimal job sequence that minimizes the make span
CO4: construct networks and analyze optimality for various applications
CO5: identify inventory models and solve for optimality
CO6: assess queuing characteristics and solve problems
CO7: compute the optimum replacement period for capital equipment's and items that fail suddenly

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2						2	2	1	2
CO2	3	3	3	2	2						2	2	1	2
CO3	3	3	3	2	2						2	2	1	2
CO4	3	3	3	2	2						2	2	1	2
CO5	3	3	3	2	2						2	2	1	2
CO6	3	3	3	2	2						2	2	1	2
CO7	3	3	3	2	2						2	2	1	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MEC51 MACHINE DRAWING

3 0 3 3

Pre-requisites: Engineering Drawing.

UNIT – I **9**

Introduction: Need of Graphical Language - Importance of Machine Drawing - Tools (from Instruments to Current Software), Classification of Machine Drawings - Principles of Machine Drawing - BIS specifications for machine drawing - lines, scales, dimensioning - Conventional representation of Machine Elements, Abbreviations and Symbols.

UNIT – II **9**

Projections: Designation – Relative position of views – Examples. **Sectioning:** Introduction – Types – Conventions – Examples. **Limits, Fits and Tolerance:** Definitions - Classifications of Fits - System of Fits - Computations - Selection of Fits - Method of Indicating Fits on Drawings - Tolerance Grade - Computations of Tolerance - Positions of Tolerance - Fundamental of Deviations - Shaft and Hole Terminology - Method of Placing Limit Dimensions - Need of Geometrical Tolerance - Geometrical Characteristics of Symbols - Indication of Minimum material condition - Interpretation of Indication of Geometrical Tolerance – Examples.

UNIT– III **9**

Screwed Fastenings: Screw Thread Nomenclature - Threads Form - Conventional representations - Types of Bolts – Designation - Types of Nuts and Screw - Designation of Bolted Joints - Types of Nut Locking Arrangements - Special Types of Bolts and Nuts – Washers. **Joints and Key:** Types of Joints - Cotter Joints, Pin Joints and Knuckle Joints, Types of key. **Welded Joints:** Types of Welded Joints - Representation of Welds - Symbols and its conventions.

UNIT – IV **9**

Drawing of Projections: Orthographic view to isometric view and Isometric view to orthographic view of simple machine elements. **Drawing of Sectional Views:** Keys, Bolts and Nuts, Gib and Cotter Joints, Knuckle Joint, Coupling: Flanged, Bush Type – Footstep Bearing, Piston, Connecting Rod, Cross heads.

UNIT – V **9**

Assembly Drawing of Mechanical Components: Introduction - Types of Assembly - Importance of Bill of materials - Assembly procedures–Assembly of: Lathe Tail stock, Machine Vice, Pipe Vice, Simple Eccentric, Screw jack, Stuffing Box, Plummer Block, Swivel Bearing and Safety Valve.

TOTAL: 45

TEXT BOOKS:

1. Narayana K.L. and Kannaiah P., "Machine Drawing", 4th Edition, New Age International Publishers Ltd., New Delhi, 2010.
2. Gopalakrishna K.R., "Machine Drawing", 22nd Edition, Subhas Publications, New Delhi, 2013.

REFERENCE BOOKS:

1. Bhatt N.D. and Panchal V.M., "Machine Drawing", 45th Edition, Charotar Publishing House Pvt. Ltd., Gujarat, 2010.
2. Sidheswar N., Kannaiah P., Sastry V.V., "Machine Drawing", 27th Reprint, Tata-McGraw Hill Education, Chennai, 2004.
3. Faculty of Mechanical Engineering "Design Data", Revised Edition 1978, Reprint on October 2011, Kalaikathir Achchagam, 2011.
4. https://www.slideshare.net/gunabalans1/machine-drawing-18283689
5. http://mh-mechanicalengineering.blogspot.in/2012/07/machine-drawing.html

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the basic concepts and BIS conventions of machine drawing.
CO2: demonstrate and evaluate the projections, sectioning, limits, fits and tolerance.
CO3: draw fasteners and different joints.
CO4: draw and demonstrate the projections and sectional views of various mechanical elements.
CO5: construct assembly drawings of mechanical components conforming to BIS conventions.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	2						2		2	2	1
CO2	2	3	1	2						2		2	2	1
CO3	2	3	1	2	3	2			2	2		2	2	1
CO4	2	3	1	2	3	2			2	3		2	2	1
CO5	2	3	1	2	3	2			2	3		2	2	1

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL51 CAD LABORATORY

(Common to Mechanical and Automobile branches)

0 0 3 1

LIST OF EXPERIMENTS:

1. Practice for Sketching with different sketching tools (Line, Polyline, Circle and Generalized constraint methods)
2. Practice for Datum Plane, Axis, Point and Coordinate systems.
3. Practice for reading two dimensional (2D) drawings with conventional tolerances, conversion of two dimensional drawings to three dimensional (3D) models.
4. 3D Part modeling options – protrusion and cut (extrude, revolve)
   Exercises: Flange Coupling, Screw Jack.
5. 3D Part modeling options – protrusion and cut (sweep, blend, helical sweep)
   Exercises: Machine Vice, Knuckle Joint.
6. Features creation with editing operations – Move, Pattern, Mirror, Round, Chamfer, Rib
   Exercises: Simple Eccentric.
7. Model Tree with family table and parametric concepts
   Exercises: Types of Bolts and Nuts with different sizes.
8. Assembly – creating assembly from individual parts – Imposing assembly constraints.
9. Assembly mass properties and checking of interferences of components.
10. Conversion of 3D solid model to 2D drawing –different views, sections, isometric view and dimensioning creations.
11. Surface Modeling with advanced options (Trim, Merge, Projections, Toroidal and Spinal bend)

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Creo 4.0 , Pro-E Wildfire 4.0, Solid works 2014 and CATIA V5R12

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the concept of CAD parametric and applications in engineering fields.

CO2: identify the features ,operations associated with Modeling, Assembly and Drafting.

CO3: apply the advanced feature creation concept of CAD to create Model, Assembly and Drafting.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3		3	3	2			1	2		2	3	3
CO2	2	3		3	3	2			1	2		2	3	3
CO3	2	3		3	3	2			1	2		2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL52 METROLOGY AND DYNAMICS LABORATORY

0 0 3 1

Pre-requisites: Engineering Mechanics and Fundamentals of Measurements

LIST OF EXPERIMENTS:

METROLOGY LABORATORY

1. Calibration of vernier caliper, micrometer and measurement of the given component.
2. Calibration of Linear variable differential transducer and compare and check the dimensional tolerance using LVDT or Electrical Comparator.
3. Calibration of bore gauge, inside micrometer and measurement of given component.
4. Calibration of depth gauge, vernier height gauge and measurement of given component.
5. Calibration of dial gauge and measurement of component.
6. Calibration of gear tooth vernier and measurement of gear tooth thickness by gear tooth vernier caliper of given component.
7. Calibration of bevel protractor and measurement of angle of given component by using sine bar
8. Characteristics of first order instrument thermometer.
9. Calibration and draw the profile of the given component by using the profile projector
10. A Study/Demonstration experiment on flatness and straightness checking by using autocollimator.
11. A Study/Demonstration experiment on measuring cylinder and cone dimensions using coordinate measuring machine.
12. A Study/Demonstration experiment on measuring the surface roughness of materials using surface roughness testing machine.

DYNAMICS LABORATORY

1. Determine the natural frequency of given spring using spring mass system.
2. Draw the force and couple polygon for static and dynamics balancing of rotating masses.
3. Determine the efficiency of worm gear box using speed reducer apparatus.
4. Generation of cam profile with roller follower and knife edge follower using cam analysis machine.
5. Determine the characteristics of governor using universal governor apparatus. (Porter, Proell and Watt governor set up)
6. Determine the transmissibility ratio of given eccentric mass in vibration table.
7. Determine the loss of couple due to friction using gyroscopic couple apparatus.
8. Determine the natural and critical frequency of given shaft using whirling of shaft apparatus.
9. Analyse the balancing of rotating mass using balancing machine.
10. Performance analysis of journal bearing using journal bearing apparatus.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Laboratory Manuals

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: calibrate the measuring instruments and measure the dimension of the components.
CO2: determine the characteristics of instruments.
CO3: analyze dynamic characters of systems such as frequency, profile and critical speed.
CO4: analyze the characteristic behavior of gear box, governors and journal bearing.
CO5: solve and evaluate the vibratory systems, forced transmittance and gyroscope effects.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	3				2	2	2	3	3	2
CO2	3	2	3	2	3				2	1	2	2	3	2
CO3	2	2	1	2	2				1	2	1	2	3	2
CO4	2	2	1	2	2				1	2	1	2	3	2
CO5	2	2	1	2	2				1	2	1	2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

14EGL41 COMMUNICATION SKILLS LABORATORY

(Common to all Engineering and Technology branches)

0 0 3 1

LIST OF EXPERIMENTS:

1. Listening Skills: Listening activity using software package in the communication laboratory - Listening to native speakers - 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.

Audio Visual Lab: Activity based learning

2. Activity based Reading Skills: Reading for getting information and understanding; scanning, skimming and identifying topic sentences – Reading for gaining knowledge-Group activity.

3. Activity based Writing Skills: Preparing a draft – Word editing features, editing and proof reading; Writing a short essay using the draft prepared - Group activity.

4. Speaking Skills: Verbal and Non-Verbal Communication; Introducing oneself -Describing a place, Expressing views and opinions; Giving a presentation on a Topic - eye contact, speaking audibly, clearly and with confidence; Group discussion.Conversations – Face-to-Face conversation – Simulated Telephonic Conversation.

Career Lab

5. Interview Skills: Introducing oneself – Answering other FAQ's. Presentation Skills: Elements and structure of effective presentation – Presentation Tools – Voice modulation – Body language –Video samples. Group Discussion: Structure of Group Discussion – Strategies in group discussion - Team work – Video Samples. Soft Skills: Fundamentals of Soft Skills – Work Place Culture and Inter-Personal Relationships.

TOTAL : 45

REFERENCES / MANUALS / SOFTWARE:

1. Orell Digital Language Lab Software

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: communicate efficiently in real life and career related situations
CO2: demonstrate good Presentation skills and team skills
CO3: familiarize in using modern communication software packages to enhance their soft skills

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									3	3		2		
CO2									2	3		1		
CO3									1	3		2		

1 – Slight, 2 – Moderate, 3 – Substantial

14GET61 ECONOMICS AND MANAGEMENT FOR ENGINEERS

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Economics – Basics Concepts and Principles – Demand and Supply – Law of demand and Supply – Determinants – Market Equilibrium – Circular Flow of Economic activities and Income.

UNIT – II **9**

National Income and its measurement techniques. Inflation - Causes of Inflation – Controlling Inflation – Business Cycle. Forms of business – Management Functions: Planning, Organizing, Staffing, Leading and Controlling - Managerial Skills - Levels of Management - Roles of manager.

UNIT – III **9**

Marketing - Core Concepts of Marketing - Four P's of Marketing - New product development - Product Life Cycle - Pricing Strategies and Decisions.

UNIT – IV **9**

Operations Management - Resources - Types of Production system - Site selection, Plant Layout, Steps in Production Planning and Control - Inventory - EOQ Determination.

UNIT – V **9**

Accounting Principles – Financial Statements and its uses – Depreciation: Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting: Meaning – Types of decisions – Methods (Theory).

TOTAL : 45

TEXT BOOK:

1. "Economics and Management for Engineers", Complied by Department of Management Studies, Kongu Engineering College, McGraw-Hill Education, India, 2013.

REFERENCE BOOKS:

1. Geetika, Piyali Ghosh and Purba Roy Choudhury, "Managerial Economics", 1st Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Jeff Madura, "Fundamentals of Business", Cengage Learning Inc., India, 2007.
3. Stanley L. Brue and Campbell R. Mcconnell, "Essentials of Economics", Tata McGraw-Hill, New Delhi, 2007.
4. Jain S.P., Narang K.L. and Simi Agrawal, "Accounting for Management", 1st 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 management decisions

CO4: apply appropriate operation management concept in business situations

CO5: interpret financial and accounting statements

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2			3		2	2	2	3	2		2
CO2		1	2			2	2	2	2	2	3	2		2
CO3	1	2	1			2		2	2	2	3	2	1	2
CO4	1	2	1			2		2	2	2	3	2		2
CO5	2	2				2		2	2	2	3	2		2

1 – Slight, 2 – Moderate, 3 – Substantial

14MTT62 FLUID POWER SYSTEM

(Common to Mechatronics and Mechanical branches)

3 0 0 3

Pre-requisites: Fluid Mechanics and Machinery

UNIT – I **9**

Fundamentals of Hydraulic System: Basics of fluid power system – Advantages and applications of Fluid power systems – Fluid properties – Pascal's Law and its application – Losses in pipes, valves and fittings – Fluid power symbols – Hydraulic pumps: Gear, Vane and Piston pumps, Pump Performance, Characteristics and Selection - Sizing of pumps.

UNIT – II **9**

Control Components of Hydraulic System: Direction control valves: Three way valve, Four way valve, Check valve and shuttle valve – Actuation mechanisms in DCV – Pressure control valves: Pressure relief, Pressure Reducing, Counter balance, Sequencing and Unloading Valves – Flow control valves and its types – Proportional Valves – Servo valves: Mechanical type and Electrohydraulic servo valves.

UNIT – III **9**

Pneumatic System and Actuators: Properties of Air - Perfect Gas laws – Compressors: piston, screw and vane compressor – Fluid conditioning Elements: Filter Regulator and Lubricator unit, Pneumatic silencers, After coolers, Air dryers – Air control valves – Fluid power actuators: Linear and Rotary actuators – types – Cushioning mechanism in cylinders – Sizing of Actuators.

UNIT – IV **9**

Fluid Power Circuit Design: Basic pneumatic circuits – Pneumatic vacuum systems –Electrical components and electrical controls for Fluid power circuits – Cascade Circuit design method (two / three cylinder circuits) – Introduction to Fluid logic devices and applications – Accumulator – Types and application circuits – Pressure intensifier circuits – PLC applications in Fluid power circuit.

UNIT – V **9**

Industrial Circuits and Maintenance: Industrial circuits: Speed control circuits – Regenerative cylinder circuits – Pump unloading circuit – Double pump circuit – Counter balance valve circuit – Hydraulic cylinder sequencing circuit – Automatic cylinder reciprocating circuit – Cylinder synchronizing circuits – Fail safe circuits - Sealing devices: Types and materials – Safety aspects in Fluid Power System, Installation, Maintenance and trouble shooting of Fluid Power systems.

TOTAL: 45

TEXT BOOKS:

1. Esposito Anthony, "Fluid Power with Applications", 7th Edition, Pearson Higher Education, New York, 2015.
2. Majumdar S.R., "Oil Hydraulic Systems – Principles and Maintenance", 2nd Edition, Tata McGraw-Hill, New Delhi, 2012.
3. Majumdar S.R., "Pneumatic Systems – Principles and Maintenance", 2nd Edition, Tata McGraw-Hill, New Delhi, 2015.

