NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University Chennai & Accredited by NAAC)

K.R.NAGAR, KOVILPATTI – 628 503
www.nec.edu.in

REGULATIONS – 2015
&
CURRICULUM & SYLLABUS

B. E. – MECHANICAL ENGINEERING

Accredited by NBA

B.E. – MECHANICAL ENGINEERING

CURRICULUM AND SYLLABUS

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

Producing globally competitive Mechanical Engineers with social responsibilities.

MISSION

- Imparting quality education by providing excellent Teaching-learning environment.
- Inculcating qualities of continuous learning, professionalism, team spirit, communication skill and leadership with social responsibilities.
- Promoting leading edge research and development through collaboration with academia and industry.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Programme educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

After 3 to 5 years of completion of our graduation our,

1. Graduates will have successful profession in Mechanical or allied Industries or Research/Academics or business enterprise.
2. Graduates will have the attitudes and abilities of leaders to adapt the changing global scenario.

PROGRAM OUTCOMES (POs)

After the successful completion of Mechanical Engineering Program, the graduates will be able to,

- Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization in Mechanical Engineering to the solution of complex engineering problems.
- Identify, formulate, research literature, and analyze complex problems in Mechanical Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- Design solutions for complex Mechanical 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.
- 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 for complex Mechanical Engineering Problems.
- Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex Mechanical Engineering activities with an understanding of the limitations.
- 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.
- Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 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.

- 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.
- 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.

PREAMBLE OF THE CURRICULUM & SYLLABI

The Curriculum and Syllabi under Regulations 2015 is designed keeping in mind the Outcome Based Education (OBE) and Choice Based Credit System (CBCS). The course content of each course shall be fixed in accordance with the Program Educational Objectives (PEOs), Program Outcomes (POs) and Course Outcomes (COs).

The CBCS enables the students to earn credits across programmes and provides flexibility for slow and fast learners in registering the required number of credits in a semester. The CBCS facilitates transfer of credits earned in different departments / Centers of other recognized / accredited universities or institutions of higher education in India and abroad either by studying directly or by online method.

The curriculum of **Mechanical Engineering programme** is designed with total number of credits ***171 (127*** for Lateral entry) and shall have the following category of courses in the curriculum.

1. **Foundation courses**

   a. **Common Foundation Courses (CFC)** include Mathematics, Basic Sciences, Engineering Sciences and Skill Based Courses.

   b. **Specific Foundation Courses (SFC)** include the basic courses specific to a programme of study.

2. **Programme Core Courses (PCC)** include the core courses relevant to the chosen programme of study and the Employability Enhancement courses such as Project, Seminar and Inplant training/ Internship.

3. **Programme Elective Courses (PEC)** include the elective courses relevant to the chosen programme of study.

4. **Open Elective Courses (OEC)** include Inter-disciplinary and Trans-disciplinary courses. The students shall study Inter-disciplinary courses offered in other Engineering/Technology Programmes through regular mode and Trans-disciplinary courses through self study mode.

5. **Mandatory courses (MAC)** include the courses recommended by the regulatory bodies such as AICTE, UGC etc as given below:

    a. Technical English / Professional English
    b. Professional Ethics and Human Values
    c. Environmental Science and Engineering
    d. Communication Skills Laboratory

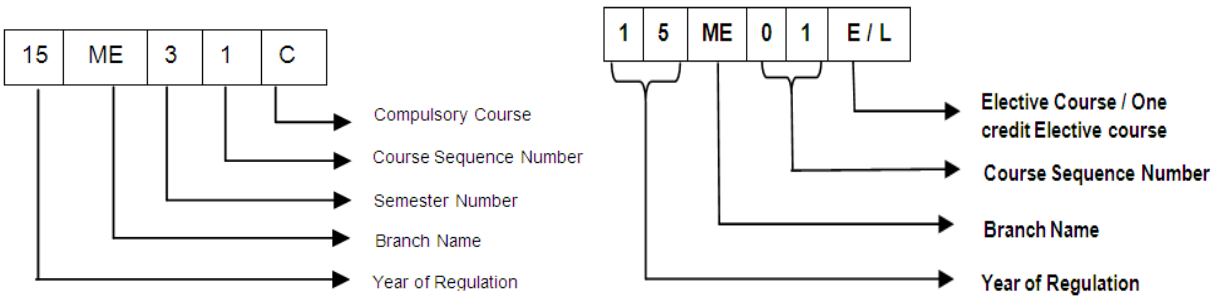
6. Every student shall undergo one Interdisciplinary and one Transdisciplinary course.

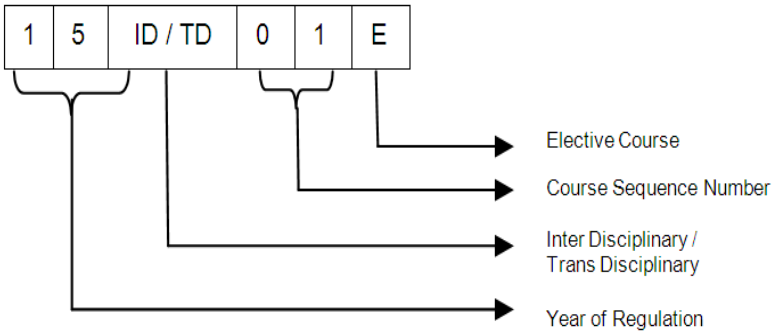
    Performance in each course of study shall be evaluated based on Continuous Assessment throughout the semester and end semester examination at the end of the programme. Keeping in mind the content of the courses and delivery methods, different question paper patterns are suggested.

QP - Question Pattern

Question pattern	1 mark	2 marks	4 marks	10 marks	12 marks	16 marks	20 marks	Total
A	--	--	--	--	--	--	1 Qn Compulsory & 4 Qns (either or type)	100
B	--	10	--	--	--	1 Qn Compulsory & 4 Qns (either or type)	--	100
C	10	--	10 out of 12	1 Qn Compulsory & 4 Qns (either or type)	--	--	--	100
D	10	10	5 out of 6	1 Qn Compulsory & 4 Qns (either or type)	--	--	--	100
E	--	10	5 out of 6	--	1 Qn Compulsory & 4 Qns (either or type)	--	--	100
F	--	--	--	--	--	--	5 out of 8	100
G	--	5	--	2 Qns (either or type)	--	--	--	30

FORMAT FOR COURSE CODE





B.E. – MECHANICAL ENGINEERING

REGULATIONS – 2015

CURRICULUM AND SYLLABUS

SEMESTER – I

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	MAC	15SH11C	Technical English*	3	0	0	3	B
2.	CFC	15SH12C	Mathematical Foundations for Engineers*	3	2	0	4	B
3.	CFC	15SH13C	Engineering Physics*	3	0	0	3	B
4.	CFC	15SH14C	Engineering Chemistry*	3	0	0	3	B
5.	CFC	15SH15C	Introduction to Engineering*	2	0	0	2	A
6.	CFC	15SH16C	Engineering Graphics*	2	0	2	3	A
PRACTICAL								
7.	CFC	15SH17C	Engineering Physics and Engineering Chemistry Laboratory*	0	0	2	1	-
8.	CFC	15SH18C	Engineering Practice Laboratory*	0	0	2	1	-
			TOTAL	**16**	**2**	**6**	**20**	

SEMESTER – II

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	MAC	15ME21C	Professional English*	3	0	0	3	B
2.	SFC	15ME22C	Computational Methods with Algorithm	3	2	0	4	B
3.	SFC	15ME23C	Engineering Materials Science	3	0	0	3	B
4.	SFC	15ME24C	Chemistry for Mechanical Engineering	3	0	0	3	B
5.	CFC	15ME25C	C Programming for Engineers*	3	0	0	3	B
6.	SFC	15ME26C	Mechanics of Rigid Body	3	2	0	4	C
7.	SFC	15ME27C	Introduction to Mechanical Engineering and Design	2	0	0	2	A
PRACTICAL								
8.	CFC	15ME28C	C Programming Laboratory*	0	0	2	1	-
9.	SFC	15ME29C	Physics and Chemistry Laboratory	0	0	2	1	-
			TOTAL	**20**	**4**	**4**	**24**	

MAC - Mandatory Course, CFC - Common Foundation Course, SFC - Specific Foundation Course,
PCC – Programme Core Course, *X*EC - *X* Stands for P or O (PEC – Programme Elective Course,
OEC – Open Elective Course) *****Common to all B.E. / B.Tech., Programmes

SEMESTER – III

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	SFC	15ME31C	Applied Mathematics	3	2	0	4	B
2.	SFC	15ME32C	Basic Electrical Engineering	3	0	0	3	B
3.	SFC	15ME33C	Material Technology	3	0	0	3	B
4.	SFC	15ME34C	Thermal science	3	2	0	4	B
5.	PCC	15ME35C	Manufacturing Technology-I	3	0	0	3	B
PRACTICAL								
6.	PCC	15ME36C	Manufacturing Technology Laboratory-I	0	0	2	1	-
7.	SFC	15ME37C	Drafting and Modeling Laboratory	0	0	2	1	-
8.	MAC	15ME38C	Communication Skills Laboratory*	0	0	2	1	-
9.	SFC	15ME39C	Electrical Engineering Laboratory	0	0	2	1	-
			TOTAL	**15**	**4**	**8**	**21**	

SEMESTER – IV

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	SFC	15ME41C	Fluid Mechanics and Machinery	2	2	0	3	C
2.	SFC	15ME42C	Mechanics of Materials	3	2	0	4	C
3.	PCC	15ME43C	Thermal Engineering	3	2	0	4	E
4.	PCC	15ME44C	Manufacturing Technology-II	3	0	0	3	B
5.	PCC	15ME45C	Kinematics of Machinery	3	2	0	4	B
6.	MAC	15ME46C	Environmental Science and Engineering	3	0	0	3	A
PRACTICAL								
7.	SFC	15ME47C	Fluid Mechanics and Machinery Laboratory	0	0	2	1	-
8.	SFC	15ME48C	Material Testing Laboratory	0	0	2	1	-
9.	PCC	15ME49C	Manufacturing Technology Laboratory-II	0	0	2	1	-
			TOTAL	**17**	**8**	**6**	**24**	

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SEMESTER – V

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY & INTEGRATED COURSES								
1.	PCC	15ME51C	Heat and Mass Transfer	2	2	0	3	A
2.	PCC	15ME52C	Dynamics of Machinery	2	2	0	3	B
3.	PCC	15ME53C	Design of Machine Elements	3	2	0	4	A
4.	PCC	15ME54C	Computer Aided Design and Manufacturing	3	0	0	3	E
5.	PCC	15ME55C	Instrumentation, Mechanical Measurements and Control	3	0	0	3	B
6.	MAC	15ME56C	Professional Ethics and Human Values*	3	0	0	3	A
PRACTICAL								
7.	PCC	15ME57C	Thermal and Heat Transfer Laboratory	0	0	2	1	-
8.	PCC	15ME58C	Dynamics Laboratory	0	0	2	1	-
9.	PCC	15ME59C	Computer Aided Design and Manufacturing Laboratory	0	0	2	1	-
			TOTAL	**17**	**4**	**6**	**22**	

SEMESTER – VI

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY & INTEGRATED COURSES								
1.	PCC	15ME61C	Metrology and Quality Engineering	3	0	0	3	B
2.	PCC	15ME62C	Design of Transmission Systems	3	2	0	4	A
3.	PCC	15ME63C	Finite Element Analysis	2	2	0	3	B
4.	MAC	15ME64C	Project Management and Finance*	3	0	0	3	B
5.	*X*EC		Elective-I	3	0	0	3	
PRACTICAL								
6.	PCC	15ME65C	Comprehension	0	0	2	1	-
7.	PCC	15ME66C	Metrology and Automation Laboratory	0	0	2	1	-
8.	PCC	15ME67C	Computer Aided Analysis Laboratory	0	0	2	1	-
9.	PCC	15ME68C	Simulation Laboratory	0	0	2	1	-
10.	PCC	15ME69C	Product Development Laboratory*	0	0	4	2	-
			TOTAL	**13**	**6**	**12**	**22**	

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OEC – Open Elective Course) *****Common to all B.E. / B.Tech., Programmes

SEMESTER – VII

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	*X*EC		Elective-II	3	0	0	3	-
2.	*X*EC		Elective-III	3	0	0	3	-
3.	*X*EC		Elective-IV	3	0	0	3	-
4.	*X*EC		Elective-V	3	0	0	3	-
5.	*X*EC		Elective-VI	3	0	0	3	-
PRACTICAL								
6.	PCC	15ME71C	Mini Project	0	0	8	4	-
7.	PCC	15ME72C	Research Paper and Patent Review-Seminar	0	0	2	1	-
			TOTAL	**15**	**0**	**10**	**20**	

SEMESTER – VIII

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
THEORY								
1.	*X*EC		Elective-VII	3	0	0	3	-
2.	*X*EC		Elective-VIII	3	0	0	3	-
PRACTICAL								
3.	PCC	15ME81C	Internship / Inplant Training	0	0	4	2	-
4.	PCC	15ME82C	Project Work	0	0	20	10	-
			TOTAL	**6**	**0**	**24**	**18**	

MAC - Mandatory Course, CFC - Common Foundation Course, SFC - Specific Foundation Course,
PCC – Programme Core Course, *X*EC - *X* Stands for P or O (PEC – Programme Elective Course,
OEC – Open Elective Course) *****Common to all B.E. / B.Tech., Programmes

PROGRAMME ELECTIVE COURSES (PEC)

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Thermal Engineering Domain								
1.	PEC	15ME01E	Refrigeration and Air Conditioning	3	0	0	3	E
2.	PEC	15ME02E	Design of Heat Exchanger And Pressure Vessel	2	0	2	3	A
3.	PEC	15ME03E	Automobile Engineering	3	0	0	3	B
4.	PEC	15ME04E	Internal Combustion Engines	3	0	0	3	E
5.	PEC	15ME05E	Gas Dynamics	3	0	0	3	E
6.	PEC	15ME06E	Propulsion Systems	3	0	0	3	E
7.	PEC	15ME07E	Turbomachines	3	0	0	3	E
8.	PEC	15ME08E	Power Plant Engineering	3	0	0	3	B
9.	PEC	15ME09E	Wind Energy	3	0	0	3	B
10.	PEC	15ME10E	Solar Energy	3	0	0	3	B
11.	PEC	15ME11E	Solar Photovoltaic Fundamentals and Applications	3	0	0	3	E
12.	PEC	15ME12E	Thermal Design and Management of Electronic Equipments	3	0	0	3	A
13.	PEC	15ME13E	Energy Conservation and Waste Heat Recovery	3	0	0	3	A
Design Engineering Domain								
14.	PEC	15ME31E	Hydraulics and Pneumatics	3	0	0	3	B
15.	PEC	15ME32E	Design of Jigs, Fixtures And Press Tools	3	0	0	3	A
16.	PEC	15ME33E	Mechatronics and Modern Control	3	0	0	3	B
17.	PEC	15ME34E	Robotics	3	0	0	3	B
18.	PEC	15ME35E	Aircraft Engineering	3	0	0	3	B
19.	PEC	15ME36E	Experimental Stress Analysis	3	0	0	3	A
20.	PEC	15ME37E	Fatigue, Fracture and Failure Analysis	3	0	0	3	B
21.	PEC	15ME38E	Advanced Modeling Techniques	2	0	2	3	A
22.	PEC	15ME39E	Piping Design Engineering	2	0	2	3	A
23.	PEC	15ME40E	Applied Computational Fluid Dynamics and Finite Element Analysis	2	0	2	3	A
24.	PEC	15ME41E	Vibration Control	3	0	0	3	B
25.	PEC	15ME42E	Vehicle Systems Design	3	0	0	3	B
26.	PEC	15ME43E	Industrial Tribology	3	0	0	3	B

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
27.	PEC	15ME44E	New Product Development	3	0	0	3	A
Manufacturing and Industrial Engineering Domain								
27.	PEC	15ME61E	Fundamentals of Nano Technology	3	0	0	3	B
28.	PEC	15ME62E	Composite Materials	3	0	0	3	B
29.	PEC	15ME63E	Unconventional Machining Processes	3	0	0	3	A
30.	PEC	15ME64E	Welding Technology	3	0	0	3	B
31.	PEC	15ME65E	Maintenance Engineering	3	0	0	3	B
32.	PEC	15ME66E	Non Destructive Evaluation	2	0	2	3	A
33.	PEC	15ME67E	Quality Control of Welded Structures	3	0	0	3	B
34.	PEC	15ME68E	Industrial Safety Engineering	3	0	0	3	B
35.	PEC	15ME69E	Production Planning and Control	3	0	0	3	B
36.	PEC	15ME70E	Engineering Economics and Cost Analysis	3	0	0	3	B
37.	PEC	15ME71E	Total Quality Management	3	0	0	3	B
38.	PEC	15ME72E	Marketing Management	3	0	0	3	B
39.	PEC	15ME73E	Operations Research	3	0	0	3	A
40.	PEC	15ME74E	Entrepreneurship Development	3	0	0	3	B
41.	PEC	15ME75E	Additive Manufacturing	3	0	0	3	B

ONE CREDIT ELECTIVE COURSES (PEC)

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Thermal Engineering Domain								
1.	PEC	15ME01L	Shell and Tube Heat Exchanger Design	1	0	0	1	G
2.	PEC	15ME02L	Energy Audit and Management	1	0	0	1	G
3.	PEC	15ME03L	Pyrolysis and Gasification	1	0	0	1	G
4.	PEC	15ME04L	Heat Transfer Enhancement	1	0	0	1	G
5.	PEC	15ME05L	Grid Tied PV System Design	1	0	0	1	G
6.	PEC	15ME06L	Off Grid PV System Design	1	0	0	1	G
7.	PEC	15ME07L	Thermal Energy Storage Systems	1	0	0	1	G
8.	PEC	15ME08L	Solar Thermal Steam Generation Systems	1	0	0	1	G
9.	PEC	15ME09L	Solar Cooling Systems	1	0	0	1	G

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
10.	PEC	15ME10L	Desalination	1	0	0	1	G
Design Engineering Domain								
11.	PEC	15ME11L	Industrial Drawing Reading with GD&T	1	0	0	1	G
12.	PEC	15ME12L	Process Equipment Design	1	0	0	1	G
13.	PEC	15ME13L	Techniques for Vibration monitoring and controls	1	0	0	1	G
14.	PEC	15ME14L	Crashworthiness of Tubular Shells	1	0	0	1	G
15.	PEC	15ME15L	Failure mode and effects Analysis	1	0	0	1	G
16.	PEC	15ME16L	Design of Experiments	1	0	0	1	G
17.	PEC	15ME17L	Taguchi Methods	1	0	0	1	G
Manufacturing and Industrial Engineering Domain								
18.	PEC	15ME18L	Natural Fiber Composites	1	0	0	1	G
19.	PEC	15ME19L	Optimization in Scheduling	1	0	0	1	G
20.	PEC	15ME20L	Functional Materials for Energy Conversion	1	0	0	1	G
21.	PEC	15ME21L	Design for Manufacturability	1	0	0	1	G
22.	PEC	15ME22L	Project Management	1	0	0	1	G
23.	PEC	15ME23L	Design a Startup	1	0	0	1	G
24.	PEC	15ME24L	CDIO Approach in Product Design and Project Management	1	0	0	1	G
25.	PEC	15ME25L	Digital Manufacturing	1	0	0	1	G
26.	PEC	15ME26L	Codes and Standards	1	0	0	1	G

Open Elective Course (OEC)

Group – I (Inter-disciplinary courses)

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Any one of the following course is compulsory								
1.	OEC	15ID01E	Product Design and Development	3	0	0	3	A
2.	OEC	15ID02E	Disaster Management	3	0	0	3	A
3.	OEC	15ID03E	Energy Engineering	3	0	0	3	A
4.	OEC	--	Other Programme Courses	3	0	0	3	**As specified for the Chosen Course**

Group-II (Trans-disciplinary courses) - Self Study Course

S. No	Course Category	Course Code	COURSE TITLE	L	T	P	C	QP
Any one of the following course is compulsory								
1.	OEC	15TD01E	Indian Business Laws	0	0	0	3	F
2.	OEC	15TD02E	Leadership and Personality Development	0	0	0	3	F
3.	OEC	15TD03E	International Business Management	0	0	0	3	F
4.	OEC	15TD04E	Basics of Marketing	0	0	0	3	F
5.	OEC	15TD05E	Retailing and Distribution management	0	0	0	3	F
6.	OEC	15TD06E	International Economics	0	0	0	3	F
7.	OEC	15TD07E	Indian Economy	0	0	0	3	F
8.	OEC	15TD08E	Rural Economics	0	0	0	3	F
9.	OEC	15TD09E	International Trade	0	0	0	3	F
10.	OEC	15TD10E	Global Challenges and issues	0	0	0	3	F
11.	OEC	15TD11E	Indian Culture and Heritage	0	0	0	3	F
12.	OEC	15TD12E	Indian History	0	0	0	3	F
13.	OEC	15TD13E	Sustainable Development and Practices	0	0	0	3	F
14.	OEC	15TD14E	Women in Indian Society	0	0	0	3	F
15.	OEC	15TD15E	Indian Constitution	0	0	0	3	F
16.	OEC	15TD16E	Bio Mechanics in Sports	0	0	0	3	F

15SH11C TECHNICAL ENGLISH L T P C

(Common to all B.E. / B.Tech. Degree Programmes) 3 0 0 3

COURSE OUTCOMES

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

CO1: acquire the basics of English communication skills**.** (K3)

CO2: apply the basic language skills to understand various aspects of technical writing. (K3)

CO3: understand main ideas, specific details and implied meaning while listening and develop the factual & imaginative information. (K2)

CO4: coordinate and communicate in a wide range of situation. (K3)

CO5: integrate and apply the acquired skills in real life situation. (K2)

UNIT I **9**

Parts of Speech - Sentence Structure (SV/SVO/SVC/SVIODO) - Identifying the kinds of sentences (Statement, Interrogative, Imperative, Exclamatory & Negative) - Informal writing (Diary writing & letter to friend / parent / siblings) - Self Introduction -Listening for general information.

UNIT II **9**

Transformation of words into different grammatical forms- Converting one kind of sentence into another sentence (Statement, Interrogative, Imperative, Exclamatory & Negative) - Technical Vocabulary - Tense Usage (Present tense- Past tense - Future tense - Writing passages in all tenses) -Letter writing (Permission letter & Requisition letter) - Listening for specific information.

UNIT III **9**

Personality Adjective - Concord - Letter Writing: Invitation / Acceptance letters - Itinerary Writing (with valued points / situation) - Phonetics (Vowels - Consonants - Diphthongs) - Listening and filling up the information - Process Description (with valued points).

UNIT IV **9**

IF Conditionals - British & American Vocabulary - Letter Writing (Declining / Thanking letters) - Email writing (with valued points) - Instruction Writing - Listening and giving opinion on the pictures.

UNIT V **9**

Reading comprehension **-** Error Spotting (Article, Preposition, Modals and Concord) **-** Presenting article based on newspaper reading- Situational Conversation - Listening and writing dialogues – Checklists.

L: 45 TOTAL: 45 PERIODS

Suggested Activity: Each student should read the suggested fiction for oral assignment

TEXT BOOKS

1. Rizvi. M. Ashraf, “Effective Technical Communication”, 1st Edition, The Mc Graw Hill Education Private Limited, New Delhi, 2005.

2. Dutt P. K., Rajeevan G. and Prakash C.L.N., "A Course in Communication Skills", 1st Edition, Cambridge University Press, India, 2007.

REFERENCES

1. John Sinclair, "Collins Cobuild English Grammar", 3rd Edition, Collins Publishers, London, 2011.
2. Jan Svartvik, Sidney Greenbaum, Geoffery Leech, Randolph Quirk "A Comprehensive Grammar of the English Language", 2nd Edition, Longman Inc., Newyork, 2014.
3. Micheael Vince, Peter Sunderland, "Advanced Language Practice with Key", 3rd Edition, Macmillan Publishers Limited, Italy, 2003.

Listening files: Audio files from net sources,
Softwares: ODLL, Globerena.

15SH12C MATHEMATICAL FOUNDATIONS FOR ENGINEERS L T P C
(Common to all B.E. / B.Tech. Degree Programmes) 3 2 0 4

COURSE OUTCOMES

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

CO 1: make use of orthogonal transformation. (K3)
CO 2: use the basic concepts of three dimensional geometry in engineering. (K2)
CO 3: obtain maxima and minima of real valued functions. (K3)
CO 4: solve ordinary differential equations. (K3)
CO 5: solve partial differential equations. (K3)

UNIT I MATRICES 15

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Independency and dependency of Eigen vectors – Properties of Eigen values and Eigen vectors (excluding proofs) - Diagonalization of a matrix by orthogonal transformation - Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation and its nature.

UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY 15

Direction cosines and Direction ratios- Planes and Lines - Equations of plane and line - Intersection of two planes - Shortest distance between two lines - Equation of a sphere - Plane section of a sphere - Tangent Plane - Orthogonal spheres.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 15

Euler's theorem on homogeneous functions of two variables - Taylor's Series - Jacobians - Maxima and Minima - Constrained Maxima and Minima by the method of Lagrange multipliers.

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 15

Solutions of higher order linear differential equations with constant coefficients - Cauchy's and Legendre's linear equations - Solutions of simultaneous first order linear equations with constant coefficients - Method of variation of parameters.

UNIT V PARTIAL DIFFERENTIAL EQUATIONS 15

Formation of partial differential equations - Lagrange's linear equations - Solutions of standard types of first order partial differential equations - Solutions of homogeneous linear partial differential equations of second and higher order with constant coefficients.

L: 45 T: 30 TOTAL: 75 PERIODS

TEXT BOOKS

1. Grewal.B.S. "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India, 2011.

REFERENCES

1. Bali.N.P. and Manish Goyal, "A Textbook of Engineering Mathematics", 8th Edition, Laxmi Publications Private Limited, 2011.
2. George B.Thomas, Jr. Ross L.Finney, "Calculus and Analytic Geometry", 9th Edition, Dorling Kindersley Private Limited, 2010.
3. Sharma.G.S and Sarna.I.J.S, "Engineering Mathematics", 10th Edition, CBS Publishers and Distributors, New Delhi, 2005.
4. James C. Robinson, "An Introduction to Ordinary Differential Equations", Cambridge University Press, 2004.
5. Anthony Croft, Robert Davison, Martin Hargreaves and James Flint, "Engineering Mathematics: A Foundation for Electronic, Electrical, Communications and System Engineers", 4th Edition, Pearson Education Private Limited, 2013.

15SH13C ENGINEERING PHYSICS L T P C

(Common to all B.E. / B.Tech. Degree Programmes) 3 0 0 3

COURSE OUTCOMES

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

CO 1: summarize the properties and structures of solids. (K2)

CO 2: define the principles of acoustics and ultrasonics and apply the ultrasonic methods for industrial and medical field. (K2)

CO 3: choose the appropriate Laser technique for industrial and medical applications. (K3)

CO 4: describe the different types, fabrication, losses of optical fibers and their applications in communication and instrumentation. (K2)

CO 5: explain the physical properties of photons & electrons and their applications in different electron microscopes. (K3)

UNIT I PROPERTIES OF MATTER AND CRYSTAL PHYSICS 9

Hooke's law - Types of moduli of elasticity - Determination of Rigidity modulus and Young's modulus - I shaped Girders.

Miller indices – d spacing - Characteristics of SC, BCC, FCC and HCP structures.

UNIT II ACOUSTICS AND ULTRASONICS 9

Acoustics: Weber-Fechner law - Sabine's formula - Absorption Coefficient and its determination - factors affecting acoustics of buildings and their remedies.

Ultrasonics: Production - magnetostriction generator - piezoelectric generator, Properties - Cavitations - Velocity measurement - acoustic grating, Industrial applications - Medical application - Sonograms.

UNIT III LASER SYSTEM AND APPLICATIONS 9

Einstein's A and B coefficients – Types and working of Lasers - CO_2 Laser, Nd-YAG Laser, Semiconductor Laser (Homojunction), Determination of wavelength of Laser and Particle size - Industrial applications - Medical applications-Holography.

UNIT IV FIBER OPTICS AND ITS APPLICATIONS 9

Numerical aperture and Acceptance angle - Types of optical fibers - Double crucible technique – Splicing - Loss in optical fiber - Fiber optical communication system - Applications - Fiber optic sensors - Endoscope.

UNIT V QUANTUM PHYSICS 9

Photo electric effect - Matter Waves - Davisson and Germer experiment - Heisenberg's Uncertainty principle - Schrodinger's wave equation - particle in one dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics", 10th Edition, John Wiley & Sons Inc.USA, 2014.
2. Arthur Beiser, "Concepts of Modern Physics", 6th Edition, McGraw Hill Publications Private Limited, 2008.

REFERENCES

1. Richard P.Feynmann, Robert B Leighton and Mathew Sands, "Feynmann's Lectures on Physics", 4th Edition, Addison Wesley Publication USA, 2010.
2. Yoav Peleg, Reuven Pnini, Elvahu Zaarur, Eugene Hecht, "Schaum's Outline of Quantum Mechanics", 2nd Edition, McGraw Hill Companions Limited, USA, 2010.
3. William T.Silfvast, "Laser Fundamentals", 2nd Edition, Cambridge University Press, NewYork, 2008.

15SH14C ENGINEERING CHEMISTRY L T P C

(Common to all B.E. / B.Tech. Degree Programmes) 3 0 0 3

COURSE OUTCOMES

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

CO 1: identify suitable water treatment techniques for industrial and domestic purpose. (K3)

CO 2: explain the type of corrosion and corrosion control methods. (K3)

CO 3: select the polymer for specific application. (K2)

CO 4: explain the preparation, properties and applications of nano materials. (K2)

CO 5: outline the principle and instrumentation of various analytical techniques. (K2)

UNIT I WATER TREATMENT 9

Types of water - hardness - estimation of hardness of water – disadvantages of using hard water in boiler – oils and silica in water; water softening – internal conditioning – external conditioning – domestic water treatment – desalination.

UNIT II CORROSION AND ITS CONTROL 9

Chemical corrosion – electrochemical corrosion – mechanism – different types of electrochemical corrosion – factors influencing corrosion – corrosion control methods.

UNIT III ENGINEERING POLYMERS 9

Polymers – polymerization – free radical mechanism – plastics – thermo plastics and thermosetting plastics – processing and moulding of plastics – special polymers: fire retardant, conducting, photonic and electro luminescent polymer; composites – polymer matrix composites.

UNIT IV NANO MATERIALS 9

Nanoparticles – synthesis of CNT – precipitation, thermolysis, hydrothermal, solvothermal, electrodeposition, chemical vapour deposition, laser ablation – toxic effect of nano materials- properties and applications.

UNIT V ANALYTICAL TECHNIQUES 9

Principle, instrumentation and applications of UV-Visible and IR spectroscopy; chromatography: instrumentation and working of gas chromatography and HPLC; conductivity measurements – pH measurements – applications.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Jain P.C. and Jain. M., “Engineering Chemistry”, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2013.
2. Dara S.S. and Umare S.S., “A text book of Engineering Chemistry”, S.Chand and Company Limited, New Delhi, 2013.
3. Chawla.S, “A text book of Engineering Chemistry”, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2015.

REFERENCES

1. Ahmed Z., "Principles of corrosion engineering and corrosion control", Butterworth Heinemann, 2006.
2. Ebewele R.O., "Polymer science and Technology", CFC Press, Newyork, 2000.
3. Charless P. P. and Frank O. J, ,"Introduction to nano technology" John Wiley & Sons, 2008
4. Skoog D.A., James H. F. and Crouch S.R., "Instrumental Analysis", Cengage Learning India Private Limited, New Delhi, 2011
5. Mc Cash E.M. and Banwell C.N., "Fundamentals of molecular spectroscopy", 5th Edition, McGraw Hill Education (India) Private Limited, 2013.

15SH15C INTRODUCTION TO ENGINEERING L T P C
(Common to all B.E./B.Tech. Degree Programmes) **2 0 0 2**

COURSE OUTCOMES

Upon Completion of this course, the students will be able to

CO 1: discuss the history of engineering through various engineering wonders in past and identify the engineering profession. (K2)

CO 2: analyze various engineering career paths and prepare for an engineering career. (K3)

CO 3: explain the profile of engineers in various fields. (K2)

CO 4: summarize the OBE concepts and its components. (K2)

CO 5: explain the components of learning and creativity. (K2)

UNIT I HISTORY OF ENGINEERING AND INTRODUCTION TO ENGINEERING PROFESSION 7

History of Engineering: Definition of Engineering, The Beginnings of Engineering, Overview of ancient Engineering, Traveling through the Ages, A case study of two historic Engineers – Lionardo da Vincy, Gutenberg.

Introduction to Engineering Profession: Engineering work is all around you - Engineering as a profession and common traits of Good Engineers – History of Engineering Disciplines – Functions of Engineering.

UNIT II CAREER PATHS OF ENGINEER AND PREPARING FOR AN ENGINEERING CAREER 8

Career Paths for Engineers: The corporate ladder, The independent entrepreneur, Employment Opportunities in Government, The military, Engineering and social service abroad, The Engineering Professor, Graduate work outside of engineering, A mix of two or more of the first six options.

Preparing for an Engineering Career: Making the Transition from High School to College - Budgeting Your Time - Daily Studying and Preparation - Getting Involved with an Engineering Organization - Your Graduation Plan - Other Considerations.

UNIT III PROFILES OF ENGINEERS 4

Initial Career Profiles of Civil, Mechanical, Electrical, Electronics, Instrumentation, Communication, Information Technology, Computer Engineering Graduates.