REFERENCE BOOKS:

1. Jegadeesa T., "Hydraulics and Pneumatics", I.K International Publishing House Pvt. Ltd., New Delhi, 2015.
2. Pippenger, John and Hicks, Tyler, "Industrial Hydraulics", 3rd Edition, Tata McGraw-Hill, New Delhi, 1987.
3. Sullivan James A., "Fluid Power - Theory and Applications", 4th Edition, Prentice Hall International, New Jersey, 1998.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify fluid power components and their symbols as used in industry and also select suitable pump for hydraulic power pack

CO2: choose appropriate control valves for fluid power applications

CO3: select pneumatic components and fluid power actuators for low cost automation

CO4: design and construct a fluid power circuits real time applications

CO5: design, construct, test, install, maintain and trouble shoot fluid power circuits for engineering applications

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2			1	1				1	1	2	2
CO2	2	2	3	1		1	1					2	3	3
CO3	2	2	3	1	2	1	1				2	2	3	3
CO4	2	3	3	1	2	1	1				1	2	3	3
CO5	2	3	3	1		3	1				2	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MET61 HEAT AND MASS TRANSFER

3 1 0 4

Pre-requisites: Thermodynamics, Fluid Mechanics.

UNIT – I **9**

Conduction: 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.

UNIT – II **9**

Convection: Basic Concepts – Dimensional Analysis –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 – Porous media.

UNIT– III **9**

Radiation: Basic laws of radiation – Concept of Black body – Absorptivity, Reflectivity and Transmissivity – Emissivity – Grey body radiation –Shape Factor Algebra – Radiosity and Irradiation –Electrical Analogy for parallel plates – Radiation Shields –Introduction to Gas Radiation.

UNIT – IV **9**

Phase Change Heat Transfer and Heat Exchangers: Boiling – Pool boiling and Film boiling – Condensation – Drop-wise and Film-wise Condensation –Correlations in boiling and condensation.

Heat Exchangers – Types of heat exchangers – LMTD Analysis – Effectiveness – NTU Analysis – Overall Heat Transfer Coefficient – Fouling Factors – Theory of Compact Heat Exchangers.

UNIT – V **9**

Mass Transfer: Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Equimolar Diffusion – Convective Mass Transfer – Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

Lecture:45, Tutorial:15, TOTAL: 60

Use of HMT Data book is permitted for the End Semester Examination

TEXT BOOKS:

1. Sachdeva R.C., "Fundamentals of Engineering Heat and Mass Transfer", 4th Edition, New Age International, New Delhi, 2010.
2. Holman J.P., "Heat and Mass Transfer", 10th Edition, Tata McGraw-Hill, New Delhi, 2013.

REFERENCE BOOKS:

1. Yunus Cengel, "Heat and Mass Transfer-A Practical Approach", 4th Edition, Tata McGraw-Hill, 2010.
2. Ozisik M.N., "Heat Transfer: A Practical Approach", 2nd Edition, McGraw-Hill Education, India, 2001.
3. Nag P.K., "Heat and Mass Transfer", 3rd Edition, Tata McGraw-Hill, New Delhi, 2011.
4. http://nptel.ac.in/courses/112101097/
5. http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Heat%20and%20Mass%20Transfer/New_index1.html
6. http://nptel.ac.in/downloads/112108149/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate an understanding of the physics behind conduction and solve problems on conduction heat transfer.
CO2: demonstrate an understanding of phase change heat transfer process.
CO3: solve the physical problems in which convection and radiation heat transfers are involved.
CO4: identify the type of heat exchanger and analyze its performance.
CO5: apply mass transfer correlations to real time problems and correlate them with heat transfer phenomenon.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2		2			2		2	2	3
CO2	3	3	3	3	2	1	2			2		2	2	3
CO3	3	3	3	3	2	3	2			2		2	2	3
CO4	3	3	3	3	2	3	2			2		2	2	3
CO5	3	3	3	3	2	2	2			2		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MET62 DESIGN OF TRANSMISSION SYSTEMS

3 0 0 3

Pre-requisites: Strength of Materials, Design of Machine Elements.

UNIT – I **9**

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

UNIT – II **9**

Gear Drives, Design of Spur and Helical Gears: 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.

UNIT– III **9**

Design of Bevel, Worm gears: 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.

UNIT – IV **9**

Design of Gear Boxes: Geometric progression –Standard step ratio –Ray diagram, kinematic layouts -Design of sliding mesh gear box-Constant mesh gear box – Design of multi speed gear box.

UNIT – V **9**

Design of Clutches and Brakes: Design of plate clutches – axial clutches-cone clutches-internal expanding rim clutches-internal and external shoe brakes, disc brakes.

Use of PSG Design Data Book is permitted **TOTAL: 45**

TEXT BOOKS:

1. Prabhu T.J., "Design of Transmission Elements", 3rd Edition, Mani Offset, Chennai, 2005.
2. Bhandari V.B., "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill, New Delhi, 2012.

REFERENCE BOOKS:

1. Maitra G.M. and Prasad L.V., "Hand Book of Mechanical Design", 2nd Edition, Tata McGraw-Hill, New Delhi, 1995.
2. Shigley J.E. and Mischke C.R., "Mechanical Engineering Design", 10th Edition, McGraw-Hill International Editions, New York, 2010.
3. Hamrock B.J., Jacobson B. and Schmid S.R., "Fundamentals of Machine Elements", 3rd Edition, CRC Press, 2013.
4. https://sites.google.com/site/designoftransmissionsystems/
5. http://nptel.ac.in/courses/112106137/

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: make proper assumptions and perform correct analyses and selection of belt drives and chain drives.
CO2: find suitable dimensions of spur and helical gear drives for given application.
CO3: design of bevel gear, worm gear to suit given loading conditions.
CO4: select the number of speeds and design the gears in the gear box.
CO5: estimate the dimensions to design clutches and brakes.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2	2	1			1	1		2		1
CO2	3	2	3	2	2	1			1	1		2		1
CO3	3	2	3	2	2	1			1	1		2		1
CO4	3	2	3	2	2	1			1	1		2		1
CO5	3	2	3	2	2	1			1	1		2		1

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL61 HEAT TRANSFER LABORATORY

0 0 3 1

Pre-requisites: Thermal Engineering

LIST OF EXPERIMENTS:

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 double pipe heat exchanger (Parallel/Counter flow).
10. Effectiveness of shell and tube heat exchanger.
11. Performance test on air blower.
12. Performance test on evacuated solar tubes.
13. Determination of heat transfer coefficient in heat pipe demonstrator.
14. Determination of critical heat flux.
15. Determination of COP of a refrigeration system.
16. Performance study on air-conditioning system.
17. Experimental study on transient heat conduction.
18. Experimental study on boiling and condensation.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Sachdeva R.C., "Fundamentals of Engineering Heat and Mass Transfer", 4th Edition, New Age International, New Delhi, 2010.
2. 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 COP of Refrigeration and Air-conditioning systems and interpret the results
CO3: examine a heat exchanger and determine the effectiveness of the heat exchanger
CO4: test the air blower and heat pipe
CO5: do the calculations on boiling and condensation and solar evacuated tubes

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	2		2			2	2	3
CO2	3	3	3	3	2	2	2		2			2	2	3
CO3	3	3	3	3	2	2	2		2			2	2	3
CO4	3	3	3	3	2	2	2		2			2	2	3
CO5	3	3	3	3	2	2	2		2			2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL62 CAM AND ROBOTICS LABORATORY

0 0 3 1

Prerequisites: Manufacturing Processes, C-Programming, Control System.

LIST OF EXPERIMENTS:

CAM LABORATORY

1. Study of G codes and M codes for machining centre and turning centre.
2. Part program generation and machining of given component using HMT VMC 200T.
3. Part Programming and machining of given component using HMT VMC T70.
4. Part program generation and Machining of given component using CNC Turning Centre.
5. Simulate a given part and generate CNC code for a given component using MASTER CAM (Lathe) and interfacing it to CNC turning centre.
6. Part Programming and machining of given component using CNC Machining Centre.
7. Simulate a given part and generate CNC code for a given component using MASTER CAM (Mill) and interfacing it to CNC machining centre.

ROBOTICS LABORATORY

1. Study of various types of robots according to configurations and applications.
2. Robot programming using Virtual reality software for a given application.
3. TCP creating using 6 axis articulated arm robot.
4. Development of work objects for 6 axis articulated arm robot.
5. Point to Point Programming for a given application using 6 axis articulated arm robot.
6. Continuous Programming for a given application using 6 axis articulated arm robot.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Lab Manuals

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: develop, simulate and execute part program using CNC production and trainer machines.

CO2: simulate using CAM package and interface the developed program with the machine.

CO3: demonstrate the physical configuration of robot.

CO4: analyze the robot work cell problems and program an industrial robot.

CO5: solve the path planning problems of a mobile robot.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	3	2	2	2	1			3	3	2	3	2	2
CO2	1	3	2	2	2	1			3	3	2	3	2	2
CO3	1	3	3	2	2	1			3	3	2	3	2	2
CO4	1	3	2	3	2	1			3	3	2	3	2	2
CO5	1	3	3	3	2	1			3	3	2	3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial 3

14MEL63 MECHATRONICS LABORATORY

0 0 3 1

Pre-requisites: Basics of Electrical and Electronics Engineering, Metrology and Measurements.

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. Arithmetic operations of two 8 bit numbers using microprocessor
6. Arrange a series of numbers in ascending and descending orders using microprocessor
7. Sum of N numbers and factorial of N numbers using microprocessor
8. Interfacing a microprocessor with stepper motor control
9. Construction of simple ladder programming for Boolean operations.
10. Actuation of pneumatic cylinder with timer and counter using PLC.
11. Speed control of a DC motor using PLC.
12. Develop a graphical program for real time interface with sensor measurement system

TOTAL: 45

REFERENCES / MANUALS / SOFTWARES:

1. Goankar, Ramesh, "Microprocessor Architecture Programming and Applications with the 8085", 5th Edition, Penram International Publishing, Bombay, 2002.
2. Petruzella, Frank D., "Programmable Logic Controllers", 3rd Edition, McGraw-Hill, New York, 2010.
3. Jeffery Travis and Jim kring, "LabVIEW for Everyone: Graphical programming made easy and Fun", 3rd Edition, Pearson Education, India, 2009.
4. Sensors like speed sensor, displacement sensor, temperature sensor and force sensor
5. Microprocessor kit, PLC Interfacing module, LabVIEW 2015

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: attain knowledge on the working principles of sensors and signal processing system.

CO2: infer the basic knowledge about microprocessors and its real time applications.

CO3: learn the hardware and software concepts of programmable logical controllers.

CO4: realize virtual Instrumentation concepts and Data acquisition system.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3		2	3	2	1	1		1		2	2	2
CO2	2	3		2	3	2	1	1		1		2	2	2
CO3	2	3		2	3	2	1	1		1		2	2	2
CO4	2	3		2	3	2	1	1		1		2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

14GET71 TOTAL QUALITY MANAGEMENT

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

Quality (Basic concepts and principles) : Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs, Basic concepts of Total Quality Management, Historical Review. Principles of TQM, Leadership – Concepts, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

UNIT – II **9**

TQM Principles and strategies : 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

UNIT – III **9**

TQM Tools (Process Control): 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.

UNIT – IV **9**

TQM Tools: 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, Poka Yoke.

UNIT – V **9**

Quality Systems -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.

TOTAL : 45

TEXT BOOKS:

1. Besterfield, Dale H. et al., "Total Quality Management", 3rd Edition (Revised), Pearson Education, 2011.
2. Subburaj Ramasamy, "Total Quality Management", Tata McGraw Hill, New Delhi, 2008.

REFERENCE BOOKS:

1. Feigenbaum A.V., "Total Quality Management", 4th Edition, Tata McGraw Hill, New Delhi, 2004.
2. Suganthi L. and Samuel A. Anand, "Total Quality Management", PHI Learning, New Delhi, 2011.
3. Evans James R. and Lindsay William M., "The Management and Control of Quality", 7th Edition, South-Western (Thomson Learning), 2011.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the meaning of quality and its importance

CO2: know the principles of total quality management and peculiarities of their implementation

CO3: develop in-depth knowledge on various tools and techniques of quality management

CO4: learn the applications of quality tools and techniques in both manufacturing and service industry

CO5: develop analytical skills for investigating and analyzing quality management issues in the industry and suggest implement able solutions to those

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	2	3	2	2	2	3		3
CO2						3	2	3	3	3	2	3		3
CO3	3	2	2	2	2	2		1	2	2	3	2		3
CO4	2	2	2	2	2	2		1	2	2	3	2		3
CO5						3	3	2	3	2	2	2		3

1 – Slight, 2 – Moderate, 3 – Substantial

14MET71 FINITE ELEMENT ANALYSIS

(Common to Mechanical and Automobile branches)

3 1 0 4

Pre-requisites: Fundamentals of matrix approach, Knowledge on governing differential equations, Strength of materials.

UNIT – I **9**

Fundamental of Finite Element Analysis: Historical background – Matrix approach – Coordinates, Numerical simulation– Gauss Elimination based Solvers. FEA General procedure – Basic element shapes -Discretization process, Node Numbering Scheme –Interpolation **–**Weighted residual method – Ritz techniques. Application of FEA

UNIT – II **9**

One Dimensional Problem: One Dimensional finite element modeling – Element Types–Linear Elements – Linear Element Shape Function –Finite Element Equation – Galerkin's method – Solid Mechanics – Heat transfer – fin pin and composite wall– Beam Element.

UNIT– III **9**

Two Dimensional Problems: Introduction to 2-D Finite element modeling – Constant Strain Triangular – Finite element formulation – Shape Functions – strain displacement and stress strain relationship matrix – Plane Stress and Plane Strain - Temperature Effects.

UNIT – IV **9**

Axisymmetric Continuum and Plane truss: Axisymmetric formulation – Element stiffness matrix and force vector – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures – Applications of plane truss.

UNIT – V **9**

Isoparametric Elements for Two Dimensional Continuum: Natural Co-ordinate Systems –Isoparametric elements – The four node quadrilateral – Shape functions – Element stiffness matrix and force vector – Jacobin matrix – Stress calculations – Numerical integration- Gauss Quadrature.

Lecture:45, Tutorial:15, TOTAL: 60

TEXT BOOKS:

1. Logan L. Daryl, "A first course in the Finite Element Method", 5th Edition, Cengage learning India Pvt. Ltd., Delhi, 2012.
2. Rao S.S., "The Finite Element Method in Engineering", 5th Edition, Butterworth–Heinemann (An imprint of Elsevier), Elsevier India Pvt. Ltd., New Delhi, 2013.

REFERENCE BOOKS:

1. Robert D. Cook, David S. Malkus, Michael E. Plesha, and Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley, John & Sons, 2003.
2. Segerlind L.J., "Applied Finite Element Analysis", 2nd Edition, John Wiley, 1984.
3. Reddy J.N., "An Introduction to the Finite Element Method", International Edition, McGraw Hill, 2005.
4. https://sites.google.com/site/designoftransmissionsystems/
5. http://nptel.ac.in/courses/112106137/

Course Outcomes:

On completion of the course the students will be able to

CO1: formulate finite element equations and solve the engineering problems
CO2: solve and analyze the 1D structural and heat transfer problems for different applications
CO3: Evaluate and analyze the 2D structural problems for different applications
CO4: impart knowledge on axisymmetric problems and plane truss
CO5: formulate and analyze isoparametric formulation and numerical integration

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	1	3	3		2		1	2		1	2	3
CO2	2	3	1	3	3		2		1	2		1	2	3
CO3	2	3	1	3	3		2		1	2		1	2	3
CO4	2	3	1	3	3		2		1	2		1	2	3
CO5	2	3	1	3	3		2		1	2		1	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MET72 INDUSTRIAL ENGINEERING AND COST ANALYSIS

3 0 0 3

Pre-requisites: Statistical quality control, Fundamentals of statistical mathematics.

UNIT – I **9**

Method and Work Study: 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.

UNIT – II **9**

Production Planning and Control: Need for PPC-objectives–functions-information required for PPC-production-organization-manufacturing methods -Types of production system-Characteristics flow, job, batch – problems - Productivity-Factors affecting productivity–Plant layout-Layout classification- Layout Design Procedures-CRAFT, ALDEP, CORELAP Productivity measures –problems–productioncontrol-loading-sequencing-scheduling-dispatching-problems.

UNIT– III **9**

Forecasting and Facility Planning: Need for forecasting-demand patterns-Forecasting models–Judgmental 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.

UNIT – IV **9**

Material Requirement Planning and Capacity Planning: MRP-objectives-terminologies –systems–outputs – management information to MRP – manufacturing resource planning-capacity requirement planning-measures of capacity–capacity–need–Capacity Planning influencing –-Aggregate Planning-guidelines master production schedule-Introduction to ERP-Strategy-need-benefit-modules- SCM-objectives-outsourcing.

UNIT – V **9**

Value Engineering: Value engineering – Function, aims, procedure-value analysis-function analysis –system techniques-Make or buy decision, Interest formulae and their applications —Time value of money- Single payment compound amount factor-present worth factor, Equal payment series sinking fund factor and series method - capital recovery factor-Uniform gradient series annual equivalent factor - Effective interest rate.

TOTAL: 45

TEXT BOOKS:

1. Telsang, Martand, "Industrial Engineering and Production Management", 2nd Revised Edition, S. Chand and Company, New Delhi, 2012.
2. Panneerselvam R., "Production and Operations Management", 3rd Edition, Prentice-Hall of India, 2012.

REFERENCE BOOKS:

1. Buffa Elwood S., and Sarin Rakesh K., "Modern Production and Operations Management", 8th Edition, John Wiley and Sons, New York, 2009.
2. Nair N.G., "Production and Operations Management", 4th Edition, Tata McGraw-Hill, New Delhi, 2008, Reprint.
3. Chase, Jacobs and Aquilano, "Operations Management for Competitive Advantage", 11th Edition, Tata McGraw-Hill, New Delhi, 2006.
4. http://nptel.ac.in/courses/112107142/2
5. http://www.managementstudyguide.com/work-study-and-industrial-engineering.htm

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: rephrase the various components through industrial engineering principle techniques.
CO2: apply the concept of production, planning and control techniques.
CO3: test and interpret the estimated forecasting data.
CO4: measure and analyze the various resources in organization.
CO5: examine the value engineering concepts in industries.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2	1	2	1			1	1	2	1	3	3
CO2	3	2	2	1	2	1			2	1	2	1	3	3
CO3	3	2	2	2	2	1			2	1	2	1	3	3
CO4	3	2	2	2	2	1			2	1	2	1	3	3
CO5	3	2	2	2	2	1			2	1	2	1	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL71 COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY

(Common to Mechanical and Automobile branches)

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 loads.
3. Application of plane stress and plane strain conditions.
4. Deflection of Tensile and Compressive Springs
5. Axisymmetric Application.
6. Heat conduction and convection applications.
7. Thermo-structural Analysis.
8. Contact Analysis of Two Bodies.
9. Modal Analysis of a Beam.
10. Harmonic Response of a Beam for stepped and ramped loads.
11. Bimetallic Layered Cantilever Plate with structural Loading.
12. Incompressible fluid flow analysis with and without obstacles.

TOTAL: 45

REFERENCES / MANUALS/SOFTWARE:

1. Robert D. Cook, Malkus, Witt, and Plesha, "Concepts and Applications of Finite Element Analysis", 4th Edition, Wiley India Pvt. Ltd., 2007.
2. Rao S.S., "The Finite Element Method in Engineering", 5th Edition, Butterworth-Heinemann Ltd,. 2010.
3. ANSYS 16.2 Software.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the Boundary conditions with respect to FEA for the real physical problem.
CO2: perform structural, thermal and fluid problems in FEA and FVM, software packages.
CO3: validate the various FEA and FVM results based on theoretical or experimental results.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3	3	2				2		2	3	3
CO2	2	3	2	3	3	2				2		2	3	3
CO3	2	3	2	3	3	2				2		2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEL72 AUTOMOBILE ENGINEERING AND FLUID POWER LABORATORY

0 0 3 1

Pre-requisites: Basics Automobile Engineering and Fluid Power System.

LIST OF EXPERIMENTS:

AUTOMOBILE ENGINEERING LABORATORY:

1. Study of Automobile Components and Its Functions.
2. Study of Petrol and Diesel fuel injection systems.
3. Dismantling and assembly of single/multi cylinder Petrol engine.
4. Dismantling and assembly of single/multi cylinder Diesel engine.
5. Dismantling and Assembly of Clutches
6. Dismantling and Assembly of Gear boxes.
7. Dismantling and Assembly of Differential.
8. Dismantling and Assembly of Braking systems.
9. Dismantling and Assembly of Suspension systems.
10. Performance test on Static and Dynamic balancing of wheel.

FLUID POWER LABORATORY:

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.

TOTAL: 45

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", 9th Edition, Tata McGraw Hill, New Delhi, 2003.
3. Fluid Power Lab Manual.
4. "Hydraulic Power Pack – Instruction Manual", Mansco Fluidtek Pvt. Ltd., Coimbatore.
5. "Automation Studio Exercise Circuits", Janatics Ltd., Coimbatore.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify the basic components of automobiles and dismantle and assemble various components like Engines,Braking and Suspension system.
CO2: dismantle and assemble the various elements in transmission system like clutch, gear box, propeller shaft and differential unit.
CO3: recognize the important hydraulic and pneumatic components and their functions in the simple systems.
CO4: know the hydraulic power generating devices and how to transmit and control the system.
CO5: gain the knowledge in design of fluid power circuits using simulation software.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3				3	2	1		3	2		2	3	3
CO2	3				3	2	1		3	2		2	3	3
CO3	3	1	2		3	2	1		2	2		2	3	3
CO4	3	1	2	2	3	2	1		2	2		2	3	3
CO5	3	1	2	2	3	2	1		2	2		2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEP71 DESIGN AND FABRICATION PROJECT

0 0 6 3

Prerequisites:

- Knowledge of Basic sciences, Material science and metallurgy, Engineering Design, Optimization tools, Cost and Economic Analysis, Project Management (PERT and CPM) and comprehensive knowledge of Mechanical Engineering
- Skill to identify and interpret project ideas
- Knowledge of planning, implementation and control

Project Description:

Upon identification of the real time engineering issues that needs to the modified or solved for better effectiveness and efficiency, the team of project students is expected to undergo the following.

i. Explore the problem further through literature survey.
ii. Formulate the problem to be solved based on literature survey or field survey.
iii. Fix appropriate Project title, objectives, methodology and expected outcomes.
iv. Design the overall system and sub assemblies.
v. Fabricate and test the system.
vi. Check for expected results.
vii. Present project reports.

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: design/develop/assemble/experiment components/systems applying engineering research tools/methods.
CO4: plan, carryout and control project activities like Design, Development, fabrication, Experimentation, Analytical, and Simulation work, etc.
CO5: present the project work in the form of oral presentation, Report/Thesis and Technical papers publications.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO3	PSO2
CO1	3	3	3	2	3	3	3	3	3	3	3	2	3	3
CO2	3	3	3	2	3	3	3	3	3	3	3	2	3	3
CO3	3	3	3	2	3	3	3	3	3	3	3	2	3	3
CO4	3	3	3	2	3	3	3	3	3	3	3	2	3	3
CO5	3	3	3	2	3	3	3	3	3	3	3	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14GET81 PROFESSIONAL ETHICS AND HUMAN VALUES

(Common to all Engineering and Technology branches)

3 0 0 3

UNIT – I **9**

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.

UNIT – II **9**

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. Meaning of Engineering experimentation - engineers as responsible experimenters.

UNIT – III **9**

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, Bhobal Gas Tragedy and Chernobyl case studies.

UNIT – IV **9**

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

UNIT – V **9**

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).

TOTAL : 45

TEXT BOOKS:

1. Martin Mike and Schinzinger Roland, "Ethics in Engineering", 4th Edtion, Tata McGraw-Hill, New Delhi, 2014.
2. Govindarajan M., Natarajan S., and Senthil Kumar V.S., "Engineering Ethics", Prentice Hall of India, New Delhi, Reprint 2013.

REFERENCE BOOKS:

1. Fleddermann Charles D., "Engineering Ethics", 4th Edition, Pearson Education/Prentice Hall, New Jersey, 2014.
2. Harris Charles E., Protchard Michael S. and Rabins Michael J., "Engineering Ethics: Concepts and Cases", 4th Edition Wadsworth Thompson Learning, United States, 2008.
3. Seebauer Edmund G. and Barry Robert L., "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the components of ethics and values

CO2: acquire knowledge on ethical theories and attain moral autonomy

CO3: highlight ethical issues in risky situation

CO4: understand the knowledge of interpersonal and organizational issues in ethics

CO5: understand the role of professional bodies as well to identify global issues concerned to ethics

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3	2	2		2		2
CO2						3		3	2	3		2		2
CO3						3	2	3	2	1		2		2
CO4						3	3	3	2	3		2		2
CO5						2	2	3	2	2		2		2

1 – Slight, 2 – Moderate, 3 – Substantial

14MEP81 PROJECT WORK

0 0 18 9

Pre-requisites:

- Knowledge of Basic sciences, Material science and metallurgy, Engineering Design, Optimization tools, Cost and Economic Analysis, Project Management (PERT and CPM) and comprehensive knowledge of Mechanical Engineering
- Skill to identify and interpret project ideas
- Knowledge of planning, implementation and control

Project Description:

Upon identification of the real time engineering issues that needs to the modified or solved for better effectiveness and efficiency, the team of project students is expected to undergo the following.

i. Explore the problem further through literature survey and/or field survey.
ii. Formulate the problem to be solved based on literature survey and/or field survey.
iii. Carryout gap analysis.
iv. Fix appropriate Project title and objectives.
v. Identify solution methodology and the research tools used.
vi. Fix the expected result and outcome.
vii. Carryout appropriate design/analysis/experimentation.
viii. Analyze the result and compare it with expected results or do necessary comparison if necessary.
ix. Check for expected outcomes and present the conclusion.
x. Prepare project reports.

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: design/develop/assemble/experiment components/systems applying engineering research tools/methods
CO4: plan, carryout and control project activities like Design, Development, Fabrication, Experimentation, Analytical, and Simulation work, etc.
CO5: present the project work in the form of oral presentation, Report/Thesis and Technical papers publications

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14CST35 OBJECT ORIENTED PROGRAMMING

(Common to Mechanical, EEE, EIE & ECE branches)

3 0 0 3

Pre-requisites: Problem Solving and Programming

UNIT – I **9**

Principles of Object Oriented Programming: Object Oriented Programming Paradigm - Basic concepts and benefits of OOP - Object Oriented Languages - Applications of OOP - Structure of C++ - Tokens - Expressions and Control Structures - Operators in C++. Function Prototyping - Call by Reference - Return by Reference - Inline Functions – Default and const Arguments - Function Overloading**.**

UNIT – II **9**

Classes and Objects: Specifying a Class – Defining Member Functions - Nesting of Member Functions - Private Member Functions - Memory Allocation for Objects - Static Data Members - Static Member Functions - Array of Objects - Objects as Function Arguments - Friendly Functions - Returning Objects - const Member Functions - Pointers to Members.

UNIT – III **9**

Constructors and Destructors: Constructors - Parameterized Constructors – Multiple Constructors in a Class – Constructors with Default Arguments – Dynamic Initialization of Objects - Copy and Dynamic Constructors – Destructors. **Overloading:** Defining Operator Overloading - Overloading Unary and Binary Operators – Overloading Binary Operators using Friend Functions.

UNIT – IV **9**

Inheritance: Defining Derived Classes – Single Inheritance – Making a Private Member Inheritable – Multilevel Inheritance - Multiple Inheritance – Hierarchical Inheritance - Hybrid Inheritance - Virtual Base Classes – Abstract Classes. **Pointers, Virtual functions and Polymorphism:** Pointers to Objects - this Pointer - Pointers to Derived Classes - Virtual Functions - Pure Virtual Functions.

UNIT – V **9**

Managing Console I/O Operations: Introduction – C++ Streams – C++ Stream Classes – Unformatted I/O Operations- Formatted Console I/O Operations- Managing Output with Manipulators. **Working with Files:** Introduction- Classes for File Stream Operations- Opening and Closing a File- Detecting End-of-File - File Modes- File Pointers and Manipulations- Sequential File- Random Access File- Command line Arguments.

TOTAL: 45

TEXT BOOKS:

1. Balagurusamy E., "Object Oriented Programming with C++", 6th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.

REFERENCE BOOKS:

1. Hubbard John R., "Schaum's Outline Programming with C++", Tata McGraw Hill Publishing Company, New Delhi, 2003.
2. Venugopal.K.R. and Raj Buyya, "Mastering C++", Tata McGraw Hill, Oxford, 2009.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: use the C++ object oriented programming language and associated class libraries to develop object oriented programs

CO2: use constructor and destructor functions to initialize and destroy class objects

CO3: apply operator overloading to overload operators for user defined types

CO4: identify the differences between private, public and protected members of a class and use inheritance and virtual functions to build class hierarchies

CO5: develop simple application using files

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		3						2				
CO2	3	2		3						2				
CO3	3	3	1	3						2			1	
CO4	3	3	1	3						2			1	
CO5	3	2		3						2				2

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE01 CAD/CAM/CIM

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Basic knowledge of Mathematics, Production Technology and Engineering Drawing.

UNIT – I **9**

CAD: The Design process and role of CAD – Introduction to computer graphics –Output primitives – Bresenhams line and circle drawing algorithms– Parametric equations for line and circle – 2D & 3D transformations – Translation – Scaling – Rotation – Homogeneous coordinate.

UNIT – II **9**

Visual Realism: Hidden line – Surface algorithms – Shading and Coloring, RGB, HSV, HLS – UCS, WCS –Solid modeling – CSG and B-rep Techniques –Parametric modeling.

UNIT– III **9**

CAM:CNC Technology, Classification–contouring – interpolators-open loop and closed loop system–CNC controller-Structural members of CNC machines–Function of ball screws-ATC, feedback devices–Fundamentals of part programming – Manual programming–Canned cycle and subroutines – APT language programs.