UNIT IV OVERVIEW OF OBE AND CBCS 4

Graduate attributes of Washington Accord – Programme Specific Criteria (PSC) – Programme Educational Objectives (PEOs) – Programme Outcomes (POs) – Course Outcomes (COs) – CBCS : Course categories - Scheme of instruction, Assessment and Evaluation.

UNIT V LEARNING AND CREATIVE THOUGHT 7

Introduction: The successful engineering student - the engineering curriculum - curriculum planning and management - adapting to the college classroom.

The learning process: the nature of learning - information processing and memory - determinants of efficient learning - practical suggestions for learning.

Differences in the way people think: The four-quadrant model of thinking - hindrances to problem solving.

On Creativity: What is creativity? - the nature of creativity - characteristics of creative people - the creative process - overcoming obstacles to creative thinking.

L: 30 TOTAL: 30 PERIODS

REFERENCES

1. Paul H. Wright, “Introduction to Engineering”, School of Civil and Environmental Engineering, 3rd Edition, John Wiley & Sons, Inc, 2002.
2. Saeed Moaveni, “Engineering Fundamentals an Introduction to Engineering”, 4th Edition, Cengage Learning, USA, 2011.
3. William C. Oakes, Les L. Leone and Craig J. Gunn, “Engineering Your Future – A Comprehensive Introduction to Engineering”, Oxford University Press, USA, 2010.
4. Philip Kosky, George Wise, Robert Balmer and William Keat, “Exploring Engineering An Introduction to Engineering and Design”, Academic Press, Elsevier, USA, 2010.

WEB RESOURCES

www.ieagreements.org/IEA-Grad-Attr-Prof-Competencies.pdf

15SH16C ENGINEERING GRAPHICS L T P C

(Common to all B.E./B.Tech. Degree Programmes) 2 0 2 3

COURSE OUTCOMES

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

CO 1: sketch the projections of points, straight lines and lamina. (K2)

CO2: construct the projections of various solids in different positions. (K2)

CO 3: draw the sectional views of various solids and construct the true shape of the section. (K3)

CO 4: draw the surface areas and isometric views of solids. (K3)

CO5: draw perspective views of simple solids and draw the orthographic views of simple objects. (K3)

UNIT I PROJECTION OF POINTS, LINES AND PLANE SURFACES 12

Drawing Instruments- IS specifications on lines- drawing sheets- Printing letters and dimensioning- scales - First angle projection. (Not for examination).

Projections of points and straight lines located in the first quadrant- Determination of true lengths and true inclinations. Projections of regular polygonal surfaces and circular lamina inclined to both reference planes

UNIT II PROJECTION OF SOLIDS 12

Projections of simple solids - axis inclined to one reference plane - change of position method.

UNIT III SECTION OF SOLIDS 12

Sectioning of simple solids - cutting planes inclined to one reference plane and perpendicular to the other.

UNIT IV DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS 12

Development of lateral surfaces of simple and truncated solids - Principles of isometric projection and view of simple solids - truncated prism and pyramids.

UNIT V PERSPECTIVE PROJECTIONS AND ORTHOGRAPHIC PROJECTIONS 12

Perspective projection of cube, prisms and pyramids by visual ray method and vanishing point method. Orthographic projection – simple objects with straight and curved surfaces.

L: 30 P: 30 TOTAL: 60 PERIODS

TEXT BOOKS

1. Bhatt N.D, "Engineering Drawing", 53rd Edition, Charotar Publishing House, 2014.
2. Natrajan K.V, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.

REFERENCES

1. Kumar M.S, "Engineering Graphics", D.D. Publications, 2007.
2. Venugopal K and Prabhu Raja V, "Engineering Graphics", New Age International Private Limited, 2008.
3. Shah M.B and Rana B.C, "Engineering Drawing", Pearson Education, 2005.
4. Gopalakrishna K.R, "Engineering Drawing", 32nd Edition, Subhas Publications, 2005.
5. Dhananjay Jolhe A, "Engineering Drawing with an Introduction to AutoCAD", Tata McGraw Hill Publishing Company Limited, 2008.
6. Basant Agarwal and Agarwal C.M, "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

15SH17C ENGINEERING PHYSICS AND ENGINEERING CHEMISTRY LABORATORY

(Common to all B.E./B.Tech. Degree Programmes) **L T P C**

0 0 2 1

PART A – ENGINEERING PHYSICS LABORATORY

COURSE OUTCOMES

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

CO1: demonstrate the properties of light waves. (K3)

CO2: interpret the production of ultrasounds and how the velocity of ultrasounds varies with respect to medium. (K3)

CO3: illustrate the mechanical and electrical properties of materials. (K3)

LIST OF EXPERIMENTS

1. Determination of thickness of a thin wire – Air wedge method.
2. Determination of velocity of sound and compressibility of the liquid – Ultrasonic Interferometer.
3. Determination of Dispersive power of a prism using Spectrometer.
4. Determination of Young's modulus – Uniform bending method.
5. Torsional pendulum – Determination of Moment of Inertia of the disc and Rigidity modulus of the material of the wire.
6. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.
7. Calibration of voltmeter / ammeter using potentiometer.
8. Determination of Frequency of A.C. mains using Sonometer.
9. Determination of the angular divergence of a laser beam using He-Ne laser or diode laser.
10. Determination of temperature coefficient of resistance.

P: 15 TOTAL: 15 PERIODS

PART B - ENGINEERING CHEMISTRY LABORATORY

COURSE OUTCOMES

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

CO 1: estimate the amount of hardness of the water sample (K5)

CO 2: determine the rate of corrosion (K5)

CO 3: synthesize a polymer and to determine molecular weight of the polymer (K6)

CO 4: synthesize silver nano particles (K6)

CO 5: quantify different ions by different analytical techniques (K5)

LIST OF EXPERIMENTS

1. Estimation of hardness of water sample by EDTA method
2. Rate of corrosion- weight loss method
3. Synthesis of urea-formaldehyde resin
4. Determination of molecular weight of a polymer – Oswald's viscometer

5. Synthesis and characterization of silver nano particles.
6. Estimation of iron (Fe^{2+}) in water sample by dichrometry
7. Estimation of hydrochloric acid by conductometric method
8. Estimation of mixture of acids by conductometric method
9. Determination of purity of simple organic compounds using HPLC- (Demo).

P: 15 TOTAL: 15 PERIODS

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.

REFERENCES

1. Harris D.C., "Quantitative Chemical Analysis: International Edition", 8th Edition, W.H. Freeman, 2010.
2. Mendham J., "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson Publisher, 2009.
3. Vogel A.I., "Vogel's Textbook of Quantitative Chemical Analysis", 5th Edition, Longman Scientific & Technical, 1989.

15SH18C ENGINEERING PRACTICE LABORATORY L T P C
(Common to all B.E./B.Tech. Degree Programmes) 0 0 2 1

PART A - MECHANICAL LABORATORY

COURSE OUTCOMES

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

CO 1: make basic carpentry joints. (K3)
CO 2: prepare welded joints using arc and gas welding. (K3)
CO 3: perform machining operations using lathe, shaper and drilling machine. (K3)

UNIT I CARPENTRY PRACTICES 5

Study of carpentry tools – preparation of joints like half lap, Tee and dove tail in wood.

UNIT II WELDING 5

Study of welding tools – Preparation of welded joints with Mild steel specimen like lap, butt and tee joints using ARC and Gas welding. (any one exercise should be given using Gas welding among three)

UNIT III BASIC MACHINING PRACTICES 5

Simple turning and taper turning using lathe – use of shaper and drilling machine for basic operations (Minimum three exercises should be given for students)

P: 15 TOTAL: 15 PERIODS

TEXT BOOK

1. Bawa H.S, "Workshop Practice", Tata McGraw Hill Publishing Company Limited, 2007.

REFERENCES

1. Ramesh Babu V, "Engineering Practices Laboratory Manual", Revised Edition, VRB Publishers Private Limited, Chennai, 2014.
2. Jeyachandran K, Natarajan S. and Balasubramanian S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
3. Jeyapoovan T, Saravanapandian M. and Pranitha S, "Engineering Practices Lab Manual", Vikas Publishing House Private Limited, 2006.
4. Rajendra Prasad A and Sarma PMMS, "Workshop Practice", Sree Sai Publication, 2002
5. Kannaiah P and Narayana KL, "Manual on Workshop Practice", Scitech Publications, 1999.

PART – B ELECTRICAL AND ELECTRONICS LABORATORY

COURSE OUTCOMES

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

CO 1: develop simple residential wiring circuits. (K5)
CO 2: calculate the basic electrical quantities. (K3)
CO 3: identify the value of resistance using appropriate methods. (K4)
CO 4: realize the fundamentals of Boolean algebra using digital logic gates. (K3)
CO 5: practice soldering to design PCB for electronic circuits. (K3)

I. ELECTRICAL ENGINEERING PRACTICE **8**

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair-case wiring.
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of electrical equipment.

II. ELECTRONICS ENGINEERING PRACTICE **7**

1. Study of Electronic components and equipments – Resistor, colour coding, measurement of AC signal parameters (peak-peak, rms period, frequency) using CRO
2. Study of logic gates AND, OR, XOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

P: 15 TOTAL: 15 PERIODS

REFERENCES

1. Jeyachandran K, Natarajan S and Balasubramanian S, “A Primer on Engineering Practices Laboratory”, Anuradha Publications, 2007.
2. Jeyapoovan T, Saravanapandian M and Pranitha S, “Engineering Practices Lab Manual”, Vikas Publishing House Private Limited, 2006.
3. Bawa H.S, “Workshop Practice”, Tata McGraw Hill Publishing Company Limited, 2007.
4. Rajendra Prasad A and Sarma P.M.M.S., “Workshop Practice”, Sree Sai Publication, 2002.
5. Kannaiah P and Narayana K.L, “Manual on Workshop Practice”, Scitech Publications, 1999.

15ME21C PROFESSIONAL ENGLISH L T P C

(Common to all B.E. / B.Tech. Degree Programmes) 3 0 0 3

COURSE OUTCOMES

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

CO 1: contribute the lingual power to frame sentences in different context. (K2)
CO 2: write effectively in any Professional context. (K3)
CO 3: acquire the skills related to Group discussion. (K3)
CO 4: communicate and respond in different social and professional contexts. (K3)
CO 5: recall the acquired skills in solving competitive exam. (K2)

UNIT I **9**

Phrasal Verbs (Based on root words: call, come, get, look, put, run, and take) - Foreign Words and Phrases (from the given list) - Listening to audio files and finding the technical words and framing different sentences - Channel conversion- Descriptive writing on various charts.

UNIT II **9**

Idioms and Phrases (with animal names from the given list) - Report writing (types-structure- stages in report writing- model report) - Job Application Letter with curriculum vitae.

UNIT III **9**

One word substitution (from the list given) Group Discussion (Why is GD a part of selection process? - Structure of GD – Strategies in GD – Team Work - Body Language - Video Samples-GD).

UNIT IV **9**

Choosing a suitable connotation (from the given list) - Note making – Preparing Circular and Minutes of meeting – Listening to TED Talks – Giving opinion on the given TED Talks and interviewing the TED talkers.

UNIT V **9**

Error Spotting (Tense, Relative Pronouns, Conjunctions, Sentence Structure, Adverb Placement) Sentence Completion - Reading comprehension.

L: 45 TOTAL: 45 PERIODS

Activity: Each student should read the suggested fiction for oral assignment.

TEXT BOOK

1. Tyagi Kavita and Padma Misra, "Advanced Technical Communication", 1st Edition, PHI Learning Private Limited, New Delhi, 2011.

REFERENCES

1. Smith-Worthington, Darlene & Sue Jefferson. "Technical Writing for Success", 1st Edition, Cengage Mason, USA, 2007.
2. Bovee, Courtland L., John V.Thill. "Business Communication Today", 12th Edition, Pearson Education, New Delhi, 2013.
3. Anderson, Paul V. "Technical Communication: A Reader - Centered Approach", 8th Edition, Cengage, New Delhi, 2013.

Listening files: Audio files from net sources and softwares: ODLL, Globerena.

15ME22C COMPUTATIONAL METHODS WITH ALGORITHM **L T P C**
3 2 0 4

COURSE OUTCOMES

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

CO 1: solve algebraic and transcendental equations using numerical methods. (K3)
CO 2: interpolate and approximate the polynomial. (K2)
CO 3: perform numerical differentiation and integration. (K3)
CO 4: find the solution of ordinary differential equation using numerical methods. (K2)
CO 5: classify and solve partial differential equations. (K2)

UNIT I SOLUTIONS OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS 15

Algorithm and simple problems on Newton - Raphson Method, Regula-Falsi Method, Fixed Point Iteration method - Solutions of Algebraic simultaneous linear equations - Direct Methods - Gauss Elimination and Gauss Jordan methods - Iterative Methods - Gauss-Jacobi and Gauss-Seidel Methods.

UNIT II INTERPOLATION WITH EQUAL AND UNEQUAL INTERVALS 15

Finite differences - Newton's Forward & Backward Difference Formulae - Central Differences - Stirling's Formula - Bessel's Formula - Lagrange's Formula and Newton's Divided Difference Formula - Algorithm for above methods.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 15

Algorithm and simple problems on Trapezoidal rule - Simpson's rules - Weddle's rule - Derivatives using Forward and Backward difference Formulae - Romberg integration - Double integration using Trapezoidal and Simpson's rules.

UNIT IV NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS 15

Taylor's Series Method - Euler's Method – Runge Kutta fourth order Method – Predictor - corrector Methods - Milne's Method - Adams Bash forth Method - Finite difference for solving ordinary differential equation - Algorithm for above methods.

UNIT V NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 15

Classification of Partial Differential Equations of second order - Algorithms and problems on finite difference solution of one dimensional heat equation by explicit and implicit methods - One dimensional wave equation and two dimensional Laplace and Poisson equations.

L: 45 T: 30 TOTAL: 75 PERIODS

TEXT BOOKS

1. Grewal.B.S., "Numerical Methods in Engineering and Science", 7th Edition, Khanna Publishers, New Delhi, 2007.
2. R.W.Ramming, "Numerical Methods for Scientists and Engineers", 2nd Edition, Dover Publication, Inc., New York, 1987.

REFERENCES

1. K.Sankara Rao, "Numerical Methods for Scientists and Engineers", 3rd Edition, Prentice Hall of India, 2008.
2. M.K.Jain, S.R.K.Iyengar & R.K.Jain, "Numerical Methods for Scientific and Engineering Computation", 5th Edition, New Age International Private Limited Publishers, (Reprint: 2009).

15ME23C ENGINEERING MATERIALS SCIENCE L T P C

3 0 0 3

COURSE OUTCOMES

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

CO1: express the thermal properties of materials. (K2)
CO2: explain the electrical properties of conducting and semiconducting materials. (K2)
CO3: summarize the physics underlying the magnetic and superconducting behaviours of materials. (K2)
CO4: predict the mechanism by which the electric field interacts with dielectric material and their applications. (K2)
CO5: illustrate the advanced materials' properties which are used in engineering applications and devices. (K2)

UNIT I THERMAL PROPERTIES OF MATERIALS 9

Modes of heat transfer - Rectilinear flow of heat along a metal bar - Methods of radial flow of heat - (i) Spherical shell method and (ii) cylindrical tube method - thermal conductivity of a poor conductor - Lee's disc method, Black body radiation – Planck's Theory.

UNIT II CONDUCTING MATERIALS AND SEMICONDUCTORS 9

Conductors:

Band theory of solids - Classical free electron theory of metal - Electrical and thermal conductivity – Wiedemann Franz law, Quantum free electron theory - Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – Carrier concentration in metals.

Semiconductors:

Types of Semiconductors - Intrinsic and Extrinsic Semiconductors – Definition - Hall effect.

UNIT III MAGNETIC MATERIALS AND SUPERCONDUCTORS 9

Magnetic materials:

Types and Properties of magnetic materials - Domain theory of ferromagnetic materials – Ferrites – Structure and applications.

Superconductors:

BCS Theory, Properties - Meissner effect – Isotopic effect, Type I and Type II superconductors - Applications of superconductors – Cryotron, SQUID and Magnetic levitated training.

UNIT IV DIELECTRIC MATERIALS 9

Types of dielectric materials - Polar and non-polar dielectrics - Types of Polarization – Electronic, ionic, orientation and space charge polarization - Frequency and temperature dependence of polarization, Internal field - Clausius – Mosotti relation - Dielectric loss and dielectric breakdown - Applications of dielectric materials - Ceramic materials - properties and applications.

UNIT V ADVANCED ENGINEERING MATERIALS 9

Shape memory alloys (SMA) - Nano materials - Solar cell – Biomaterials – Preparation, Properties and Applications.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Charles Kittel, "Introduction to Solid State Physics", 7th Edition, John Wiley and Sons, Singapore, 2007.
2. William D.Callister,Jr, "Materials Science and Engineering An introduction", 6th Edition, John Wiley and Sons, 2006.

REFERENCES

1. Daniel V Schroeder "An introduction to Thermal Physics" 1st Edition, Addison Wesley USA, 1999
2. Charles P. Poole and Frank Ownen.J, "Introduction to Nanotechnology", Wiley India, 2003
3. Ali Omar.M, "Elementary Solid State Physics", 6th Edition, Pearson Education Inc., 2009

15ME24C CHEMISTRY FOR MECHANICAL ENGINEERING L T P C
3 0 0 3

COURSE OUTCOMES

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

CO 1: apply the concept of phase rule to alloys (K3)
CO 2: acquire knowledge of electrochemistry and its applications. (K3)
CO 3: design an energy storage device by applying the basic concepts of batteries (K3)
CO 4: summarize different types of fuels and flue gas analysis (K2)
CO 5: select proper engineering materials for desired engineering application (K3)

UNIT I PHASE RULE AND ALLOYS 9

Phase rule – reduced phase rule – simple eutectic system, compound formation with congruent melting point – thermal analysis – non ferrous alloys – copper and aluminium alloys – bearing materials (babbits) – ferrous alloys – steel – heat treatment of steel.

UNIT II ELECTROCHEMISTRY AND ITS APPLICATION 9

Electrode potential – Nernst equation – EMF and its measurement – reference electrode – measurement of pH using glass electrode – potentiometric redox titration – electroplating and electrochemical machining.

UNIT III BATTERIES AND FUEL CELL 9

Principle and working of alkaline battery, NICAD battery, lead acid battery, lithium battery – solar cell – fuel cell: H_2-O_2, PEMFC, MOFC and SOFC.

UNIT IV FUELS AND COMBUSTION 9

Solid fuel: analysis of solid fuel – Otto-Hoffman method of coke manufacture – Liquid Fuel: manufacture of synthetic petrol – knocking – octane number – cetane number – Gaseous Fuel: composition, production and uses of water gas and producer gas – biodiesel; combustion: calculation of minimum amount of air for combustion – flue gas analysis – Orsat apparatus.

UNIT V ENGINEERING MATERIALS 9

Refractories: classification and properties – Lubricants: mechanism of lubrication – properties of lubricants – solid lubricants – Abrasives: classification and uses.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Jain P.C. and Jain. M., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2013.
2. Dara S.S. and Umare S.S., "A text book of Engineering Chemistry", S.Chand and Company Limited, New Delhi, 2013.
3. Chawla S, "A text book of Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2015.

REFERENCES

1. Ricci J.E. “The Phase rule and Heterogenius Equilibrium”, Van Nostrand, 2007.
2. Glasstone S., “An introduction to Electrochemistry”, 10th Edition, Affiliated to East West Press Private Limited, 2007.
3. Revankar S.T., Majumdar P, “Fuel Cell: Principles, Design and Analysis”, CRC Press, 2014.
4. Rajput.R.K, “Engineering Materials and Metallurgy”, 1st Edition, S.Chand and Company Private Limited, New Delhi, 2008.

15ME25C C PROGRAMMING FOR ENGINEERS L T P C

(Common to all B.E. / B.Tech. Degree Programmes) **3 0 0 3**

COURSE OUTCOMES

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

CO 1: recognize the system fundamentals and the role of hardware components of the Computer. (K3)

CO 2: apply the basic concepts and solve simple problems by analyzing the logics of conditional statements and looping constructs. (K3)

CO 3: handle similar types of data using array and utilize their functionality. (K3)

CO 4: appreciate the call by value and call by reference features in functions. (K5)

CO 5: design programs involving their own derived data types, pointers, memory allocation concepts. (K4)

CO 6: handle the file contents with access permissions. (K3)

UNIT I COMPUTER FUNDAMENTALS 10

Introduction – Characteristics of Computers – Evolution of Computers – Computer Generations – Classification of Computers – Basic Computer organization – Number Systems – Problem Analysis – Algorithms – Flow charts – Computer Software – Types of Software.

UNIT II BASIC C PROGRAMMING 9

Overview of C Program – Constants, Variables and Data Types – Operators and Expressions – Managing Input and Output operations – Decision Making and Branching – Decision making and Looping.

UNIT III ARRAYS AND FUNCTIONS 9

Arrays: One dimensional arrays – Two dimensional arrays – Multi dimensional arrays. Character arrays and Strings: Declaring and initializing String Variables – Comparison of two strings – String handling functions. User defined Functions: Definition – Declaration – Function calls – Category of Functions – Recursion - Storage Classes.

UNIT IV STRUCTURES AND POINTERS 9

Structures and Unions: Definition – Declaration – Accessing structures – Initialization of structures – Arrays of structures – Arrays within Structure – Structures within Structures -

Structures and functions - Unions. Pointers: Initialization – Pointers and arrays- Array of pointers – Pointers as function arguments – Pointers to functions – Pointers and Structure.

UNIT V FILES AND DYNAMIC MEMORY ALLOCATION 8

File management in C – Defining and opening a file – closing a file - Input and Output operations on file – Error handling during IO operations – Random access to files – Command line Arguments. Dynamic memory allocation: Allocating a block of memory - Allocating a multiple block of memory – Releasing the used space – Altering the size of a block.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Ashok.N.Kamthane, "Computer Programming", Pearson Education, India, 2008.
2. E. Balagurusamy, "Programming in ANSI C", 6th Edition Multicolor, 2013.

REFERENCES

1. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", 1st Edition, Oxford University Press, 2009
2. Stephen G.Kochan, "Programming in C", 3rd Edition, Pearson Education, India, 2005.
3. Brian W.Kernighan and Dennis M.Ritchie, "The C Programming Language", Pearson Education Inc., 2005.

15ME26C MECHANICS OF RIGID BODY L T P C
3 2 0 4

COURSE OUTCOMES

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

CO1: apply basic laws of mechanics to solve the problems on statics of particles. (K2)

CO2: draw free body diagram and apply equilibrium principles for two dimensional rigid bodies. (K3)

CO3: determine the centroid and moment of inertia of plane lamina. (K2)

CO4: apply fundamental principles to solve problems in dynamics of particles. (K3)

CO5: summarize the basic principles of friction and general plane motion. (K2)

UNIT I BASICS AND STATICS OF PARTICLES 15

Laws of Mechanics – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force – Vectorial representation of forces.

UNIT II EQUILIBRIUM OF RIGID BODIES 15

Free body diagram – Types of supports and their reactions – Moments and Couples – Moment of a force about a point and about an axis, Vectorial representation of moments

and couples – Scalar components of a moment – Equilibrium of Rigid bodies in two dimensions.

UNIT III PROPERTIES OF SURFACES 15

First moment of area of simple sections from integration – Second moment of simple plane area –Parallel axis theorem and perpendicular axis theorem.

UNIT IV DYNAMICS OF PARTICLES 15

Displacements - Velocity and acceleration, their relationship – Projectile motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 15

Frictional force -Laws of Coulomb friction -Simple contact friction – Rolling resistance – Belt friction – Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

L: 45 T: 30 TOTAL: 75 PERIODS

DEMONSTRATION

(Understanding the basic concepts of Engineering Mechanics both statics and Dynamics - Not included for the examination)

1. Idealization of Particles and Rigid bodies
2. Beam and Structures
3. Moment and Torque
4. Centroid
5. Kinematics of Rolling
6. Static and Dynamic friction.
7. General plane motion

TEXT BOOKS

1. Hibbeller RC, "Engineering Mechanics: Statics & Dynamics", 13th Edition, Pearson India Education Services Private Limited, 2012.
2. Beer FP, Mazurek DF, Sanghi S, Eisenberg ER, Johnston ER and Cornwell PJ, "Vector Mechanics for Engineers: Statics and Dynamics", 10th Edition, Tata Mcgraw Hill Education Private Limited, 2012.

REFERENCES

1. Rajasekaran S and Sankarasubramanian G, "Fundamentals of Engineering Mechanics", 3rd Edition, Vikas Publishing House Private Limited, 2010.
2. Irving H Shames, "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education Asia Private Limited, 2003.
3. Ashok Gupta, "Interactive Engineering Mechanics–Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Private Limited, 2002.
4. Palanichamy MS and Nagam S, "Engineering Mechanics – Statics and Dynamics", 3rd Edition, Tata McGraw Hill, 2004.

15ME27C INTRODUCTION TO MECHANICAL ENGINEERING AND DESIGN **L T P C 2 0 0 2**

COURSE OUTCOMES

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

CO 1: recognize the scope and applications of fundamental courses related to Mechanical Design. (K2)

CO 2: identify the thrust areas in Manufacturing and Industrial Engineering. (K3)

CO 3: identify the thrust areas in Thermal Engineering. (K2)

CO 4: explore the emerging areas in mechanical engineering and choose a specific domain based on interest. (K3)

CO 5: explain the concept of engineering design process. (K2)

UNIT I MECHANICAL DESIGN **6**

Overview of Strength of Materials, Mechanics, Kinematics and Dynamics of Machines, Machine Design, Computer Aided Design.

UNIT II MANUFACTURING AND INDUSTRIAL ENGINEERING **6**

Overview of Manufacturing Processes and Technology, Computer Aided Manufacturing, Measurements and Metrology, Industrial Engineering.

UNIT III THERMAL ENGINEERING **6**

Overview of Thermodynamics, Fluid Mechanics and Machines, Heat and Mass Transfer, Refrigeration and Air Conditioning, Power Plants.

UNIT IV EMERGING AREAS AND APPLICATIONS OF MECHANICAL ENGINEERING **6**

Emerging areas and Research facilities available in Thermal, Design, Manufacturing and Industrial Engineering Domain.

Details of the applications of Mechanical Engineering and other engineering and science disciplines exemplifying the job potential. Examples to show and discuss: Transportation: Land - automobiles, bicycle, train, earthmovers, etc., Aerospace – aircraft etc., Sea – Ships etc., Energy: Conventional energy - thermal power, nuclear, hydel plant etc, Renewable energy - solar, wind, biomass etc., Process Industries: chemical, petrochemical, paper, pharmaceutical, fertilizer plants etc.

UNIT V ENGINEERING DESIGN PROCESS **6**

Introduction - Qualities of good design engineer - Managing Design Project-Ground rules for Design -Steps in the engineering Design process: Defining the problem - Generation of Alternative concepts -Evaluation of alternatives and selection of a concept - Detailed Design - Design Defense - Manufacturing and Testing - Performance Evaluation - Design report.

L: 30 TOTAL: 30 PERIODS

TEXT BOOK

1. Sawhney, “Fundamentals of Mechanical Engineering”, 2nd Edition, PHI Learning Private Limited, New Delhi, 2011.

REFERENCES

1. Devendra Vashist, "Mechanical Engineering: Fundamentals", I.K.International Publishing House Private Limited, New Delhi, 2010.
2. Philip Kosky, George Wise, Robert Balmer and William Keat, "Exploring Engineering: An Introduction to Engineering and Design", Academic Press, Elsevier, USA, 2010.

15ME28C C PROGRAMMING LABORATORY L T P C

(Common to all B.E. / B.Tech. Degree Programmes) **0 0 2 1**

COURSE OUTCOMES

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

CO 1: solve the given problem using the syntactical structures of C language. (K3)

CO 2: develop, execute and document computerized solution for various logic based problems using the flow control features of C language. (K3)

CO 3: enhance the programming skills in C by discriminating constants, variables and arrays and the functionality. (K3)

CO 4: learn about the connection between function return values and variables. (K5)

CO 5: develop programs using string manipulation and file manipulation functions. (K3)

Simple programs

1. Solve problems such as temperature conversion, student grading, interest calculation.
2. Solving the roots of a quadratic equation
3. Designing a simple arithmetic calculator. (Use switch statement)
4. Given distance traveled by a vehicle as d = ut + 1/2at2, where 'u' and 'a' are the initial velocity and acceleration. Calculate the distance traveled for different time intervals

Programs using different control structures

5. Performing the following operations:
    a. Generate Pascal's triangle.
    b. Construct a Pyramid of numbers.
6. Generation of the first 'n' terms of the Fibonacci sequence and prime sequence.
7. Computing Sine series and Cosine series.
8. Finding the 2's complement of a binary number.

Programs using arrays

9. Performing the following operations:
    a. Matrix addition.
    b. Transpose of a matrix.
    c. Matrix multiplication by checking compatibility.

Programs using string manipulation

10. Performing the following operations to a string:
    a. To insert a sub-string into main string at a given position.
    b. To delete 'n' characters from a given position in a string.

c. To replace a character of string either from beginning or ending or at a specified location.

Programs using functions

11. Performing the following operations: (Use recursive functions)
    a. To find the factorial of a given integer.
    b. To find the GCD (Greatest Common Divisor) of two given integers.
    c. To solve Towers of Hanoi problem.

Programs using files

12. Performing the Student Information Processing using Structures and File handling concepts.

P: 30 TOTAL: 30 PERIODS

15ME29C PHYSICS AND CHEMISTRY LABORATORY L T P C
0 0 2 1

PART A – PHYSICS LABORATORY

COURSE OUTCOMES

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

CO1: demonstrate the optical properties of waves. (K2)
CO2: analyze the characteristics of semiconducting materials and devices. (K3)
CO3: quantify the acceleration due to gravity (g). (K2)
CO4: analyze the thermal properties of materials. (K3)

LIST OF EXPERIMENTS

1. (a) Determination of Wave length of Laser source.
   (b) Particle size determination using Diode Laser.
   (c) Determination of Numerical Aperture and Acceptance angle of an optical fiber.
2. Determination of Band Gap of a semiconductor material.
3. Determination of Radius of curvature of a Plano convex lens using Newton's rings Method.
4. Determination of Wavelength of Mercury Spectrum using spectrometer & grating.
5. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
6. Determination of g using compound pendulum.
7. Determination of Hall Coefficient.
8. Specific heat capacity of liquid – Newton's law of cooling.
9. Characteristics of LED.
10. Study of V-I characteristics of a solar cell.

P: 15 TOTAL: 15 PERIODS

PART - B CHEMISTRY LABORATORY

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO 1: estimate the amount of metal ions by different analytical techniques. (K3)
CO 2: determine the amount of acid by pH metric method. (K3)
CO 3: synthesize biodiesel from waste vegetable oil. (K3)
CO 4: estimate the free acid value and iodine value of given oil sample. (K3)

LIST OF EXPERIMENTS

1. Estimation of copper in brass by EDTA method.
2. Estimation of iodine value of oil.
3. Estimation of iron (Fe^{2+}) by potentiometric method.
4. Estimation of amount of acid by pH metric method.
5. Synthesis of biodiesel from waste vegetable oil.
6. Estimation of the amount of free acid of a given oil sample.

P: 15 TOTAL: 15 PERIODS

- A minimum of FIVE experiments shall be offered.
- Laboratory classes on alternate weeks for Physics and Chemistry.

REFERENCES

1. Harris D.C. "Quantitative Chemical Analysis: International Edition", 8th Edition, W.H.Freeman, 2010
2. Mendham J. "Vogel's Quantitative Chemical Analysis", 6th Edition, Pearson Publisher, 2009.
3. Vogel A.I., "Vogel's Textbook of Quantitative Chemical Analysis", 5th Edition, Longman scientific & Technical, 1989.

15ME31C	APPLIED MATHEMATICS	L	T	P	C
		3	2	0	4

COURSE OUTCOMES

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

CO1: calculate the Fourier series solution of Wave and Heat equations. (K3)
CO2: grasp Analytic functions and their properties. (K2)
CO3: evaluate complex integration over contour. (K3)
CO4: evaluate area and volume using double and triple integrals. (K3)
CO5: analyze the concepts related to vector calculus. (K3)

UNIT I BOUNDARY VALUE PROBLEMS 15

Fundamentals of Fourier series - Half Range Fourier Series - Classification of Partial Differential Equations - Fourier Series Solutions of one dimensional wave equation and heat equation - Steady state solution of two dimensional heat equation (Insulated edges excluded).

UNIT II ANALYTIC FUNCTIONS 15

Analytic functions - Necessary and Sufficient conditions (excluding proofs) - Harmonic and orthogonal properties of analytic functions - Harmonic Conjugate - Construction of analytic functions - Conformal Mapping: w= z+c, cz, 1/z and Bilinear Transformation.

UNIT III COMPLEX INTEGRATION 15

Statement and applications of Cauchy's Integral Theorem and Cauchy's Integral Formula (excluding proofs) - Taylor's and Laurent's series expansions - Singular points - Residues - Residue theorem (excluding proof) - Application of residue theorem to evaluate real integrals - Unit circle and semi-circular contour (excluding poles on boundaries).

UNIT IV INTEGRAL CALCULUS 15

Evaluation of Double and Triple integrals - Change of Order of Integration - Area and volume - Beta and Gamma integrals - Definite integrals in terms of Beta and Gamma functions.