UNIT – IV **9**

Code generation and CIM: ISO standards for coding – G codes and M-codes, CL data and tool path simulation–Code generation from 3D solid models using software. 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.

UNIT – V **9**

Process Planning and FMS: Process planning –variant 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", 3rd Edition, New Age International Publishers, New Delhi, 2008.
2. Zeid, Ibrahim, Sivasubramanian, "CAD/CAM Theory and Practice", 2nd Edition, Tata McGraw Hill, New Delhi, 2010.

REFERENCE BOOKS:

1. Groover M.P., "Automation, Production System and Computer Integrated Manufacturing", 3rd Edition, Prentice-Hall of India, New Delhi, 2008.
2. Bedworth David, "Computer Integrated Design and Manufacturing", 1st Edition, McGraw-Hill, 1991.
3. Hearn Donald and Baker M. Pauline,"Computer Graphics", 2nd Edition, Pearson Education, 2004.
4 nptel.ac.in/courses/112102101/
5 nptel.ac.in/courses/112102103/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate and analyze various modeling algorithms and 2D & 3D transformations.
CO2: understand and create the concepts behind visual realism and parametric modeling.
CO3: generate the CNC part programs using G and M codes.
CO4: identify the part families and demonstrate different classification and coding systems.
CO5: streamline the concepts of FMS, CAPP and LAN implementations.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3	2	1		3	2		1	3	3
CO2	3	2	3	2	3	2	1		3	2		1	3	3
CO3	3	2	3	2	3	2	1		3	2		1	3	3
CO4	3	2	3	3	3	2	1		3	2		1	3	3
CO5	3	2	2	3	3	2	1		3	2		1	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE02 DESIGN FOR MANUFACTURE AND ASSEMBLY

3 0 0 3

Pre-requisites: Machine Drawing, Material Removal Process.

UNIT – I **9**

Design For Manufacture (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.

UNIT – II **9**

Design For Assembly (DFA) Guidelines: Principal materials –Selection of materials and processes –Design –Possible solutions –Evaluation method –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.

UNIT– III **9**

Machining Considerations: Design for machining – Design features to facilities 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

UNIT – IV **9**

Design for Injection Molding: 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

UNIT – V **9**

Design for Sand and Die Casting: Sand casting alloys – Sand cores –Design rules for sand castings –Identification of uneconomical design –Modifying the design. Die casting alloys –The die casting cycle, Determination of number of cavities and appropriate machine size in die casting – Design principles for die casting.

TOTAL: 45

TEXT BOOKS:

1. Boothroyd G., "Product Design for Manufacture and Assembly", 3rd Edition, New York, CRC Press, London, 2010.
2. Peck, Harry, "Design for Manufacture", 1st Edition, Pitman Publications, London, 1983.

REFERENCE BOOKS:

1. Otto, Kevien and Wood, Kristin, "Product Design", 1st Edition, Pearson Publication, New Delhi, 2009.
2. Matousek, "Engineering Design: A Systematic Approach", 1st Edition, Blackie & Son Ltd., Glasgow, 1974.
3. Bralla, "Design for Manufacturability Handbook", 2nd Edition, McGraw Hill, New York, 1999.
4. nptel.ac.in/courses/112102101/
5. nptel.ac.in/courses/112102103/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: determine the suitable geometrical tolerances for manufacturing oriented design.
CO2: demonstrate the design considerations for assembly in different applications.
CO3: suggest suitable machining considerations for various applications.
CO4: analyze the design for injection molding applications.
CO5: identify uneconomical design and modify design for sand die castings.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	2	2	1	1					2	2	2
CO2	1	2	3	2	2	1	1					2	2	2
CO3	1	2	3	2	2	1	1					2	2	2
CO4	1	2	3	2	2	1	1	1				2	2	2
CO5	1	1	3	2	2	1	1	1				2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE03 REFRIGERATION AND AIR CONDITIONING

3 0 0 3

Pre-requisites: Engineering Thermodynamics, Applied Mathematics.

UNIT – I **9**

Refrigeration Cycle: 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.

UNIT – II **9**

Refrigerants and System Components: Compressors – reciprocating and rotary, Types of condensers, evaporators, Expansion devices, cooling towers – Functional aspects. Refrigerants – properties – selection of refrigerants, Alternate Refrigerants, Cycling controls.

UNIT– III **9**

Psychrometry: Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature,
Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature-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.

UNIT – IV **9**

Air Conditioning Systems: Requirements of comfort air conditioning - summer and winter air conditioning. Cooling load calculation working principles of Centralized air conditioning systems, Split, Ductable split, Packaged air conditioning, VAV & VRV Systems. Air distribution system – Duct Design by equal friction method, Indoor Air quality concepts.

UNIT – V **9**

Unconventional Refrigeration Cycles: Vapour absorption refrigeration system – Ejector jet, Steam jet refrigeration, thermo electric refrigeration. Thermoionic refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems. **Applications:** Ice plant, food storage plants, milk, chilling plants.

Approved Refrigeration & Air-conditioning Data book is permitted for the End Semester Examination **TOTAL: 45**

TEXT BOOKS:

1. Prasad Manohar, "Refrigeration and Air Conditioning", 3rd Edition, New Age International Pvt. Ltd., New Delhi, 2014.
2. Arora C.P., "Refrigeration and Air Conditioning", 3rd Edition, Tata McGraw Hill, New Delhi, 2008.

REFERENCE BOOKS:

1. Roy J. Dossat, "Principles of Refrigeration", 4th Edition, Pearson Education Asia, New Delhi, 2001.
2. Jordan R.C. and Priester G.B., "Refrigeration and Air Conditioning", 2nd Edition, Prentice Hall of India, New Delhi, 1985.
3. Wilbert F. Stoecker, "Refrigeration and Air Conditioning", 2nd Edition, Tata McGraw-Hill, New Delhi, 2002.
4. https://onlinecourses.nptel.ac.in/noc17_mm14/preview
5. http://dx.doi.org/10.1615/AtoZ.r.refrigeration

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: analyze the refrigeration cycle for different refrigerants.
CO2: understand the characteristics of refrigerants and types of refrigeration system components.
CO3: assess the air quality by using Psychrometry process and chart with their applications.
CO4: appraise cooling load calculation for air-conditioning system and also design the air-conditioning system with ducts.
CO5: demonstrate the understanding of unconventional refrigeration processes with their applications.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2	3	3			1		2	2	3
CO2	3	2	3		2	3	2			1		2	2	3
CO3	3	2	3		2	3	2			1		2	2	3
CO4	3	3	3		2	3	2			1		2	2	3
CO5	3	2	2		2	2	1			1		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE04 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

3 0 0 3

Pre-requisites: Design of Machine Elements, Strength of Materials.

UNIT – I **9**

Purpose Types and Functions of Jigs and Fixtures: Tool design objectives - Production devices –inspection 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**.**

UNIT – II **9**

Jigs: 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.

UNIT– III **9**

Fixtures: General principles of boring**,** lathe, milling and broaching fixtures- Grinding, planning and shaping fixtures assembly, Inspection and welding fixtures- Modular fixtures. Design and development of fixtures for given components.

UNIT – IV **9**

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.

UNIT – V **9**

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.

TOTAL: 45

TEXT BOOKS:

1. Edward G. Hoffman, "Jigs & Fixture Design", 5th Edition, Thomson-Delmar Learning, Singapore, 2004.
2. Donaldson C, "Tool Design", 4th Edition, Tata McGraw-Hill, 1986.

REFERENCE BOOKS:

1. Joshi P.H., "Jigs & Fixtures", 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.
2. Kempster, "Jigs & Fixtures Design", 3rd Edition, The English Language Book Society, 1978.
3. Hiram E. Grant, "Jigs and Fixture", 1st Edition, Tata McGraw-Hill, New Delhi, 1989.
4. http://nptel.ac.in/courses/112105126/34
5. http://nptel.ac.in/courses/112105126/35

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate and analyze the types and functions of jigs and fixtures.

CO2: design, specify and analyze the jigs for various applications.

CO3: demonstrate and design the fixtures for various applications.

CO4: demonstrate and analyse the press working terminologies of die and strip layout.

CO5: design, specify and analyze the dies for different applications.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3		2	2		1	2		1		3
CO2	2	3	3	3		2	2		1	2		1		3
CO3	2	3	3	3		2	2		1	2		1		3
CO4	2	3	3	3		2	2		1	2		1		3
CO5	2	3	3	3		2	2		1	2		1		3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE05 INDUSTRIAL TRIBOLOGY

3 0 0 3

Pre-requisites: Fluid Mechanics and Machinery, Design of Machine Elements.

UNIT – I **9**

Surfaces and Friction: 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.

UNIT – II **9**

Wear and Lubrication: 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. Types and properties of Lubricants –Testing methods.

UNIT– III **9**

Film Lubrication Theory: Hydrodynamic Lubrication – Fluid film in simple shear–Viscous flow between very close parallel plates-Reynolds Equation for film Lubrication –Solid Lubrication–Hydrostatic Lubrication.

UNIT – IV **9**

Journal 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 .

UNIT – V **9**

Bearing Materials: 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. GwidonW. Stachowiak, Andrew W. Batchelor, "Engineering Tribology", 4th Edition, Butterworth-Heinmann, 2013.
2. Cameron A., "Basic Lubrication theory", 3rd Edition, Ellis Horwood Ltd. Publishers, 1983.

REFERENCE BOOKS:

1. Williams J.A., "Engineering Tribology", 1st Editon, Oxford University Press, New Delhi, 2005.
2. Halling J., "Principles of Tribology", New Edition, Macmillan India Ltd., New Delhi, 1978.
3. Neale M.J., "Tribology Handbook", 2nd Edition, Butterworth–Heinemann, U.K., 1996.
4. http://nptel.ac.in/courses/112102015/
5. http://www.ewp.rpi.edu/hartford/~ernesto/F2012/FWM/Notes/ch01.pdf
6. http://www.ewp.rpi.edu/hartford/~ernesto/F2012/FWM/Notes/ch02.pdf
7. http://www.ewp.rpi.edu/hartford/~ernesto/F2012/FWM/Notes/ch03.pdf
8. http://www.ewp.rpi.edu/hartford/~ernesto/F2012/FWM/Notes/ch04.pdf
9. http://www.ewp.rpi.edu/hartford/~ernesto/F2012/FWM/Notes/ch05.pdf
10. http://www.ewp.rpi.edu/hartford/~ernesto/F2012/FWM/Notes/ch06.pdf

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: analyze the surface topography and physic-chemical aspects of solid surfaces.

CO2: Demonstrate ,analyze the different wear mechanisms and lubrication aspectson solid metal surfaces.

CO3: demonstrate and analyze the hydrodynamic and hydrostatic lubrication.

CO4: design and analyze the journal bearings for different applications.

CO5: demonstrate and characterize the materials for bearings for different applications.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1						1		1		3
CO2	3	2	3	1						1		1		3
CO3	3	2	3	3						1		1		3
CO4	3	2	3	3						1		1		3
CO5	3	2	3	1						1		1		3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE06 RAPID PROTOTYPING

3 0 0 3

Pre-requisites: Manufacturing Technology

UNIT – I **9**

Introduction to Rapid Prototyping: Need for the time compression in product development, History of RPT systems, Survey of applications, Growth of RPT industry and classification of RPT systems.

UNIT – II **9**

Rapid Prototyping Methods: Fused deposition Modeling (FDM): Principle, Process Parameters, Path generation, Applications. Solid Ground Curing: Principle of operation, Machine details, Applications. Stereo Lithographic Resin (SLR) systems: Process parameters, Process details, Data Preparation, Data files, and Machine details, Applications. Selective Laser Sintering (SLS): Types of machines, Principle of operation, Process parameters, Data preparation for SLS, applications. Laminated Object Manufacturing (LOM): Principle of Operation, LOM materials, Process details, Applications.

UNIT– III **9**

Concept Modelers: 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.

UNIT – IV **9**

Rapid Tooling: Indirect Rapid Tooling- Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, etc., Direct rapid tooling- Direct Accurate clear epoxy solid injection molding (AIM), Quick cast Process, Copper polyamide, Rapid Tools, Direct metal laser sintering (DMLS), ProMetal, Sand Casting Tooling, Laminate tooling, Soft tooling v/s Hard tooling.

UNIT – V **9**

Software for Rapid Tooling: STL Files, Over view 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 orientation. Allied process – 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", 1st Edition, Springer-Verlag, London, 2001.
2. Chua C.K., Leong K.F. and Lim C.S., "Rapid Prototyping: Principles and Applications", 3rd Edition, World Scientific, New Jersey, 2010.

REFERENCE BOOKS:

1. Wohlers Terry, "Wohlers Report 2014", Wohlers Associates, 2014.
2. Frank W. Liou, "Rapid Prototyping and Engineering Applications", CRC Press, 2008.
3. Jacobs P.F., "Rapid Prototyping and Manufacturing: Fundamentals of Stereolithography", McGraw-Hill, New York, 1993.
4. nptel.ac.in/courses/112102103/16
5. nptel.ac.in/courses/112107077/38

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate various material processes and additive manufacturing systems
CO2: deliver the concepts, fabrication and analysis of manufacturing components through Rapid prototyping technique.
CO3: elucidate the working principles and parameters involved in Rapid prototyping methods.
CO4: reveal the methods of rapid tooling.
CO5: expose the skills on programming and software knowledge of RPT.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	2		1			1		3	2	1
CO2	3	3	2	2	3	1				1	1	3	2	2
CO3	3	2	2	2	3	1						3	2	3
CO4	2	1	1		2	1	1			1	1	2	2	2
CO5	2	2	3	3	3		1		2		3	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE07 INDUSTRIAL AUTOMATION

3 0 0 3

Pre-requisites: Basics of Electrical and Electronics Engineering, Metrology and Measurements.

UNIT – I **9**

Sensors in Industrial Automation: Introduction to Industrial Automation, Role of automation in industries – Sensors in industrial automation: pressure, temperature, displacement, vibration, force, capacitive and optical sensors.

UNIT – II **9**

Control System: Basic Elements of control system – Open loop and closed loop systems – Differential equation and Transfer function: Electric systems (Kirchhoff's voltage and current law), Mechanical: translational and rotational systems.

UNIT– III **9**

Microprocessor and Its Interfacing: Organization of 8085 – Addressing modes – Instruction set – Simple programs involving logical, branch/call, sorting, evaluating arithmetic expressions and string manipulation instructions - A/D and D/A converters.

UNIT – IV **9**

Programmable Logic Controller: Introduction - Architecture of PLC – I/O modules – Distributed I/O modules – Programming of PLC: Conversion of relay logic to ladder logic programming, Math instructions, Logical instructions, Timer and Counter – Selection of PLC – Maintenance and trouble shooting of PLC.

UNIT – V **9**

Application of Mechatronics: Pick and Place robot – Engine management system – Car park barrier - Automatic camera and Automatic washing machine.

TOTAL: 45

TEXT BOOKS:

1. Bolton W., "Mechatronics", 4th Edition, Pearson Education, New Delhi, 2008.
2. Goankar Ramesh, "Microprocessor Architecture. Programming and Applications with the 8085", 5th Edition, Penram International Publishing, Bombay, 2002.
3. Petruzella Frank D., "Programmable Logic Controllers", 3rd Edition, Tata McGraw-Hill, New York, 2010.

REFERENCE BOOKS:

1. Histand Michael B. and Alciatore David G., "Introduction to Mechatronics and Measurement Systems", 3rd Edition, McGraw-Hill, New York, 2007.
2. Gopal M., "Control Systems: Principles and Design", 3rd Edition, Tata McGraw-Hill, New Delhi, 2008.
3. http://nptel.ac.in/courses/112102011/
4. http://nptel.ac.in/courses/108107029/
5. http://nptel.ac.in/courses/112102011/11

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify the different types of sensors used in automation system

CO2: infer knowledge about the different forms of control system in real time interfacing

CO3: understand the fundamentals of microprocessor based system design

CO4: analyze the operations of programmable logic controllers in automation industries

CO5: interpret an interdisciplinary action of Electronics, Electrical, Mechanical and Computer Systems in real time applications

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	1	2	2	1				2	2	2
CO2	3	2	2	1	1	2	2	1				2	2	2
CO3	3	2	2	1	1	2	2	1				2	2	2
CO4	3	2	2	1	1	2	2	1				2	2	2
CO5	3	2	2	1	1	2	2	1				2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MTT52 CNC TECHNOLOGY

(Common to Mechatronics and Mechanical branches)

3 0 0 3

Pre-requisites: Manufacturing Processes

UNIT – I **9**

Basic Concepts of Metal Cutting and CNC Machines: Introduction – Mechanics of chip formation-Mechanics of oblique cutting- Cutting forces and power- Tool life –Surface finish-Machinability. CNC machines: Classification – Construction details: Structure, Configuration of CNC system – Interfacing – Monitoring – Diagnostics – Machine data – Compensations for Machine accuracy – DNC – Adaptive control CNC systems.

UNIT – II **9**

Drives and Controls: Drive Mechanism, gearbox, Spindle Drives, Axes drives - Magnetic Levitation and Linear motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation. Slide ways. Re-circulating ball screws – Backlash measurement and compensation, linear motion guide ways.

UNIT – III **9**

Part Programming of CNC Machines: Part Program Terminology - G and M Codes – Types of interpolation. CNC part programming – Manual part programming (Turning and Milling). Various programming techniques – APT programming for various machines in ISO and FANUC - CAM packages for CNC machines.

UNIT – IV **9**

Tooling For CNC Machines: Interchangeable tooling system – Preset and qualified tools – coolant fed tooling system – Modular fixturing – Quick change tooling system – Automatic head changers – Tooling requirements for Turning and Machining centres – Tool holders – Tool assemblies – Tool Magazines – ATC Mechanisms – Automatic Pallet Changer-Tool management. Principles of location, clamping and work holding devices.

UNIT – V **9**

Economics of CNC Machines and Retrofitting: Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, Other maintenance requirements. Retrofitting- Necessary for Retrofitting-Advantages.

TOTAL: 45

TEXT BOOKS:

1. Kalpakjian S. and Schmid S.R., "Manufacturing Engineering and Technology", 5th Edition, Pearson Education India, New Delhi, 2014.
2. Radhakrishnan P., "Computer Numerical Control Machines", New Central Book Agency, 2013.
3. Narang J.S. and Narang V.D.S., "CNC Machines and Automation", Dhanpat Rai and Co. Pvt. Ltd., 2014.

REFERENCE BOOKS:

1. HMT Limited, "Mechatronics", Tata McGraw-Hill, New Delhi, 2001.
2. I.V Thyer G.E., "Computer Numeric Control of Machine Tools", 2nd Edition, Butterworth- Heinemann, Burlington, 1996.
3. Adithan M. and Pabla B.S., "CNC Machines", 2nd Edition, New Age International Pvt. Ltd., New Delhi, 2008.

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: estimate the parameters of metal cutting and comprehend the basic components involved in a CNC system
CO2: choose the appropriate drives and controls for CNC machines
CO3: develop Part Programming for various machining process
CO4: select various tooling systems and fixtures
CO5: compute operation and maintenance cost of CNC machines

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2								2	2	2
CO2	2	3	2									2	2	2
CO3	2	3	3		3							2	2	2
CO4	2	3	2	1	3							2	2	2
CO5	2	3	2	1	1	1					2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE08 GAS DYNAMICS AND JET PROPULSION

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Engineering Thermodynamics, Fluid Mechanics.

UNIT – I **9**

Fundamentals and Flow Through Variable Area Ducts: Energy and momentum equations for compressible fluid flows, stagnation state, critical states, 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

UNIT – II **9**

Flow Through Constant Area Ducts: 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

UNIT– III **9**

Flow Across Shock: Generation of shock in shock tubes – Desirable and undesirable effects of shock –Governing equations of normal shock, variation of flow parameters across the normal shock, Prandtl –Meyer equation, Impossibility of shock in subsonic flows – Strength of shock wave –Introduction to oblique shock

UNIT – IV **9**

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, Ram jet and Pulse jet engines

UNIT – V **9**

Rocket Propulsion: Types of Rocket engines – Solid Propellant rocket, Liquid Propellant rocket and Hybrid rocket – 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 for the End Semester Examination

TEXT BOOKS:

1. Yahya S.M., "Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion", 4th Edition, New Age International Pvt. Ltd., New Delhi, 2012.
2. Rathakrishnan E., "Gas Dynamics", 5th Edition, Prentice Hall of India, New Delhi, 2013.

REFERENCE BOOKS:

1. Oosthuizen Patrich H. and Carscallen William E., "Introduction to Compressible Fluid Flow", 2nd Edition, CSR Press, 2013.
2. Cohen H., Rogers R.E.C. and Saravanamuttoo, "Gas Turbine Theory", 6th Edition, Pearson Education, 2008.
3. Ganesan V., "Gas Turbines", 3rd Edition, Tata McGraw-Hill, New Delhi, 2010.
4. http://nptel.ac.in/courses/112103021/
5. https://swayam.gov.in/course/3861-gas-dynamics
6. https://ocw.mit.edu/courses/mechanical-engineering/2-26-compressible-fluid-dynamics-spring-2004/lecture-notes/

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 and heat transfer
CO3: solve the problems in flow associated with shock waves
CO4: assess the performance of jet engines
CO5: demonstrate an understanding of working of different types of rocket engines

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	2	2			2		2	2	3
CO2	3	3	2	2	2	2	2			2		2	2	3
CO3	3	3	2	2	2	2	2			2		2	2	3
CO4	3	3	2	2	2	2	2			2		2	2	3
CO5	3	3	2	2	2	2	2			2		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE09 MANUFACTURING INFORMATION SYSTEM

3 0 0 3

Pre-requisites: Manufacturing Technology, Material Removal Process

UNIT - I **9**

Introduction to Evolution of Order Policies: Introduction – Goals for manufacturing-The evolution of order policies - from MRP to MRP II- the role of production organization - operation control.

UNIT - II **9**

Database Concepts: Data modeling for Database-Records and files-Abstraction and Data integration Three level architecture for Data Base Management System (DBMS)-Components of DBMS-Advantages and disadvantages of DBMS.

UNIT - III **9**

Designing of Database: Relationship among entities-Entity Relationship (ER) diagram-Data Models-Relational, Network, Hierarchical - Relational Model - Concepts, Principles, keys, Relational operations-Functional Dependency-Normalization-Query languages.

UNIT - IV **9**

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 (IOM) -Stock status database-Complete IOM database.

UNIT - V **9**

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 BOOKS:

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

REFERENCE BOOKS:

1. Date C.J., "An Introduction to Database Systems", 8th Edition, Addison Wesley, 2003.
2. Orlicky G., "Material Requirements Planning", 3th Edition, McGraw-Hill, 2011.
3. Kerr R., "Knowledge Based Manufacturing Management", Addison Wesley, 1991.
4. http://www.nptelvideos.in/2012/12/manufacturing-systems-management.html
5. http://www.nptelvideos.in/2012/11/database-management-system.html

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the evolution of order practices.
CO2: report the concept of Data Base Management System.
CO3: illustrate the concept involved in designing of data base.
CO4: demonstrate about shop floor control and inventory management in an organization.
CO5: discuss the concept and parameters involved in computerised production planning and control.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1				1	1		1	1	1	2	1	2
CO2	3	1			1	1	1	1	1		1	2	1	2
CO3	3	2	2	1	2	1	1	1	1	1	1	2	2	2
CO4	2	2	2	1	2	1	1		1	1	1	2	2	2
CO5	3	2	2	2	2	1	1		1		1	3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE10 AUTOMOBILE ENGINEERING

3 0 0 3

Pre-requisites: Thermal Engineering.

UNIT – I **9**

Vehicle Structure and Engines: Types of Automobiles - Vehicle Construction, Chassis –Types, Frame and Body – Types, Engine types, Components of Engine – Functions and Materials. Turbo Chargers - Superchargers. Introduction to Electronic Engine Management System.

UNIT – II **9**

Fuel Supply System and Electrical Systems: Carburetion and Simple carburetor - Electronically controlled gasoline fuel injection system – Monopoint and MultiPoint Fuel Injection Systems (MPFI). Diesel engine fuel supply system - Types, Electronically controlled diesel fuel injection system – CRDi. General layout of electrical system – Different sub circuits. Construction and operation of Lead Acid battery - Lighting system – Starting motor and drives.

UNIT– III **9**

Transmission Systems: Clutch – Types and Construction, Gear Boxes – Types, Manual and Automatic, Selector mechanism - Over Drives – Transfer Box - Fluid flywheel - Torque converter – Propeller shaft – Slip Joint – Universal Joints – Differential unit. Rear Axle – Hotchkiss drive and Torque Tube drive.

UNIT – IV **9**

Steering, Brakes and Suspension Systems: Wheels and Tyres – Wheel alignment parameters, Types of Front axle - Steering geometry and mechanism - Steering gear box and types – Power Steering. Brakes – Types, Hydraulic and Pneumatic braking systems - Construction and working, Antilock Braking System, Suspension systems – Types – Independent suspension systems.

UNIT – V **9**

Alternative Fuels in Automobiles: Properties and applications of Natural Gas, LPG, Biodiesel, Bioethanol, Gasohol, Biogas, Producer gas and Hydrogen in Automobiles, Electric vehicles - Hybrid vehicles - Solar powered vehicles - Fuel Cells. **Emission Control & Safety:** Global Standards, Indian Pollution norms for Petrol & Diesel vehicles, Safety measures in automobiles.

TOTAL: 45

TEXT BOOKS:

1. Kirpal Singh, "Automobile Engineering", Volume I & II, 13th Edition, Standard Publishers, New Delhi, 2013.
2. Rajput R.K., "A Text book of Automobile Engineering", 2nd Edition, Laxmi Publication, New Delhi, 2014.

REFERENCE BOOKS:

1. Crouse William H. and Anglin Donald L., "Automotive Mechanism", 9th Edition, Tata McGraw-Hill, New Delhi, 2003.
2. Jain K.K. and Asthana R.B., "Automobile Engineering", 1st Edition, Tata McGraw Hill Publishers, New Delhi, 2002.
3. Srinivasan S., "Automotive Mechanics", 2nd Edition, Tata McGraw-Hill, New Delhi, 2003.
4. nptel.ac.in/courses/125106002/
5. nptel.ac.in/courses/108103009/module2/lec4/1.html
6. nptel.ac.in/courses/112104033/39
7. nptel.ac.in/courses/112104033/pdf_lecture/lecture40.pdf

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: illustrate the various automobile components and engine parts.

CO2: describe the fuel supply systems and electrical systems in automobiles.

CO3: express the transmission system and its various elements.

CO4: understand the working of suspension, steering and braking systems.

CO5: know the various possible alternate fuels that could be used in automobiles.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3		1		2	3	3			2		2	2	3
CO2	3		1		2	3	3			2		2	2	3
CO3	3		1		2	3	3			2		2	2	3
CO4	3		1		2	3	3			2		2	2	3
CO5	3		1		2	3	3			2		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14GEE81 ENTREPRENEURSHIP DEVELOPMENT

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

3 0 0 3

Unit-I **9**

Entrepreneurship Concepts: Meaning and concept of entrepreneurship, Role of Entrepreneurship in Economic Development. Factors affectingEntrepreneurship –Creativity, Innovation and Entrepreneurship, Intrapreneurship

UNIT – II **9**

Entrepreneur: Definition, Entrepreneurial Motivation, Characteristics of Entrepreneurs, Distinction between an Entrepreneur and a Manager.

UNIT – III **9**

Business Plan: Objectives of a Business Plan, Business Planning Process, Opportunity Identification and Selection, Contents of a Business Plan, Functional Plans.

UNIT – IV **9**

Entrepreneurial Eco System: Forms of Business Ownership, Sources of Finance, Institutional Support to Entrepreneurs.

UNIT – V **9**

Small Business Management: Definition of Small Scale Industries, Strengths and Weaknesses of Small Business, Growth Strategies in Small Scale Enterprises, Sickness in Small Enterprises – Symptoms, Causes and Consequences.

TOTAL : 45

TEXT BOOK:

1. S.S.Khanka, ―Entrepreneurial Development‖, 4th Edition, S.Chand & Company Ltd., 2012.
2. Madhurima Lall and Shikha Sahai, ―Entrepreneurship‖, 2nd Edition, Excel Books, New Delhi, 2008.

REFERENCE BOOKS:

1. Raj Shankar, ―Entrepreneurship, Theory and Practice‖, Vijay Nicole Imprints Pvt. Ltd., Chennai 2012.
2. Barringer and Ireland, ―Entrepreneurship‖, 3rd Edition, Pearson Education, 2012.
3. Zimmer and Scarborough, ―Essentials of Entrepreneurship and Small Business Management‖, 5th Edition, PHI Learning Pvt. Ltd., 2009.
4. https://www.scribd.com/doc/32063037/1-Concept-of-Entrepreneur-Entrepreneurship
5. http://www.oecd.org/cfe/leed/entrepreneurial-ecosystems.pdf

Course Outcomes:

On completion of the course the students will be able to

CO1 understand the concepts of entrepreneurship and its importance

CO2 understand the traits of an entrepreneur and the sources of his motivation

CO3 understand the components of a business plan

CO4 demonstrate knowledge of various sources of finance and institutions supporting entrepreneurship

CO5 understand the nature of small business and causes of industrial sickness

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						1	3	2	3		3	2	1	1
CO2						1	3	2	3		3	2	1	1
CO3				2		1	3	2	3		3	2	1	1
CO4				1		1	3	2	3		3	2	1	1
CO5		2		2		1	3	2	3		3	2	1	1

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE11 ADVANCED STRUCTURE OF MATERIALS

3 0 0 3

Pre-requisites: Engineering Mechanics, Strength of Materials.

UNIT – I **9**

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.

UNIT – II **9**

Shear Centre and Unsymmetrical Bending: Location of shear center for various sections – shear flow. Unsymmetrical bending –Stresses and deflection in beams subjected to unsymmetrical loading – Kern of a section.