UNIT V VECTOR CALCULUS 15

Differentiation of vectors, Gradient, Divergence, Curl and Directional derivatives. Line, Surface and Volume Integrals - Statement of Green's, Gauss Divergence and Stokes' theorem - Simple applications involving rectangular parallel piped and cubes.

L:45; P:30; TOTAL: 75 PERIODS

TEXT BOOKS

1. Grewal B.S, "Higher Engineering Mathematics", Khanna Publishers, 40th Edition, Delhi, 2007.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2011.

REFERENCES

1. Bali N.P and Manish Goyal, "Textbook of Engineering Mathematics", Laxmi Publications (P) Ltd., 7th Edition, 2010.
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2007.
3. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", Narosa Publishing House Pvt. Ltd., 3rd Edition, 2007.

15ME32C	**BASIC ELECTRICAL ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES

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

CO1: describe the basic concepts of electric circuits and measuring instruments. (K2)
CO2: explain the concepts and characteristics of motor drives. (K2)
CO3: describe the speed control methods of DC and AC drives. (K2)
CO4: explain the architecture and functions of Microprocessor. (K2)
CO5: explain the functional interrupts and architecture of Microcontroller. (K2)

UNIT I ELECTRICAL CIRCUITS AND MEASUREMENTS 9

Ohm's Law - Kirchhoff's Laws - AC Circuits - Power and Power factor - Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters) - Dynamometer type Watt meters and Energy meters.

UNIT II DRIVE MOTOR CHARACTERISTICS 9

DC machine construction - DC generator - Armature reaction- DC motors - Types - characteristics of DC motors - Braking of Electrical motors - Single phase and three phase induction motors - construction - operation characteristics.

UNIT III SPEED CONTROL OF DC AND AC DRIVES 9

Need for speed control - Speed control of DC series and shunt motors - Armature control - field control - Ward Leonard control - Speed control of three phase induction motor - conventional method of speed control - Voltage control method - voltage frequency control - slip power recovery scheme.

UNIT IV MICROPROCESSORS 9

Architecture of 8085 - Instruction set - Subroutine - Timing Diagram - Interrupts - Simple arithmetic and logical programming - 8255 Programmable Peripheral Interface - Simple I/O interface.

UNIT V MICROCONTROLLER 9

Architecture of 8051 - Instruction set - Interrupts - Serial Port - Simple arithmetic and logical programming - Stepper Motor interface - ADC/DAC interface.

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", 4th Edition, Tata McGraw Hill, 2007.
2. Nagrath IJ and Kothari DP, "Electric Machines", Tata McGraw Hill, 2010.
3. Krishna Kant "Microprocessor and Microcontrollers" Eastern Company Edition, Prentice - Hall of India, New Delhi, 2007.

REFERENCES

1. Nagsarkar TK and Sukhija MS, "Basics of Electrical Engineering", Oxford press, 2005.
2. Pillai SK,"A first course on Electrical Drives New Age International New Delhi, 2012.
3. Senthilkumar N and Saravanan M, "Microprocessor and Microcontrollers", Oxford University Press, 2011.
4. Ramesh S Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085", Penram International Publishing (India) Pvt Ltd., Fifth Edition, 2013.

15ME33C	MATERIAL TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Describe the structure and properties of materials referring suitable phase diagrams. (K2)

CO2: Select appropriate heat-treatment techniques to impart desired properties in materials /alloys. (K2)

CO3: Describe the different types of ferrous and non - ferrous materials and their applications. (K2)

CO4: Select suitable plastics and ceramics for specific engineering applications. (K2)

CO5: Explain different damage mechanisms and metallurgical characterization. (K2)

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Review of crystal structures - Lattices - Grain size measurement - ASTM Standard. Slip, twinning and Strengthening mechanisms - phase diagrams-various reactions – Iron-carbon equilibrium diagram. Alloying of Mn, Si, Cr, Mo, V, Ti and W in steel and its effects.

UNIT II HEAT TREATMENT 9

Annealing types - properties and applications, hardening- control of parameters. Tempering –Austempering - martempering. Isothermal transformation (IT) diagrams - continuous cooling curves - Hardenability - Jominy end quench test - case hardening.

UNIT III FERROUS AND NON FERROUS MATERIALS 9

Classification of Ferrous and Non-Ferrous materials and alloys - composition, properties and applications.

UNIT IV NON-METALLIC MATERIALS 9

Polymers - types, commodity and engineering polymers - Engineering Ceramics - Properties and applications.

UNIT V METALLURGICAL DAMAGE MECHANISMS AND FRACTURE ANALYSIS 9

Types of fracture - fatigue and creep analysis. Corrosion-types, damage mechanisms and control. Metallurgical characterization - OM, SEM and XRD.

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Kenneth G Budinski and Michael K Budinski, “Engineering Materials” 9th Indian Reprint, Prentice-Hall of India Private Limited, 2009.
2. George E Dieter, “Mechanical Metallurgy”, McGraw Hill Book Company,1988

REFERENCES

1. Callister S and Balasubramaniam R, "Material Science and Engineering", John Wiley and Sons, 2012.
2. Raghavan V "Materials Science and Engineering", 5th Edition, Prentice Hall of India Private Limited, 2004.
3. Sydney H Avner "Introduction to Physical Metallurgy", 2nd Edition, McGraw Hill Book Company, 2008.
4. Jindal UC, "Material Science and Metallurgy", Pearson India, 2012.

15ME34C	**THERMAL SCIENCE**	**L**	**T**	**P**	**C**
		3	**2**	**0**	**4**

COURSE OUTCOMES

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

CO1: Describe the thermodynamic systems and apply first law of thermodynamics to analyze the systems. (K3)

CO2: Discuss second law of thermodynamics and its corollaries, and analyze the feasibility of a process based on first and second law of thermodynamics. (K3)

CO3: Evaluate the change in properties of ideal and real gases subjected to thermodynamics processes using equation /table/ chart. (K3)

CO4: Calculate the change in properties of steam subjected to thermodynamics processes using equation/table/chart. (K3)

CO5: Determine the change in properties of atmospheric air subjected to psychrometric processes using equation/table/chart. (K3)

CO6: Analyze various thermal systems by applying basic concepts of thermodynamics. (K3)

UNIT I BASIC CONCEPT AND FIRST LAW OF THERMODYNAMICS 15

Thermodynamics and its applications - Closed and open system - Properties of a system - State and equilibrium - Processes and cycles - Zeroth law of thermodynamics - Absolute temperature scales - Heat and work transfer - First law of thermodynamics in closed system - Conservation of mass principle - Conservation of energy principle - Steady flow process - First law of thermodynamics in open system

UNIT II SECOND LAW OF THERMODYNAMICS 15

Thermal energy reservoir - Kelvin and Clausius statements - Heat engines - Refrigerators -Reversible and irreversible processes - Carnot cycle and theorem - Perpetual motion machine - Clausius inequality - Concept of Entropy - Increase of entropy principle - Property diagrams involving entropy - Entropy as a measure of disorder.

UNIT III IDEAL AND REAL GASES AND THERMODYNAMIC RELATIONS 15

Gas mixtures - properties ideal and real gases - equation of state - Avagadro's Law - Vander Waal's equation of state - compressibility factor - compressibility chart - Dalton's law of partial pressure - exact differentials - T-D relations - Maxwell's relations - Clausius Clapeyron - equations - Joule -Thomson coefficient.

UNIT IV PROPERTIES OF PURE SUBSTANCE 15

Pure substance - Phase change of pure substances - Property diagrams for phase change processes - Property tables - thermodynamic properties of steam - Calculations of work done and heat transfer in non-flow and flow processes.

UNIT V PSYCHROMETRY 15

Psychrometry and psychrometric charts - property calculations of air vapour mixtures - Psychrometric process - Sensible heat exchange processes - Latent heat exchange processes. Adiabatic mixing - evaporative cooling.

L:45; T:30; TOTAL:75 PERIODS

Note: (Use of steam tables and psychrometric chart are permitted in the End Semester Examination)

TEXT BOOKS

1. Yunus A Cengel and Michael A Boles, "Thermodynamics - An Engineering Approach", 7th Edition, Tata McGraw-Hill Education, 2014.
2. Nag PK, "Engineering Thermodynamics", 5th Edition, the McGraw-Hill Book Company, 2013.

REFERENCES

1. Sonntag, Borgnakke and Van Wylen, "Fundamentals of Thermodynamics", 1st Edition, Wiley India Private Limited, 2010.
2. Holman JP, "Thermodynamics", McGraw-Hill Education, 1988.
3. Rajput RK, "A Textbook of Engineering Thermodynamics", 4th Edition, Laxmi Publications Private Limited, 2015.
4. NPTEL Videos: http://nptel.ac.in/video.php?subjectId=112105123.

15ME35C MANUFACTURING TECHNOLOGY- I

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Elucidate and select appropriate casting method for a product. (K2)
CO2: Identify and select suitable metal joining process for fabrication. (K2)
CO3: Discuss the features and applications of various metal forming processes. (K2)
CO4: Explain the various stages in component preparation through powder metallurgy technique. (K2)
CO5: Discuss various polymer processing methods and applications. (K2)

UNIT I METAL CASTING PROCESSES 9

Sand casting - sand properties and testing - patterns - allowances - Core making - Melting furnaces - Working principle of Special casting processes - Casting defects.

UNIT II METAL JOINING PROCESSES 9

Fusion and solid state welding processes - Brazing and soldering processes - Weld defects.

UNIT III METAL FORMING PROCESSES 9

Hot working and cold working of metals - forging, rolling, drawing and extrusion processes - principles and applications. Sheet metal forming processes - principles and applications.

UNIT IV POWDER METALLURGY 9

Metallic and ceramic Powder preparation methods - powder metallurgy techniques- Recent developments and Industrial applications.

UNIT V PROCESSING OF PLASTICS 9

Types of plastics - plastic processing techniques - Recycling and Eco friendly processing - Applications.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Begman, "Manufacturing Process", 8th Edition, John Wiley & Sons, 2005.
2. Gowri S, Hariharan P and Suresh Babu A, "Manufacturing Technology-1", Pearson Education, 2008.

REFERENCES

1. Magendran Parashar BS and Mittal RK, "Elements of Manufacturing Processes", Prentice Hall of India, 2003.
2. Rao PN, "Manufacturing Technology", 2nd Edition, Tata McGraw-Hill Publishing Limited, 2002.
3. Sharma PC, "A Text book of Production Technology", 11th Edition, S Chand and Company, 2008.
4. Serope Kalpajian and Steven R Schmid, "Manufacturing Engineering and Technology", 2nd Indian Reprint Pearson Education, 2002.
5. Beddoes J and Bibby MJ, "Principles of Metal Manufacturing Processes", Elsevier, 2006.
6. Rajput RK, "A text book of Manufacturing Technology", Lakshmi Publications, 2007.
7. Larry Jeffus, "Welding and Metal Fabrication", Cengage Learning, 2012.

15ME36C MANUFACTURING TECHNOLOGY LABORATORY- I

L	T	P	C
0	0	2	1

COURSE OUTCOMES

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

CO1: Prepare green sand mould for a component. (K3)
CO2: Make simple joints using TIG welding process. (K3)
CO3: Prepare simple components using forging techniques. (K3)
CO4: make simple sheet metal components.(K3)
CO5: Describe powder metallurgy process and injection molding process. (K2)

1. Preparation of mould using green sand and split pattern.

2. Sand testing
    i. Grain fineness number
    ii. Moisture content determination
3. Preparation of weld joint using TIG welding.
    i. TEE Joint
    ii. BUTT Joint
4. Hand forging processes:
    i. Preparation of job using Upset forging.
    ii. Swaging (square to circular cross section).
5. Fabrication of sheet metal jobs with preparation of development of surfaces
    i. Square Tray with specified dimensions
    ii. Funnel with specified dimensions
6. Preparation of circular billet using Powder metallurgy route
7. Preparation of simple plastic component using Injection moulding machine.

P:30; TOTAL: 30 PERIODS

15ME37C	**DRAFTING AND MODELING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OUTCOMES

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

CO1: Perform 2D Drafting using software tools for creating simple machinery parts models. (K3)
CO2: Create 3D modeling and assembly of given machine components. (K3)
CO3: Draw sectional views of machine elements through manual and computer assisted technique. (K3)
CO4: Draw different 2D views of given real object. (K3)
CO5: Interpret industrial drawing. (K3)

Exercises from the following topics

1. Manual and computer assisted machine 2D drawing of a simple machine element as per BIS SP 46: 2003 Edition.
   Example: Couplings, Flexible joints, gear profiles, hand wheels, hooks, supporting units, clamping units, cam profiles, Connecting rod and crank shaft.
2. Creation of 3D models from the given 2D orthographic drawing.
   Examples: Couplings, Flexible joints, gear profiles, hand wheels, hooks, supporting and clamping units, cam profiles, Connecting rod, crank shaft.
3. Creation of standard 2D views of given part
   Examples: Simple Pulley, bolts and nuts, spur and helical gear profiles and L-clamps.
4. Assembly of machine components in 2D or 3D modeling and detailing, mass properties and C.G
   Examples: Lathe tail stock, Gear box assembly, Screw jack, Ball valve housing with open and closing lever and Machine vice.

5. Creation of 3D model for the components having complex surface profile
   Examples: Computer mouse, Light dooms for automobile sector, aero-dynamic shapes, Safety helmets and plastic containers.

P:30; TOTAL: 30 PERIODS

15ME38C	**COMMUNICATION SKILLS LABORATORY**	**L T P C**
	(Common to all B.E. / B.Tech., Programmes)	**0 0 2 1**

COURSE OUTCOMES:

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

CO 1: Interpret any passage after listening and interact at different situations fluently (K2)

CO2: Excel appropriately in competitive and professional contexts. (K3)

CO3: Acquire the sub-skills required for paper presentations and group discussions which will help them to excel in their workplace. (K3)

Unit I

Lab session:

i) Listening to audio files :
- Conversations
- Speech
- TED Talks

ii) Listening and responding to any audio files:
- Drawing the map
- Picture completing task
- Transferring data to Graph.

Practice session: On the spot Speaking activities: Just a minute speech, Picture description.

Unit II

Lab session: Read and understand the comprehension passages given in competitive examinations.

Practice session: Giving opinions and suggestions, analyzing a social issue.

Unit III

Lab session: Listening to audio files related to soft skills.

Practice session: Practicing Power point presentation, Group discussion and Interview skills.

P: 30 TOTAL: 30 PERIODS

REFERENCES

1. Rizvi.M.Ashraf, “Effective Technical Communication”, First Edition, The MC Graw Hill Education Private Limited, Companies, New Delhi, 2010.
2. Sangeetha Sharma and Binod Mishra, “Communication Skills for Engineers and scientists”, PHI Learning Private Limited, Delhi, 2009.

15ME39C	**ELECTRICAL ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**

0 0 2 1

COURSE OUTCOMES

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

CO1: demonstrate the basic concepts and laws with DC and AC circuits. (K2)
CO2: determine the performance and characteristics of motor drives. (K2)
CO3: choose the appropriate speed control methods for DC and AC drives. (K2)
CO4**:** develop the simple programs with Microprocessor and Microcontroller. (K2)
CO5: perform the peripheral interrupts with Microprocessor and Microcontroller.(K2)

UNIT I ELECTRICAL CIRCUITS AND MEASUREMENTS 6

1. Verification of Kirchhoff's laws
2. Verification of Thevenin's and Norton's theorem
3. Measurement of power and power factor

UNIT II DRIVE MOTOR CHARACTERISTICS 6

4. Load test on DC shunt motor
5. Load test on DC series motor

UNIT III SPEED CONTROL OF DC AND AC DRIVES 6

6. Load test on three phase Induction motor
7. Speed control of DC shunt motor
8. Speed control of Induction motor (v/f)

UNIT IV MICROPROCESSORS 6

9. Arithmetical operation using 8085 microprocessor
10. Interfacing peripherals using 8255 PPI

UNIT V MICROCONTROLLER 6

11. Arithmetical operation using 8051 microcontroller
12. Stepper motor interface using 8051 microcontroller
13. Interfacing DAC with 8051 microcontroller

P:30; TOTAL:30 PERIODS

REFERENCES

1. Fritgerald AE, Kingsley C and Umans S, "Electric Machinery", Mc Graw-Hill Companies, 5th Edition, 2014
2. Virtual Lab Electrical machines
http://iitg.vlab.co.in/index.php?sub=61&brch=168&sim=1050&cnt=1918,
http://iitg.vlab.co.in/index.php?sub=61&brch=168&sim=912&cnt=1681
3. Senthilkumar N and Saravanan M, "Microprocessor and Microcontrollers", Oxford University Press, 2011.

15ME41C FLUID MECHANICS AND MACHINERY L T P C
2 2 0 3

COURSE OUTCOMES

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

CO1: Explain the fundamentals of fluid properties and fluid flows. (K2)
CO2: Use Euler and Bernoulli's equations for various applications. (K3)
CO3: Determine flow rates, pressure changes, minor and major head losses for laminar and turbulent flows through pipes. (K3)
CO4: Apply dimensional analysis to simple problems. (K3)
CO5: Apply principles of fluid mechanics to the operation, design, and selection of hydraulics turbines. (K3)
CO6: Apply principles of fluid mechanics to the operation, design, and selection of pumps. (K3)

UNIT I INTRODUCTION 12

Units and Dimensions - Properties of fluids- gas laws - capillarity and surface tension. Flow characteristics: concepts of system and control volume- Application of control volume to continuity equation.

UNIT II FLOW THROUGH CIRCULAR CONDUITS 12

Bernoulli's equation - applications - Venturimeter, Orificemeter, Rotameter, Pitot tube - Laminar flow though circular conduits and circular annuli. Boundary layer concepts - Darcy-Weisbach's equation - Flow through pipes in series and in parallel - Losses in pipes.

UNIT III DIMENSIONAL ANALYSIS 12

Dimension and units: Buckingham's Π theorem. Discussion on dimensionless parameters. Models and similitude - Applications of dimensionless parameters.

UNIT IV HYDRAULIC TURBINES 12

Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies - performance curve for turbines.

UNIT V HYDRAULIC PUMPS 12

Pumps: definition and classifications - Centrifugal pump - Reciprocating pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves - rotary pumps: working principles of gear and vane pumps - cavitations in pumps.

L:30 T:30; TOTAL:60 PERIODS

TEXT BOOKS

1. Streeter VL and Wylie EB, "Fluid Mechanics", 7th Edition, McGraw-Hill Ltd, New Delhi, 2010.
2. White FM, "Fluid Mechanics", 7th Edition, Tata McGraw-Hill, New Delhi, 2011.

REFERENCES

1. Bansal RK, "Fluid Mechanics and Hydraulics Machines", (5th edition), Laxmi

publications (P) Ltd, New Delhi, 2013.
2. Rathakrishnan E, "Fluid Mechanics", 2nd Edition, Prentice Hall of India, 2007.
3. Ramamrutham S, "Fluid Mechanics, Hydraulics and Fluid Machines", Dhanpat Rai & Sons, Delhi, 2004.
4. Modi PN and Seth SM, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 19th Edition, Standard Book House, 2013.
5. Kumar KL, "Engineering Fluid Mechanics", 7thEdition, Eurasia Publishing House Private Limited, New Delhi, 1995.
6. Shiv Kumar, "Fluid Mechanics & Fluid Machines: Basic Concepts & Principles", Ane Books Pvt. Ltd., New Delhi, 2010
7. http://nptel.ac.in/
8. http://eerc03-iiith.virtual-labs.ac.in/

15ME42C	MECHANICS OF MATERIALS	L	T	P	C
		3	2	0	4

COURSE OUTCOMES

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

CO1: Determine various stresses on simple load carrying members subjected to axial, shear and thermal loads. (K2)

CO2: Apply Mohr's circle to resolve stresses on inclined planes and determine stresses in thin cylinders. (K2)

CO3: Construct shear force and bending moment diagrams to estimate the stresses and size of beam section. (K3)

CO4: Estimate slope and deflection of beams and columns to determine critical speed, stresses and deformation in columns subjected to various loads. (K2)

CO5: Determine the size of the shaft and springs for engineering applications. (K3)

UNIT I STRESS ANALYSIS 15

Types of stresses, stresses and strain in simple and compound bars under axial load, properties of materials, working stress, factor of safety, volumetric strain, thermal stress, and elastic constants - relationship. Strain energy - uni-axial loads.

UNIT II BIAXIAL STRESSES 15

Stress tensor, principle planes and stresses, Mohr's circle for biaxial stresses, case studies. Evaluation of hoop stress and longitudinal stress in thin cylindrical and spherical shells, case studies.

UNIT III SHEAR FORCE AND BENDING MOMENT IN BEAMS 15

Shear force and Bending Moment diagrams for cantilever, simply supported beams -point loads, UDL and UVL. Theory of simple bending and assumptions, curved beams, flitched beams.

UNIT IV DEFLECTION OF BEAMS AND COLUMNS 15

Beam slope and deflection of cantilever and simply supported beams - double integration, Mecaulay, Moment area and Conjugate methods - Columns and struts -Euler's and Rankine's formulae.

UNIT V SHAFTS AND SPRINGS 15

Torsional equation, maximum torque- various sections - stepped shaft, compound shafts - Fixed and simply supported shafts, critical speed. Open and closed coil helical springs, basic equations, applications, design concepts.

L:45 T:30; TOTAL:75 PERIODS

TEXT BOOKS

1. Timoshenko SP, "Elements of Strength of Materials", Tata McGraw-Hill, New Delhi, 2004.
2. Popov EP, "Engineering Mechanics of Solids", 2nd Edition, Prentice-Hall of India, New Delhi, 2002.

REFERENCES

1. Hibbeler RC, "Mechanics of Materials", 8th Edition, Prentice Hall, 2011.
2. Ramamurtham S, "Strength of Materials", 14th Edition, Dhanpat Rai Publications, 2011.
3. Nash WA, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co., New York, 1995.
4. Kazimi SMA, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
5. Ryder GH, "Strength of Materials", 3rd Edition, Macmillan India Limited, 2002.
6. Beer FP and Johnston R," Mechanics of Materials", 3rd Edition, McGraw-Hill Book Co., 2002.
7. Bansal RK, "Strength of Materials", Laxmi Publications, New Delhi, 2012.

15ME43C	**THERMAL ENGINEERING**	**L**	**T**	**P**	**C**
		3	**2**	**0**	**4**

COURSE OUTCOMES

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

CO1: Analyze different gas power cycles with their application in IC engines and Gas turbines (K2)

CO2: Investigate steam power cycle and modify the cycle to improve the overall efficiency. (K2)

CO3: Describe and carry out the performance study on steam nozzles and turbines. (K2)

CO4: Analyze the vapour compression refrigeration cycle. (K2)

CO5: Apply different psychrometric processes for the various Air conditioning applications. (K3)

UNIT I GAS POWER CYCLES and THEIR APPLICATIONS 15

Gas Power Cycles - Otto, Diesel, Dual and Brayton cycles - I.C Engines - Components - Types and Working - Valve Timing and Port timing diagrams - Theoretical and Experimental Investigation on Performance and Heat Balance of I.C. Engines - Gas turbines - Components of Gas turbines – Performance.

UNIT II STEAM POWER CYCLE 15

Simple, Actual Rankine Cycle and components - Methods to improve the performance of steam power cycles - Reheat, Regeneration and Combined Reheat – Regeneration.

UNIT III STEAM NOZZLES, BOILERS and TURBINES 15

Steam Nozzles - Effect of friction, critical pressure ratio, supersaturated flow - Steam Turbines - Impulse and Reaction principles, compounding, degree of reaction, velocity diagram for simple and multi-stage turbines, speed regulations, Condition for maximum efficiency; Steam Boilers - Types - Working Principle - Mountings and Accessories.

UNIT IV REFRIGERATION SYSTEMS 15

Vapour compression refrigeration cycle- super heat, sub cooling - Components - Performance calculations - working principle of vapour absorption system, Ammonia - Water, Lithium bromide -water systems (Description only) - Types and Properties of Refrigerants - Comparison between vapour compression and absorption systems.

UNIT V AIR CONDITIONING SYSTEMS 15

Fundamentals of Psychrometry - Psychrometry Processes - Air Conditioning - Types - Cooling load calculations- Performance calculations.

L:45 T:30; TOTAL:75 PERIODS

Note: (Use of steam tables, Refrigeration tables and psychrometric chart are permitted in the End Semester Examination)

TEXT BOOKS

1. Rajput RK,"Thermal Engineering", 9th Edition, Laxmi Publications, Ltd., 2013.
2. Yunus A Cengel and Michael A Boles, "Thermodynamics - An Engineering Approach", 7th Edition, Tata McGraw-Hill Education, 2014.

REFERENCES

1. Manohar Prasad "Refrigeration and Air Conditioning", 2nd Edition, New Age International Publishers, 2011.
2. Ganesan V, "Internal Combustion Engines", 4thEdition, Tata McGraw-Hill, 2012.
3. Mahesh M Rathore, "Thermal Engineering", Tata McGraw-Hill, New Delhi, 2010.
4. IS 10001:1981, Performance of IC engines.
5. IS: 1391-2002 Part II, Performance test of RAC.
6. http://nptel.ac.in/courses/112105128/11.
7. http://nptel.ac.in/video.php?subjectId=108105058.
8. http://vlab.co.in/, http://iitg.vlab.co.in/?sub=62&brch=176 (Virtual Laboratory).

15ME44C MANUFACTURING TECHNOLOGY- II L T P C

3 0 0 3

COURSE OUTCOMES

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

CO1: Describe the theories of metal cutting. (K2)
CO2: Identify accessories and tools required to perform a particular operation in centre and special purpose lathes. (K2)
CO3: Describe the constructional and operational features of various special purpose machine tools. (K2)
CO4: Discuss the process of grinding and gear manufacturing. (K2)
CO5: Discuss various surface finishing operations. (K2)

UNIT I THEORY OF METAL CUTTING 9

Material removal processes, types of machine tools - theory of metal cutting: cutting tool materials, tool wear and life, cutting fluids and cutting force measurement techniques.

UNIT II CENTRE LATHE AND SPECIAL PURPOSE LATHES 9

Centre lathe - cutting tool geometry - taper turning and thread cutting methods. Capstan and turret lathes.

UNIT III OTHER MACHINE TOOLS 9

Shaping, milling, planning and drilling operations - Indexing calculations in milling machine.

UNIT IV GEAR MANUFACTURING AND ABRASIVE PROCESSES 9

Gear Manufacturing. Grinding processes - Selection of grinding wheel.

UNIT V SURFACE FINISHING PROCESSES 9

Electrochemical grinding, Honing, lapping, buffing and other super finishing processes and their applications.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Rao PN, “Manufacturing Technology”, Metal Cutting and Machine Tools Volume 2, Tata Mc Graw -Hill, New Delhi, 3rd Edition, 2013.
2. HMT, “Production Technology”, Tata McGraw-Hill, 1998.

REFERENCES

1. Sharma PC, “A Text Book of Production Engineering”, S Chand and Company Limited, 11th Edition, 2008.
2. Milton C Shaw, “Metal Cutting Principles”, 2nd Edition, Oxford University Press, 2012.
3. Rajput RK, “A Text book of Manufacturing Technology”, Laxmi Publications, 2007.
4. Philip F Ostwald and Jairo Munoz, “Manufacturing Processes and systems”, 9th Edition, John Wiley and Sons, 2011.
5. Mikell P Groover, “Fundamentals of Modern Manufacturing, Materials, Processes and Systems”, 3rd Edition, John Wiley and Sons, 2011.
6. Chapman WAJ and Martin SJ, “Workshop Technology”, Part III, Viva Books Private Ltd., 2006.

15ME45C KINEMATICS OF MACHINERY L T P C

3 2 0 4

COURSE OUTCOMES

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

CO1: Demonstrate the simple mechanisms with suitable examples. (K2)
CO2: Determine displacement, velocity and acceleration of any point on a link in simple mechanisms. (K3)
CO3: Construct cam profile for different follower motion. (K2)
CO4: Describe laws of gearing, types of gears, terminologies of spur gears and gear trains. (K2)
CO5: Describe the basic concept of friction in drives and brakes. (K2)

UNIT I BASICS OF MECHANISMS 15

Definitions - Link, Kinematic pair, Kinematic chain, Mechanism and Machine - Degrees of Freedom - Mobility - Kutzbach criterion (Gruebler's equation) - Grashoff's law- Kinematic inversions of four-bar chain and single slider crank chain - Mechanical Advantage- Transmission angle. Description of common mechanisms - Offset slider mechanism as quick return mechanisms, pantograph, straight line generators (Peaucellier and Watt mechanisms) and steering gear for automobile.

UNIT II KINEMATIC ANALYSIS 15

Displacement, velocity and acceleration analysis in simple mechanisms - Graphical Methods for relative velocity and acceleration polygons - Coincident points - Coriolis acceleration - Approximate analytical expression for displacement, velocity and acceleration of piston in reciprocating engine mechanism.

UNIT III KINEMATICS OF CAMS 15

Types of cams and followers - Displacement diagrams - Graphical layouts of cam profiles for different types of followers - knife edge, roller and flat faced - uniform velocity, simple harmonic and uniform acceleration and retardation motions of follower - Pressure angle and undercutting.

UNIT IV GEARS 15

Types - Spur gear terminology and definitions - Law of toothed gearing - Involute Gearing- inter changeability - Interference and undercutting. Gear trains - Simple, compound and Epicyclic gear trains - Differentials.

UNIT V FRICTION DRIVES 15

Dry friction, Friction in power screws Pivot, collar and conical bearings - Plate clutches - Conical clutches - Belt and rope drives - Block brakes, band brakes. Conditions for self-locking.

L: 45; T: 30;TOTAL: 75 PERIODS

TEXT BOOKS

1. Rattan SS, “Theory of Machines”, Tata McGraw -Hill Publishers, New Delhi, 2009.
2. Robert L Norton, “Design of Machinery”, 5th Edition, McGraw-Hill Higher Education, 2011.

REFERENCES

1. Uicker JJ, Pennock GR andShigley JE, “Theory of Machines and Mechanisms”, Indian Edition, Oxford University Press, 2003.
2. Ambekar AG, “Mechanism and Machine Theory”, 1st Edition, Prentice Hall of India, New Delhi, 2009.
3. Thomas Bevan, “Theory of Machines”, 3rd Edition, CBS Publishers and Distributors, 2005.
4. Ramamurti V, “Mechanism and Machine Theory”, 2nd Edition, Narosa Publishing House, 2005.
5. Ghosh A and Mallick AK, “Theory of Mechanisms and Machines”, Affiliated East-West Private Limited, New Delhi, 1998.
6. Rao JS and Dukkipati RV, “Mechanism and Machine Theory”, Wiley-Eastern Limited, New Delhi, 1992.

BIS Codes of Practice

a. IS 2458 : 2001, Vocabulary of Gear Terms - Definitions Related to Geometry
b. IS 2467: 2002 (ISO 701: 1998), International Gear Notation - Symbols for Geometric Data.
c. IS 5267: 2002 Vocabulary of Gear Terms - Definitions Related to Worm Gear Geometry.
d. IS 5037 : Part 1 : 2004, Straight Bevel Gears for General Engineering and Heavy Engineering
   i. Part 1: Basic Rack.
e. IS 5037 : Part 2 : 2004, Straight Bevel Gears for General Engineering and Heavy Engineering

i. Part 2: Module and Diametral Pitches.

15ME46C	**ENVIRONMENTAL SCIENCE AND ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES

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

CO1: Identify the various ecosystems and the importance of Biodiversity. (K2)
CO2: Recognize the need for natural resources and the role of individual in conservation. (K2)
CO3: Analyze the root causes and effects of various environmental pollution and management activities being taken for various disasters. (K2)
CO4: Discuss various types of solid waste management systems. (K2)
CO5: Analyze various social issues related to environment. (K2)

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Environment - Definition and scope. Ecosystem - structure and functions. Biodiversity - levels and values - India as a mega-diversity nation - hotspots and threats to biodiversity-conservation of biodiversity.

UNIT II NATURAL RESOURCES 9

Forest, water, land, energy and food resources- use - over exploitation - case studies. Role of an individual in conservation of natural resources.

UNIT III ENVIRONMENTAL POLLUTION AND DISASTER MANAGEMENT 9

Definition - causes, effects and control measures of air, water, soil, marine, noise and thermal pollution. Nuclear hazards. Disaster management: floods, earthquake, cyclone and landslides.

UNIT IV SOLID WASTE MANAGEMENT 9

Solid waste management: causes, effects and control measures of municipal solid wastes (hospital wastes, hazardous wastes and e-wastes) - Risks related to toxic substances - role of an individual in managing solid waste.

UNIT V SOCIAL ISSUES AND THE ENVIRONMENT 9

Water conservation and rain water harvesting. Climate change: global warming, acid rain, ozone layer depletion. Population growth - variation among nations - population explosion - family welfare programme - environment and human health - human rights - value education - HIV / AIDS - role of information technology in environment and human health.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Gilbert M Masters, 'Introduction to Environmental Engineering and Science', Pearson Education, 2004.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.

REFERENCES

1. Clair Nathan Sawyer, Perry L McCarty, Gene F Parkin, 'Chemistry for Environmental Engineering and Science" McGraw-Hill, Science, 2002.
2. Deswal, "An Introduction to Environmental Science", Dhanpat Rai & Co Pvt. Ltd., 2011.
3. De, AK, 'Environmental Chemistry", New Age Publications (Academic), India, 1989.
4. Koteswara Rao MVR, "Energy Resources: Conventional & Non-Conventional" BSP Publications, 2006.
5. Cunningham WP Cooper, TH Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
6. Rajagopalan R, "Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.
7. Trivedi RK, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
8. Emission norms: Bharat stages, European and US Standards.

15ME47C FLUID MECHANICS AND MACHINERY LABORATORY L T P C

0 0 2 1

COURSE OUTCOMES

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

CO1: Apply Bernoulli's equations in flow experiments to determine the coefficient of discharge. (K3)

CO2: Determine flow rates, pressure changes, and minor and major head losses for viscous flows through pipes. (K3)

CO3: Evaluate the performance of turbines. (K3)

CO4: Evaluate the operation and performance of different types of pumps. (K3)

UNIT I FLUID MECHANICS 10

Bernoulli's Equation - Venturimeter - Orificemeter - Rotameter - Viscous flow through Pipes and pipe fittings.

UNIT II PERFORMANCE OF TURBINES 10

Pelton Wheel turbine - Francis Turbine - Kaplan Turbine - Performance curves.

UNIT III PERFORMANCE OF PUMPS 10

Centrifugal Pump - Reciprocating Pump - Gear oil Pump - Performance curves.

P:30; TOTAL:30 PERIODS

REFERENCES

1. Streeter VL and Wylie EB, "Fluid Mechanics", 9th Edition, McGraw Hill, 2010.
2. Bansal RK, "Fluid Mechanics and Hydraulics Machines", 9th Edition, Laxmi Publications Private Limited, New Delhi. 2013.
3. Virtual labs: http://iitg.vlab.co.in/?sub=62&brch=176
   http://eerc03-iiith.virtual labs.ac.in/index.php?section=List%20of%20experiments

15ME48C MATERIAL TESTING LABORATORY L T P C

0 0 2 1

COURSE OUTCOMES

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

CO1: Evaluate mechanical properties experimentally for materials subjected to direct, shear and bending. (K3)

CO2: Compare hardness and impact resistance of the materials before and after heat treatment. (K4)

CO3: Perform metallurgical characterization of materials. (K3)

CO4: Analyze the strength and stiffness of helical coil springs. (K3)

UNIT I MECHANICAL PROPERTIES OF MATERIALS 12

Mechanical properties - elastic constants, yield strength, ultimate tensile strength (UTS), S-N curve, hardness, shear strength, impact strength and torsional strength.

UNIT II STRENGTHENING MECHANISMS 6

Heat treatment - Effect of hardening and tempering - Improvement in hardness and impact resistance of steels.

UNIT III CHARACTERIZATION OF MATERIALS 6

Micro structural analysis - Optical microscopy.

UNIT IV SPRINGS 6

Mechanical properties - Stiffness, modulus of rigidity, maximum strain energy.

P:30; TOTAL:30 PERIODS

REFERENCES

1. Timoshenko SP, “Elements of Strength of Materials”, Tata McGraw-Hill, New Delhi, 2004.
2. Popov EP, “Engineering Mechanics of Solids”, 2nd Edition, Prentice-Hall of India, New Delhi, 2002.

15ME49C MANUFACTURING TECHNOLOGY LABORATORY- II

L	T	P	C
0	0	2	1

COURSE OUTCOMES

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

CO1: Perform lathe operations to create components. (K3)
CO2: Estimate cutting forces in a single point cutting tool. (K3)
CO3: Perform shaping, slotting and milling operations. (K3)
CO4: Generate gear profile using milling and hobbing machines. (K3)
CO5: Perform surface finishing operations on simple parts. (K3)

UNIT I CENTRE LATHE AND SEMI AUTOMATIC LATHE 10

Thread cutting with centre lathe and simple machining practices in capstan lathe. Cutting force measurement using cutting tool.

UNIT II SPECIAL PURPOSE MACHINE TOOLS 10

Shaping, milling and slot cutting operations.

UNIT III GEAR MANUFACTURING AND ABRASIVE PROCESSES 10

Gear milling, gear hobbing and simple grinding operations.

P:30; TOTAL:30 PERIODS

REFERENCES

1. Rao PN “Manufacturing Technology”, Metal Cutting and Machine Tools Vol- 2, TataMcGraw -Hill, New Delhi, 3rd Edition, 2013.
2. Philip F Ostwald and Jairo Munoz, “Manufacturing Processes and systems”, 9th Edition, John Wiley andSons, 2011.
3. Mikell P Groover, “Fundamentals of Modern Manufacturing, Materials, Processes and Systems”, 3rd Edition, John Wiley and Sons, 2011.
4. Chapman WAJ and Martin SJ, “Workshop Technology”, Part III, Viva Books Private

Ltd., 2006.

15ME51C	**HEAT AND MASS TRANSFER**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

COURSE OUTCOMES

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

CO1: Solve problems involving steady state and transient heat conduction in simple geometries. (K3)

CO2: Apply empirical correlations for both free and forced convection to determine values for the convection heat transfer coefficient of fluid in thermal systems. (K3)

CO3: Design simple heat exchangers using systematic procedure. (K3)

CO4: Apply the basic concepts of radiation heat transfer to evaluate radiation view factors using data book. (K3)

CO5: Solve problems involving mass transfer due to diffusion and convection. (K3)

UNIT I CONDUCTION 12

General differential equation of heat conduction in coordinates system - One dimensional heat conduction for steady state and unsteady state condition - Extended Surfaces - case studies.

UNIT II CONVECTION 12

Basic Concepts - Boundary Layer Concept -Forced Convection- External and Internal Flow - Free Convection -External Flow - Dimensional Analysis - Applications.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 12

Nusselts theory of condensation - pool and flow boiling - Basics of Heat Exchanger design -Fouling Factors - compact heat exchanger - case studies.

UNIT IV RADIATION 12

Laws of Radiation - Black Body Radiation - Grey body radiation - Shape Factor Algebra - Electrical Analogy - Radiation Shields - Introduction to Gas Radiation - Solar radiation - Concept and application.

UNIT V MASS TRANSFER 12

Basic Concepts - Diffusion Mass Transfer - Steady state Molecular Diffusion - Convective Mass Transfer - Application of Mass transfer: Cooling Tower - Performance characteristics.

L:30 T:30; TOTAL:60 PERIODS

Note: (Use of HMT data book and steam tables are permitted in the End Semester Examination)

TEXT BOOKS

1. Sachdeva R C, “Fundamentals of Engineering Heat and Mass Transfer”, New Age International, 2009.
2. Frank P Incropera and David P DeWitt, “Fundamentals of Heat and Mass Transfer”, John Wiley and Sons, 2007.

REFERENCES

1. Yadav R, “Heat and Mass Transfer”, Central Publishing House, 1995.
2. Ozisik MN, “Heat Transfer”, McGraw-Hill Book Co., 1994.
3. Nag PK, “Heat Transfer”, Tata McGraw-Hill, New Delhi, 2002.
4. Holman JP, “Heat and Mass Transfer”, Tata McGraw-Hill, 2000.
5. Kothandaraman CP, “Fundamentals of Heat and Mass Transfer”, New Age International, New Delhi, 2008.
6. NPTEL Lecture notes: http://nptel.ac.in/downloads/112108149/
7. NPTEL videos: http://nptel.ac.in/video.php?subjectId=112101097
8. Virtual Lab: http://vlab.co.in/http://iitg.vlab.co.in/

15ME52C	DYNAMICS OF MACHINERY	L	T	P	C
		2	2	0	3

COURSE OUTCOMES

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

CO1: Perform dynamic analysis on reciprocating engines and determine the energy of Flywheel. (K2)

CO2: Balance reciprocating and rotating masses. (K3)

CO3: Determine natural frequency of simple vibratory system. (K2)

CO4: Determine the amplitude of the forced vibration caused by various means.(K3)

CO5: Determine the characteristics of centrifugal governors and predict the effect of gyroscopic couple (K2)

UNIT I DYNAMIC FORCE ANALYSIS AND FLYWHEEL 12

Static and dynamic force analysis in slider crank mechanism, Engine force analysis, Turning moment on crank shaft, Dynamically equivalent system.
Flywheel: Turning moment diagram - fluctuation of energy and speed, weight of flywheel required-Application.

UNIT II BALANCING 12

Balancing of rotating masses in one and several planes, balancing of reciprocating masses in single and multi cylinder engines: in-line, radial, primary and secondary balancing analysis, concept of direct and reverse cranks method.

UNIT III FREE VIBRATION 12

Basic features of vibratory systems - Basic elements and lumping of parameters -Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion -natural frequency - Types of Damping - Damped free vibration - Whirling of shafts and critical

speed -Torsional systems; Natural frequency of two and three rotor systems.

UNIT IV FORCED VIBRATION 12

Response to periodic forcing - Harmonic Forcing - Forced vibration caused by unbalance - Support motion - Force transmissibility and amplitude transmissibility -Vibration isolation , Vibration measuring devices and analyzers.

UNIT V MECHANISM FOR CONTROL: GOVERNORS AND GYROSCOPE 12

Centrifugal Governors - Watt, Porter and Proell - Spring loaded governors - Hartnell and Hartung governors. Sensitiveness, isochronism and hunting-effort and power of a governor

Gyroscopes - Gyroscopic couple - Gyroscopic stabilization - Gyroscopic effects in aeroplanes, ships and automobiles.

L:30 T:30; TOTAL:60 PERIODS

TEXT BOOKS

1. Rattan SS, “Theory of Machines”, Fourth Edition, Tata Mc Graw Hill, New Delhi, 2015.
2. Rao J S, “The Theory of Machines through Solved Problems”, 1st Edition, New Age International Limited, New Delhi, 2012.

REFERENCES

1. Uicker JJ, Pennock GR and Shigley JE “Theory of Machines and Mechanisms”, 3rd Edition, Oxford University Press, New Delhi, 2009.
2. Bevan T, “Theory of Machines”, 3rdEdition, Pearson India, 2010.
3. Ballaney P L, “Theory of Machines and Mechanisms”, Khanna Publishers, New Delhi, 2005.
4. Ambedkar AG, ”Mechanism and Machine Theory”, PHI Learning, New Delhi, 2009.
5. Machine Dynamics & Mechanical Vibration, virtual Lab, http://mdmv-nitk.vlabs.ac.in/

15ME53C	DESIGN OF MACHINE ELEMENTS	L	T	P	C
		3	2	0	4

COURSE OUTCOMES

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

CO1: Describe the fundamental scientific principles of mechanical design (stress, strain, material properties, failure theories, fatigue phenomena, fracture mechanics) and their importance and use in design analysis. (K2)

CO2: Analyze and design power transmission shafts carrying various elements with geometrical features**.** (K4)

CO3: Select and design a mechanical spring based upon the application and requirements. (K4)

CO4: Analyze and design suitable joint for any given application. (K4)

CO5: Analyze and design a journal bearing and select a suitable rolling element bearing based on the given conditions. (K4)

UNIT I VARIABLE STRESSES AND FATIGUE FAILURE 15

Simple stress and strain relationship, types of stresses - combined stresses - criteria for

failure - theories of failure - factor of safety - preferred numbers. Mechanism of fatigue failure - fatigue limit and fatigue strength - S-N curves - types of stress variations, terminology - Soderberg, Goodman and Gerber equations - stress raisers - stress concentration factor and notch sensitivity factor, factors affecting fatigue limit - finite and infinite life, equivalent stress and combined variable stresses.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 15

Forces on shafts due to gears - belts and chains - estimation of shaft size based on strength and critical speed. Coupling - types and applications - Design of square keys-use of standards - rigid couplings, flexible flange couplings - selection.

UNIT III DESIGN OF SPRINGS 15

Helical springs and leaf springs-stresses and deflection in round wire helical springs-accounting for variable stresses concentric springs. Design of leaf springs- stress and deflection equation.

UNIT IV DESIGN OF JOINTS 15

Strength equations, efficiency and design of riveted joints - joints of uniform strength, eccentrically loaded riveted joints. Types of welded joints - weld symbols, strength of welds, centrally loaded, unsymmetrical sections, axially loaded and eccentrically loaded joints. Bolted joints - simple analysis only.

UNIT V DESIGN AND SELECTION OF BEARINGS 15

Sliding Contact Bearing: Theory of lubrication –hydrodynamic bearings - Sommerfield number - design of hydrodynamic bearings.

Rolling Contact Bearings: Static and dynamic load capacity - cubic mean load and variable load - probability of survival - selection of deep groove and angular contact ball bearings.

L:45; T:30; TOTAL:75 PERIODS

Note: (Use of P S G Design Data Book is permitted in the End Semester Examination)

TEXT BOOKS

1. Bhandari V B, Design of Machine Elements, Tata McGraw Hill Education (India) Private Limited, New Delhi, 3rd Edition, 2010.
2. Joseph Edward Shigley, Mechanical Engineering Design, McGraw-Hill, 6th edition, 2003.

REFERENCES

1. Kamlesh Purohit and Sharma CS, “Design of Machine Elements”, Prentice -Hall of India Private Limited, New Delhi, 3rd Edition, 2005.
2. Wentzell Timothy H, “Machine Design; Machine Design, Delmar Cengage learning”, U.S.A, 1st Edition, 2003.
3. Robert L Nortan, “Machine Design-An Integrated Approach”, Pearson Publishers, New Delhi, 2003.
4. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", M/s. DPV Printers, Coimbatore, 2000.

5. Jacobson BO, Bernard J Hamrock and Steven R Schmid, “Fundamentals of Machine Elements”, Mcgraw Hill, Inc., Second Edition, 2006.
6. IS 7906-Springs.
7. IS 3688-power transmission- shafts - dimensions for cylindrical and l/10 conical shaft ends.

15ME54C COMPUTER AIDED DESIGN AND MANUFACTURING

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Perform translation, rotation, scaling, line drawing, clipping and viewing operations using algorithms. (K2)
CO2: Describe techniques in representation of curves, surfaces and solids. (K2)
CO3: Describe constructional features of CNC machines and generate part code for given applications. (K3)
CO4: Apply group technology principle in cellular manufacturing. (K3)
CO5: Discuss rapid prototyping techniques. (K2)

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS 9

Product cycle - Design process - sequential and concurrent engineering - Computer aided design - CAD system architecture - Computer graphics - co-ordinate systems -2D and 3D transformations - output primitives - Line, circle - Clipping - viewing transformation.

UNIT II GEOMETRIC MODELING 9

Representation of curves - Hermite curve - Bezier curve - B-spline curves - rational curves -Techniques for surface modeling - Bezier and B-spline surfaces. Solid modeling techniques - CSG, B-rep. and sweep representation.

UNIT III COMPUTER NUMERICAL CONTROL 9

Computer Numerical Control (CNC) and DNC: Features of CNC, Elements of CNC machines, the machine control unit for CNC, CNC software, CNC Part programming - direct numerical control, distributed numerical control.

UNIT IV GROUP TECHNOLOGY AND CELLULAR MANUFACTURING 9

Introduction to GT, benefits, part families, part classification and coding, product flow analysis, cellular manufacturing, adaptation consideration in GT, quantitative analysis in cellular manufacturing, GT applications for manufacturing processes. CAPP - approaches**.** Introduction to robotics.

UNIT V INTRODCUCTION TO RAPID PROTOTYPING SYSTEMS 9

Liquid-based Rapid Prototyping Systems: Stereo lithography apparatus (SLA) - Fused Deposition Modeling - Laminated Object Manufacturing (LOM) Process, working principle, Applications, Advantages and Disadvantages.

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS) - Three

dimensional Printing (3DP) - Applications - Need of Rapid Tooling (RT) - Conventional Tooling Vs RT.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Ibrahim Zeid, “CAD/CAM, Theory and Practice”, Tata Mc Graw Hill, 2010.
2. Alavala and Chennakesava, “CAD/CAM: Concepts of Application”, PHI - Eastern Economy Editions, 2008.

REFERENCES

1. Foley, Van Dam, Feiner and Hughes, “Computer Graphics Principles and Practice”, 2nd Edition, Addison Wesley, 2000.
2. Martenson and Micheal E, “Geometric Modeling”, John Wiley & Sons, 1995.
3. Hill Jr and F S, “Computer Graphics using open GL”, Pearson Education, 2003.
4. P N Rao, “CAD/CAM”, Tata McGraw-Hill Company Limited, New Delhi.
5. Yoram Koren and Joseph Ben-Uri, “Numerical Control of Machine Tools”, Khanna Publishers, Delhi.
6. Groover and Zimmer, “CAD/CAM”, Pearson Education, 1993.

15ME55C	INSTRUMENTATION, MECHANICAL MEASUREMENTS AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Discuss the concepts of measuring instruments. (K2)
CO2: Describe the working of pressure and flow gauges. (K2)
CO3: Illustrate the vibration and temperature measuring instruments. (K2)
CO4: Recognize various transducer variables and measurement signals. (K2)
CO5: Explain the basic principle of control systems. (K2)

UNIT I CONCEPTS OF MEASUREMENT SYSTEM 9

Fundamental methods of measurement - Generalized measuring system - Types of input quantities - Calibration - The standards of length, mass, time and frequency, temperature and electrical standards. Error and its classifications. Uncertainty- Estimation of uncertainty.

UNIT II PRESSURE AND FLOW MEASUREMENT 9

Manometer, elastic transducer - pressure gauge and types - Mc-Leod gauge - thermal conductivity gauge. Flow measurement - Venturi and Orifice meters, Pitot tubes, turbine type meter, hotwire anemometer, magnetic flow meter. Liquid level sensors, light sensors and its selection - Intrusive and non intrusive methods - LDA and PIV.

UNIT III VIBRATION AND TEMPERATURE MEASUREMENT 9

Elementary accelerometer and vibrometer - seismic instrument for acceleration - velocity

measurement, Piezo electric accelerometer-uni-axial and tri-axial, Temperature measurement - liquid in glass thermometer, pressure thermometer, resistance temperature detector, thermocouples and thermopiles, thermistor, total radiation pyrometer, optical pyrometer - temperature measuring problem in flowing fluid.

UNIT IV TRANSDUCER AND MEASUREMENT 9

Displacement transducers - potentiometer, strain gauge-Rosette - orientation of strain gauge - LVDT - variable reluctance transducers, proximity sensors, capacitance transducers, tacho generator; smart sensors, integrated sensors, radio telemetry, torque measurement.

UNIT V CONTROL SYSTEM 9

Basic elements of control systems - open loop and closed loop control - elements of closed loop control system - introduction to sampled data, digital control and multivariable control systems. Elements of lead and lag compensation, elements of proportional, integral - derivative (PID) control.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Beckwith TG and Buck NL, “Mechanical Measurements”, Addition Wesley Publishing Company Limited, 2009.
2. Gopal M, “Control Systems - Principles and Design”, Tata McGraw Hill Co. Ltd., New Delhi, 2002.

REFERENCES

1. Jain RK, “Mechanical and Industrial Measurements”, Khanna Publishers, Delhi, 1999.
2. Rangan, Mani and Sharma, “Instrumentation”, Tata McGraw Hill Publishers, New Delhi, 2004.
3. Nagarath IJ and Gopal M, “Control Systems Engineering”, New Age International Publishers, 2007.
4. Regtien PPL, “Measurement Science for Engineers”, Kogan Page, 2005.
5. Alan S Morris, “Measurement and Instrumentation Principles”, Butterworth, 2006.
6. Dominique Placko, “Fundamentals of Instrumentation and Measurement”, ISTE, 2007.

15ME56C	PROFESSIONAL ETHICS AND HUMAN VALUES	L	T	P	C
	(Common to all Programmes)	3	0	0	3

COURSE OUTCOMES

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

CO1: Recognize the core human values that shape the ethical behavior of an engineer. (K2)
CO2: Expose awareness on professional ethics. (K2)
CO3: Analyze the engineering ethical breach from past study. (K2)
CO4: Distinguish and apply safety, responsibility and rights in workplaces. (K2)
CO5: Discuss about the global issues with regard to ethics. (K2)

UNIT I HUMAN VALUES 9

Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Co-operation - Commitment - Empathy - Self-Confidence - Character – Spirituality

UNIT II ENGINEERING ETHICS 9

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

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

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

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the three mile island and chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT V GLOBAL ISSUES 9

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Moral leadership - sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (IETE),India, etc.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 1996.
2. Govindarajan.M, Natarajan S and Senthil Kumar VS, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCES

1. Charles D and Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint)
2. Charles E Harris, Michael S Protchard and Michael J Rabins, “Engineering Ethics - Concepts and Cases”, Wadsworth Thompson Learning, United States, 2000 (Indian Reprint now available)
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford 2001.

15ME57C THERMAL AND HEAT TRANSFER LABORATORY L T P C

0 0 2 1

COURSE OUTCOMES

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

CO1: Characterize different type of Oil//Fuels. (K4)

CO2: Design and conduct experiments on internal combustion engines to investigate and compare the performances. (K4)

CO3: Conduct experiments to evaluate the performance of compressors, refrigeration and air conditioning systems. (K4)

CO4: Conduct heat transfer experiments and analyze experimental data to understand different modes of heat transfer. (K4)

CO5: Conduct experiments on heat exchangers and analyze data to study the performance. (K4)

UNIT I CHARACTERIZATION OF OIL/FUEL 4

Viscosity measurement- redwood viscometer, Saybolt viscometer - flash point, fire point measurement.

UNIT II PERFORMANCE TESTS ON ENGINES 8

Morse Test - Retardation Test - optimum load determination

UNIT III PERFORMANCE TESTS ON THERMAL SYSTEMS 6

Compressors - Rotary - Reciprocating; Refrigeration and Air conditioning systems - Performance Tests

UNIT IV CONDUCTION 4

Thermal conductivity of material - Guarded plate method - Lagged pipe apparatus - Heat transfer through Composite wall.

UNIT V CONVECTION 4

Heat transfer - Forced convection inside a tube - Natural convection from a vertical cylinder - Pin fin - Heat Exchangers.

UNIT VI RADIATION 4

Determination of Stefan Boltzman constant- Emissivity of grey surface.

P:30; TOTAL:30 PERIODS

REFERENCES

1. Sachdeva RC, “Fundamentals of Engineering Heat and Mass Transfer”, New Age International, 2009.
2. Frank P Incropera and David P DeWitt, “Fundamentals of Heat and Mass Transfer”, John Wiley and Sons, 2007.
3. Arora CP, "Refrigeration and Air Conditioning”, Tata McGraw-Hill Publishers, 2nd Edition, 2008.

4. Kothandaraman CP, Domkundwar S, Domkundwar AV, "A course in Thermal Engineering", Dhanpat Rai & sons, 5th Edition, 2002.
5. Virtual Labs: http://iitg.vlab.co.in/?sub=62&brch=176 http://vlab.amrita.edu/?sub=1&brch=194&sim=801&cnt=1http://iitg.vlab.co.in/?sub=62&brch=176

15ME58C DYNAMICS LABORATORY

L	T	P	C
0	0	2	1

COURSE OUTCOMES

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

CO1: Carry out analysis on the control mechanisms.(K4)
CO2: Balance rotating masses in a rotor shaft system. (K4)
CO3: Balance reciprocating masses. (K3)
CO4: Validate critical speed of the rotor shaft system analytically. (K4)
CO5: Evaluate mass moment of inertia. (K3)

UNIT I MOMENT OF INERTIA **10**

Moment of inertia- flywheel and connecting rod.

UNIT II BALANCING OF MASSES AND VIBRATION ANALYSIS **10**

Balancing - Rotating masses and reciprocating masses - Critical speed - Vibration measurement and Analysis.

UNIT III CONTROL MECHANISMS **10**

Governors- Sensitivity and effort - Gyroscope - Gyroscopic couple, Cam - cam profile and Jump phenomenon.

P:30; TOTAL:30 PERIODS

REFERENCES

1. Rattan SS, "Theory of Machines", Fourth Edition, Tata Mc Graw Hill, New Delhi, 2015.
2. Rao JS, "The Theory of Machines Through Solved Problems", 1st Edition, New Age International Limited, New Delhi , 2012.
3. Bevan T, "Theory of Machines", 3rd Edition, Pearson India, 2010.
4. Machine Dynamics & Mechanical Vibration, virtual Lab, http://mdmv-nitk.vlabs.ac.in/

15ME59C COMPUTER AIDED DESIGN AND **L T P C**

MANUFACTURING LABORATORY 0 0 2 1

COURSE OUTCOMES

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

CO1: Develop Part modeling, Assembly and detailing of practical engineering components. (K3)
CO2: Develop a Part model of existing physical component. (K3)
CO3: Develop a prototype using 3D printing. (K3)
CO4: Generate CL data using CAM software. (K3)
CO5: Perform simple operations in CNC Lathe and Milling machines. (K3)

UNIT I COMPUTER AIDED DESIGN 8

Part Modeling, Assembly and Detailing of Screw Jack, Flange Coupling, Knuckle Joint, Plummer Block.

UNIT II REVERSE ENGINEERING 7

3D Modeling of physical components - Connecting Rod, Spur Gear, Piston - Image conversion using 3D scanner.

UNIT III NEW PRODUCT DEVELOPMENT 7

Design and development of new product using Fusion Deposition Modeling.

UNIT IV COMPUTER AIDED MANUFACTURING 8

Numerical Control (NC) code generation using CAM software's for milling and turning operations.

P:30; TOTAL:30 PERIODS

REFERENCES

1. Ibrahim Zeid, "CAD/CAM, Theory and Practice", Tata Mc Graw Hill, 2010.
2. Alavala and Chennakesava, "CAD/CAM: Concepts of Application", PHI - Eastern Economy Editions, 2008.

15ME61C METROLOGY AND QUALITY ENGINEERING L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: Explain precision and accuracy of linear and angular measuring instruments. (K2)
CO2: Use thread, gear profile and form measuring instruments. (K2)
CO3: Discuss the application of laser and CMM in metrology. (K2)
CO4: Apply quality control techniques and draw the control charts. (K3)
CO5: Select gauges for attribute inspection considering tolerances. (K2)

UNIT I GEOMETRICAL MEASUREMENT AND INSTRUMENTATION 9

Accuracy, precision, sensitivity, range, sources of errors, calibration. Taylor's principle of gauges. Linear and angular precision measuring instruments- Comparators, applications- Taper measurements.

UNIT II FORM MEASUREMENT 9

Measurement of screw threads- gear profiles using various instruments. Constant chord and base tangent method-gear testing machines. Radius, surface finish, straightness, flatness and roundness measurements.

UNIT III ADVANCES IN METROLOGY 9

Precision instruments based on laser, laser interferometer-application in linear, angular measurements and machine tool metrology. Coordinate measuring machine (CMM) - Constructional features - types, applications.

UNIT IV STATISTICAL QUALITY CONTROL 9

Process capability - control charts for variables and attributes - solving problems using the charts. basic principles of sampling - determination of sample size - inspection, single and double sampling. Operating Characteristic (OC) curves, Average Outgoing Quality (AOQ).

UNIT V DESIGN OF GAUGES 9

Fits and tolerance, Allowances, Gauge tolerance, Allocation of tolerances. Errors - Sources and prevention. Design of inspection tools, plug, snap and thread gauges. Uses of different gauges.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Gupta I C, "Engineering Metrology", Dhanpat Rai and Sons, 2005.
2. Jain R K, "Engineering Metrology", Khanna Publications, 2010.

REFERENCES

1. Beckwith G Thomas, Roy D Marangoni, John HLienhard V, "Mechanical Measurements" 6th Edition, Pearson publications, 2006.
2. Jayal AK, "Instrumentation and Mechanical Measurements", Galgotia Publications 2005.
3. IS 2984-1966, Indian Standard on Slip Gauges.
4. IS: 2341-1963, Large Metric Capacity Calibrating Measures.

15ME62C	DESIGN OF TRANSMISSION SYSTEMS	L	T	P	C
		3	2	0	4

COURSE OUTCOMES

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

CO1: Design and analyze flexible drive system for a given application. (K3)

CO2: Design suitable gear drive to transmit power between two parallel shafts**.** (K3)

CO3: Design suitable gear drive to transmit power between two non-parallel shafts.

(K3)

CO4: Select a suitable ray diagram and construct the kinematic arrangement of gears to design multi speed gear box. (K3)

CO5: Select and design brakes, clutches and Power screws for appropriate applications. (K3)

UNIT I DESIGN OF FLEXIBLE TRANSMISSION SYSTEMS 15

Design of flat belt and V-Belt for the given power and velocity ratio - rope and chain drives.

UNIT II DESIGN OF PARALLEL GEARS 15

Design of Spur Gear and Helical gear based on strength and wear - Gear correction.

UNIT III DESIGN OF NON-PARALLEL GEARS 15

Design of Bevel and Worm gears based on strength and wear.

UNIT IV DESIGN OF GEAR BOX 15

Multi Speed Gear Box: Ray diagram - gear tooth profile correction - finalization of the gear train; gear tooth loads and bearing reactions.

UNIT V DESIGN OF CLUTCHES, BRAKES AND SCREWS 15

Design and selection of Clutches - Plate and Cone clutch, Brakes - Band and Block - Design of power screw - square and trapezoidal threads - force analysis, (for screw jack, lathe, etc.,)

L:45; T:30; TOTAL:75 PERIODS

Note: ***(Use of PSG Design Data Book is permitted in the End Semester Examination)***

TEXT BOOKS

1. Prabhu T J, “Design of Transmission Systems”, Private Publication, 5th Edition, 2000.
2. Mehtha N K, “Machine Tool Design and Numerical Control”, Tata Mc-GrawHill, 3rd Edition, 2012.

REFERENCES

1. Robert Norton, “Design of Machinery”, McGraw Hill, 5th Edition, 2011.
2. Spotts M F, Shoup T E, Hornberger L E, “Design of Machine Elements”, Prentice Hall of India Eighth Edition, 2004.
3. William Orthwein, “Machine Component Design”, Vol. I and II, Jaico Publishing house, New Edition, 2006.
4. Gitin M Maitra, Prasad L, “Handbook of Gear Design”, Tata Mcgraw-Hill, 2004.
5. Richard Budynas, Keith Nisbett, “Mechanical Engineering Design”, Mc-GrawHill, 2011.
6. IS 6938: Design of rope drum and chain hoists for hydraulic gates-Code of practice
7. IS 15146:2002 ISO 155:1998, Belt Drives- Pulleys-Limiting Values Adjustment of

Centers.

15ME63C	FINITE ELEMENT ANALYSIS	L	T	P	C
		2	2	0	3

COURSE OUTCOMES

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

CO1: Apply fundamental concepts of FEA and to select suitable approximate methods to solve mechanical engineering problems. (K2)

CO2: Solve engineering problems using one dimensional element. (K3)

CO3: Select suitable two dimensional element to solve structural problems under plane stress and plane strain conditions. (K3)

CO4: Apply the principles of axisymmetric and Isoparametric and solve the mechanical engineering problems. (K4)

CO5: Formulate and solve basic problems in heat transfer and vibration. (K3)

UNIT I FEA BASICS AND APPROXIMATION METHODS 12

Basic concepts of FEA - Engineering analysis - General procedure for FEA - discretization - Elasticity equations - Weighted residual method - Variational method - Rayleigh Ritz method - Weak formulation method - Application to structural and heat transfer problems.

UNIT II ONE DIMENSIONAL FINITE ELEMENT ANALYSIS 12

Introduction - Finite element modeling, Coordinates - linear bar element-Interpolation function, Element matrices, Problems on bar element - The quadratic bar element - Shape function and element matrices only - Beam element - Shape function, Element matrices, Problems on beam element -Truss element - Element matrices, Problems on truss element.

UNIT III TWO DIMENSIONAL FINITE ELEMENT ANALYSIS 12

Dimensionality of a problem - Constant strain triangular element - Shape function, strain displacement, Stress calculations, temperature effects - Plane problems of elasticity, Example problems in plane stress and plane strain - Four noded rectangular element -Shape function, Strains and stresses, Application to solid mechanics problems.

UNIT IV AXISYMMETRIC AND ISOPARAMETRIC ELEMENT FORMULATION 12

Modeling techniques - use of symmetry, modeling of offsets, supports and joints. Axisymmetric formulation, Applications to cylinders under internal pressure and rotating disc- Need for Isoparametric formulation - four node quadrilateral element - Numerical Integration, Application to structural problems.

UNIT V FEA APPLICATIONS IN HEAT TRANSFER AND DYNAMICS 12

Application to one dimensional and two dimensional heat transfer problems. Types of dynamic analysis, General dynamic equation of motion, lumped and consistent mass, Mass matrices formulation of bar and beam element. Undamped-free vibration - Eigen value problem, Evaluation of eigenvalues and eigenvectors (natural frequencies and mode shapes).

L:30 T:30; TOTAL:60 PERIODS

TEXT BOOKS

1. Chandrupatla and Belagundu, "Introduction to Finite Elements in Engineering", 4th Edition, Pearson, 2012.
2. Seshu P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2013.

REFERENCES

1. ReddyJ N, "An Introduction to the Finite Element Method", McGraw-Hill International Editions, 2006.
2. David V Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition, 2005.
3. Cook, Robert D, Plesha, Michael E and Witt Robert J "Concepts and Applications of Finite Element Analysis", Wiley Student Edition, 2004.

15ME64C	PROJECT MANAGEMENT AND FINANCE (Common to all Programmes)	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Explain the concept of operational and project management. (K2)
CO2: Apply the scope of the project to develop the project plan. (K2)
CO3: Relate the technical, business and social environment in the projects. (K3)
CO4: Apply the management principles to form project team successfully. (K3)
CO5: Prepare project schedule using appropriate tools and techniques. (K3)

UNIT I BASIC CONCEPT 9

Concept and categories of project - Project development cycle - Concept, tools and techniques of project management - Logistics and supply chain management - Forms of project organizations.