UNIT– III **9**

Stresses on Curved Beams: Curved flexural members –Analysis of stresses in beams with large curvature – Stress distribution in curved beams – Stresses in crane hooks and C clamps – closed ring subjected to concentrated load and uniform load – chain link.

UNIT – IV **9**

Stresses Due to Rotation: Stresses due to rotation – Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness – allowable speed.

UNIT – V **9**

Beams on Elastic Foundation: Infinite beam subjected to concentrated load – Boundary Conditions – Infinite beam subjected to a distributed load segment.

TOTAL: 45

(Approved Data Book is Permitted)

TEXT BOOKS:

1. Sadhu Singh, "Strength of Materials", 11th Edition, Khanna Publishers, New Delhi, 2006.
2. Den-Hartog, "Advanced Strength of Materials", Dover Publications, New York, 1987.

REFERENCE BOOKS:

1. Timoshenko S.P., "Elements of Strength of Materials", 3rd Edition, Tata McGraw-Hill, New Delhi, 2006.
2. Rajput R.K., "Strength of Materials", 4th Edition, S.Chand & Co, New Delhi, 2012.
3. Timoshenko and Gaodler, "Theory of Elasticity", Illustrated Reprint, Tata McGraw-Hill, 1985.
4. https://ocw.mit.edu/courses/materials-science-and-engineering/3-60-symmetry-structure-and-tensor-properties-of-materials-fall-2005/index.htm
5. http://nptel.ac.in/courses/113105057/2

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate and estimate the stress and strain at a point in three dimensional systems.
CO2: analyze analytically the shear centre, stresses due to unsymmetrical bending.
CO3: analyze the stresses and deflections on curved beams for different applications.
CO4: analyze and estimate the stresses due to rotation.
CO5: analyze the stresses in beams under elastic foundation.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2		1	2		1	1		2	1	3
CO2	3	3	3	2		1	2		1	1		2	1	3
CO3	3	3	3	2		1	2		1	1		2	1	3
CO4	3	3	3	2		1	2		1	1		2	1	3
CO5	3	3	3	2		1	2		1	1		2	1	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE12 ROBOTICS

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Industrial Automation, Engineering Mechanics.

UNIT – I **9**

Fundamentals of Robot: 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.

UNIT – II **9**

Robot Drive Systems and End Effectors: Robot Drive Systems – Mechanical, Electrical, Hydraulic and Pneumatic Actuators – Features, Applications and Comparison of all the above Actuators –Robot End Effectors and Classifications – Gripper Mechanisms and Force analysis – Other Types of Grippers – Gripper Selection and design.

UNIT– III **9**

Robot Sensors: Transducers – Requirements of a sensor – Types of sensors – Principles and Applications – Non Optical and Optical Position sensors: Piezo Electric Sensor, Linear Variable Differential Transducer (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.

UNIT – IV **9**

Machine Vision and Robot Kinematics: Introduction to Machine Vision – Sensing and Digitizing the data, Image Processing and Analysis – Training and Vision Systems – Robotic Applications –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.

UNIT – V **9**

Robot Programming and Artificial Intelligence: 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 – Artificial Intelligence (AI) Techniques – An Approach for Implementing Robotics in Industries – Various Steps; Safety Considerations for Robot Operations – Future Applications.

TOTAL: 45

TEXT BOOKS:

1. Groover M.P., "Industrial Robotics – Technology, Programming and Applications", 2nd Edition, McGraw-Hill Education (India) Pvt. Ltd., 2012.
2. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering – An Integrated Approach", 1st Edition, Prentice-Hall India, 2010.

REFERENCE BOOKS:

1. Fu K.S., Gonzalz R.C. and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", 1st Edition, McGraw-Hill Book Co., 2008.
2. Saha S.K., "Introduction to Robotics", 2nd Edition, McGraw-Hill Education (India), 2014.
3. James G. Kermas, "Robot Technology Fundamentals", Cengage Learning Pvt. Ltd., New Delhi, 2009.
4. nptel.ac.in/downloads/112101098/
5. nptel.ac.in/courses/112101099/
6. www.nptelvideos.in/2012/12/robotics.html

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate an expansive view of concepts, parts and dynamic properties of robots.
CO2: explore on the drive systems of robots and end effectors.
CO3: apply the concept of sensory devices
CO4: apply the basic concepts of a machine vision and manipulator kinematics.
CO5: perform programming and develop a robot for accomplishing a particular task.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	1		2	1	1	3	2	2
CO2	2	2	2	2	2			1	1	1		1	2	3
CO3	3	3	2	2	3		1				1	3	3	2
CO4	3	3	3	2	2	1	1	1				2	2	2
CO5	2	3	3	3	3	1	1					3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE13 NON DESTRUCTIVE EVALUATION TECHNIQUES

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Materials and Metallurgy, Metrology and Measurement.

UNIT – I **9**

Introduction and Liquid Penetrant Testing: Non-destructive 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.

UNIT – II **9**

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

UNIT– III **9**

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.

UNIT – IV **9**

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.

UNIT – V **9**

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. Baldev Raj, Jayakumar T. and Thavasimuthu M., "Practical Non Destructive Testing", 3rd Edition, Narosa Publishing House, New Delhi, 2009.
2. Shull Peter J., "Non Destructive Evaluation: Theory - Techniques and Applications", Marcel Dekkar Inc., New York, USA, 2002.

REFERENCE BOOKS:

1. Baldev Raj and Venkatraman B., "Practical Radiology", Narosa Publishing House, New Delhi, 2004.
2. Hull Barry and John Vernon, "Non Destructive Testing", 1st Edition, Macmillan, London, 1988.
3. Brichan D., "Non Destructive Testing", Oxford Press, 1975.
4. ASM Handbook, "Non Destructive Evaluation and Quality Control", Vol. 17, 9th Edition, 1989.
5. https://www.asnt.org/MinorSiteSections/AboutASNT/Intro-to-NDT
6. https://www.nde-ed.org/EducationResources/CommunityCollege/communitycollege.htm

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: depict the importance of Non destructive testing methods.
CO2: gain knowledge on liquid penetrant and magnetic particle testing methods.
CO3: understand the principle of insights ultrasonic testing.
CO4: demonstrate Radiographic principles and testing of defects.
CO5: gain knowledge on other non-destructive testing techniques and select appropriate method for defect identification

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2					2	1			1		2		2
CO2	2	1			2	2	1			1		2	1	2
CO3	2				1	1	1			1		2		2
CO4	2	1			3	2	1			1		3	3	2
CO5	2	2	2	2	3	2	1			1		3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE14 COMPUTATIONAL FLUID DYNAMICS

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Fluid Mechanics, Heat Transfer, Partial Differential Equations.

UNIT – I **9**

Governing Equations and Boundary Conditions: 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

UNIT – II **9**

Finite Difference Method: Finite Difference Method – Taylor's series – Forward, Central and Backward differences – Explicit Method – Implicit Method – Tridiagonal matrix – ADI Method –Solution methodology for parabolic and elliptic equations – Errors

UNIT– III **9**

Finite Volume Method: 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.

UNIT – IV **9**

Grid and Flow Filed Variables: Types of grids –Grid generation – Grid transformation – Calculation of flow field variable – Staggered grid –Pressure and Velocity correction – SIMPLE algorithm – Flow and heat transfer analysis on simple components like nozzle, diffuser, pipe flow etc.

UNIT – V **9**

Turbulence Models: Turbulence – Effect of turbulence on Time averaged Navier Stokes equation – Characteristics of simple turbulent flow – Flat plate boundary layer – Pipe flow – Turbulence models – Mixing length model –K-ε Models – Reynolds stress equation model – Algebraic stress model.

TOTAL: 45

TEXT BOOKS:

1. Anderson John D., "Computational Fluid Dynamics: Basic with Applications", 1st Edition, Tata McGraw Hill, New Delhi, 2012.
2. Versteeg H. and Malalasekera W., "An Introduction to Computational Fluid dynamics: A Finite Volume Approach", 2nd Edition, Addison Wesley Longman Ltd., 2007.

REFERENCE BOOKS:

1. Ghoshdastidar P.S., "Computer Simulation of Fluid Flow and Heat Transfer", 1st Edition, Tata McGraw-Hill, New Delhi, 1998.
2. Patankar S.V., "Numerical Heat Transfer and Fluid Flow", 1st Edition, Hemisphere Publishing Corporation, Washington, 1980.
3. Date Anil W., "Introduction to Computational Fluid Dynamics", 1st Edition, Cambridge University Press, Cambridge, 2005.
4. http://nptel.ac.in/courses/112105045/
5. https://ocw.mit.edu/courses/mechanical-engineering/2-29-numerical-fluid-mechanics-spring-2015/index.htm

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: apply the finite difference method for convection and diffusion problems.
CO3: apply the finite volume method for convection and diffusion problems.
CO4: perform grid transformation and calculate the flow field variables.
CO5: demonstrate an understanding of turbulence models.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	3					2		2	3	3
CO2	3	3	3	2	3					2		2	3	3
CO3	3	3	3	2	3	1	1			2		2	3	3
CO4	3	3	3	2	3	1	1			2		2	3	3
CO5	3	3	3	2	3	1	1			2		2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE15 COMPOSITE MATERIALS

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Engineering mechanics, Strength of Materials, Engineering materials and Metallurgy.

UNIT – I **9**

Basics of Fibers, Matrices and Composites: Basics of fibers, matrices and composites: Definition – Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Fiber surface treatments, Fillers and Additives.

UNIT – II **9**

Manufacturing: Bag molding – Compression molding – Pultrusion – Filament winding – Resin film infusion - Elastic reservoir molding - Tube rolling – Quality inspection methods. Processing of metal matrix composites (MMC) – Diffusion bonding – Stir casting – Squeeze casting.

UNIT– III **9**

Performance: Static mechanical properties – Fatigue and impact properties – Environmental effects – Long term properties, Fracture behavior and Damage tolerance.

UNIT – IV **9**

Mechanics: Fiber content, density and void content. Rule of mixture -Volume and mass fractions – Density - Void content, Evaluation of four elastic moduli based on strength of materials approach and semi-empirical model-Longitudinal Young's modulus-Transverse Young's modulus–Major Poisson's ratio-In-plane shear modulus, Ultimate strengths of a unidirectional lamina. Characteristics of Fiber-reinforced lamina–Laminates–Lamination theory.

UNIT – V **9**

Design: Failure Predictions, Laminate Design Consideration-Design criteria-Design allowable -Design guidelines, Joint design-Bolted and Bonded Joints, Design Examples-Design of a tension member – Design of a compression member – Design of a beam-Design of a torsional member, Application of Finite element method (FEM) for design and analysis of laminated composites.

TOTAL: 45

TEXT BOOKS:

1. Mallick P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", 3rd Edition, Taylor and Francis, 2008.
2. Autar K. Kaw, "Mechanics of Composite Materials", 2nd Edition, CRC Press, 2006.

REFERENCE BOOKS:

1. Bhagwan D. Agarwal, Lawrence J. Broutman, Chandrashekhar K., "Analysis and Performance of Fiber Composites", 3rd Edition, John Wiley & Sons, New York, ISBN: 978-0-471-26891-8, June 2006.
2. Gibson R.F., "Principles of Composite Material Mechanics", 3rd Edition, CRC Press, 2011.
3. Chawla K.K., "Composite Materials", 3rd Edition, Springer – ISBN: 978-0-387-74364-6 Verlag, Boston, 2012.
4. http://nptel.ac.in/courses/101106038/
5. http://nptel.ac.in/courses/105108124/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: demonstrate the fundamentals of fibers, matrices and composites.
CO2: portray the various manufacturing processes involved in the fabrication of composite material.
CO3: gain knowledge on the performance of composite materials.
CO4: understand and solve problems concerning the mechanics of composite materials.
CO5: perform design calculations for the development of fiber reinforced matrices.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1	2	3	1	1	1	1	2	1	2
CO2	2	1	2		2	1	2		1	1		2	2	2
CO3	2	2	2	1		1	1			1		2		2
CO4	2	3	3	3	1							3	1	2
CO5	2	3	3	3	1					1		3	1	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE16 FUNDAMENTALS OF ERGONOMICS

3 0 0 3

Pre-requisites: Fundamental knowledge of industrial safety for Engineers, Engineering statistics and Engineering Mechanics.

UNIT – I **9**

Introducing Ergonomics: Fundamentals of Ergonomics/ Human factors - Disciplines - Physical, Cognitive and Organizational - Needs of Ergonomics in workplace - Ergonomic Principles - Applications - Ergonomic Evaluation - Questionnaire survey - Scope of Ergonomics in India.

UNIT – II **9**

Anthropometry: Human body - structure and function - Types of anthropometric data - Application of anthropometry in design - Anthropometric measuring techniques - Statistical treatment of data and percentile calculations.

UNIT– III **9**

Posture and Movement: Biomechanical Background - Physiological Background - Anthropometric Background - Sitting, Standing Change of Posture, Hand and arm postures - Movement - Lifting, Carrying, Pulling, Pushing - Repetitive motions - case studies.

UNIT – IV **9**

Work Counter Behavior and perception: Environmental issues - Physical work capacity - Factors affecting work capacity - Communication and cognitive issues - Information processing and perception - Interaction with machines, mental workload, error.

UNIT – V **9**

Ergonomic Design: Contribution of ergonomics to workstation design - Ergonomic approach to workstation design - Initiative Phase, Identification Phase, Selection of Solutions Phase, Implementation Phase, Evaluation Phase - Occupational / Ergonomic safety and stress at various workplace - health management rules - case studies.

TOTAL: 45

TEXT BOOKS:

1. Bridger R.S., "Introduction to Ergonomics", 2nd Edition, Taylor & Francis, 2003.
2. Dul J. and Weerdmeester B., "Ergonomics for beginners, a quick reference guide", 3rd Edition, Taylor & Francis, 2001.

REFERENCE BOOKS:

1. Green W.S. and Jordan P.W., "Human Factors in Product Design", Taylor & Francis, 1999.
2. Chakrabarti D., "Indian Anthropometric Dimensions for Ergonomic Design Practice", National Institute of Design, Ahmedabad, 1997.
3. Salvendy G., "Handbook of Human Factors and Ergonomics", 4th Edition, John Wiley & Sons, Inc., 2012.

Course Outcomes:

On completion of the course the students will be able to

- define ergonomics and its components
- identify the components of office and shop floor ergonomic evaluations
- list the common risk factors and areas for ergonomic improvement
- evaluate, select and implement ergonomic solutions
- describe the essential elements for an effective ergonomics programme

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	1	2	2	1	1	1	2	2	3	3
CO2	2	3	3	2	1	2	2	1	1	1	2	2	3	3
CO3	2	3	3	2	1	2	2	1	1	1	2	2	3	3
CO4	2	3	3	2	1	2	2	1	1	1	2	2	3	3
CO5	2	3	3	2	1	2	2	1	1	1	2	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE17 CRYOGENIC ENGINEERING

(Common to Mechanical and Automobile branches)

3 0 0 3

Pre-requisites: Applied Physics, Engineering Thermodynamics and Material science.