UNIT II PROJECT FORMULATION 9

Project identification, formulation and preparation. Market and demand estimation - Market survey techniques - Demand forecasting. Materials management - Analysis of materials input, technology, production, plant capacity, location and site, civil works, charts, layouts and work schedule. Cost of project - Means of financing, estimates of cost - Financial projections.

UNIT III PROCESS OF PROJECT APPRAISAL 9

Technical, Economic, Financial, Legal and Social appraisal of the Industrial Projects. Problems due to rate of discount, wage-rate, exchange rates, treatment of taxes, social cost-benefits - treatment of risk and uncertainty - sensitivity analysis and probability approach - Single as well as multiple projects - Big data analytics - PLM and SLM.

UNIT IV PROJECT TEAM FORMULATION AND MAXIMIZING PARTICIPATION 9

Project Team frame works - Project Team cultures - Barriers and challenges - Selecting Team Members - Key skills of effective project leaders - Giving / receiving feedback from different members of the project.

UNIT V IMPLEMENTATION, MONITORING AND CONTROL OF PROJECTS 9

Project scheduling, network techniques for resource, cost budgeting and scheduling - project management teams and coordination - Monitoring and post implementation, evaluation of the project - ERP - Project financing.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Gobalakrishnan P and Ramamoorthy VE, "Textbook of Project Management", Macmillan Publications, 2014.
2. Maylor, "Project Management", 3rd Edition, Pearson, 2010.

REFERENCES

1. Gido, "Effective project management", 3rd Edition, Cengage Learning, 2008.
2. Gray and Larson, "Project Management: The Managerial Process", 3rd Edition, TMH, 2010.
3. Choudhury S, "Project Management", 1st Edition, Tata Mc Graw Hill Publishing Co., 2007.

15ME65C	COMPREHENSION	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

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

CO1: Recollect the knowledge acquired during the earlier semesters.(K2)
CO2: Apply fundamental principle of mechanical engineering concepts to solve real life problems. (K3)
CO3: Present technical topics and discuss about them. (K2)
CO4: Analyze and interpret experimental data with relevance. (K4)

1. **Comprehensive review**
   Review of various courses learned in the previous semesters by conducting objective type tests.
2. **Presentation**
   A group of students present on any technical topic of their interest.
3. **Analysis of experimental data**

Analyzing and interpreting the results of experiments conducted in the earlier semester laboratory courses.

4. **Identifying real life problems and proposing solutions**
   Real life industrial problems which they may face in their work place will be analyzed and solutions will be formulated. At least one such problem will be identified and solved by each group of students.
5. **Report writing**
   A thirty page summary report should be submitted by each group of students for evaluation. The evaluation is based on continuous assessment by a group of Faculty Members constituted by the professor in-charge of the course.

P:30; TOTAL:30 PERIODS

15ME66C	**METROLOGY AND AUTOMATION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OUTCOMES

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

CO1: Demonstrate the usage and calibration of the measuring instruments. (K3)
CO2: Check the form features of the products. (K3)
CO3: Predict displacement, temperature and torque. (K3)
CO4: Design and simulate fluid power circuits. (K3)
CO5: Analyze and control basic electrical, hydraulic and pneumatic systems. (K3)

UNIT I LINEAR AND ANGULAR MEASUREMENT 6

Calibration of Vernier / Micrometer / Dial Gauge, Checking Dimensions of part using slip gauges, Measurement of Taper Angle using sine bar. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic /Electrical).

UNIT II FORM MEASUREMENT 6

Measurements of Gear Tooth Dimensions, Measurement of tool angles using tool makers microscope, Measurement of straightness and flatness, Measurement of thread parameters.

UNIT III MECHANICAL MEASUREMENT 6

Calibration of Thermocouple, Measurement of Displacement (Strain Gauge / LVDT), Measurement of Force, Measurement of Torque.

UNIT IV SIMULATION OF HYDRAULIC AND PNEUMATIC SYSTEMS 6

Design and simulation of fluid power circuits. - Simulation of basic Hydraulic, Pneumatic and Electric circuits using software.

UNIT V CONTROL OF DRIVES 6

Speed Control of AC and DC drives. PID controller interfacing. Modeling and analysis of basic electrical, hydraulic and pneumatic systems using LAB VIEW. Computerized data logging system with control for process variables like pressure flow and temperature.

P:30; TOTAL:30 PERIODS

REFERENCES

1. Gupta I C, “Engineering Metrology”, Dhanpat Rai and Sons, 2005.
2. Jain R K, “Engineering Metrology”, Khanna Publications, 2010.
3. William Bolton, “Mechatronics”, 4th Edition, Pearson, 2011.

15ME67C	COMPUTER AIDED ANALYSIS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

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

CO1: Analyze bar, beam and truss structure for maximum deflection and stress. (K4)
CO2: Conduct structural analysis on components. (K4)
CO3: Execute modal and harmonic analysis for structures. (K3)
CO4: Carry out conductive and convective heat transfer analysis. (K3)

UNIT I ONE DIMENSIONAL STRUCTURAL ANALYSIS 8

Bars of constant and tapered cross section area, stepped bar. Beams- cantilever simply supported and fixed beam with point and uniformly varying load. Trusses.

UNIT II TWO AND THREE DIMENSIONAL STRUCTURAL ANALYSIS 8

Stress analysis of shaft, gear with hole, Stress analysis of pressure vessel and L bracket.

UNIT III VIBRATION ANALYSIS 7

Dynamic analysis of bar and beam for natural frequency and mode shape. Vibration analysis of 2D plate, Harmonic vibration analysis of simple beam.

UNIT IV THERMAL ANALYSIS 7

Thermal analysis- 1D and 2D with conduction and convection, Transient heat transfer analysis.

P:30; TOTAL:30 PERIODS

REFERENCES

1. Paleti Srinivas, Krishna Chaitanya Sambana and Rajesh Kumar Datti, “Finite Element Analysis Using ANSYS® 11.0”, PHI Learning Pvt. Ltd., 2010.
2. Nakasone Y, Yoshimoto S and Stolarski TA, “Engineering Analysis with ANSYS software”, Elsevier Butterworth-Heinemann, 2006.
3. Saeed Moaveni, “Finite Element Analysis (Theory and application with ANSYS software)”, 4th Edition, Pearson Education Limited, 2015.
4. Erdogan Madenci, Ibrahim Guven, “The Finite Element method and Applications in Engineering using ANSYS®”, Springer Publisher, 2006.

15ME68C	SIMULATION LABORATORY	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

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

CO1: Develop analytical model of the behavior of the simple mechanical and thermal systems. (K3)

CO2: Implement and simulate mathematical model using MATLAB. (K3)

CO3: Interpret the results of the simulated model. (K4)

This course is aimed at using MATLAB for the design, and analysis of simple Mechanical, and Thermal systems.

P:30; TOTAL:30 PERIODS

15ME69C	PRODUCT DEVELOPMENT LABORATORY	L	T	P	C
		0	0	4	2

COURSE OUTCOMES

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

CO1: Capture the functionality of existing product and convert it in to 3D-assembly model using CAD modelling software (K3).

CO2: Perform kinematic simulations of simple mechanisms that are involved in the given real product. (K3)

CO3: Suggest the possible improvements that can be included in the existing real products for its better aesthetic or functionality. (K3).

CO4: Develop conceptual models for the new product by free hand sketching (K3)

CO5: Recommend possible manufacturing process to make the proposed products. (K3)

The objective of this course is to make the students learn methodologies for identifying customer needs, developing new product concepts, prototype development, estimation of manufacturing costs, and developing business plans to support the development and marketing of these products. A student or a team of students shall develop their own products based on the users need, build simple prototypes of their design, and write development plans for the products.

P: 60 TOTAL: 60 PERIODS

15ME71C	MINI PROJECT	L	T	P	C
		0	0	8	4

COURSE OUTCOMES

Upon successful completion of this course, the students will be able to

CO1: Identify an innovative or creative idea/concept/solution to a problem. (K3)
CO2: Design and Develop the working model. (K3)
CO3: Work independently to lead the project along with team members. (K3)
CO4: Interpret the results and document the report. (K3)
CO5: Communicate effectively through presentation. (K3)

1. The Mini Project is a theoretical study/analysis/prototype design/modeling and simulation or a combination of these.
2. Should be done as group (preferably four students) project.
3. The progress of the project is evaluated based on a minimum three reviews and final viva-voce examination.
4. A project report is required to be submitted in the standard prescribed format.

P:120; TOTAL:120 PERIODS

15ME72C	RESEARCH PAPER AND PATENT REVIEW-SEMINAR	L	T	P	C
		0	0	2	1

COURSE OUTCOMES

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

CO1: Discuss the state of art of the emerging technology/research development in mechanical engineering field. (K2)
CO2: Effectively communicate the contents to the target audience and handle questions with confidence. (K4)

1. Student shall select topics on their own, the topics shall be on any aspect of the mechanical engineering but normally beyond the curriculum and get it approved by faculty coordinator
2. Student has to prepare a presentation individually on the approved topic for 15 minutes duration.
3. The presentation should cover the chosen technology topic, literature survey (Research paper and patent), application, current and future scope, references etc.
4. A technical report on the chosen topic will be prepared with minimum 15 pages containing the details from the above presentation and will be submitted at the time of presentation.
5. Presentation will be reviewed by a department committee headed by Head of the department.

P:30; TOTAL:30 PERIODS

15ME81C	INTERNSHIP / INPLANT TRAINING	L	T	P	C
		0	0	4	2

COURSE OUTCOMES

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

CO1: Recognize the requirement of the industry and cope up with the industrial scenario. (K2)
CO2: Prepare a report about the work experience in industry. (K3)
CO3: Communicate effectively through technical presentation. (K3)

1. Student shall undergo internship/inplant training after getting prior permission from the department
2. A report should be submitted after the successful completion of internship / inplant training.

P:60; TOTAL:60 PERIODS

15ME82C	PROJECT WORK	L	T	P	C
		0	0	20	10

COURSE OUTCOMES

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

CO1: Carry out project by conducting appropriate study and provide solution for chosen real time problem. (K6)
CO2: Discuss the state of art of the chosen real time problem through detailed literature survey. (K2)
CO3: Work independently on a topic/ problem/experimentation. (K3)
CO4: Apply appropriate tools to solve the real time problem. (K3)
CO5: Manage teams and project processes effectively and efficiently. (K4)
CO6: Organize, compile, analyze, report and discuss the outcomes of the project. (K5)

Project work shall be based on any of the following:

1. Fabrication of product/ testing setup of an experimentation unit/ apparatus/ small equipment, in a group.
2. Experimental / Theoretical verification of principles used in Mechanical Engineering Applications.
3. Projects having valid database, data flow, algorithm, and output reports, preferably software based.
4. Research findings, Recommendations and future scope.

P:300; TOTAL:300 PERIODS

15ME01E REFRIGERATION AND AIR CONDITIONING

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Explain the concept and performance of Refrigeration and Air conditioning systems. (K2)

CO2: Demonstrate the cryogenics techniques and environmental issues of different refrigerants. (K2)

CO3: Design and select Refrigeration and Air conditioning components for different applications. (K3)

CO4: Design the Air conditioning systems using cooling load calculation, duct design and air distribution. (K3)

CO5: Demonstrate and interpret the applications of Refrigeration and Air conditioning systems. (K3)

UNIT I REFRIGERATION SYSTEMS 9

Introduction, Refrigeration machine and Reversed Carnot cycle, simple vapour compression refrigeration system, Gas cycle refrigeration, Absorption refrigeration, steam jet refrigeration, thermo electric refrigeration.

UNIT II CRYOGENICS AND REFRIGERANTS 9

Multistage compression and evaporator system-compound systems- cascade system, Manufacture of solid carbon di-oxide, Liquefaction of gases, Linde and Claude systems for liquefaction of air, Liquefaction of Hydrogen and Helium, Production of low temperature by adiabatic demagnetization of paramagnetic salt. Refrigerants

UNIT III REFRIGERATION AND AIRCONDITIONING SYSTEM COMPONENTS 9

Compressor-reciprocating, rotary, screw and scroll - Performance, capacity control and selection of compressor. Condenser-Types- Condenser capacity and efficiency, Evaporator- types, capacity and efficiency, Throttling devices-capillary tube, TEV, EEV, Solenoid valve, capacity and selection. Cooling towers

UNIT IV AIRCONDITIONING SYSTEMS 9

Basic Air conditioning processes, cooling load calculations, Air duct design, Design of room air distribution, Air handling unit, Types of Air conditioner, VAV and VRV Systems.

UNIT V APPLICATIONS OF REFRIGERATION AND AIRCONDITIONING SYSTEMS 9

Cold storages and low temperature applications, quick freezing, Ice manufacturing, milk processing, Food Preservation, Marine Air-conditioning, Transport refrigeration, Humidification plant for textile mills/textile processing, solar cooling.

L:45; TOTAL:45 PERIODS

Note: (Use of Refrigeration tables and charts are permitted in the End Semester Examination)

TEXT BOOKS

1. Ananthanarayanan P N, “Basic Refrigeration and Air conditioning”, Tata McGraw-Hill Education, 3rd Edition 2005.
2. Arora C P, “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi, 2006.

REFERENCES

1. Manohar Prasad, “Refrigeration and Air conditioning”, New Age International (P) Ltd., Revised 2nd Edition 2006.
2. http://nptel.ac.in/courses/Webcourse-Contents/IIT%20Kharagpur/Ref%20and%20Air%20Cond/New_index1.html
3. ISHRAE- HVAC Engineers Handbook, Second Edition, 2014.
4. ASHRAE Handbook for HVAC.
5. IS 1391 (PART 2) : 1992 Room Air Conditioners - Specification

15ME02E DESIGN OF HEAT EXCHANGER AND PRESSURE VESSEL

L	T	P	C
2	0	2	3

COURSE OUTCOMES

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

CO1: Describe the types and working of heat exchangers and regenerators. (K2)
CO2: Demonstrate the design of heat exchanger. (K3)
CO3: Illustrate the design of compact heat exchangers and condensers. (K3)
CO4: Analyze the stresses in pressure vessels. (K4)
CO5: Illustrate the design of pressure vessels. (K3)

UNIT I INTRODUCTION TO HEAT EXCHANGERS 12

Types of heat exchangers, shell and tube heat exchangers - regenerators and recuperators - Parts description, classification as per Tubular Exchanger Manufacturers Association.

UNIT II DESIGN OF HEAT EXCHANGERS 12

Thermal design using ε-NTU, P-NTU and LMTD methods - Effectiveness - Optimization - Calculation of heat Transfer Coefficient - Calculation of Pressure Drops - Mechanical design of baffles and tube sheets - Complete Problems.

UNIT III COMPACT HEAT EXCHANGERS, CONDENSERS AND COOLING TOWERS 12

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations - Design of surface and evaporative condensers - cooling tower - performance characteristics.

UNIT IV STRESSES IN PRESSURE VESSEL 12

Methods for determining stresses - Terminology and Ligament Efficiency - Applications. Introduction - Stresses in a circular ring, cylinder - Dilation of pressure vessels, Membrane stress Analysis of Vessel - Cylindrical, spherical and, conical heads - Thermal Stresses - Discontinuity stresses in pressure vessels.

UNIT V DESIGN OF PRESSURE VESSEL 12

Design of Tall cylindrical self supporting process columns - Supports for short vertical vessels - Stress concentration at a variable Thickness transition section in a cylindrical vessel, about a circular hole, elliptical openings. Theory of Reinforcement - Pressure Vessel Design.

L:30; P:30; TOTAL:60 PERIODS

Note: (Use of approved design data book is permitted in the End Semester Examination)

TEXT BOOKS

1. Sadik Kakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press, 2002.
2. Mukherjee R, "Practical thermal design of Shell & Tube Heat Exchanger", Begell House Inc.

REFERENCES

1. Shah RK, Dušan P Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.
2. Somnath Chattopadhyay, "Pressure Vessel Design and Practice", CRC press, 2005.
3. Henry H. Bedner,-"Pressure Vessels, Design Hand Book", CBS publishers and Distributors.
4. T Kuppan, "Heat Exchanger design handbook", Marcel Dekker, INC, 2000.
5. Podhorsky M, " Heat Exchanger: A Pratical approach to mechanical construction, Design and Calculations", Begell House, Inc, 1998.
6. ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003.
7. Stanley M Wales, Chemical Process equipment, selection and design, Butterworths Series in Chemical Engineering, 1988.
8. Dennis Moss, “Pressure Vessel Design Manual” Gulf professional Publishing, Third Edition 2004.

15ME03E AUTOMOBILE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Describe different types of layouts and chassis of an automobile. (K2)
CO2: Explain the recent advancements in engine and auxiliary systems. (K2)
CO3: Describe different transmission systems of an automobile. (K2)
CO4: Explore various types of steering, suspension and braking systems. (K2)
CO5: Discuss present and future technologies in automobile. (K2)
CO6: Explain the emission control techniques and its importance. (K2)

UNIT I VEHICLE STRUCTURE 9

Introduction - types of automobiles - vehicle construction - different layouts - types of chassis.

UNIT II ENGINE AND AUXILLIARIES 9

Engine types - Electronically controlled gasoline injection system - electronically controlled diesel injection system - electronic ignition system - turbo and super chargers - catalytic converters - engine emission - emission norms.

UNIT III TRANSMISSION SYSTEMS 9

Clutch - types - gear boxes - manual and automatic - gear shift mechanisms - over drive - fluid flywheel - torque converter - transfer case -hotchkiss drive and torque tube drive - differential - axles.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry - steering gear boxes - power steering - types - front axle - types - pneumatic and hydraulic braking system - antilock braking system - electronic brake force distribution - traction control - regenerative braking - suspension system- types.

UNIT V FUTURE VEHICLE TECHNOLOGIES 9

Use of natural gas, bio-diesel, bio-ethanol, gasohol and hydrogen in automobiles - engine modifications required - performance - combustion and emission characteristics, electric and hybrid vehicles, nitrous oxide engine, jet car, fuel cell powered vehicles.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Kirpal Singh, "Automobile Engineering Vol 1 & 2", Standard Publishers, 2013, 13th Edition, New Delhi.
2. Jain K K, and Asthana R B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 1st Edition, 2006.

REFERENCES

1. Jack Erjavec, "A Systems Approach to Automotive Technology", Cengage Learning, 1st Edition 2013.
2. Joseph Heitner, "Automotive Mechanics", East-West Press, 2nd Edition, 2006.
3. Heinz Heisler, "Advanced Engine Technology," SAE International Publications, USA, 1st Edition 1998.
4. Ganesan V, "Internal Combustion Engines", Tata McGraw-Hill, 4th Edition, 2012.
5. Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers, 9th edition, 1997.

15ME04E INTERNAL COMBUSTION ENGINES

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Distinguish normal and abnormal combustion phenomena in SI and CI engines. (K2)

CO2: Analyze the effect of combustion chamber design features and other engine parameters on the performance of SI and CI engines. (K2)

CO3: Discuss fuel metering and fuel supply systems of I C engines. (K2)

CO4: Describe the effect of engine emission on environment, their measurement and control techniques incorporating the standard emission norms. (K2)
CO5: Implement the viable alternate fuels for IC engines for the emission control and sustainable development. (K3)
CO6: Describe recent trends in IC engines and the principle of modern engine management systems. (K2)

UNIT I COMBUSTION PHENOMENA IN SI AND CI ENGINES 9

Normal and Abnormal combustion of SI and CI engines - Factors influencing abnormal combustion - Types of Combustion chambers of SI and CI engines - Effect of combustion chamber design and engine parameters on the combustion of both engines.

UNIT II FUEL SUPPLY SYSTEMS OF SI AND CI ENGINES 9

Fuel Supply systems in SI engines - Air-fuel ratio requirements, Design of carburetor - Electronic Fuel Injection Systems and their types - Fuel Supply systems in CI engines - Components - Description - Supercharging and Turbo charging.

UNIT III ENGINE EMISSION AND CONTROL 9

Emissions from SI and CI engines - Mechanism of formation of NO_X , HC, CO, Smoke and Particulate emissions, Emission measuring equipments, Methods of controlling emissions, Indian Driving Cycles and emission norms-Indian/International.

UNIT IV ALTERNATE FUELS 9

Need for Alternate fuels - Oxygenated Fuels, Vegetable oils and bio-diesel, gaseous fuels, Hydrogen - Properties and Suitability of the alternate fuels, Engine - Modifications, Performance, Combustion and Emission Characteristics of SI and CI Engines using these alternate fuels.

UNIT V RECENT TRENDS IN IC ENGINES AND ENGINE MANAGEMENT SYSTEMS 9

Homogeneous Charge Compression Ignition Engine, Lean Burn Engine, Variable Compression Ratio Engine, Dual Fuel Engine, Common Rail Direct Injection Diesel Engine, Gasoline Direct Injection Engine, Engine Electronics Management, Data Acquisition System - pressure pick up, charge amplifier PC for Combustion and different sensors used in engine management system. Introduction to simulation of IC engine.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Richard Stone, “Introduction to Internal Combustion Engines”, Palgrave Macmillan, 3rd Edition, 2012.
2. Ganesan V, “Internal Combustion Engines”, Tata McGraw-Hill, 4th Edition, 2012.

REFERENCES

1. John B Heywood, "Internal Combustion Engine Fundamentals", McGraw-Hill Education (India) Pvt. Limited, 2011.
2. Gupta H N, "Fundamentals of Internal Combustion Engines", Prentice Hall of India, 2nd Edition, 2013.
3. Mathur.M L and Sharma.RP, "Internal Combustion Engines", Dhanpat Rai and Sons, 2008.
4. SAE International Journal of Engines.
5. http://nptel.ac.in (Engine Combustion, Engine Emissions).

15ME05E	GAS DYNAMICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Apply the fundamental flow equations and basic solution techniques in solving compressible one dimensional flow.(K3)

CO2: Obtain first order solutions for compressible internal flows for variable geometry ducts. (K3)

CO3: Obtain first order solutions for compressible internal flows with friction and heat transfer. (K3)

CO4: Derive the conditions for the change in pressure, density and temperature for flow through a normal, oblique and expansion shock waves. (K3)

CO5: Perform numerical analysis to solve unsteady one-dimensional flow problem. (K3)

UNIT I ONE-DIMENSIONAL COMPRESSIBLE FLOW 9

One dimensional flow concept, Isentropic flows, Stagnation/Total conditions, Dynamic pressure and pressure coefficients, Normal shock waves, Rankine-Hugonoit equations, Rayleigh flow, Fanno flow, Crocco's theorem.

UNIT II QUASI-ONE DIMENSIONAL FLOWS 9

Governing equations, Area velocity relations, Isentropic flow through variable area ducts, Convergent-divergent (or De Laval) nozzles, Over-expanded and under-expanded nozzles, Diffusers.

UNIT III ANALYSIS OF DIFFUSERS AND NOZZLES 9

Flow through nozzles - Flow through diffusers -Effect of friction - Intake analysis of supersonic engines - intakes with normal shock - oblique shocks - Study of special supersonic nozzles and diffusers.

UNIT IV FLOW THROUGH A NORMAL, OBLIQUE AND EXPANSION SHOCK WAVES 9

Energy equation for a non-flow process - Energy equation for a flow process - The adiabatic energy equation - Momentum Equation - Moment of Momentum equation - Stagnation Velocity of Sound - Stagnation Pressure - Stagnation Density - Stagnation State - Velocity of sound - Critical states - Mach number - Critical Mach number - Various regions of flow.

UNIT V UNSTEADY WAVE MOTIONS 9

Moving normal shock waves, Reflected shock waves, Physical features of wave propagation, Elements of acoustic theory, Incident and reflected waves, Shock tube relations, Piston analogy, Incident and reflected expansion waves, Finite compression waves, Shock tube relations.

L:45; TOTAL:45 PERIODS

Note: (Use of Gas tables is permitted in the End Semester Examination)

TEXT BOOKS

1. Yahya S M, Fundamentals of Compressible Flow, New Age International Publishers, 3rd Edition (2003).
2. John J E A and Keith T, "Gas Dynamics", Prentice-Hall, 3rd Edition, NJ (2006).
3. Anderson J D, "Modern Compressible Flow", McGraw-Hill, 3rd Edition, New York (2004).
4. Bose T K, "High Temperature Gas Dynamics", Springer, New York (2004).
5. Zucker R D and Biblarz O, Fundamentals of Gas Dynamics, McGraw-Hill, 2nd Edition, New York (2002).

REFERENCES

1. Cambel A B and Jennings B H, "Gas Dynamics", McGraw-Hill, New York (1958).
2. Cheers F, "Elements of Compressible Flow", John Wiley & Sons, New York (1963).
3. Chapman A J, "High Speed Flow", Cambridge Univ. Press, Cambridge (2000).
4. Turrell G, "Gas Dynamics: Theory and Applications", Wiley, New York (1997).
5. Benedict R P, "Fundamentals of Gas Dynamics", John Wiley & Sons, New York (1983).
6. nptel.ac.in/courses/112103021.

15ME06E	**PROPULSION SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES

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

CO1: Describe various types of air breathing propulsion concepts. (K2)
CO2: Explain how thrust and shaft power are interrelated in various types of propulsion engines. (K2)
CO3: Explain the main components of jet engines (fan, compressor, and turbine). (K2)
CO4: Perform basic thermodynamic and aerodynamic analyses of jet engine components. (K2)

CO5: Describe the mechanical design process of typical jet engines. (K2)

UNIT I AIR BREATHING PROPULSION 9

Aircraft Propulsion - Introduction - Ancient aircraft engines - Types of aircraft engines - Reciprocating internal combustion engines - Gas turbine engines - Turbo jet engine - Turbo fan engine - Turbo-prop engine.

UNIT II PROPULSION 9

Aircraft propulsion theory: thrust, thrust power, propulsive and overall efficiencies - use of stagnation state - performance of ram jet, turbojet, turbofan and turboprop engines.

UNIT III COMPONENTS OF JET ENGINES 9

Air intakes-Compressors - Combustors - Turbines - Afterburners - Nozzle - Thrust Reversers - Cooling Systems - Fuel Systems - Fuel control unit - Propellant Pump - Engine starting system - Ignition - Lubrication System - Control System.

UNIT IV THERMODYNAMIC ANALYSIS OF IDEAL PROPULSION CYCLES 9

Thermodynamic analysis of turbojet engine, turbofan engine, turbo-prop engine- Study of subsonic and supersonic engine models- Analysis of Turbojet with after burner - Analysis of Turbofan with after burner.

UNIT V DESIGN OF JET ENGINES 9

Identification and selection of optimal operational parameters - Design of fuel efficient engines - Mixed flow turbo fan engine - Need for further development.

L:45; TOTAL:45 PERIODS

Note: (Use of Gas tables is permitted in the End Semester Examination)

TEXT BOOKS

1. Nicholas Cumpsty, “Jet Propulsion: A Simple Guide to the Aerodynamic and Thermodynamic Design and Performance of Jet Engines”, Cambridge University Press; 2nd Edition, 2003.
2. Ronald D Flack, “Fundamentals of Jet Propulsion with Applications”, Volume 17 of Cambridge Aerospace Series, Cambridge University Press, 2010.

REFERENCES

1. Zucrow N J, “Aircraft and Missile Propulsion”, vol.1 & II, John Wiley, 1975.
2. Zucrow N J, “Principles of Jet Propulsion and Gas Turbines”, John Wiley, New York, 1970.
3. Sutton G P, “Rocket Propulsion Elements”, John wiley, 1986, New York.
4. "Trade-offs in jet inlet design", Andras Sobester Journal of Aircraft, Vol44 No3 May-June 2007.
5. Walter J hesse and Nicholas V S, "Jet Propulsion for Aerospace Applications", 2nd Edition, Mumford Pitman Publishing Corp, 1964.

6. Hill P and Peterson C, “Mechanics and Thermodynamics of Propulsion”, Addison - Wesley Publishing company, 1992.
7. Cohen H, Rogers G E C and Saravanamutto, “Gas Turbine Theory”, Longman Group Ltd., 1980.

15ME07E	TURBOMACHINES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Describe the basic principles of operation, classifications, types and applications of pumps, fans, blowers and compressors. (K2)
CO2: Analyze thermodynamically the performance of turbo machines. (K4)
CO3: Describe the geometry of blades, cascade parameters, performances of cascade. (K2)
CO4: Describe performance, design parameters and specifications of turbo machines used for different applications. (K2)
CO5: Describe the principles of operations, performance of different types of wind turbine and their applications. (K2)

UNIT I BASIC TURBO SYSTEMS 9

Turbo Machine: Basic concept and significant, Turbines, Compressors, Fan, blowers - classifications and types, working principles, applications.

UNIT II TURBOMACHINES AND THERMODYNAMIC PRINCIPLES 9

Turbomachine - Application of Laws of thermodynamics, thermal performance - different types of thermal efficiencies.

UNIT III DYNAMIC ANALYSIS 9

Aerofoil, blade geometry, cascades, cascade analysis, different types of losses, estimation of losses, design concepts.

UNIT IV SELECTION OF TURBO-MACHINES 9

Non-dimensional parameters - Performance of tubomachines - losses and performance curves - design condition and off design conditions - design parameters - specifications - selection criteria.

UNIT V WIND TURBINES 9

Types - Construction and working - performance - latest developments - small and micro wind mills.

L:45; TOTAL:45 PERIODS

Note: (Use of Gas tables and steam tables are permitted in the End Semester Examination)

TEXT BOOK

1. Yahya S M, “Turbines, Compressors & Fans”, Tata-McGraw Hill Co., 2nd Edition (2002).

REFERENCES

1. KadambiV and Manohar Prasad, “An Introduction to energy conversion”, Volume III - Turbo machinery, New Age International Publishers (P) Ltd.
2. Gopalakrishnan G and Prithvi Raj D, “A Treatise on Turbo machines”, Scitech Publications India Pvt. Ltd., 2002.
3. Wengshilie, “Basis for Thermal Energy and Dynamic Machine”, Higher Education Press, 2004.
4. Wilson D G, Korakianitis T, “The design of high-efficiency turbomachinery and gas turbines”, Prentice Hall, 1998.
5. Logan R, Ramendra R, “Handbook of Turbomachinery”, Marcel-Dekker, 1998.
6. William W Perg, “Fundamentals of Turbomachinery” John Wiley & Sons, Inc. 2008.

15ME08E	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Explain the basic concept and performance of different power plants and select suitable one. (K3)

CO2: Identify the various components of steam power plant and explain the construction, operation and performances of each component. (K2)

CO3: Summarize the functions of different components of nuclear and hydel power plants. (K2)

CO4: Summarize the functions of different components of diesel and gas turbine power plants. (K2)

CO5: Recognize the environmental and regulatory issues related to various power plants and Estimate the economy of power plants.(K3)

UNIT I CONVENTIONAL AND NON-CONVENTIONAL POWER PLANTS 9

Layout of Steam, Hydel, Diesel, MHD, Nuclear and Gas turbine Power Plants Combined Power cycles - Geothermal- OTEC- tidal- Pumped storage -Solar central receiver system- significance and limitations.

UNIT II STEAM POWER PLANT 9

Fuel and ash handling, Combustion Equipment for burning coal, Mechanical Stokers. Pulveriser, Electrostatic Precipitator, Draught, condenser and Cooling Towers - Steam Boilers- High pressure and Super Critical Boilers - Fluidized Bed Boilers.

UNIT III NUCLEAR AND HYDEL POWER PLANTS 9

Nuclear Energy-Fission, Fusion Reaction, Types of Reactors, Waste disposal and safety-nuclear waste transportation norms - Hydel Power plant- Essential Elements, Selection of turbines, governing of Turbines- Micro hydel developments.

UNIT IV DIESEL AND GAS TURBINE POWER PLANT 9

Types of diesel plants, components, Selection of Engine type, applications-Gas turbine Power plant- Gas turbine material - open and closed cycles- reheating - Regeneration and inter cooling - combines cycle- case study.

UNIT V ECONOMICS AND ENVIRONMENTAL AFFECT OF POWER PLANTS 9

Cost of Electric Energy- Fixed and operating costs-Energy rates- Types tariffs-Economics of Load sharing- comparison of various power plants - Emission from various power plants -Environmental affects and its remedies - Environmental regulatory and norms for power plant.

L:45; TOTAL:45 PERIODS

Note: (Use of steam tables is permitted in the End Semester Examination)

TEXT BOOKS

1. Sharma PC and Nagpal, "A Text Book of Power Plant Engineering", Jain publication, reprint 2013.
2. EI-Wakil MM ,"Power Plant Technology," Tata McGraw-Hill, 2002.

REFERENCES

1. Arora SC and Domkundwar S, "A Course in Power Plant Engineering", Dhanpat Rai, 2010.
2. Nag PK, "Power Plant Engineering", Tata McGraw- Hill, 4th edition, 2014.
3. Ramalingam KK, "Power Plant Engineering", Scitech Publications, 2002.
4. Nagpal GR, "Power Plant Engineering", Khanna Publishers 1998.
5. Rai GD, "Introduction to Power Plant technology", Khanna Publishers, 1995.
6. Indian boiler regulations (IBR) Act, 2005.

15ME09E	**WIND ENERGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES

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

CO1: Describe the importance of wind resource assessment. (K2)
CO2: Explain the aerodynamics principles and performance parameters of wind turbines.(K2)
CO3: Explain the modern wind turbine control and monitoring system. (K2)
CO4: Describe the barriers in installation of wind farms. (K2)
CO5: Analyze the economics of wind farms. (K3)

UNIT I WIND RESOURCE ASSESSMENT 9

Characteristics of steady wind; Weibull wind speed distribution function; Vertical profiles of steady wind; Wind rose; Energy pattern factor; Energy content of the wind; Resource assessment.

UNIT II AERODYNAMICS 9

Introduction; NACA Aerofoil; Actuator disc; Axial momentum theory; Momentum theory for a rotating wake; Blade element theory; Strip theory; Tip losses; Tip loss correction; Wind machine parameters; C_p-λ characteristics, SERI Blade sections; Wind machine mechanics; Wind turbine: Classification of wind turbines; turbine components.

UNIT III MODERN WIND TURBINE CONTROL AND MONITORING SYSTEM 9

Classification of electrical machines; synchronous and induction generators; Variable speed generators-Details of Pitch and Yaw Systems- Protections and Safety Consideration in Wind turbines- Wind Turbine Monitoring- SCADA and Databases: Remote Monitoring and Generation Reports, Operation and Maintenance for Product Life Cycle, Balancing technique (Rotor and Blade).

UNIT IV CONCEPT OF WIND FARMS 9

Wind Farms - Site Preparation-Installation and Operation Issues - Wind Farms in Electrical Grids, Typical Grid-connected Turbine Operation. Environmental concerns: Pollution free power; Noise; birds; Aesthetics, Radio waves, interference, Rainfall.

UNIT V ECONOMICS OF WIND FARM 9

Wind farm- Power curve for wind turbine generator-Capacity factor; Planning of wind farms, Siting, wake models. Wind energy economics: Annual energy output; Simple payback period; Capital recovery factor, Depreciation; Life cycle costing.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Siraj Ahmed, “Wind Energy - Theory and Practice”, PHI Learning Private Limited, Eastern Economy Edition, New Delhi, 2010.
2. Burton T, “Wind Energy Handbook”, John Wiley and Sons, 2nd Edition, 2011.

REFERENCES

1. Freris LL, “Wind Energy Conversion Systems”, Prentice Hall 2010.
2. Ahmed, “Wind energy Theory and Practice”, PHI, Eastern Economy Edition, 2012.
3. Manwell JF, “Wind Energy Explained: Theory, Design and Application”, John Wiley & Sons, 2010.

15ME10E	**SOLAR ENERGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES

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

CO1: Describe the principles of solar radiation and able to solve the solar energy potential at any location. (K2)

CO2: Discover solutions to improve the efficiency of flat plate collector by evaluating its performance theoretically and experimentally. (K3)

CO3: Identify the solutions to improve the efficiency of concentrating collectors by evaluating its performance.(K2)

CO4: Describe the recent developments of PV and evaluate its performance. (K2)
CO5: Construct and demonstrate various solar thermal systems. (K4)

UNIT I SOLAR RADIATION 9

Source of radiation - Sun earth relationship- extra-terrestrial radiation- Atmospheric attenuation - Solar Constant, Monthly average daily global radiation and diffuse radiations - Radiation Measurement instruments.

UNIT II SOLAR FLAT PLATE COLLECTORS 9

Design considerations - classification- Flat plate collectors- air heating collector's liquid heating - Temperature distributions- Heat removal rate- Useful energy gain - Losses in the collectors -Testing of flat plate collectors - Recent advancement.

UNIT III SOLAR CONCENTRATING COLLECTORS 9

Introduction- Types of concentric collectors - Cylindrical Parabolic collector - orientation and tracking modes. Compound parabolic collector- Geometry -Tracking requirements. Material for solar concentrations - Recent advancement.

UNIT IV PHOTOVOLTAIC SYSTEMS 9

Conversion of Solar energy into Electricity - Photovoltaic Effect, Photovoltaic material - Solar Cell - Module - Silicon solar cell and types - Efficiency of solar cells - PV Systems , Photovoltaic applications.

UNIT V THERMAL APPLICATIONS 9

Solar Thermal Power Plant, Solar Desalination, Solar Dryer, Solar Water Heating- Solar Air Heating-Solar cookers-solar air conditioning-solar pumps.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Soteris Kalogirou, "Solar Energy Engineering: Processes and Systems", 2nd Edition, Academic Press, 2013.
2. Duffie JA and Beckman WA, "Solar Engineering of Thermal Processes", 4th Edition, Wiley, 2013.

REFERENCES

1. Sukhatme SP, "Solar Energy", Tata McGraw-Hill Education, 3rd Edition, 2008.
2. Garg HP and Prakash J, "Solar Energy- Fundamentals & Applications", Tata McGrawHill, 2000.
3. Partain LD, Fraas LM, "Solar Cells and Their Applications", John Wileyand Sons, 2nd Edition, 2010.
4. Luque A, Hegedus S, "Handbook of Photovoltaic Science and Engineering", John Wiley and Sons, 2003.
5. Tiwari GN, "Solar energy", CRC Press, 2002.

15ME11E	SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Explain the fundamentals of solar cells. (K2)
CO2: Recognize the various solar photovoltaic technologies and their up gradations along with their benefits. (K2)
CO3: Design and analyze on-grid photovoltaic systems. (K3)
CO4: Design and analyze off-grid photovoltaic systems. (K3)
CO5: Realize cost benefit analysis of PV installations. (K2)

UNIT I ESSENTIAL BASICS OF SOLAR CELL 9

Solar cell - physics - Photovoltaics in Global Energy Scenario - Fundamentals of Semiconductors, Energy band, Charge carriers - Motion, PN Junction diode, Solar cells - Design characteristics, Solar radiation.

UNIT II COMMERCIAL AND DEVELOPING TECHNOLOGIES 9

Commercial technologies - Mono crystalline and Multi crystalline, Silicon - Wafer based Solar cell, Thin film solar cells - A-Si, Cd-Te and CIGS, Concentrated PV cells, Developing technologies - Organic cells, Dye sensitized cells.

UNIT III SOLAR PV FOR ON-GRID APPLICATIONS 9

Solar cells to solar array - On-Grid PV system - With and Without storage - Balance of system - DC-DC converters - Inverters - Net Metering - Design and analysis - Performance evaluation and monitoring - Field visit - Grid tied PV power plant.

UNIT IV SOLAR PV FOR OFF-GRID APPLICATIONS 9

Off-Grid stand alone PV system - System sizing - Module and Battery - Storage - Batteries for PV systems - Sun Tracking mechanism - Types of tracking - One-axis, Two-axis - Maximum power point tracking - Design and analysis - Performance evaluation and monitoring - Field visit - Off-grid PV system.

UNIT V COST BENEFIT ANALYSIS FOR SOLAR PV INSTALLATIONS 9

Cost and manufacturability - Manufacturing economics - scaling - Pricing - Trends in retail pricing - energy economics - grid tied power plant -solar street lighting system.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Chetan Singh Solanki, “Solar Photovoltaics Fundamentals, Technologies and Applications”, Prentice Hall of India, 2nd Edition.
2. James P Dunlop, “Photovoltaic Systems”, American Technical Publishers, 2nd Edition.

REFERENCES

1. Robert Foster, Majid Ghassemi and Alma Cota, “Solar Energy - Renewable Energy and the Environment”, CRC Press.
2. www.pveducation.org

15ME12E	**THERMAL DESIGN AND MANAGEMENT OF ELECTRONIC EQUIPMENTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES

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

CO1: Explain the needs of thermal management in electronics packaging. (K2)
CO2: Apply the concept of conduction in cooling for electronic circuit board. (K3)
CO3: Estimate the performance of convective cooling in electronics. (K3)
CO4: Utilize the concept of heat pipe in latest electronic equipment. (K3)
CO5: Estimate the thermal and electrical reliability of the electronic equipment.(K3)

UNIT I INTRODUCTION TO THERMAL MANAGEMENT 9

Introduction - importance of thermal management of electronics - Issues in Electronics packaging design - technical management issues - temperature effects on different failure modes - Basics of conduction, convection and radiation heat transfer in electronic components - Cooling Specifications for Electronics.

UNIT II CONDUCTION 9

Mountings of electronic components - uniformly distributed heat source, steady state conduction- thermal resistance, junction to case resistance, contact interface resistance - circuit board with an aluminum heat sink core, chassis with non uniform wall sections, heat conduction through sheet metal cover and heat transfer in cylindrical shell.

UNIT III CONVECTION 9

Free convection - flow through flat horizontal and vertical plates - finned surface - cooling for PCB - forced Convection cooling - fan cooled electronic box - hollow core PCB - undesirable airflow reversal - direct air impingement cooling - finned cold plate and heat exchanger - effect of altitude in heat exchanger performance.

UNIT IV SPECIAL APPLICATIONS IN COOLING 9

Introduction to latest technology in cooling - Heat Pipes - degraded performance in heat pipes - performance - application - Liquid cooling - direct and indirect cooling - forced liquid cooling systems - pumps for cooling - liquid coolant - simple liquid cooling systems - mounting components for indirect liquid cooling - transistors on water cooled cold plate - solid state thermoelectric cooling.

UNIT V RELIABILITY 9

Mechanical reliability - stress analysis - engineering assumption - failure - life expectancy - thermal stress and strains. Electrical reliability - MTTF - first year failure - reliability model - system failure rate.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Ali, “Practical Guide to the packaging of electronics- Thermal and Mechanical design and analysis”, CRC press Inc, 2nd Edition, 2009.
2. Dave S Steinberg, “Cooling Techniques for Electronics Equipment”, John Wiley & Sons, 2nd revised Edition, 1991.

REFERENCES

1. Younes Shabany, “Heat Transfer: Thermal Management of Electronics”, CRC Press Inc, 2010.
2. Ravi Kandasamy and Arun S Mujumdar, “Thermal Management of Electronic Components”, Lambert Academic Publishing, 2010.
3. Sung Jin Kim, Sang Woo Lee, “Air Cooling Technology for Electronic Equipment”, Taylor & Francis, 1996.
4. Rao R Tummala, “Fundamentals of Microsystems Packaging”, McGraw-Hill, 2001.
5. Yunus A Cengel, “Heat Transfer: A Practical Approach”, McGraw-Hill, 2003.

15ME13E	ENERGY CONSERVATION AND WASTE HEAT RECOVERY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Realize the present energy scenario and the need for energy conservation and various energy conservation measures. (K2)
CO2: Explain the basic characteristics of instruments and select the suitable one for energy audit. (K2)
CO3: Recognize the various measures for energy conservation in thermal utilities. (K2)
CO4: Familiarize with recent energy efficient opportunities in electrical utilities. (K2)
CO5: Explain the concept and significance of various waste heat recovery systems. (K2)

UNIT I INTRODUCTION 9

Energy Scenario - Principles and Imperatives of Energy Conservation - Energy Consumption Pattern - Resource Availability - Role of Energy Managers in Industries.

UNIT II INSTRUMENTS FOR ENERGY AUDITING 9

Instrument characteristics - sensitivity, readability, accuracy, precision, hysteresis, Error and calibration. Measurement of flow, velocity, pressure, temperature, speed, Lux, power and humidity. Analysis of stack, water quality, power and fuel quality.

UNIT III THERMAL ENERGY AUDITIING 9

Energy Audit-Purpose, Methodology for various application - Various Energy Conservation Measures in Steam System - Losses in Boiler - Energy conservation in pumps, Fans and Compressors, Air conditioning and refrigeration systems - Steam Traps-Types, Function and Necessity.

UNIT IV ELECTRICAL ENERGY AUDITING 9

Power quality-Potential Areas for Electrical Energy Conservation in Various Industries-Energy Management Opportunities in Electrical Heating, Lighting system, Cable selection - Energy Efficient Motors - Factors involved in Determination of Motor Efficiency.

UNIT V WASTE HEAT RECOVERY SYSTEMS 9

Selection criteria for waste heat recovery technologies - recuperators, Regenerators, economizers - plate heat exchangers - Thermic fluid heaters - Waste heat boilers classification, location, service conditions, design Considerations - fluidized bed heat exchangers - heat pipe exchangers - heat pumps - sorption systems.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Steve Doty, Wayne C Turner, “Energy management hand book”, The Fairmont Press, Inc., 7th Edition, 2009.
2. Kreith F, Goswami D Y, “Energy management and conservation handbook”, CRC Press, 2008.

REFERENCES

1. Abbi YP and Shashank Jain. “Handbook on Energy Audit and Environment Management”,TERI Publications, 2006.
2. Beggs C, “Energy: management, supply and conservation”, Butterworth Heinemann Publications, 2nd Edition, 2002.
3. Thumann, WJ Younger, “Handbook of energy audits; Fairmont Press”, 6th Edition, 2003.
4. Kehlhofer R, Rukes B, Hannemann F, Stirnimann F, “Combined - cycle gas & steam turbine power plants”, 3rd Edition, Penn Well Books, 2009.
5. BEE, Volume I- IV

15ME31E HYDRAULICS AND PNEUMATICS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Identify the fluid power symbols and select suitable fluid for different applications. (K2)

CO2: Select appropriate fluid power driving system and actuators for any given application. (K3)

CO3: Select appropriate fluid power control elements to automate any simple machine.

(K3)

CO4: Explain the design process of PLC Circuit for real time application of hydraulic and Pneumatic circuits. (K2)

CO5: Read, construct, analyze and design the fluid power circuit for any real time application. (K3)

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 9

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids - General types of fluids - Fluid power symbols. Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow - Reynold's number -Darcy's equation - Losses in pipe, valves and fittings-Problems.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 9

Sources of Hydraulic Power: Pumping theory - Pump classification - Gear pump, Vane Pump, piston pump, construction and working of pumps - pump performance - Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators - Types of hydraulic cylinders - Single acting, Double acting special cylinders like tandem, Rod less, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators - Fluid motors, Gear, Vane and Piston motors-Problems.

UNIT III CONTROL COMPONENTS 9

Construction of Control Components : Direction control valve - 3/2 way valve - 4/2 way valve -Shuttle valve - check valve - pressure control valve - pressure reducing valve, sequence valve, Flow control valve - Fixed and adjustable, electrical control solenoid valves, Relays. Accumulators and Intensifiers: Types of accumulators - Accumulators circuits, sizing of accumulators, Intensifier - Applications of Intensifier.

UNIT IV PNEUMATIC SYSTEM COMPONENTS AND SERVO SYSTEMS 9

Pneumatic Components: Properties of air - Compressors - Filter, Regulator, and Lubricator Unit - Air control valves, Quick exhaust valves, and pneumatic actuators. Servo systems - Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics -Introduction to PLC - ladder diagrams, PLC applications in fluid power control.

UNIT V DESIGN OF HYDRAULIC AND PNEUMATIC CIRCUITS 9

Fluid Power Circuit Design, Circuits for acceleration and deceleration, synchronizing circuit, regenerative circuits, feed circuits, sequencing circuits, fail-safe circuits, Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method. Applications in Assembly, Metalworking, materials handling and plastics working.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Anthony Esposito, Fluid Power with Applications, Pearson Education New Delhi, 2014.
2. Andrew Parr, Hydraulics and Pneumatics, Jaico Publishing House, 2006.

REFERENCES

1. Majumdar SR, Pneumatic Systems - Principles and Maintenance, Tata McGraw Hill, 2006.
2. Majumdar SR, Oil Hydraulic Systems - Principles and Maintenance, Tata McGraw-Hill, 2006.
3. Illango S and Soundararajan V, Introduction to Hydraulics and Pneumatics Prentice Hall of India, 2007.
4. John S Cundiff, Fluid Power Circuits and Controls - Fundamentals & Applications, CRC Press, 2002.
5. James L Johnson, Introduction to Fluid Power, Cengage Learning, 2001.
6. William Bolton, Pneumatic & Hydraulic Systems, Elsevier Science and Technology Book, 1997.

13ME32E DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Select locating and clamping devices for a given machining operation. (K3)
CO2: Design jig and fixture for a simple component to perform simple operation.(K3)
CO3: Estimate press capacity and prepare strip layout. (K3)
CO4: Design and develop bending and drawing dies. (K3)
CO5: Design a blanking and piercing die. (K3)

UNIT I LOCATING AND CLAMPING PRINCIPLES 9

Principles of location - Locating methods and devices -Principles of clamping - Clamping elements with mechanical, pneumatic and hydraulic actuation. Standard parts - Drill bushes- Tolerances and error analysis. Design considerations for Jigs and Fixtures.

UNIT II JIGS AND FIXTURES 9

Types of Jigs - post, turnover, channel, latch, box, pot, angular post jigs - Indexing jigs. General principles of milling, Lathe, boring, broaching and grinding fixtures - Assembly, Inspection and Welding fixtures - Modular fixtures- Quick change fixtures. Design and development of jigs and fixtures for given component.

UNIT III ELEMENTS OF A PRESS TOOLS 9

Press Working Terminologies - operations - Types of presses - press accessories - Computation of press capacity - Strip layout - Centre of pressure - Material Utilization - Shearing action -Clearances - Press Work Materials. - Functions of various elements of dies - Die Block - Punch holder, Die set, guide plates - Stops - Strippers - Pilots - Selection of Standard parts.

UNIT IV BENDING AND DRAWING DIES 9

Blank development for the above operations - Types of bending dies - Press capacity - spring back - knockouts - pressure pads - ejectors - variables affecting metal flow in drawing operations - draw die inserts- Design and development of bending and drawing dies.

UNIT V BLANKING DIES 9

Design and development of blanking, piercing, compound and progressive dies. Recent trends in tool design- computer assisted metal forming.

L:45; TOTAL:45 PERIODS

Note: (Use of P S G Design Data Book is permitted in the End Semester Examination)

TEXT BOOKS

1. Joshi P H, "Jigs and Fixtures", Tata McGraw Hill, 3rd Edition, New Delhi, 2010.
2. Donaldson, Lecain and Goold "Tool Design", Tata McGraw Hill, 4th Edition, 2012.

REFERENCES

1. Design Data Hand Book, PSG College of Technology, Coimbatore, 2011.
2. Hoffman, "Jigs and Fixture Design", Thomson Delmar Learning, Singapore, 2004.
3. Venkataraman, K, "Design of Jigs Fixtures & Press Tools", Tata McGraw Hill, New Delhi, 2015.
4. Kempster, "Jigs and Fixture Design", Hoddes and Stoughton, 3rd Edition 1974.
5. Joshi P H, "Press Tools - Design and Construction", Wheels publishing, 1999.
6. ASTME Fundamentals of Tool Design, Prentice Hall of India, 1984.

15ME33E MECHATRONICS AND MODERN CONTROL L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: Discuss the importance of mechatronics systems and its applications. (K2)
CO2: Choose suitable sensors in mechatronics systems for various applications. (K3)
CO3: Sketch the electro pneumatic and hydraulic circuits for automation. (K3)
CO4: Interpret actual models of simple systems and controllers. (K3)
CO5: Describe the significance of PLC for automation. (K2)

UNIT I INTRODUCTION TO MECHATRONICS SYSTEM 9

Definition of mechatronics, introduction to mechatronics systems - need, elements of Mechatronics - Traditional and Mechatronics Design process -Design Parameters- Advanced approaches in Mechatronics for Industrial applications. Case study on the application of Mechatronics system in process automation, manufacturing, product design and testing.

UNIT II SENSORS FOR MECHATRONICS SYSTEMS 9

Importance of sensors in mechatronics, static and dynamic characteristics of sensors. Classification - transducers for measurement of displacement, strain, position, velocity, flow, pressure, temperature, humidity, vibration, liquid level and light sensors - case study on selection of sensors for specific applications.

UNIT III PNEUMATIC AND HYDRAULIC SYSTEMS 9

Introduction to pneumatic and hydraulic systems - actuators-valves- types- selection. Significance of electro-pneumatic actuator- solid-state switches, solenoids and coils.
Electric motors; DC motors, AC motors, single phase motor; 3-phase motor; induction motor; synchronous motor; stepper motors. Piezoelectric actuator: characterization, operation. Case study on electro-pneumatic actuation system for automation.

UNIT IV SYSTEM MODELS AND CONTROLLERS 9

Building blocks for simple mechanical, electrical, fluid and thermal systems, rotational transnational systems, electro mechanical systems. Continuous and discrete process controllers - control mode -two-step mode - proportional mode - derivative mode-integral mode - PID controllers - introduction. Case study on use of suitable controllers for process monitoring.

UNIT V INTRODUCTION TO PROGRAMMING LOGIC CONTROLLERS 9

Introduction to Programmable Logic Controllers-Basic Structure - Input / Output Processing - Programming - Mnemonics-Timers, Internal relays and counters-Shift Registers - Master and Jump Controls -Data Handling-Analogs Input / Output -Selection of a PLC for specific applications.

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Bolton W, “Mechatronics”, Pearson Education Asia, New Delhi, 2008.
2. Nitaigour Premch and Mahalik, “Mechatronics-Principles, Concepts and Applications”, Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 2006.

REFERENCES

1. David G Alciatore and Michael B Histand, “Introduction to Mechatronics and Measurement Systems”, Tata McGraw-Hill Pub. Co. Ltd., New Delhi. 3rd Edition, 2007.
2. HMT, “Mechatronics”, Tata McGraw Hill Publishers, New Delhi, 2008.
3. Doeblin E O, “Measurement Systems”, McGraw Hill, 1990.

15ME34E	ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Explain the basic concepts of industrial robotics. (K2)
CO2: Select suitable drive system and end effectors for the various applications of robots. (K3)

CO3: Apply robot kinematics and use appropriate sensors for specific applications. (K3)
CO4: Write robot programming for pick and place application. (K3)
CO5: Describe the use of robot in manufacturing industries. (K2)

UNIT I FUNDAMENTALS OF ROBOT 9

Introduction - laws of robot - Robot Anatomy - Co-ordinate Systems, Degrees Of Freedom, Work Envelope, types - Specifications - Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load - Flexible automation versus Robotic technology.

UNIT II ROBOT DRIVE SYSTEMS 9

Pneumatic Drives - Hydraulic Drives - Mechanical Drives - Electrical Drives – DC and AC Servo Motors, Stepper Motor - Salient Features, Applications and Comparison of Drives. Manipulators and end effectors.

UNIT III ROBOT KINEMATICS AND SENSORS 9

Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom in 2 Dimension.

Requirements of a sensor, Principles and Applications of sensors - Position, Piezo-electric Sensor, LVDT, Resolvers, Optical Encoders, Range, Triangulation Principle, Structured, Lighting Approach, Laser Range Meters, Proximity, Hall Effect, Capacitive, Ultrasonic and Optical Proximity, Touch, Binary, Analog, Wrist, Compliance, Slip Sensors.

UNIT IV ROBOT PROGRAMMING 9

Teach Pendant Programming, Lead through programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End effecter commands, and Simple programs.

UNIT V ROBOT APPLICATIONS 9

Robot applications in manufacturing, material transfer and machine loading / unloading, Welding and painting, assembly operations, Inspection, Mobile robots, Robot cell layouts.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Groover M P, “Industrial Robotics - Technology, Programming and Applications”, McGraw-Hill, 2001.
2. Deb S R and Deb S, “Robotics Technology and Flexible Automation”, Tata McGraw Hill Education Pvt. Ltd, 2010.

REFERENCES

1. Fu KS, Gonzalz RC, and Lee CSG, “Robotics Control, Sensing, Vision and Intelligence”, McGraw-Hill Book Co., 1987.
2. Saeed B Niku, “Introduction to Robotics”, Prentice Hall of India, 2003.
3. Janakiraman PA, “Robotics and Image Processing”, Tata McGraw-Hill, 1995.
4. Asada H and Slotine JJ, “Robot Analysis and Control”, New York, NY: Wiley, 1986.
5. Ray Asfahl C, “Robots and Manufacturing Automation” Wiley India Pvt Ltd, 2nd

Edition, 2012.

15ME35E	AIRCRAFT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Describe the different types and basic components in flight vehicles. (K2)
CO2: Discuss the different types of construction and select suitable materials for airplanes. (K2)
CO3: Classify different types of fuel systems, engine types and ignition systems. (K2)
CO4: Describe avionics and auto pilot system. (K2)
CO5: Discuss the recent development in aircraft technology. (K2)

UNIT I AIRCRAFT CONFIGURATIONS 9

Different types of flight vehicles, classifications. Components of an airplane and their functions. Conventional control, powered control, basic instruments for flying - typical systems for control actuation brake system - components, landing gear systems - classification - shock absorbers - retractive mechanism.

UNIT II AIRPLANE STRUCTURES AND MATERIALS 9

General types of construction, monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure, Metallic and non-metallic materials, use of aluminium alloy, titanium, stainless steel and composite materials.

UNIT III ENGINE SYSTEMS 9

Piston and jet engines - components - Fuel systems - multi-engine fuel systems - lubricating systems - starting and ignition systems.

UNIT IV AVIONICS AND AUTO PILOT SYSTEMS 9

Need for avionics in aircraft and space systems - integrated avionics and weapon systems - typical avionics subsystems, design, and technologies. Auto pilot - Basic principles, Longitudinal and lateral auto pilot.

UNIT V RECENT AIRCRAFT TECHNOLOGIES 9

Supersonic air craft- wing in ground aircraft-uninhabited aerial vehicle (UAV)-Invincible aircraft.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Anderson J D “Introduction to Flight”, McGraw-Hill, 1995.
2. Stephen A Brandt, "Introduction to Aeronautics: A design perspective" American Institute of Aeronautics & Astronautics, 1997.

REFERENCES

1. “Aviation Maintenance Technical Handbook - Airframe”, Volume 1&2, U.S. Federal

Aviation Administration.
2. Michael chungyungniu, “Airframe Structural Design”, Conmilit Press Ltd 1988.
3. “Air cadets the next generation”, volume -3, Air cadet Publication.
4. Pallet E H J, "Aircraft Instruments & Principles", Pitman & Co 1993.
5. Albert Helfrick D, "Principles of Avionics", Avionics Communications Inc., 2004.

15ME36E EXPERIMENTAL STRESS ANALYSIS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Discuss the principles of measurement, methods and their advantages. (K2)
CO2: Explain the principles, materials for gauges and calibration techniques. (K2)
CO3: Discuss the concept of photoelasticity with examples. (K2)
CO4: Apply various measuring techniques and their applications. (K2)
CO5: Discuss the fundamentals of NDT and different testing techniques. (K2)

UNIT I LINEAR MEASURMENTS 9

Principles of measurements -Accuracy, Sensitivity and range of measurements. Mechanical, Optical Acoustical and Electrical extensometers and their uses, Advantages and disadvantages.

UNIT II ELECTRICAL RESISTANCE STRAIN GAUGES 9

Principle of operation and requirements, Types and their uses, Materials for strain gauge. Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheastone Bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators. XRD, Hole drilling.

UNIT III PHOTO ELASTICITY 9

Two dimensional photo elasticity, Concept of light - photoelastic effects, stress optic law, Interpretation of fringe pattern, Compensation and separation techniques, Photo elastic materials. Introduction to three dimensional photo elasticity.

UNIT IV BRITTLE COATING AND MOIRE METHODS 9

Introduction to Moire techniques, brittle coating methods and holography.

UNIT V NON - DESTRUCTIVE TESTING 9

Fundamentals of NDT, Radiography, ultrasonic, magnetic particle inspection, Fluorescent penetrant technique, Eddy current testing, Acoustic Emission Technique.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Srinath, LS, Raghava MR, Lingaiah K, Garagesha G, Pant B, and Ramachandra K,

"Experimental Stress Analysis", Tata McGraw-Hill, New Delhi, 1984.
2. Dally JW, and Riley WF, "Experimental Stress Analysis", McGraw-Hill Inc., New York, 2005, IV edition.

REFERENCES

1. Hetyenyi M, "Hand book of Experimental Stress Analysis", John Wiley and Sons Inc., New York, 1972.
2. Pollock AA, "Acoustic Emission in Acoustics and Vibration Progress", Ed. Stephens R.W.B., Chapman and Hall, 1993.

15ME37E	FATIGUE, FRACTURE AND FAILURE ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Discuss various aspects of fatigue failure theories. (K2)
CO2: Distinguish between low and high cycle fatigue failure.(K2)
CO3: Analyze the cracked bodies for their strength under loading. (K3)
CO4: Apply the fatigue design concepts on composite materials and structures. (K3)
CO5: Analyze various factors contributing fatigue failure. (K3)

UNIT I INTRODUCTION TO FRACTURE 9

Kinds of failure - Brittle and ductile fracture - Modes of fracture failure - Griffith analysis - Energy Release rate - Crack resistance - Stable and unstable crack growth - R curves - Critical energy Release Rate.

UNIT II STRESS INTENSITY FACTOR 9

Linear elastic Fracture Mechanics - Stress Intensity factor K_{IC} - Westergaard's relations - Edge cracks - Embedded cracks - Critical stress intensity factor - SIF of some important Geometries – Problems.

UNIT III ANELASTIC DEFORMATION AT THE CRACK TIP 9

Plastic zone size - Plastic zone shape for plane stress and plane strain conditions - Irwin plastic zone correction - Plastic zone size through Dugdale approach – Problems.

UNIT IV J-INTEGRAL AND CTOD 9

Definition of J-Integral - Evaluation of J-Integral - Application of Engineering problems - Crack tip opening displacement (CTOD) - Relationship between CTOD, K_I and G_I for small scale yielding - Equivalence between CTOD and J-Integral.

UNIT V FATIGUE FAILURE AND TEST METHODS OF FRACTURE PARAMETERS 9

Terminologies involved in Fatigue failure - S-N curve - Crack propagation rate - Crack propagation life -Paris-Erdogan law - problems - Effect of an overload - K_{IC} Test techniques - Test methods to determine J-integral - Crack arrest mechanisms.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Prasanth Kumar, "Elements of fracture mechanics" - Wheeter publication, 1999.
2. Barrois W and Ripely E L, "Fatigue of aircraft structure", Pe/gamon press. Oxford, 1983.

REFERENCES

1. Sin C G, "Mechanics of fracture" Vol. I, Sijthoff and w Noordhoff International Publishing Co., Netherlands, 1989.
2. Knott J F, "Fundamentals of Fracture Mechanics", Buterworth & Co., Ltd., London, 1983.
3. Subrasuresh, "Fatigue of materials", 2nd edition, 1998.
4. Anderson T L, "Fracture mechanics: Fundamentals and applications", 3rd edition, 2004.
5. Viswanathan R, "Damage Mechanisms and Life Assessment of High Temperature Components", ASM International (1995).

15ME38E	**ADVANCED MODELING TECHNIQUES**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OUTCOMES

Upon successful completion of this course the students will be able to

CO1: Describe the principles and concepts of Geometric modeling, solid modeling, and assembly. (K3)

CO2: Apply advanced modeling and computational tools for complex mechanical parts. (K3)

CO3: Produce detailed exploded assembly views with Bills of Materials. (K3)

CO4: Execute weldment and sheet metal CAD drawings for mechanical engineering applications in the current industrial practice. (K3)

CO5: Describe the fundamentals of GD &T. (K2)

UNIT I MODELLING CORE CONCEPTS 12

Sketch – Line, Rectangle, arcs, relations, Fully defined sketch. Part – Extrude, Revolve, Sweep, Loft, Rib, Fillet, Chamfer, Shells, Mirroring, Patterns, drafts, custom properties, Planes and Axis.

Assembly – Mates, Smart mates, Interference, Collision, Dynamic clearance, Exploding assembly.

UNIT II ADVANCED PARTS AND ASSEMBLY 12

Sketch – 3D Sketch, Parabola, conic, splines, derived sketches. Part - Flex, bending, Twisting, tapering & stretching, splitting, Multi body, Configurations. Assembly – Flexible sub assembly, Path, linear coupler, Gear, Cam, Screw, Limit and Hinge mates, Assembly Configurations.

UNIT III ADVANCED DRAWINGS AND ANIMATIONS 12

Model view, projection view, section view, detail view, broken view, exploded view. Dimensions - ordinate, driving, baseline, annotations, ballons, Bill of materials, tables, Tolerances. Animations –walkthrough videos, Photoview, Rendering

UNIT IV WELDMENT AND SHEET METAL 12

Weldment – Structural Members, Trim Extend, Gusset end caps, Weld beads, Cut List, Sub-weldment, Custom profiles. Sheet Metal – Cone, Cylinder, Lofts, Base Flange, Edge Flange, Swept flange, Mitre flange, sketched bend, Jog, Hem.

UNIT V GEOMETRIC DIMENSIONING AND TOLERANCING 12

Engineering drawing and tolerance – Limits, fits and Tolerance - Tolerance symbols and terms – rules and concepts of GD&T - Why use GD&T – MMC,LMC – datum – Form – Orientation – profile – Runout

L:30;P:30; TOTAL:60 PERIODS

Note: (The End Semester Examination will be conducted in computer aided design laboratory)

REFERENCES

1. Ibrahim Zeid, “CAD/CAM, Theory and Practice”, Tata Mc Graw Hill, 2010
2. Donald Hearn, “Computer Graphics”- Pearson Education Ltd, 2nd Edition, 2008
3. Matt Lombard, Solidworks 2010 Bible, 2010
4. Alex Krulikowsi, Fundamentals of Geometric Dimensioning and Tolerancing, Second Edition, Delmar publications, 2012
5. Standards for dimensioning and tolerancing - ASME Y 14.5, 2009
6. James D Meadows, GD&T Application, analysis and Measurements, ASME Press 2009.

15ME39E	PIPING DESIGN ENGINEERING	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

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

CO1: Apply the fundamental principles for designing pipes and creating engineering drawings. (K2)
CO2: Explain the working principle of piping components and design of pipes for various piping codes and standards. (K2)
CO3: Analyze the stresses induced in the pipes under static loading condition. (K4)
CO4: Design pipes and pipe support structures considering weld reinforcement and stress intensifications. (K3)
CO5: Predict mathematically the behavior of pipes under dynamic conditions. (K4)

UNIT I FUNDAMENTALS 12

Engineering drawing fundamentals - Piping drawings – P and ID - Plot Plan - Layout - Mechanical Design fundamentals - Pressure, Temperature, Flow rates, stress, strain, theory of failure, young's modulus, moment of inertia, section modulus and radius of gyration. Dynamic loads - Harmonic, Modal, Spectrum, frequencies.