UNIT – I **9**

Cryo Physics: Review of Basic Thermodynamics− First and Second Law approaches to the study of thermodynamic cycles, Isothermal, Adiabatic and Isenthalpic processes. Insight on Cryogenics− Properties of Cryogenic fluids − Material properties at Cryogenic Temperatures − mechanical properties, thermal properties, electric & magnetic properties, super conducting materials, thermo electric materials −super fluidity of He_3 &He_4. Applications of Cryogenics in Space Programs, Medical applications.

UNIT – II **9**

Liquefaction Cycles: Carnot Liquefaction Cycle, F.O.M. and Yield of Liquefaction Cycles. Inversion Curve -Joule Thomson Effect. Linde Hampson Cycle, Precooled Linde Hampson Cycle, Claudes Cycle, Dual Cycle, Ortho-Para hydrogen conversion, Eollins cycle, Simpson cycle, Critical Components in Liquefaction Systems.

UNIT– III **9**

Separation of Cryogenic Gases: Binary Mixtures, T-C and H-C Diagrams, Principle of Rectification−Simple condensation and evaporation− Rectification Column Analysis - McCabe Thiele Method. Adsorption Systems for purification.

UNIT – IV **9**

Cryogenic Refrigerators: Isothermal and reversible isobaric source refrigeration cycles − Joule Thomson system, cascade or precooled joule Thomson refrigeration systems− expansion engine and cold gas refrigeration systems, Philips refrigerators − Importance of regenerator effectiveness for the Philips refrigerators − Gifford single volume refrigerator − Gifford double volume refrigerators analysis, COP,− regenerators − pulse tube refrigerators − various types of pulse tube refrigerator

UNIT – V **9**

Thermometry for Low Temperature: Gas thermometers, Vapor pressure thermometers, resistance thermometers, Thermocouples, 3He Melting Curve Thermometers, Noise thermometers, Superconducting Fixed point Thermometers, Nuclear Orientation thermometers, Mossbauer – Effect thermometers, Coulomb Blockade Thermometers, Osmotic Pressure Thermometers, Infrared thermometers, Fibre – Optic Thermometers, Secondary thermometers.

TOTAL: 45

TEXT BOOKS:

1. Randall F. Barron, "Cryogenic Systems", 2nd Edition, McGraw-Hill, 1985.
2. Mukhopadhyay Mamata, "Fundamentals of Cryogenic Engineering", 4th Edition, Eastern Economy Edition, New Delhi, 2010.

REFERENCE BOOKS:

1. Klaus D. Timmerhaus and Thomas M. Flynn, "Cryogenic Process Engineering", 1st Edition, Plenum Press, New York, 1989.
2. Jha A.R., "Cryogenic Technology and Applications", 1st Edition, Butterworth-Heinemann, 2006.
3. Francis S. Tse, Ivan E. Morse, "Measurement and Instrumentation in Engineering", 1st Edition, CRC Press, 1989.
4. Stephen A. Dyer, "Wiley Survey of instrumentation and Measurement", 1st Edition, John-Wiley & Sons, New York, 2004.
5. http://nptel.ac.in/courses/112101004/
6. http://www.nptelvideos.in/2012/12/cryogenic-engineering.html
7. https://www.slac.stanford.edu/econf/C0605091/present/CERN.PDF

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify the appropriate materials for cryogenic applications.
CO2: demonstrate the working principle of different cryogenic liquification cycle.
CO3: demonstrate various methods of gas separation and purification system.
CO4: design low-temperature systems and machinery to meet the requirements for their maximum performance and durability.
CO5: select appropriate thermometry for low temperature measurements.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1		2	2			2		2		3
CO2	3	2	2	1	2	2	2			2		2	2	3
CO3	3	3	2	2	2	2	2			2		2	2	3
CO4	3	3	3	2	2	2	2			2		2	2	3
CO5	3	2	2	1	2	2	2			2		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE18 ADVANCED HEAT TRANSFER

3 0 0 3

Pre-requisites: Thermodynamics, Heat Transfer, Fluid Mechanics.

UNIT – I **9**

Conduction and Radiation Heat Transfer: One dimensional energy equations and boundary condition –three-dimensional heat conduction equations –extended surface heat transfer –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.

UNIT – II **9**

Turbulent 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.

UNIT– III **9**

Phase Change Heat Transfer and Heat Exchanger: Condensation with shears edge on bank of tubes –boiling – pool and flow boiling –heat exchanger -Є – NTU approach and design procedure –compact heat exchangers.

UNIT – IV **9**

Numerical Methods in Heat Transfer: Finite difference formulation of steady and transient heat conduction problems– discretization schemes – explicit –Crank Nicolson and fully implicit schemes –control volume formulation -steady one-dimensional convection and diffusion problems –calculation of the flow field – SIMPLER Algorithm.

UNIT – V **9**

Heat Transfer Correlations: Heat transfer correlations in various applications like I.C. engines –compressors and turbines.

TOTAL: 45

Use of HMT data book is permitted for the End Semester Examination

TEXT BOOKS:

1. Frank P. Incropera and DeWitt P. Dewitt, "Fundamentals of Heat & Mass Transfer", 7th Edition, John Wiley & Sons, 2011.
2. Holman J.P., "Heat Transfer", 10th Edition, Education Pvt. Ltd., Tata McGraw Hill, 2011.

REFERENCE BOOKS:

1. Ozisik M. Necat, "Heat Transfer – A Basic Approach", 3rd Edition, McGraw-Hill Inc., US,1984.
2. Nag P.K., "Heat and Mass Transfer", 3rd Edition, Tata McGraw-Hill, Education Pvt. Ltd., 2011.
3. Ghoshdastidar P.S., "Heat Transfer", 2nd Edition, Oxford University Press, Oxford, U.K., 2012.
4. Adrain Bejan, "Convective Heat Transfer", 3rd Edition, Wiley India Pvt. Ltd., 2006.
5. http://nptel.ac.in/courses/103105052/
6. http://opencourses.emu.edu.tr/course/view.php?id=23

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: recognize the different mode of conduction and radiation heat transfer.
CO2: exhibit the various turbulent flow models used in convection heat transfer.
CO3: describe the methods used in phase change heat transfer.
CO4: use the discretization schemes and to analyze convection and diffusion problems.
CO5: select thermal system components with maximum possible heat and mass transfer uniqueness.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	1			2		2	2	3
CO2	3	3	3	2	2	2	1			2		2	2	3
CO3	3	3	3	2	2	2	1			2		2	2	3
CO4	3	3	3	2	2	2	1			2		2	2	3
CO5	3	3	3	2	2	2	1			2		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE19 INSTRUMENTATION IN THERMAL ENGINEERING

3 0 0 3

Pre-requisites: Engineering Physics, Metrology and Measurement.

UNIT – I **9**

Measurement Characteristics: Instrument Classification, Characteristics of Instruments–Static and dynamic, experimental error analysis, Systematic and random errors, Statistical analysis, Uncertainty, Experimental planning and selection of measuring instruments, Reliability of instruments.

UNIT – II **9**

Microprocessors and Computers in Measurement: Data logging and acquisition –use of sensors for error reduction, elements of microcomputer interfacing, intelligent instruments in use.

UNIT– III **9**

Measurement of Physical Quantities: Measurement of thermo-physical properties, instruments for measuring temperature, pressure and flow, use of sensors for physical variables.

UNIT – IV **9**

Advance Measurement Techniques: Shadowgraph, Schlieren, Interferometer, Laser Doppler Anemometer, Hot wire Anemometer, heat flux sensors, Telemetry in measurement.

UNIT – V **9**

Measurement Analyzers: Orsat apparatus, Gas Analysers, Smoke meters, gas chromatography, spectrometry.

TOTAL: 45

TEXT BOOKS:

1. Holman J.P., "Experimental Methods for Engineers", 10th Edition, McGraw-Hill, 2001.
2. Barnery G.C., "Intelligent Instrumentation: Microprocessor Applications in Measurement and Control", Prentice Hall of India, New Delhi, 1988.

REFERENCE BOOKS:

1. Prebrashensky V., "Measurements and Instrumentation in Heat Engineering", Vol. 1 and 2, MIR Publishers, 1980.
2. Raman C.S., Sharma G.R., Mani V.S.V., "Instrumentation Devices and Systems", Tata McGraw-Hill, New Delhi, 1983.
3. Morris A.S., "Principles of Measurements and Instrumentation", Prentice Hall of India, 1998.
4. http://www.readorrefer.in/article/Static-and-Dynamic-Characteristics-of-Measurement_12810/
5. http://www.pc-education.mcmaster.ca/Instrumentation/introduction.htm

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: apply the techniques in measurements.
CO2: use computers in measurements.
CO3: analyze measurements of various physical quantities.
CO4: use advance measuring tools.
CO5: handle the measuring instruments relating to exhaust gas analysis.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	3	2		1		2		2	3	3
CO2	3	2	2	1	3	2		1		2		2	3	3
CO3	3	2	2	1	3	2		1		2		2	3	3
CO4	3	2	2	1	3	2		1		2		2	3	3
CO5	3	2	2	1	3	2		1		2		2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE20 INTRODUCTION TO AIRCRAFT STRUCTURES

3 0 0 3

Pre-requisites: Strength of Materials, Basics of Design of Machine Elements.

UNIT – I **9**

Overview of the Aircraft Design Process, Aircraft Loads: 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.

UNIT – II **9**

Aircraft Structures Description, Aircraft Materials and properties: Types of Structural members of Fuselage and wing section, empennage Ribs, Spars, Frames, Stringers, Longeron, Splices, Types of structural joints, Type of Loads on structural joints. 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)**

UNIT– III **9**

Static and Fatigue Failures: Fatigue Failures, Fatigue theory, Introduction to Low cycle Fatigue, Stress Life and Strain Life Techniques, Mean stress effects, Multi-axial Effects, Isothermal and Thermo mechanical Fatigue, Introduction to high cycle fatigue.

UNIT – IV **9**

Box Beams, Buckling of Thin Sheets: 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.

UNIT – V **9**

Aircraft Structural Joints, Advanced materials, Vibrations and Flutter: Introduction to Fasteners, Splices, and Eccentric joints-Bolt Group Analysis, Welded joints, Bonded joints, Lug Analysis, Tension Fitting and clips. Introduction to composite Materials, Matrices, Fibers, Forms, Characteristics of composite materials. Study of Vibration and Flutter.

TOTAL: 45

TEXT BOOKS:

1. Daniel P. Raymer, "Aircraft Design - A Conceptual Approach", 6th Edition, AIAA Education Series, 2012.
2. Michael Niu, "Airframe Structural Design", 2nd Edition, Conmilit Press, 1988.

REFERENCE BOOKS:

1. Megson T.H.G., "Aircraft Structures for Engineering Students", 4th Edition, Butterworth Heinman, 2007.
2. John Cutler, "Understanding Aircraft Structures", 4th Edition, Wiley, 2006.
3. David J. Peery, "Aircraft Structures", Reprint, Dover Publications, 1950.
4. www.thebalance.com
5. aerospaceengineeringblog.com

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the various steps involved in the design process of aircraft structures, aircraft loads.
CO2: evaluate the shape and dimensions of an aircraft component to satisfy functional and strength requirements.
CO3: predict the static and fatigue failure in aircraft.
CO4: design box beam configuration for aircraft design.
CO5: design aircraft structural joints and advanced materials.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	2		3			2	1		1	2	3
CO2	3	2	3	2		3			2	1		1	2	3
CO3	3	2	3	2		3			2	1		1	2	3
CO4	3	2	3	2		3			2	1		1	2	3
CO5	3	2	3	2		3			2	1		1	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEE21 QUALITY CONTROL AND RELIABILITY ENGINEERING

3 0 0 3

Pre-requisites: Fundamentals of Statistical Mathematics and Manufacturing Processes.

UNIT – I **9**

Introduction and Process Control for Variables : 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-causes of 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.

UNIT – II **9**

Process Control for Attributes: Control chart for attributes –control chart for non-conforming– p chart and np chart – control chart for nonconformities– c and u charts, State of control and process out of control identification in charts, pattern study.

UNIT– III **9**

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

UNIT – IV **9**

Life Testing – Reliability: 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.

UNIT – V **9**

Quality and Reliability: 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

TEXT BOOKS:

1. Montgomery, Douglas C., "Introduction to Statistical Quality Control", 4th Edition, John Wiley, New York, 2008.
2. Srinath L.S., "Mechanical Reliability", 3rd Edition, Affiliated East West Press, New Delhi, 2002.

REFERENCE BOOKS:

1. Connor O., Patrick D.T., "Practical Reliability Engineering", 5th Edition, John Wiley, New York, 2012.
2. Grant, Eugene L., "Statistical Quality Control", 2nd Edition, Tata McGraw-Hill, New York, 2000.
3. Mahajan, Monohar, "Statistical Quality Control",1st Edition, Dhanpat Rai & Sons, New Delhi, 2010.
4. https://onlinecourses.nptel.ac.in/noc17_mg18
5. http://nptel.ac.in/courses/112107142/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: know the importance of process control in controlling quality
CO2: use control charts and conduct process capability analysis
CO3: construct OC curves and analyze Producer's and consumer's risk
CO4: categorize the knowledge of reliability engineering
CO5: analyze parallel, series and real time systems for reliability

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	3	2	1	2			1		2	3	3
CO2	3	3	3	3	2	2	3			2		2	3	3
CO3	3	3	3	3	2	2	3			2		2	3	3
CO4	3	3	3	3	2	2	3			2		2	3	3
CO5	3	3	3	3	2	2	3			2		2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEO01 INTRODUCTION TO AIRCRAFT SYSTEMS

(Common to Mechanical and Mechatronics branches)

3 0 0 3

UNIT – I **9**

Introduction to Aircrafts: 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.

UNIT – II **9**

Aircraft Systems and Aerofoil: Aerofoil Nomenclature, Types of Aerofoil, Wing Section–Aerodynamic Center, Aspect Ratio –Pressure Distribution over a wing section. Types of Aircraft Systems –Introduction to Mechanical, Electrical, Hydraulic and Avionics Systems.

UNIT– III **9**

Basic Principles of Flight: Significance of speed of Sound, Air speed and Ground Speed, Properties of Atmosphere. Generation of Lift, Drag, Pitching moments, Types of Drag, Lift curve, Drag Curve, Lift/Drag Ratio Curve, Factors affecting Lift and Drag. Lifting surfaces-lift and drag, angle of attack, centre of pressure and its effects.

UNIT – IV **9**

Stability and Control: Degree of Stability–Lateral, Longitudinal and Directional Stability Controls of Aircraft. Taxying, Landing, Gliding and Turning –Forces acting on an Aero plane during a Turn, Correct and incorrect Angles of Bank.

UNIT – V **9**

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, Aerobatics, Inverted Maneuvers, Maneuverability.

TOTAL: 45

TEXT BOOKS:

1. Kermode A.C., "Mechanics of Flight", 5th Edition, Pearson Education, New Delhi. 2009.
2. Shevell, "Fundamentals of Flight", 2nd Edition, Pearson Education, New Delhi. 2003.