UNIT II PIPING ELEMENTS AND MATERIALS 12

Introduction to piping -Piping Components - Pipe, Fittings, Flanges, Gaskets and Bolting - Valves - Isolation, Regulation, Non–return and Special purpose. Piping Materials - Piping Codes and Standards - Pipe Sizing, Diameter and Pressure drop calculations.

UNIT III PIPING SUPPORTS AND STATIC STRESS ANALYSIS 12

Piping Supports - Restraints and hangers - Variable and Constant load spring hangers - selection design methodologies - Stress analysis introduction - Method of analysis -Static Stress analysis exercises - Piping Flexibility - Code Stress requirement.

UNIT IV WRC AND SIF IN PIPING 12

Welding reinforcement calculations - Nozzle design - Stress intensification at elbows, tees and branch - Structure basics - Piping supporting structure modeling.

UNIT V DYNAMIC ANALYSIS 12

Wind and Seismic analysis - Damping - Lumped Mass - Steady state vibration and harmonic analysis - Time history Analysis.

L:30; P:30;TOTAL:60 PERIODS

TEXT BOOKS

1. Mohinder L Nayyar, "Piping Handbook", McGraw Hill Handbook, 7thEdition, 1999
2. George A Antaki, "Piping and Pipeline Engineering: Design, Construction, Maintenance Integrity and Repair", CRC Press, 2003

REFERENCES

1. "Power and Process Piping Standards" ASME B 31.1 & B 31.3, 2012
2. Kellog M W, "Design of Piping Systems", John Wiley & Sons, 2ndRevised Edition, 1991
3. Liang-Chuan Peng and Tsen-Loong Peng, "Pipe Stress Engineering", ASME Press, New York, 2009

15ME40E	**APPLIED COMPUTATIONAL FLUID DYNAMICS AND FINITE ELEMENT ANALYSIS**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OUTCOMES

Upon successful completion of the course the students will be able to

CO1: Apply computational techniques for solving engineering problems. (K3)

CO2: Discuss the fundamentals and procedures used in CFD/FEM. (K3)

CO3: Apply CFD to analyze the fluid flow. (K4)
CO4: Apply CFD to analyze the thermal systems. (K4)
CO5: Perform static and dynamic analysis using FEA in structural members.(K4)

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 12

Basics of computational fluid dynamics - Governing equations of fluid dynamics - Continuity, Momentum and Energy equations - Physical boundary conditions - Laminar and Turbulent Flow - Turbulent-Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD -Elliptic, Parabolic and Hyperbolic equations.

UNIT II TURBULENCE MODELS AND MESH GENERATION 12

Turbulence models, mixing length model, Two equation (k-Є) models - High and low Reynolds number models - Structured Grid generation - Unstructured Grid generation - Mesh refinement - Adaptive mesh - Software tools.

UNIT III APPLIED PROJECTS CFD – I 12

Internal Fluid flow - Pipe bends, Branch and lateral-Symmetric - Transient - Header Flow Distribution Post processing - Different CFD Outputs : Contour plots - Surface Plots, Plotting, Vectors, Turbulence Modeling External Flow - Flow over a circular cylinder, simple car and aero plane.

UNIT IV APPLIED PROJECTS CFD – II 12

Radiation problems - Heat Transfer distribution - Porous media - Pump - Fan - Gaseous Combustion -Particle Study - Multi phase problems.

UNIT V APPLIED PROJECTS FEA 12

Stress - Strain - FOS -Machine elements under Static Structural Loads - Modal Analysis - Thermal Analysis - Vibrations - Non-Linear Analysis.

L:30; P:30;TOTAL:60 PERIODS

TEXT BOOKS

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd.Second Edition, 2007.
2. Jiyuan TL, Guan HengYeoh, “Computational Fluid Dynamics A Practical Approach” Butterworth-Heinemann, First Edition 2008.

REFERENCES

1. Hyoung Woo Oh, “Applied Computational Fluid Dynamics”, InTech Publishers, 2012.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005.
4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
5. ProdipNiyogi, Chakrabarty, S.K., Laha, M.K. "Introduction to Computational Fluid Dynamics", Pearson Education, 2005.
6. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University

Press, 2005.
7. Anderson “Computational Fluid Dynamics the Basics with Application” Mcgraw Hill.

15ME41E	VIBRATION CONTROL	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Describe the basic concepts of vibration and vibration control. (K2)
CO2: Analyze the vibration generation mechanism. (K3)
CO3: Explain the passive vibration control techniques. (K2)
CO4: Discuss the active vibration control methods. (K2)
CO5: Articulate the vibration measurement and analysis techniques. (K2)

UNIT I BASIC CONCEPTS 9

Free and forced vibrations with and without damping; Free and forced vibration of single, two and multi-degrees of freedom systems with and without viscous damping. Vibration reduction at source, Active feedback control, vibration isolation.

UNIT II VIBRATION GENERATION MECHANISM 9

Vibration generation mechanisms: Source classification, self-excited vibration, flow induced vibration, field balancing of rigid rotors/flexible rotors and damping models and measures, Design consideration of material selection-Critical speed for cantilever and simply supported elements.

UNIT III PASSIVE VIBRATION CONTROL 9

Basics, design of shock absorber, absorber with ideal spring, shock absorber (hydraulic, pneumatic), isolators with stiffness and damping.

UNIT IV ACTIVE VIBRATION CONTROL 9

Basics, Piezoelectric materials, electro and magneto rheological fluids, Magneto and Electrostrictive Materials in Vibration Control, shape memory alloys and electro-magnetic materials for vibration control.

UNIT V VIBRATION MEASUREMENT 9

Accelerometer, vibrometer, standards for allowable vibration in machineries, data acquisition, FFT analysis and filters, identification of defects in rotomachinery-case studies.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Rao S S, “Mechanical Vibrations”, Pearson Education Inc. (4th Ed.), 2007.
2. Kihong Shin and Joseph Hammond, “Fundamentals of Signal Processing for Sound and Vibration Engineers”, John Wiley & Sons, Ltd., 2008.

REFERENCES

1. Tamadonni S and Graham S Kelly, “Mechanical Vibrations”, Schaum’s outline Series, Mc-Graw Hill Inc, 1998.
2. Rao JS, “Vibration Condition Monitoring of Machines”, Tata Mc-Graw Hill, 2006.
3. Krugar, “Critical speed of shaft”, Technical Bulletin TBN017.0/1998.

15ME42E VEHICLE SYSTEMS DESIGN

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Express the importance of aerodynamic factors on vehicle body design. (K2)
CO2: Explain the role of ergonomics and vibration control in automobile design. (K2)
CO3: Discuss the mechanisms and analyzing techniques of chassis and suspension system. (K2)
CO4: Explain the design considerations for braking and transmission systems. (K2)
CO5: Discuss failure analysis and its importance in vehicle design. (K2)

UNIT I BODY DESIGN 9

Aerodynamics - Aerodynamic forces - Drag - Drag reduction - Stability and cross-winds - Noise - Under hood ventilation - Cabin ventilation - Wind tunnel testing - Computational fluid dynamics.

UNIT II HUMAN COMFORT IN VEHICLE DESIGN 9

Occupant accommodation - Ergonomics - Eight fundamental fallacies - Ergonomics methods and tools.

Vibration control - Fundamentals of acoustics - Human response to sound - Sound measurement - Automotive noise criteria - noise sources - control techniques.

UNIT III CHASSIS AND SUSPENSION DESIGN 9

Load case, introduction - Chassis types, introduction - Structural analysis by simple structural surfaces method.

Vehicle suspension - Factors affecting design - Definitions and terminology - Mobility of suspension mechanisms - Kinematic analysis - Roll centre analysis - Force analysis.

UNIT IV TRANSMISSION AND BRAKING SYSTEMS DESIGN 9

Engine Characteristics - Vehicle’s power requirement - manual gearbox - automatic transmission - Continuously variable transmissions.

Fundamentals of braking - Legislation - Brake proportioning and adhesion utilization - design of brake materials.

UNIT V FAILURE PREVENTION AND CRASHWORTHINESS 9

Aspects of failures - endurance and durability - Testing and failure prediction - automotive failures

Accident and injury analysis - Vehicle impacts: general dynamics - crush characteristics -

Structural collapse.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Julian Happian-Smith, “An Introduction to Modern Vehicle Design”, Reed Educational and Professional Publishing Ltd 2002.
2. Lorenzo Morello et.al, “The Automotive Body; Volume II:S ystem Design”, Springer, New York, 2011.

REFERENCES

1. Donald E Malen, “Fundamentals of Automobile Body Structure Design”, SAE International, 2011.
2. John Fenton, “Advances in Vehicle Design”, Wiley, 2007.
3. Jan PN orbye, “Car Design: Structure & Architecture”, Tab Books, 2011.
4. Vivek D Bhise, “Ergonomics in the Automotive Design Process”, CRC Press, 2015.

15ME43E	INDUSTRIAL TRIBOLOGY	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Discuss the basic concepts of Tribology in detail. (K2)

CO2: Discuss about the fundamental concepts and different mechanism involved in friction and wear**.** (K2)

CO3: Discuss the basic principles of hydrodynamic lubrication and the influence of various operating parameters on the thin film. (K2)

CO4: Discuss the basic principles of hydrostatic lubrication and the influence of various operating parameters on the thick film.(K2)

CO5: Select suitable surface modification methods based on the bearing materials. (K2)

UNIT I INTRODUCTION TO TRIBOLOGY 9

Introduction - Surface topography - Tribology in design-Tribology in industry - economic aspects of tribology - lubrication - properties of lubricants - types of additives - extreme pressure lubricants - recycling of used oils and oil conservation - disposal of scrap oil - oil emulsion - Tribology in bearings.

UNIT II FRICTION AND WEAR 9

Friction - Laws of friction - Kinds of Friction - Causes of friction - Friction Measurement - Theories of Friction - effect of surface preparation.

Wear - Wear classification - Wear between solids and liquids - Factors affecting wear - Measurement of wear - Theories of Wear - approaches to Friction Control and Wear Prevention.

UNIT III HYDRODYNAMIC LUBRICATION 9

Hydrodynamic lubrication: Theory of hydrodynamic lubrication, mechanism of pressure development in oil film, two-dimensional Reynold's equation, infinitely long journal bearing, infinitely short journal bearing and finite bearing.
Hydrodynamic thrust bearing: Introduction, flat plate thrust bearing, pressure equation, load, center of pressure and friction in tilting pad thrust bearing.

UNIT IV HYDROSTATIC LUBRICATION 9

Hydrostatic lubrication: Basic concept, advantages and limitations, viscous flow through rectangular slot, load carrying capacity and flow requirement of hydrostatic step bearing, energy losses and optimum design of step bearing. Compensators and their actions.
Squeeze film lubrication: Introduction, circular and rectangular plates approaching a plane.

UNIT V SURFACE ENGINEERING 9

Surface Engineering for Wear and Corrosion resistance: Diffusion, coating, electro and electroless plating, hot deep coating, metal spraying, cladding, crystallizing coating, selection of coating for wear and corrosion resistance, potential properties and parameters of coating.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Bharat Bhushan, "Introduction to Tribology", John wiley & Sons Ltd, Publication, 2nd Edition, USA, 2013.
2. Mehtha NK, "Machine Tool Design and Numerical Control", Tata Mc-GrawHill, 3rd Edition, 2012.

REFERENCES

1. Gwidon Stachowiak and Andrew W Batchelor, "Engineering Tribology", Elsevier International Publishing, Australia, 4th Edition, 2013.
2. Michael M Khonsari and Richard Booser E "Applied Tribology: Bearing Designand Lubrication", John wiley & Sons Ltd Publication, 2nd Edition, USA, 2008.
3. Giovanni Straffelini (Author), "Friction and Wear: Methodologies for Design and Control (Springer Tracts in Mechanical Engineering)", Springer International Publishing, Switherland, 2015.
4. Ghosh M K, Majumdar B C, Mihir Sarangi (Authors), "Fundamentals of Fluid Film Lubrication", McGraw Hill Education (India) Pvt. Ltd, New Delhi, 1st Edition, 2013.
5. http://nptel.ac.in/courses/IIT-MADRAS/Machine_Design_II/pdf/5_4.pdf

15ME44E	NEW PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Recognize and apply the criterion in product initiation process (K3)
CO2: Summarize the stages in product development. (K2)
CO3: Discuss the design validation and product cost calculation(K2)
CO4: Apply the quality concepts to develop robust product. (K3)
CO5: Discuss the legal aspects in product design and development (K2)

UNIT I PRODUCT INITIATION 9

Product Identification, Identifying Customer Needs, Need For Developing Products, Market Research, Design Goals, Specifications, Industrial Design, Concept Designs, Creativity, Out Of Box Ideas - On The Fly Design - Evolved Design - Emotional Design, Innovative Products, Re Engineering Products - Reverse Engineering Products.

UNIT II PRODUCT DEVELOPMENT 9

Various Stages Of Product Development, Ergonomics, Structural Design, Modular Design, Need Of Prototypes, Various Prototyping Techniques, Rapid Prototyping, Concurrent Engineering, Reliability, Endurance, Product Data Management

UNIT III DESIGN VALIDATION AND PRODUCT COSTING 9

Analyzing The Degrees Of Freedom, Indented Application And Actual Application, Various Validation Process, BOM, Types Of Cost, Element Wise Classification With Preparation Of Cost Sheet

UNIT IV QUALITY CONCEPTS 9

Design For Quality - Quality Function Deployment, Design Of Experiments, Failure Modes & Effect Analysis - TQM - Design For Six Sigma, Brain Storming Techniques, Design For Manufacturing, Design Ethics, Safety and Environmental Considerations in Product Design

UNIT V PRODUCT LEGALITY 9

Product Standards - Drawing Standards, Product Certifications - System Certifications, Patent - Copy Right, Trademarks, Geographical Indication

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. George E.Dieter, Linda C.Schmidt, “Engineering Design”, McGraw-Hill International Edition, 4th Edition, 2009
2. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development”, 4th Edition, 2009, Tata McGraw-Hill Education
3. Advanced Cost Accounting by S.P. Jain & K.L. Marng

REFERENCES

1. Kevin Otto, Kristin Wood, "Product Design", Indian Reprint, Pearson Education, 2004
2. Clive L.Dym, Patrick Little, "Engineering Design: A Project-based Introduction", 3rd Edition, John Wiley & Sons, 2009
3. Yousef Haik, T. M. M. Shahin, "Engineering Design Process", 2nd Edition Reprint, Cengage Learning, 2010, ISBN 0495668141Jindal UC, "Material Science and Metallurgy", Pearson India, 2012.
4. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin, Homewood, 1992
5. Cost Accounting by S. N. Maheswari.

15ME61E FUNDAMENTALS OF NANO TECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Describe the basic concept of nanotechnology. (K2)
CO2: Discuss bulk synthesis of nano materials. (K2)
CO3: Choose appropriate chemical methods for synthesis of nano materials. (K2)
CO4: Illustrate the concept of nano materials synthesis by physical approaches. (K2)
CO5: Demonstrate the various imaging technique to characterize nano materials. (K2)

UNIT I INTRODUCTION TO NANO MATERIALS 9

Background to Nanoscale Science and Technology, Band theory of materials, fundamental physics and chemistry of nano materials, Effect of nano dimension on materials properties. Classification of nano materials - properties and applications, Quantum confinement effects with examples.

UNIT II BULK SYNTHESIS 9

High energy ball mill – types of balls – ball ratio – medium for grinding – limitations – severe plastic deformation – Mechanochemical process – Arc plasma - Bulk and nano composite materials.

UNIT III SYNTHESIS OF NANO MATERIALS BY CHEMICAL APPROACHES 9

Sol gel processing - Solvo thermal, hydrothermal, Precipitation, Spray pyrolysis - Electro spraying and spin coating - Self-assembly, self-assembled monolayers (SAMs) - Langmuir-Blodgett (LB) films - micro emulsion polymerization - templated synthesis, Pulsed electrochemical deposition

UNIT IV SYNTHESIS OF NANO MATERIALS BY PHYSICAL APPROACHES 9

Vapour deposition and different types of epitaxial growth techniques (CVD, MOCVD, MBE) - Pulsed laser deposition, Magnetron sputtering - Lithography: Photo/UV/EB/FIB techniques, Dip pen nanolithography - Etching process: Dry and wet etching - micro contact printing.

UNIT V CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy – modes of operation- Resolution and contrast enhancement, TEM- modes of operation- Specimen preparation, HRTEM in nanostructures, AFM- Different modes of operation – contact and non-contact mode - Imaging and manipulation of samples in air/liquid environments, Surface and molecular manipulation using scanning tunneling microscopy, Nanoindentation

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Chattopadhyay K. K and Banerjee A. N, "Introduction to Nanoscience and nanotechnology", PHI Learning Private Ltd, 2009.
2. Ying Wang and Guozhong Cao, "Nanostructures and Nanomaterials: Synthesis, Properties and Applications", World Scientific Publishing Ltd, 2nd Revised Edition, 2010

REFERENCES

1. Edelstein A.S. and Cammaratra R.C., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1997.
2. Suryanarayana C., "Mechanical alloying and milling", Marcel Dekker, Inc., New York, 2005.
3. Cao G., "Nanostructures & Nano materials: Synthesis, properties & applications", Imperial college press, 2004.
4. John Dinardo N, "Nanoscale characterization of surfaces & Interfaces", Weinheim Cambridge, Wiley-VCH, 2nd Edition, 2000.
5. George J., "Preparation of thin films", Marcel Dekker, Inc., New York, 2005a

15ME62E	**COMPOSITE MATERIALS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES

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

CO1: Elucidate the classification and micro mechanics of composite materials. (K2)
CO2: Explain the processing methods of MMC, PMC and CMC. (K2)
CO3: Elaborate the influence of various physical parameters on composite behavior. (K2)
CO4: Discuss the characterization of composite materials. (K2)
CO5: Explain about hybridization in composite material science. (K2)

UNIT I INTRODUCTION TO COMPOSITE MATERIALS 9

Fundamentals of composites -Matrix materials- Reinforcement materials - Applications. Introduction to micro mechanics

UNIT II COMPOSITE FABRICATION 9

Processing techniques and equipment:metal matrix, polymer matrix and ceramic matrix composites.

UNIT III DESIGN AND FABRICATION PARAMETERS 9

Factors influencing composite behaviors: Particle reinforced composites, fiber reinforced composites and laminates.

UNIT IV PERFORMANCE OF COMPOSITE MATERIALS 9

Static mechanical properties and testing standards: tensile, flexural, impact, creep, in-plane shear and interlaminar shear strength. Environmental effects: elevated temperature and moisture

UNIT V HYBRID COMPOSITES 9

Introduction to hybridization-hybridization through: matrix phase, reinforcement phase. hybrid MMC and hybrid PMC: examples and applications

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Ronald Gibson, “Principles of Composite Material Mechanics”, 3rd Edition, CRC press, 2011.
2. Mallicak, P K, “Fiber-reinforced composites: Materials, manufacturing and Design”, 3rd Edition, CRC press, 2007.

REFERENCES

1. John Cuppoleeti, “Metal, ceramic and polymeric composites for various uses”, Intech, 2011.
2. Madhujit Mukhopadhyay, “Mechanics of composite materials and structures”, Universities Press (India) Pvt Ltd, 2009.
3. Ning Hu, “Composites and their properties”, Intech, 2012.
4. Adel zaki el-sonbati, “Thermoplastic-composite materials”, 2012.
5. “Advances in composite materials-eco design and analysis”, Intech, 2011.

15ME63E	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Discuss the technological and commercial needs of unconventional machining processes. (K2)

CO2: Describe the applications and process parameters of various mechanical energy based unconventional machining processes. (K2)

CO3: Analyze the influence of EDM process parameters on MRR and surface finish. (K4)

CO4: Discuss the features of chemical energy based machining processes. (K2)

CO5: Explain various high energy density machining processes and its applications. (K2)

UNIT I OVERVIEW OF UNCONVENTIONAL MACHINING PROCESSES 9

Technological and commercial need, Advantages over conventional machining, classification, performance constraints, selection of UCMP, hybrid processes.

UNIT II MECHANICAL ENERGY BASED PROCESSES 9

Abrasive Jet Machining - Water Jet Machining - Abrasive Water Jet Machining - Ultrasonic Machining - Working Principle - equipments- Process parameters - MRR- Applications.

UNIT III ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining and Wire cut EDM - working Principle - equipments - Power and control Circuits - Process Parameters - Surface Finish, MRR, Tool Wear, Dielectric and Flushing - Applications.

UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining - masks - Etchants - Applications. Principles of ECM- equipments- Electrical circuit - Process Parameters - Surface Roughness and MRR - ECG and ECH - Applications.

UNIT V THERMAL ENERGY BASED PROCESSES 9

Laser Beam machining and drilling, plasma Arc machining and Electron Beam Machining- Principles - Equipments -Types - Beam control techniques - Applications.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Gary F Benedict, “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 1987.
2. Pandey PC and Shan HS, “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2007.

REFERENCES

1. Paul De Garmo, Black JT, and Ronald A Kohser, “Material and Processes in manufacturing”, 8th Edition Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
2. Mc Geough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.
3. Vijay K Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007

15ME64E WELDING TECHNOLOGY L T P C

3 0 0 3

COURSE OUTCOMES

Upon successful completion of this course, the students will be able to

CO1:Select suitable welding process for making a welded joint with the emphasis on safety. (K2)

CO2:Discuss welding techniques such as EBM, LASER, friction and friction stir welding. (K2)

CO3:Demonstrate the ability to select suitable welding techniques for making pressure vessel and pipe lines. (K3)

CO4:Use design codes and standards for making welds. (K3)

CO5:Discuss welding standards for pipes and welding procedure and welder qualification. (K3)

UNIT I CONVENTIONAL WELDING PROCESSES 9

Principles and applications of Arc, Gas, GTA, GMAW, PAW and SAW welding processes. Soldering and Brazing.

UNIT II SPECIAL WELDING PROCESSES 9

Resistance welding, Friction welding, Friction stir welding, Explosive, diffusion, ultrasonic welding, Electron Beam Welding (EBW) and Laser Beam Welding (LBW): principles of operation, process characteristics and applications.

UNIT III WELDING APPLICATION TECHNOLOGY 9

Heat exchanges, power cycle piping, super heaters, reheaters, economiser, fabrication techniques and field welding for pressure vessel applications, Oil and gas industry, materials, processes, fabrication, inspection and testing - case studies.

UNIT IV WELDING CODES AND STANDARDS 9

Design requirements, allowable stress values, workmanship and inspection - Introduction to welding codes and standards, AWS D1.1 and Welding symbols IS 813.

Design requirements, fabrication methods, joint categories, welding and inspection, post weld heat treatment and hydro testing - ASME codes II, V, VIII and IX.

UNIT V WELDER AND WELDING PROCEDURE QUALIFICATION 9

Welding procedure and welder qualification, API 1104 Welding procedure specification, procedure qualification records, performance qualification, variables. Introduction to materials standards and testing of materials, consumables testing and qualification as per ASME/AWS requirements.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Parmer RS, ‘Welding Engineering and Technology’, Khanna Publishers, 1997.
2. Howard B Cary, “Modern Welding Technology’, prentice Hall, 1998.

REFERENCES

1. Schwartz M, “Materials and Applications - Metal Joining Manual”, McGraw-Hill, 1979
2. Nadkarni SV, “Modern Arc Welding Technology”, Oxford IBH Publishers, 1996
3. Christopher Davis, ‘Laser Welding - A Practical Guide’, Jaico Publishing House, 1994
4. Mishra RS and Mahoney MW, “Friction Stir Welding and Processing”, ASM,2007
5. AWS D1.1 Structural Welding Code
6. API 5L
7. API 1104
8. ASME Section VIII - Division 1
9. ASME Section IX
10. ASME Section II Part A and C

15ME65E MAINTENANCE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Explain the principles of maintenance planning and evaluate the system reliability. (K2)
CO2: Apply different maintenance policies for industrial configuration. (K3)
CO3: Utilize state of the art condition monitoring techniques to develop effective maintenance policies. (K3)
CO4: Identify and apply suitable repair method for basic machine elements. (K3)
CO5: Identify and apply a suitable repair method for material handling equipment. (K3)

UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

Basic Principles of maintenance planning and activity - Importance and benefits of active Maintenance systems -Reliability and machine availability - MTBF, MTTR and MWT - Factors of availability -Maintenance organization - Maintenance economics.

UNIT II MAINTENANCE POLICIES 9

Types of Maintenance policies - Merits and demerits - Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication - Total productive maintenance.

UNIT III CONDITION MONITORING 9

Condition Monitoring (CM) - Cost comparison with and without CM - On-load and off load testing - Methods and instruments for CM - Temperature sensitive tapes - Pistol thermometers - wear-debris analysis

UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 9

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings - Failure analysis - Failures and their development - Logical and sequential fault location methods.

UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 9

Repair methods for Material handling equipments - Equipment records - Job order systems - Use of computers in maintenance.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Srivastava SK, “Industrial Maintenance Management”, S. Chand and Co., 2002
2. Bhattacharya SN, “Installation, Servicing and Maintenance”, S. Chand and Co., 2001.

REFERENCES

1. White EN, “Maintenance Planning, Control and Documentation”, Gower Press, 1979.
2. Garg M R, “Industrial Maintenance”, S. Chand & Co., 1986.
3. Higgins LR, Keith Mobley “Maintenance Engineering Hand book”, McGraw Hill, 7th Edition, 2008.
4. Davies, “Handbook of Condition Monitoring”, Chapman & Hall, 2012.

15ME66E	NON DESTRUCTIVE EVALUATION	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

Upon completion of the course the students will be able to

CO1: Discuss liquid penetrant test for identifying welding defects. (K3)
CO2: Discuss the standards in ultrasonic testing of welded structures. (K3)
CO3: Perform magnetic particle test for identifying defects. (K3)
CO4: Conduct radiographic test to identify defects in welded components. (K3)
CO5: Identify the suitable NDT procedure for practical application. (K3)

UNIT I LIQUID PENETRANT TESTING 12

Liquid Penetrant Groups, Types of Developers - Testing techniques - Qualification of consumables - Applicable standards.

UNIT II ULTRASONIC TESTING 12

Introduction to UT - Physics of UT. UT equipments - Calibration and reference blocks - Testing techniques and variables. Calibration of test equipment - Distance Amplitude Correction (DAC), curve, Testing of Raw material, weld, casting, applicable codes and standards.

UNIT III MAGNETIC PARTICLE TESTING 12

Physics of Magnetism - magnetization techniques - test equipment, accessories, media - systems check. Testing techniques, demagnetization.

UNIT IV RADIOGRAPHIC TESTING FILM INTERPRETATION 12

Interaction of Radiation with Matter - Radiation safety, Sources of Radiation and their characteristics - Films and Film Processing, radiographic quality - Sensitivity, I.Q.Is, Other Accessories , Interpretation and Evaluation of Radiographs, Standards.

UNIT V TESTING PROCEDURE 12

Non destructive testing Overview- Comparison of NDT methods, Selection of NDT processes - nature of defects.

L:30; P:30; TOTAL: 60 PERIODS

TEXT BOOKS

1. Parmer R.S, "Welding Engineering and Technology", 2nd Edition, Khanna publishers, Delhi, 2010.
2. R Halmshaw, "Introduction to the Non-Destructive Testing of Welded Joints"- 2nd Edition ,Woodhead Publishing, 1997.

REFERENCES

1. ASM Metals Handbook Vol. 17 -Non destructive testing, published by ASM, USA
2. ASME Sec V, 2013 Non destructive testing, published by ASME.
3. ASTM E165 Standard Practice for Liquid Penetrant Examination for General Industry.
4. ASTM E-94 Standard Guide for Radiographic Examination.
5. Industrial Radiography, Image forming Techniques published in Internet by GE Inspection Technologies.
6. ASTM -709 Standard Guide for Magnetic Particle Testing.
7. ASTM E-797 Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method.

15ME67E	**QUALITY CONTROL OF WELDED STRUCTURES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES

Upon successful completion of this course, the students will be able to

CO1: Select appropriate welding process for making welded structures for various material combinations. (K3)
CO2: Prepare quality assurance plan for a structure. (K2)
CO3: Assess the quality of the welded structure and acquires skills for welding inspection. (K2)
CO4: Carry out visual inspection and LPT of welded structures. (K3)
CO5: Perform MPT, RT and UT to detect defects in weldments. (K3)

UNIT I WELDING PROCESSES 9

Welding processes - techniques, welding defects , types of joints, types of welds, power sources, edge preparation, defect formation, defect rectification and filler metal specification.

UNIT II QUALITY SYSTEM IN WELDED STRUCTURES 9

Quality assurance - Manufacturing quality plan (MQP) and Quality control procedures (QCP)

UNIT III QUALITY CONTROL IN WELDING 9

Introduction to steel plates - IS 2062, Raw material QC, welding procedure specification, welder qualification systems and fit up stage inspection.

UNIT IV INSPECTION OF WELDS 9

Inspection before, during and after welding mechanical testing, visual inspection, weld sizing, training on visual inspection and LPT of welded structures.

UNIT V NON DESTRUCTIVE TESTING 9

Application of MT, RT, UT methods for welded structures, case studies.

L:45; TOTAL: 45 PERIODS

TEXT BOOKS

1. Parmer R.S, "Welding Engineering and Technology", 2nd Edition, Khanna publishers, Delhi, 2010.
2. R Halmshaw, "Introduction to the Non-Destructive Testing of Welded Joints"- 2nd Edition ,Woodhead Publishing, 1997.

REFERENCES

1. Little R.L, "Welding and Welding Technology" - Tata McGraw Hill Publishing Limited, New Delhi, 1989.
2. Welding handbook Vol.1 publisher American welding society.
3. Pocket book for visual inspection.
4. http://www.aws.org/files/205/2009011/AWSPHB~2.PDF.
5. Metals Handbook Vol.6 Welding, brazing, and soldering by ASME.
6. ASME Section VIII - Division 1.
7. ASME Section IX.

15ME68E	**INDUSTRIAL SAFETY ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES

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

CO1: Appraise the concept of accidents and their prevention. (K2)
CO2: Use the ergonomics to design the work system and to change the human behavior to avoid accidents. (K3)
CO3: Appraise various industrial hazards and their control measures. (K2)
CO4: Select the appropriate fire extinguishing systems for various classes of fire. (K3)
CO5: Use various safety management techniques to promote safety practice and avoid accidents. (K3)

UNIT I ACCIDENT INVESTIGATION, ANALYSIS AND PREVENTION 9

Concept of an Accident, reportable and non-reportable accidents, reporting to statutory authorities. Principles of accident prevention-accident investigation and analysis-Unsafe act and unsafe condition- Domino sequence-cost of accidents-- role of safety officer - safety supervisor - safety committee-. Factories act and rules related to safety

UNIT II ERGONOMICS AND HUMAN BEHAVIOUR 9

Introduction to ergonomics and its area of application in the work system. Anatomy, Posture and body mechanics-low back pain, risk factors for musculoskeletal disorders in the work place-behavioral aspects of posture - effectiveness. Individual differences, Factors contributing to personality, fitting the man to the job. Motivation -job satisfaction - Emotion and frustration. Attitudes - determination of attitudes- changing attitudes.

UNIT III HAZARDS AND THEIR CONTROL 9

Physical hazards-Noise, heat, vibration, ionizing and non ionizing radiations and effects. Chemical hazards-dusts, fumes, mist, vapor, fog, gases, types, concentration, exposure Vs dose, TLV. Mechanical hazards. Hazards prevention - Administrative control methods, Engineering control methods- use of personal protective equipments

UNIT IV FIRE PREVENTION AND PROTECTION 9

Fire triangle-principles of fire extinguishing- various classes of fire- A, B, C, D types of fire extinguishers- Industrial fire protection systems. Sprinklers- Fire hydrants- Alarm and detection systems- other suppression systems- CO_2 system, foam system and DCP system.

UNIT V SAFETY MANAGEMENT TECHNIQUES, EDUCATION AND TRAINING 9

Incident Recall Technique, Disaster Control, Job Safety Analysis, safety survey, safety inspection, safety Audit. Safety training, seminars, conferences, competitions - method of promoting safe practice - creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign - Domestic Safety and Training.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Heinrich.H W “Industrial Accident Prevention”, McGraw Hill Company, New York, 1980.
2. John V Grimaldi and Rollin H Simonds, “Safety Management”, All India Travellers Book Seller, New Delhi, 1989.

REFERENCES

1. Krishnan.N V “Safety Management in Industry”, Jaico Publishing House, Bombay, 1997.
2. McCormick E.J and M.S. Sanders “Human Factors in Engineering and Design”, TMH, New Delhi, 1982.
3. Hand Book of “Occupational Safety and Health”, National Safety Council, Chicago, 1982.
4. Derek James, “Fire Prevention Hand Book”, Butter Worths and Company, London, 1986.
5. Lees F P “Loss Prevention in Process Industries”, Butter Worth publications, London, 2nd Edition, 1990.
6. Dan Peterson, “Techniques of Safety Management”, McGraw Hill Company, Tokyo, 1981.
7. “Accident Prevention Manual for Industrial Operations”, N.S.C. Chicago, 1982.

8. Hunter Gomos, “Engineering Design for Safety”, McGraw Hill Inc., 1992.
9. Encyclopedia of “Occupational Health and Safety” Vol I and II, Published by International Labour Office, Geneva, 1985.
10. Gupta R S, “Hand Book of Fire Technology”, Orient Black Swan, 2010.
11. The Factories Act 1948, Madras Book Agency, Chennai, 2000.
12. Deshmukh, L M “Industrial safety management”, TATA McGraw Hill, 2010

15ME69E PRODUCTION PLANNING AND CONTROL

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Describe the functions and significances of production planning and control. (K2)
CO2: Apply suitable work study methods to improve production process. (K3)
CO3: Prepare the route sheet for manufacturing a product. (K3)
CO4: Analyze the feasible production scheduling method to improve productivity. (K3)
CO5: Discuss the recent techniques in production planning. (K2)

UNIT I INTRODUCTION **9**

Objectives and benefits of planning and control - Functions of production control - Types of production environment - Product development and design - Marketing, functional, operational, durability, dependability and aesthetic aspects - Profit consideration - standardization - Break even analysis -Economics of a new product design.

UNIT II WORK STUDY **9**

Method study - basic procedure - Micro and memo motion study - work measurement and techniques.

UNIT III PRODUCT AND PROCESS PLANNING **9**

Product planning - Value analysis - Problems in lack of product planning. Process planning and routing - Steps in process planning - Quantity determination in batch production -Machine capacity, balancing - Analysis of process capabilities in a multi product system.

UNIT IV PRODUCTION SCHEDULING **9**

Production Control Systems - Loading and scheduling - Master Scheduling - Gantt charts - Basic scheduling problems - Line balancing - Product sequencing - Manufacturing lead time - Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC **9**

Inventory control - Effect of demand on inventories - Ordering Procedures - Two bin system - Ordering cycle system - ABC analysis - Kanban and JIT - Introduction to computer integrated production planning systems - MRP II and ERP.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. MukhpadyayS K, “Production Planning And Control” PHI Learning Pvt. Ltd., 2007
2. MartandTelsang, “Industrial Engineering and Production Management”, S.Chand and Company, 1st Edition, 2000.

REFERENCES

1. UpendraKachru, “Production and operations management - Text and cases”, Excel books, 1st Edition, 2007.
2. James B Dilworth, “Operations management - Design, Planning and Control for manufacturing and services”, McGraw Hill International Edition, 1992.
3. Kanishka Bedi, “Production and Operations management”, Oxford University press, 2nd Edition, 2007.
4. Norman Gaither, Frazier G, “Operations management”, Thomson learning, 9th Edition, IE, 2007.
5. Elwood Buffa S, and Rakesh Sarin K, “Modern Production / Operations Management”, 8thEdition, John Wiley and Sons, 2000.

15ME70E	ENGINEERING ECONOMICS AND COST ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Describe basic concepts and terminologies used in engineering economics. (K2)
CO2: Describe the concept of value engineering and find the time value of money. (K3)
CO3: Compare and select alternative methods based on time value of money. (K3)
CO4: Perform replacement and maintenance analysis for different alternatives. (K3)
CO5: Estimate the depreciation and economic life of asset. (K3)

UNIT I INTRODUCTION TO ECONOMICS 9

Introduction to Economics- flow in an economy, law of supply and demand, concept and scope of engineering economics - engineering and economic efficiency - element of costs-break-even analysis- P/V ratio, elementary economic Analysis.

UNIT II VALUE ENGINEERING 9

Make or buy decision, value engineering - function, aims and procedure. Interest formulae and their applications - Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series present worth factor- equal payment series capital recovery factor-Uniform gradient series annual equivalent factor, Effective interest rate.

UNIT III CASH FLOW 9

Methods of comparison of alternatives - present worth method, Future worth method, Annual equivalent method, rate of return method.

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9

Replacement and maintenance analysis - types of maintenance and replacement

problem, determination of economic life of an asset, replacement of an asset with a new asset - capital recovery with return and concept of challenger and defender, simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION 9

Depreciation, Straight line method, declining balance method -Sum of the years digits method, sinking fund method , Annuity method, service output method -Evaluation of public alternatives - Inflation adjusted decisions - procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

L:45; TOTAL:45 PERIODS

Note: (Use of Interest tables is permitted in the End Semester Examination)

TEXT BOOKS

1. Panneer Selvam R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi, 2th Edition, 2013.
2. Suma Damodaran, “Managerial economics”, Oxford University press 2006.

REFERENCES

1. Chan S Park, “Contemporary Engineering Economics”, Prentice Hall of India, 2002.
2. Donald G Newman and Jerome P Lavelle, “Engineering Economics and analysis”,Engg. Press, Texas, 2002.
3. Degarmo EP, Sullivan WG and Canada JR, “Engineering Economy”, Macmillan, New York, 1984.
4. Smith GW, “Engineering Economy”, Lowa State Press, Iowa, 1987.
5. Truettand Truett, “Managerial economics - Analysis, problems & cases”, 8thEdition, Wiley India, 2004.
6. Luke M Froeb / Brian T Mccann, “Managerial Economics - A problem solving approach” Thomson learning, 2007.

15ME71E TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: Explain the quality management philosophies and Framework. (K2)
CO2: Discuss the need of customer expectations, employee involvement and Supplier partnership. (K2)
CO3: Analyze the TQM tools and Techniques to improve the product and process Quality. (K3)
CO4: Apply modern tools to improve quality of the product. (K3)
CO5: Describe ISO 9001, Environmental Management Standards and ISO 14001 Certification process. (K2)

UNIT I INTRODUCTION 9

Introduction - Need, evolution and definition of quality - Dimensions of manufacturing and

service quality - Basic concepts, definition and framework of TQM - Contributions of Deming, Juran and Crosby - Barriers to TQM.

UNIT II TQM PRINCIPLES 9

Leadership - Strategic quality planning, Quality statements - Customer focus, orientation, satisfaction, complaints and retention - Employee involvement - Motivation, Team and Teamwork, Recognition and Reward, Performance appraisal - Supplier partnership - Partnering, Supplier selection, Supplier Rating - Continuous process improvement - PDSA cycle, 5s and Kaizen.

UNIT III TQM TOOLS AND TECHNIQUES 9

Quality circles - Quality Function Deployment (QFD) - Taguchi quality loss function -TPM - Concepts, improvement needs - Quality cost, types and its analysis techniques - Performance measures.

UNIT IV APPLICATION OF TQM TOOLS AND TECHNIQUES 9

Seven traditional tools of quality - New management tools - Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages and types - criteria for getting Quality awards.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9000-2000 Quality System - Elements, Documentation, Quality auditing- QS 9000 - ISO 14000 - ISO 17025 - Concepts, Requirements and Benefits - Case studies of TQM.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Dale H Besterfiled, “Total Quality Management”, Pearson Education Asia, 3rd Edition, Indian Reprint 2012.
2. Janakiraman B and Gopal R K, “Total Quality Management - Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006

REFERENCES

1. James R Evans and William M Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland J S, “TQM - Text with Cases”, Butterworth - Heinemann Ltd., Oxford, 3rd Edition, 2003.
3. Suganthi L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd., 2006.
4. Ramachandran S, “Total Quality Management”, Air Walk Publications, 3rd Edition 2014.

15ME72E	MARKETING MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Recognize the need of marketing for the success of a product. (K2)
CO2: Discuss product development process and pricing strategies. (K2)
CO3: Indentify the appropriate distribution channel and promotion techniques. (K3)
CO4: Apply marketing research techniques for the success of a product. (K3)
CO5: Discuss the issues and recent developments in marketing. (K2)

UNIT I INTRODUCTION 9

Concept, nature, scope, importance and evolution of marketing. Marketing mix, Strategic marketing planning - an overview, Market Analysis and Selection, Marketing environment - macro and micro components and their impact on marketing decisions - Market segmentation and positioning - Buyer behavior, consumer versus organizational buyers and consumer decision making process.

UNIT II PRODUCT AND PRICING 9

Product Decisions: Concept and classification of products, Major product decisions, Product line and product mix, Branding, Packaging and labeling, Product life cycle - strategic implications, New product development and consumer adoption process.

Pricing Decisions: Factors affecting price determination, Pricing policies and strategies, Discounts and rebates.

UNIT III DISTRIBUTION CHANNELS AND PROMOTION 9

Distribution Channels and Physical Distribution Decisions: Nature, functions, and types of distribution channels; Distribution channel intermediaries; Channel management decisions; Retailing and wholesaling.

Promotion Decisions: Communication Process; Promotion mix - advertising, personal selling, sales promotion, publicity and public relations; Determining advertising budget; Copy designing and testing; Media selection; Advertising effectiveness; Sales promotion - tools and techniques.

UNIT IV MARKETING RESEARCH 9

Meaning, scope and process of marketing research. Marketing Organization and Control: Organizing and controlling of marketing operations.

UNIT V ISSUES AND DEVELOPMENTS IN MARKETING 9

Social, ethical and legal aspects of marketing; Marketing of services; International marketing; Green marketing; Cyber marketing; Relationship marketing and other developments of marketing.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Kotlar Philip, “Marketing Management”, 15th edition, Prentice Hall, New Delhi, 2015
2. Stanton Etzel, “Fundamentals of Marketing”, Walker, 13th edition, Tata-McGraw Hill, New Delhi, 2000

REFERENCES

1. Saxena Rajan, "Marketing Management", 5th edition, Tata-McGraw Hill, New Delhi, 2005.
2. McCarthy, Jerome E and Irwin "Basic Marketing: A managerial approach", New York, 1997.
3. Ramaswamy V S and Namakumari S,"Marketing Management", 4th Edition, Macmillan, 2009

15ME73E	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Formulate and solve the real world linear programming problems (LPP) using suitable tools. (K3)
CO2: Solve transportation, Assignments and travelling sales man problems. (K3)
CO3: Construct network and apply CPM and PERT techniques for project evaluation. (K3)
CO4: Select suitable replacement models and find the economic life of the items. (K3)
CO5: Solve various queuing problems. (K3)

UNIT I LINEAR MODEL 9

The phases of OR study - Mathematical formulation of L.P. Problems - Graphical solution methods- Simplex method - slack, surplus and artificial variables - two phase method.

UNIT II TRANSPORTATION, ASSIGNMENT AND TRAVELLING SALES MAN PROBLEMS 9

Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problems. Applications of Transportation problems. Assignment Problems: Formulation, unbalanced assignment problems, Traveling salesman problems.

UNIT III NETWORK MODELS 9

CPM - Network construction, determining critical path, floats, project duration. PERT - Network Analysis. Cost trade off.

UNIT IV REPLACEMENT AND SEQUENCING MODELS 9

Replacement of items that deteriorate with time - value of money changing with time - not changing with time - optimum replacement policy - individual and group replacement. Sequencing problem: models with 'n' jobs on two machines - problem with n jobs with three machines.

UNIT V QUEUING MODELS 9

Queuing models - queuing systems and structures - notation -parameter - single server

and multi-server models - Poisson input - exponential service - constant rate service - infinite population.

L:45; TOTAL:45 PERIODS

Note: (Use of Normal distribution tables is permitted in the End Semester Examination)

TEXT BOOKS

1. Taha HA, "Operation Research", Pearson Education, 8th edition, 2007.
2. Wayne L Winston, "Operations research applications and algorithms", Thomson learning, 4th Edition, 2007.

REFERENCES

1. Frederick Hiller and Gerald Lieberman, "Introduction to Operations Research: Concepts And Cases", 8th Edition, Tata McGraw Hill,2005
2. Sharma JK, "Operations research theory and applications", 3rd Edition, Macmillan India, 2007.
3. Hira and Gupta "Problems in Operations Research", S.Chand and Co, 2002.
4. Panneerselvam, "Operations Research" Prentice Hall of India, 2003.
5. Srinivasan G, "Operations research principles and applications", PHI (EEE) 2007.
6. Wagner, "Operations Research", Prentice Hall of India, 2000.

15ME74E ENTREPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1: Describe the concept of entrepreneurship and need for becoming an entrepreneur. (K2)
CO2: Discuss about competencies and motivation acquired for an entrepreneur. (K2)
CO3: Demonstrate business plan to start a small enterprise. (K3)
CO4: Analyze the financial and accounting details needed to start and run a small enterprise. (K3)
CO5: Summarize the various supports available to start a small enterprise. (K2)

UNIT I ENTREPRENEURSHIP 9

Concept of Entrepreneurship - Characteristics of successful Entrepreneur - Functions of Entrepreneur- Need for an Entrepreneur - Types of Entrepreneur - Distinction between an Entrepreneur and Intrapreneur - Role of Entrepreneurship in Economic development - Factors affecting entrepreneurship growth - Knowledge and skills of an Entrepreneur

UNIT II ENTREPRENEURIAL MOTIVATION AND COMPETENCIES 9

Meaning of Entrepreneurial Motivation - Motivational Cycle - Theories of Entrepreneurial Motivation - Entrepreneurial motivation factors - Achievement motivation - Entrepreneurial Motivational behaviour - case studies. Meaning of Entrepreneurial Competency - Major Entrepreneurial Competencies - Development Entrepreneurial Competencies - Case studies. Entrepreneurship Development Programmes - Need - Objectives - Phases -

Evaluation.

UNIT III BUSINESS 9

Small Enterprises - Definition, Classification -Characteristics, Ownership Structures - Project Formulation - Steps involved in setting up a Business - identifying, selecting a Good Business Opportunity, Market Survey and Research, Techno Economic Feasibility Assessment - Preparation of Preliminary Project Reports - Project Appraisal - Sources of Information - Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING 9

Need - Sources of Finance, Term Loans, Capital Structure, Financial Institution, management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT/CPM - Taxation - Income Tax, Excise Duty - Sales Tax

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business - Concept, Magnitude, causes and consequences, Corrective Measures -Government Policy for Small Scale Enterprises - Growth Strategies in small industry - Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

L45; TOTAL:45 PERIODS

TEXT BOOKS

1. Khanka SS, “Entrepreneurial Development”, S.Chand and Co. Ltd., New Delhi, 2014.
2. Hisrich RD and Peters M P, “Entrepreneurship”, 5th Edition, Tata McGraw-Hill, 2002.

REFERENCES

1. Rabindra N Kanungo, “Entrepreneurship and innovation”, Sage Publications, New Delhi, 2010.
2. EDII-Faulty and External Experts, “A Hand Book for New Entrepreneurs”, Entrepreneurship Development Institute of India, Ahmadabad, 1986.

15ME75E	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

Upon successful completion of this course, the students will be able to

CO1: Discuss the need and process of additive manufacturing. (K2)
CO2: Describe the reverse engineering and modeling techniques. (K2)
CO3: Explain liquid and solid based additive manufacturing systems. (K2)
CO4: Discuss powder based manufacturing systems. (K2)
CO5: Identify the suitable 3D printing systems for specific application. (K3)

UNIT I INTRODUCTION 9

Need and Development of AM systems - AM process chain - Impact of AM on Product Development - Virtual Prototyping - Rapid Tooling - RP to AM - Classification of AM processes - Benefits - Applications.

UNIT II REVERSE ENGINEERING AND CAD MODELING 9

Basic concept- Digitization techniques - Model reconstruction - Data Processing for Rapid Prototyping: CAD model preparation, Data requirements - Geometric modeling techniques: Wire frame, surface and solid modeling - data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation - Software for AM - Case studies.

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 9

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

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 9

Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS - powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications – Case Studies.

UNIT V OTHER ADDITIVE MANUFACTURING SYSTEMS 9

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

L45; TOTAL:45 PERIODS

TEXT BOOKS

1. Gibson I, Rosen DW and Stucker B, “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Chua CK, Leong KF and Lim CS, “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010.

REFERENCES

1. Gebhardt A, “Rapid prototyping”, Hanser Gardener Publications, 2003.
2. Liou LW and Liou FW, “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2011. Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
3. Hilton PD and Jacobs PF, “Rapid Tooling: Technologies and Industrial Applications”, CRC press, 2005.

B.E. – MECHANICAL ENGINEERING

ONE CREDIT ELECTIVE COURSES

15ME01L	SHELL AND TUBE HEAT EXCHANGER DESIGN	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Conceive a design based on the information provided for a specific application (K4).

CO2: Determine the size of heat exchanger for a given requirement (K4).

Types of heat exchangers, shell and tube heat exchangers – regenerators and recuperators – Parts description, classification as per Tubular Exchanger Manufacturers Association.

Kern method – Bell Delware method – classification of baffles – flow induced vibrations- Demo about HTRI Suite Software.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Kuppan T, “Heat Exchanger Design handbook”, 2nd Edition, CRC Press, 2013.
2. Sadik Kakac and Hongtan Liu, "Heat Exchangers Selection, Rating and Thermal Design”, CRC Press, 2012.

15ME02L	ENERGY AUDIT AND MANAGEMENT	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Play the role of energy manager in an industry (K4).

CO2: Develop methodology to carry out energy audit and management of equipment and processes (K4).

Energy Scenario – Energy monitoring, auditing & targeting – Economics of various Energy Conservation schemes. Total Energy Systems.

Steam engineering – Conservation Measures in Steam; Boilers – types, losses and efficiency calculation methods.

Refrigeration and Air conditioning – Heat load estimation – Energy conservation in cooling towers and spray ponds.

Energy conservation in Centrifugal pumps, Fans & Blowers, Air compressor – energy consumption and energy saving potentials.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Frank Kreith, Yogi Goswami D, “Energy Management and Conservation Handbook”, 2nd Edition, CRC Press, 2016.

2. Tarik Al-Shemmeri, “A Workbook for Energy Management in Buildings”, John Wiley & Sons, 2011.
3. Penni McLean-Conner, “Energy Efficiency: Principles and Practices”, Penn Well Books, 2009.
4. Barney L Capehart, Wayne C Turner, William J Kennedy, “Guide to Energy Management”, The Fairmont Press, Inc., 2008.
5. Eastop T D, Croft D R, “Energy Efficiency for Engineers and Technologists”, Logman Scientific & Technical, 1990.
6. Reay D A, “Industrial Energy Conservation”, 1st Edition, Pergamon Press, 1979.
7. Bureau of Energy Efficiency Books, Volumes I-IV.

15ME03L	PYROLYSIS AND GASIFICATION	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Develop a simple design for pyrolysis and gasification process (K4).

Pyrolysis: Introduction – Types of pyrolysis – pyrolysis products – kinectics. Pyrolzer types – simple design.

Gasification: Gasifier Reactions and steps – gasification process – types of gasifiers: Fixed bed, fluidized bed and Simple process design.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Yongseung Yun, “Gasification for Practical Applications”, InTech, 2012.
2. Prabir Basu, “Biomass Gasification and Pyrolysis Practical Design and Theory”, Academic Press, Elsevier, 2010.
3. Jean – Pierre, “Biomass gasification: chemistry, Processes and applications”, Nova Science Publishers, UK, 2009.
4. Christopher Higman, “Gasification”, 2nd Edition, Gulf professional, Elsevier, 2008.
5. Berlin A A, “Chemical Physics of Pyrolysis, Combustion, and Oxidation”, Nova Publishers, 2005.

15ME04L	HEAT TRANSFER ENHANCEMENT	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Analyze and apply different heat transfer enhancement techniques (K4).

CO2: Analyze the influence of nano-materials for heat transfer augmentation (K4).

Need for heat transfer enhancement – Types of heat transfer enhancements – Heat transfer associated with internal flows – Application of Nanomaterials in Heat Transfer – Nanofluids – Mechanism of Heat Transfer Augmentation using Nanofluids - Heat transfer associated with external flows – Optimization of Heat Transfer Enhancement – Case Studies on the Heat Transfer Augmentation.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Theodore L Bergman, Frank P Incropera, David P DeWitt, Adrienne S Lavine, “Fundamentals of Heat and Mass Transfer”, John Wiley & Sons, 2011.
2. James P Hartnett, “Advances in Heat Transfer”, Vol. 36, Academic Press, 2002.
3. Fan J F, Ding W K, Zhang J F and He Y L, Tao W Q, “A performance evaluation plot of enhanced heat transfer techniques oriented for Energy-Saving”, International Journal of Heat and Mass Transfer, vol. 52(2009), pp. 33–44.
4. Mourad Rebay, Sadik Kakaç, Renato M Cotta, “Microscale and Nanoscale Heat Transfer: Analysis, Design, and Application”, CRC Press, 2016.
5. Ashutosh Tiwari, Yogendra Kumar Mishra, Hisatoshi Kobayashi, Anthony P F Turner, “Intelligent Nanomaterials”, 2nd edition , John Wiley & Sons, 2016.
6. Vincenzo Bianco, Oronzio Manca, Sergio Nardini, Kambiz Vafai, “Heat Transfer Enhancement with Nanofluids”, CRC Press, 2015.
7. Sarit K Das, Stephen U Choi, Wenhua Yu, Pradeep T, “Nanofluids: Science and Technology”, 2008.
8. Visinee Trisaksria, Somchai Wongwises, “Critical review of heat transfer characteristics of nanofluids”, Renewable and Sustainable Energy Reviews, vol. 11(3)-2007, pp. 512–523.
9. Sadik, Anchasa P, “Review of convective heat transfer enhancement with nanofluids”, International Journal of Heat and Mass Transfer, vol. 52 (2009), pp.3187–3196.
10. https://www.journals.elsevier.com/international-journal-of-heat-and-fluid-flow/
11. https://www.journals.elsevier.com/international-journal-of-heat-and-mass-transfer/
12. http://www.sciencedirect.com/science/journal/00179310/53/21-22.

15ME05L	**GRID TIED PV SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Design the grid tied PV system for small power applications (K3).

CO2: Predict and evaluate the performance of grid tied PV systems (K4).

Meteorological aspects – Shading analysis – System components - Grid tied PV system configuration – Design methodology of PV system – PV array design – Balance of systems – Net metering– PV system design for small & medium power applications – Remote monitoring – Performance prediction using PVsyst – Field study – Performance evaluation.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Suneel Deambi, "Photovoltaic System Design: Procedures, Tools and Applications", CRC Press, 2016.
2. Chetan Singh Solanki, "Solar Photovoltaic Technology and Systems: a manual for technicians, trainers and Engineers", Prentice Hall of India, 2014.
3. John R Balfour, Michael Shaw, "Advanced Photovoltaic System Design", Jones & Bartlett Publishers, 2011.
4. Roger Messenger, Amir Abtahi, "Photovoltaic Systems Engineering", 3rd Edition, CRC Press, 2010.
5. Web sources : www.pveducation.org; www.pveducation.com; nptel.ac.in/courses/108105058/17

15ME06L	**OFF GRID PV SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Design the standalone PV system for residential buildings (K3).

CO2: Predict and evaluate the performance of stand-alone PV systems (K4).

Meteorological aspects – Shading analysis - Solar PV module-PV array-selection of batteries for PV system - charge controller-standalone PV system configuration- with battery, AC and DC loads-Design methodology of PV system- Applications - Estimation of residential building load –design of standalone system - Performance prediction and evaluation using software.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Suneel Deambi, "Photovoltaic System Design: Procedures, Tools and Applications", CRC Press, 2016.
2. Parimita Mohanty, Tariq Muneer, Mohan Kolhe, "Solar Photovoltaic System Applications: A Guidebook for Off-Grid Electrification", Springer, 2015.
3. Chetan Singh Solanki, "Solar Photovoltaic Technology and Systems: a manual for technicians, trainers and Engineers", Prentice Hall of India, 2014.
4. Chetan Singh Solanki, "Solar Photovoltaics Fundamentals, Technologies and Applications", 2nd edition, Prentice Hall of India, 2012.
5. John R Balfour, Michael Shaw, "Advanced Photovoltaic System Design", Jones & Bartlett Publishers, 2011.
6. Roger Messenger, Amir Abtahi, "Photovoltaic Systems Engineering", 3rd edition, CRC Press, 2010.

15ME07L	THERMAL ENERGY STORAGE SYSTEMS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Choose suitable energy storage technology for given application (K4).

Different energy storage technologies - phase change and sensible energy storage materials – materials for different temperature applications – design considerations – charging and discharging characteristics – performance.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Shannaq R Al and Barreneche C, “Advances in Thermal Energy Storage Systems- Methods and Applications”, A volume in Woodhead Publishing Series in Energy, 2015.
2. Cabeza Luisa F, “Advances in Thermal Energy Storage Systems: Methods and Applications”, Elsevier, 2014.
3. Kalaiselvam S, Parameshwaran R, “Thermal Energy Storage Technologies for Sustainability: Systems Design, Assessment and Applications”, Elsevier, 2014.
4. Ibrahim Dincer and Marc A Rosen, “Thermal Energy Storage: Systems and Applications”, 2nd edition, John Wiley & Sons, Ltd., 2011.
5. Nasiru I Ibrahim et al., “Heat transfer enhancement of phase change materials for thermal energy storage applications: A critical review”, Renewable and Sustainable Energy Reviews, vol. 74 (2017) 26–50.
6. Belen Zalba et al., “Review on thermal energy storage with phase change: materials, heat transfer analysis and applications”, Applied Thermal Engineering, vol. 23 (2003), pp. 251–283.

15ME08L	SOLAR THERMAL STEAM GENERATION SYSTEMS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Choose appropriate solar steam generation system for given application (K4).

Solar Concentrated Collectors generation technologies, direct and indirect steam generation system, flash evaporation, Concentrating solar collectors, solar steam generation using different type of collectors, power tower, energy storage, design considerations and performance, applications and economics.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Manuel Blanco, Lourdes Ramirez Santigosa, “Advances in Concentrating Solar Thermal Research and Technology”, Woodhead Publishing, 2016.
2. Soteris A Kalogirou, “Solar Energy Engineering: Processes and Systems”, 2nd edition, Acadamic Press, Elsevier Inc., 2014.
3. Lovegrove K, Stein W, “Concentrating Solar Power Technology: Principles, Developments and Applications”, Elsevier, 2012.
4. Soteris A Kalogirou, “Solar thermal collectors and applications”, Progress in Energy and Combustion Science, vol. 30 (2004), pp. 231–295.

15ME09L	SOLAR COOLING SYSTEMS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Choose appropriate solar cooling system for given application (K4).

Different solar cooling technologies, integrating vapour compression systems and vapour absorption systems, desiccants, energy storage requirements, design considerations, economy and applications.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Ioan Sarbu, Calin Sebarchievici, “Solar Heating and Cooling Systems: Fundamentals, Experiments and Applications”, Academic Press, 2016.
2. Ruzhu Wang, Tianshu Ge, “Advances in Solar Heating and Cooling”, Woodhead Publishing, 2016.
3. Paul Kohlenbach and UliJakob, “Solar Cooling: The Earthscan Expert Guide to Solar Cooling Systems”, Routledge, England, 2014.
4. Garg H P, Prakash J, “Solar Energy: Fundamentals and Applications”, Tata McGraw-Hill Education, 2000.
5. Mehdi Zeyghami, Yogi Goswami D, Elias Stefanakos, “A review of solar thermo-mechanical refrigeration and cooling methods”, Renewable and Sustainable Energy Reviews, vol. 51 (2015), pp. 1428–1445.

15ME10L	DESALINATION	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Choose suitable desalination technology for given application (K4).

Different Desalination technologies – Membrane, Thermal and hybridation Desalination – Solar PV powered Desalination - Solar thermal Desalination: passive and active type – Technical Challenges – Design consideration – Performance.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Chandrashekara M and Avadhesh Yadav, "Water desalination system using solar heat: A review", Renewable and Sustainable Energy Reviews, Vol. 67, pp. 1308–1330.
2. Mohammed Shadi S Abujazar, Fatihah S, Rakmi A R, Shahrom M Z, "The effects of design parameters on productivity performance of a solar still for seawater desalination: A review", Desalination, Vol. 385, pp. 178–193.
3. Sharshir S W, Elsheikh A H, et al., "Thermal performance and exergy analysis of solar stills – A review", Renewable and Sustainable Energy Reviews, Vol. 73, pp. 521–544.
4. Sharon H and Reddy K.S, "A review of solar energy driven desalination technologies", Renewable and Sustainable Energy Reviews, Vol.41, pp. 1080–1118.
5. Malik M A S, Tiwari G N, Kumar A and Sodha M S, "Solar Distillation", Pergamon Press, New York, 1982.
6. Soteris A Kalogirou, "Solar Energy Engineering: Processes and Systems", Academic Press, Technology & Engineering, 2009.
7. Vassilis Belessiotis Soteris Kalogirou Emmy Delyannis, "Thermal Solar Desalination", Academic Press, ISBN: 9780128097823, 2016.
8. Garg H P, Prakash J, "Solar Energy: Fundamentals and Applications", Tata McGraw-Hill Education, 2000.

15ME11L	**INDUSTRIAL DRAWING READING WITH GD&T**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Evaluate limits, fits and tolerance for components/products (K4).

Industrial Drawing reading – First and third angle projection – free hand sketches – BIS SP46 - Engineering drawing and tolerance – Limits, fits and Tolerance - Tolerance symbols and terms – rules and concepts of GD&T - use of GD&T – MMC, LMC – datum – Form – Orientation – profile – Runout.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Alex Krulikowsi, "Fundamentals of Geometric Dimensioning and Tolerancing", 2nd Edition, Delmar publications, 2012.

2. Standards for dimensioning and tolerancing - ASME Y 14.5, 2009.
3. James D Meadows, “GD&T Application, analysis and Measurements”, ASME Press 2009.

15ME12L	PROCESS EQUIPMENT DESIGN	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Design the components of process equipments (K4).

Pressure Vessel Introduction – Design of Flanges – Design of supports for vertical and horizontal vessels – Openings, nozzles and External loadings – Storage Vessels - Evaporators crystallizers – Distillation and fractionization equipment.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Joshi, “Process Equipment Design”, Macmillan Company of India, 2016.
2. Dennis R Moss, Michael M. “Pressure Vessel Design Manual”, 4th edition, Butterworth-Heinemann, 2012.
3. James R Couper, Roy Penney W, James R Fair, “Chemical Process Equipment: Selection and Design”, 3rd Edition, Elsevier, 2012.
4. Stanley M Walas, “Chemical Process Equipment Selection and design”, Butterworth-Heinemann, 1988.
5. Lloyd E Brownell and Edwin H Young, “Process Equipment Design: Vessel Design”, John Wiley & Sons, 1959.

15ME13L	TECHNIQUES FOR VIBRATION MONITORING AND CONTROLS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Apply vibration based condition monitoring in rotating machineries. (K4).

Condition monitoring- methods – measurement of vibration, Vibration analysis, Vibration and predictive maintenance, Monitoring machine vibration, Vibration transducers, Common vibration monitoring techniques. Industrial case studies. Active and passive techniques in vibration control.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Davies A, “Handbook of Condition Monitoring: Techniques and Methodology”, Springer Science & Business Media, 2012.
2. Anders Brandt, “Noise and Vibration Analysis: Signal Analysis and Experimental Procedures”, John Wiley & Sons, 2011.
3. Robert Bond Randall, “Vibration-based Condition Monitoring”, John Wiley and Sons, Ltd., 2011.
4. Peter Tavner, Li Ran, Jim Penman, “Condition Monitoring of Rotating Electrical Machines”, the Institution of Engineering and Technology, London, United Kingdom, 2008.
5. Lihui Wang, Robert X Gao, “Condition Monitoring and Control for Intelligent Manufacturing”, Springer Science & Business Media, 2006.
6. Rao B K N, Davies A, “Handbook of Condition Monitoring Techniques and Methodology”, Springer-science business media, 1998.
7. Rao B K N, “Handbook of Condition Monitoring”, Elsevier, 1996.

15ME14L	CRASHWORTHINESS OF TUBULAR SHELLS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Select suitable thin-walled sectional member for specific application (K4).

CO2: Evaluate the crashworthiness characteristics of shell structures. (K4).

Structural members–types- selection and applications. Crashworthiness –definitions-types of loading-Influence of materials, shape, and boundary conditions on energy absorption and mode of collapse.

Evaluation on crashworthiness characteristics of simple shell member. Case studies–impact on helmets –mode of collapse- inferences.

L:15; TOTAL: 15 PERIODS

REFERENCES

1.
2. Ambrosio J A C, “Crashworthiness: Energy Management and Occupant Protection”, Springer, 2001.
3. Ahmed Elmarakbi, Lukaszewicz, “Automotive Composite Structures for Crashworthiness”, John Wiley & Sons Ltd, 2014.
4. http://www.tandfonline.com/toc/tcrs20/current.
5. https://www.journals.elsevier.com/thin-walled-structures/
6. https://www.journals.elsevier.com/international-journal-of-impact-engineering.
7. https://www.journals.elsevier.com/composite-structures.
8. https://www.journals.elsevier.com/materials-and-design/

15ME15L	FAILURE MODE AND EFFECTS ANALYSIS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Apply FMEA techniques for product improvement (K4).

Failure mode effect analysis (FMEA) – requirements of reliability - failure rate - FMEA stages – Types of FMEA - Failure - Failure mode - Failure cause and/or mechanism - Failure effect – Detection –Probability - Risk Priority Number (RPN) – Severity - Remarks / mitigation / actions.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Bilal M Ayyub, “Risk Analysis in Engineering and Economics”, 2nd Edition, CRC Press, 2014.
2. Carl Carlson, “Effective FMEAs: Achieving Safe, Reliable, and Economical Products and Processes using Failure Mode and Effects Analysis”, John Wiley & Sons, 2012.
3. Raymond J Mikulak, Robin McDermott, Michael Beauregard, “The Basics of FMEA”, 2nd Edition, CRC Press, 2008.
4. Stamatis D H