REFERENCE BOOKS:

1. Anderson, Dave "Introduction to Flight", 7th Edition, McGraw-Hill, 2011.
2. Ian Moir, Allan Seabridge "Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration", 3rd Edition, Wiley, 2011.
3. Delp Frank, and Kroes, Michael J. and Watkins, William A., "Aircraft Maintenance & Repair", 7th Edition, Glencoe & McGraw-Hill, 2013.
4. www.b737.org.uk
5. https://ice.mit.edu

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify and configure the various types of aircrafts available
CO2: analyze and demonstrate the issues in designing new aircraft
CO3: exhibit the basic principles of flight
CO4: reveal the stability and control aspects of the aircrafts
CO5: analyze aircraft performance and maneuvers

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	3	2						2	1	1
CO2	3	3	3	2	3	2						3	2	2
CO3	3	3	2	2	3	2						3	2	2
CO4	3	3	3	2	3	2						3	2	2
CO5	3	3	2	2	3	2						3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MEO02 RENEWABLE ENERGY SOURCES

3 0 0 3

UNIT – I **9**

Solar 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

UNIT – II **9**

Wind Energy: Wind Data and Energy Estimation – wind energy conversion Systems – Wind energy generators and its performance – Wind Energy Storage –Type of wind turbines– Applications –Hybrid systems

UNIT– III **9**

Bio – Energy: Biomass – Biogas – Sources – Composition - Technology for utilization – Biomass direct combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio diesel production and economics

UNIT – IV **9**

OTEC, Tidal, Geothermal and Hydel Energy: Tidal energy – Wave energy – Data - Technology options – Open and closed OTEC Cycles – Small hydro turbines – Geothermal energy sources.

UNIT – V **9**

Direct Energy Conversion Systems, New Energy Sources: MHD generators – Thermoelectric power generation. Hydrogen – generation – storage - transport and utilization – Applications - power generation - transport – Fuel cells – technologies, Types –economics and the power generation.

TOTAL: 45

TEXT BOOKS:

1. Rai G.D., "Non Conventional Energy Sources", 4th Edition, Khanna Publishers, New Delhi, 2011.
2. Kothari D.P., "Renewable Energy Sources and Emerging Technologies", 2nd Edition, Prentice Hall of India Pvt. Ltd., 2008.

REFERENCE BOOKS:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", 3rd Edition, Oxford University Press, U.K., 1996.
2. Tiwari G.N., "Solar Energy - Fundamentals Design, Modeling and Applications", 1st Edition, Narosa Publishing House, New Delhi, 2014.
3. Sukhatme S.P., "Solar Energy", 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.
4. http://nptel.ac.in/courses/108105058/
5. http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/notused/Non-Conventional%20Energy%20Systems-/Learning%20Materail%20-%20NCES.pdf

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: assess the working and applications of solar energy systems

CO2: understand wind Energy Conversion Systems and its applications

CO3: demonstrate an understanding of bio-energy production and its economics

CO4: develop an understanding of OTEC, tidal and geothermal energy systems

CO5: identify the working and applications of new energy systems

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3				2		3			2		2	2	3
CO2	3				2		3			2		2	2	3
CO3	3	3			2		3			2		2	2	3
CO4	3				2		3			2		2	2	3
CO5	3				2		3			2		2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEO03 ENERGY AUDITING AND ENERGY MANAGEMENT

3 0 0 3

UNIT – I **9**

General Principles of Energy Audit and Management: Energy audit: Need, types, methodology and approach. Energy management: definition and objectives, general principles, energy management skills, energy management strategy. Energy management approach, understanding energy costs, bench marking, energy performance, matching energy usage to requirements, maximizing system efficiency, optimizing the input energy requirements, fuels and energy substitution.

UNIT – II **9**

Energy Conservation: Introduction to ENCON, approach and modern (Thermal energy) techniques, benefits, trends. Development of energy balance and material balance, need for energy conservation, identification of energy losses and conservation measures, efficiency improvements- Energy balance sheet and MIS waste minimization and resource conservation. Application of non-conventional and renewable energy resources (case studies for energy conservation).

UNIT– III **9**

Energy Policy Planning and Implementation: Force field analysis, energy policy – purpose, perspective, contents of formulation. Format and ratification, organizing: location of energy manager, top management support, managerial functions and responsibilities of energy manager, accountability motivating – motivation of employees and training requirements for energy action planning.
Information systems: Designing, barriers, strategies, marketing, communication & planning.

UNIT – IV **9**

Energy Audit Instruments and Financial Analysis: Instruments for audit: and monitoring energy and energy savings, types and accuracy – Electrical, Temperature, light, level, pressure, speed and flow measuring instruments. Hygrometer, combustion analyser, leak detectors, fuel measurement. Financial analysis: cost analysis of energy savings, simple payback period, PW method, Lifecycle cost analysis. Annual lifecycle cost with inflation, Lifecycle cost of renewable energy systems (simple problems).

UNIT – V **9**

Energy Performance Assessment for Equipment and Utility Systems: Boilers, furnaces, compressors, lighting systems, electric motors and variable speed drives, HVAC systems, water pumps, fans and blowers and heat exchangers.

TOTAL: 45

TEXT BOOKS:

1. Murphy W.R., Mckay G., "Energy Management", 1st Edition, Butterworth-Heinemann Ltd., 1982.
2. Craig B. Smith, "Energy Management Principles", 1st Edition, Pergamon Press, 1981.

REFERENCE BOOKS:

1. Dyden I.G.C.,"The Efficient Use of Energy", IGC Dryden Butterworth, London, 1982.
2. Witte L.C., Schmidt P.S., Brown D.R., "Industrial Energy Management and Utilization", Hemisphere Publishing Corp., New York, 1988.
3. Dale R. Patrick, "Energy Conservation Guide Book", 2nd Edition, Fairmont Press, 2007.
4. Energy Auditing and Management
5. http://www.em-ea.org/gbook1.asp

COURSE OUTCOMES

On completion of the course the students will be able to
CO1: apply the energy audit principles.
CO2: use the techniques for energy conservations.
CO3: understand the role of energy manager.
CO4: use energy measuring instruments.
CO5: apply techniques to assess the energy performance.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2	1	2	1	3	2	1	2	3	3
CO2	3	3	2	2	2	1	2	1	3	2	1	2	3	3
CO3	3	3	2	2	2	1	2	1	3	2	1	2	3	3
CO4	3	3	2	2	2	1	2	1	3	2	1	2	3	3
CO5	3	3	2	2	2	1	2	1	3	2	1	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEO04 POWER PLANT ENGINEERING

3 0 0 3

UNIT – I **9**

Energy Scenario and Steam Power Plant: Indian and Global Energy Scenario, Environmental issues of present day power generation. **Steam Power Plant:** Rankine Cycle – Thermodynamic analysis of cycles -Layout of Steam Power Plant – Selection criteria - High Pressure boilers-Types, Super Critical Boilers – Fluidized Bed Boilers – Boiler Trial and testing, Fuel and Ash Handling systems, Pulverisers - Types, Stokers - Types, Dust Collectors and Cooling towers.

UNIT – II **9**

Gas Turbine Power Plant: Gas turbine cycles – Thermodynamic analysis of cycles - Reheating – Regeneration and Intercooling - Layout of Gas Turbine Power Plant- Selection criteria - Binary and combined cycle - IGCC. **Diesel Power Plant:** Layout of Diesel power plant, Types - Selection criteria, Selection of Engine.

UNIT– III **9**

Nuclear Power Plant: Layout of Nuclear power plant - Selection criteria, Types of Reactors - Radioactivity – Fission process – Reaction rates – Diffusion theory, Elastic scattering and slowing down – Global Standards in waste disposal and nuclear safety. **Hydel Power Plant:** Layout of Hydel power plant - Selection criteria - Selection of Turbines -Micro Hydel developments.

UNIT – IV **9**

Other Types of Power Generation: MHD power generation, Solar thermal and PV system- WECS – Biomass -Geo thermal –OTEC- Micro fuel cells & Portable power. Comparative analysis of combined heat and power cycles– Binary cycle.

UNIT – V **9**

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 – Types, Energy auditing for Thermal Power Plant – Waste heat recovery Techniques - Types.

TOTAL: 45

TEXT BOOKS:

1. Arora S.C. and Domkundwar S., "A Course in Power Plant Engineering", 5th Edition, Dhanpat Rai, New Delhi, 2012.
2. Rajput R.K., "Power Plant Engineering", 4th Edition, Laxmi Publications, New Delhi, 2012.

REFERENCE BOOKS:

1. Nag P.K., "Power Plant Engineering", 3rd Edition, Tata McGraw-Hill, New Delhi, 2011.
2. Hegde R.K., "Power Plant Engineering", 1st Edition, Pearson India Education Services Pvt. Ltd., Delhi, 2015.
3. Rai G.D., "An Introduction to Power Plant Technology", 3rd Edition, Khanna Publishers, New Delhi.
4. http://www.nptelvideos.in/2012/11/energy-resources-and-technology.html
5. http://nptel.ac.in/courses/112106133/15

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: illustrate the layout and working of various sub circuits in steam power plant.
CO2: gain the knowledge in working of gas and diesel power plants.
CO3: understand the basic knowledge on Nuclear processes and working of Nuclear and Hydel power plants with their layouts.
CO4: gain the knowledge on various renewable energy sources used for power generation.
CO5: know the various terminologies behind power plant economics and electricity cost estimation.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2		2		2			2		2	2	3
CO2	3	3	2		2		2			2		2	2	3
CO3	3	3	2		2		2			2		2	2	3
CO4	3	1	2		2		2			2		2	2	3
CO5	3	3	3		2		2			2	3	2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

14MEO05 MAINTENANCE ENGINEERING

(Common to Mechanical and Mechatronics branches)

3 0 0 3

UNIT – I **9**

Principles and Maintenance System Planning: Introduction to repair and Maintenance – Maintenance as business – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems: Maintenance systems – reactive, preventive or proactive systems – Maintainability – Inherent and overall availability – Mean time between failures, Mean time to repairs and mean down time - hazard rate - coding and cataloguing.

UNIT – II **9**

Condition Based Maintenance: Introduction to Condition based monitoring of equipment and systems; Condition Monitoring Techniques -Vibration analysis–Ultrasonic detection techniques -Thermograph - lubrication methods and its analysis – Motor condition monitoring (MCM); Cost comparison with and without CM; On-load testing and off-load testing methods – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.

UNIT– III **9**

Maintenance Techniques: Total Productive Maintenance (TPM) –Relationship between Overall Equipment Effectiveness (OEE) and world class Maintenance – seven modern tools –applications - Ladder of Maintenance improvement– Computerized online health monitoring of machine– data acquisition for effective management of Computerized Maintenance Management System (CMMS) - logic tree analysis -Criticality matrix.

UNIT – IV **9**

Failure Analysis and Repair Methods of Basic Elements: Defect/failure definition; Failure - rate –mode -reporting – date collection; Failure analysis - tools –fault tree analysis - event tree analysis-Root cause analysis – FMEA – FMECA - Electrical Stress analysis. Repair methods for machine beds, sideways, spindles, gears, lead screws and bearings – Repair methods for Material handling equipment –Equipment records –Job order systems.

UNIT – V **9**

Reliability Engineering and Safety in Maintenance: Reliability – Definition, failure data, failure density, failure rate, mean failure rate, types of failures, failure rate curve. System Reliability- series, parallel and mixed configuration – reliability increasing techniques. Safety – Definition – methods of enhancing safety – modern industrial scenarios- safety tools – case studies – quantification of safety - code and standards- hazards and its management.

TOTAL: 45

TEXT BOOKS:

1. Srivastava, S.K., “Industrial Maintenance Management”, S. Chand & Co., New Delhi, 2014.
2. Srinath L.S., “Reliability Engineering”, East-West Press, New Delhi, 2009.

REFERENCE BOOKS:

1. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S.Chand & Co., New Delhi, 2011.
2. White E.N., “Maintenance Planning”, Gower Press, 2008.
3. Garg H.P., “Industrial Maintenance”, S. Chand & Co., New Delhi, 2007.
4. http://nptel.ac.in/courses/112107142/28
5. http://nptel.ac.in/courses/112105048/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: understand the principles and functions of maintenance in industry
CO2: interpret the various condition based maintenance principles
CO3: plan and implement maintenance management systems
CO4: identify and analyze failures
CO5: synthesize the functional concepts of reliability and safety engineering

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2			2						2	3	2
CO2	3	2	2			1						2	3	2
CO3	3	2	2			1					2	2	3	2
CO4	3	2	2	2		2						2	3	2
CO5	3	2	2			2					1	2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

14MEO06 INDUSTRIAL SAFETY ENGINEERING

3 0 0 3

UNIT – I **9**

Safety Management: Need for safety- safety and productivity- planning for safety – formulation of safety policy – safety management techniques- job safety analysis- safety sampling technique- incident recall technique- plant safety inspection- safety organization and its functions.

UNIT – II **9**

Accident Prevention: Nature and causes of accidents- accident proneness- cost of accident – accident prevention methods. Accident reporting and investigation – personal protective equipment – safety education and training- damage control and disaster control.

UNIT– III **9**

Operation Safety: General safety considerations in material handling- manual and mechanical safety in machine shop- safety in use of hand and portable (power) tools- safety in use of electricity- safety in welding and cutting- principles of guarding – safety in heat treatment- safety in gas furnace operation.

UNIT – IV **9**

Safety in Metal Working Machinery: General safety rules- principles- maintenance- inspection of turning machines- boring machines- milling machines- planning machines- grinding machines- CNC machines- shaping machines- drilling machines.

UNIT – V **9**

Safety in Cold and Hot Working of Metals: cold working: power presses- point of operation safe guarding – auxiliary mechanisms- feeding and cutting mechanism- hand or foot operated presses- power press setup and die removal- inspection and maintenance. Metal shears- hot working: safety in forging, hot rolling mill operation- safe guards in hot rolling mills- hot bending pipes- foundry: health hazards and safety measures.

TOTAL: 45

TEXT BOOKS:

1. Krishnan N.V., "Safety in Industry", 1st Edition, Jaico Publishing House, 1996.
2. Jane Bluent, Nigel and Balchin C., "Health and Safety in Welding and Allied Processes", 5th Edition, Wood Head Publishing, 2002.

REFERENCE BOOKS:

1. "Occupational Safety Manual" BHEL, Trichy, 1988.
2. Blake R.P., "Industrial Safety", 3rd Edition, Prentice Hall, New Jersey, 2006.
3. nptel.ac.in/courses/103106071/
4. https://www.osti.gov/servlets/purl/7278484/

COURSE OUTCOMES

On completion of the course the students will be able to

CO1: apply the safety management concepts.

CO2: understand the accident prevention methods.

CO3: use the safety techniques in industry.

CO4: use the different kind of safety rules in metal working machinery.

CO5: apply the safety rules in hot and cold working processes.

Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	3	2	2	1	2	1	2	2	3
CO2	3	2	2	2	2	3	2	2	3	2	1	2	2	3
CO3	3	2	2	2	2	3	2	2	2	2	1	2	2	3
CO4	3	2	2	2	2	3	2	2	2	2	1	2	2	3
CO5	3	2	2	2	2	3	2	2	2	2	1	2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial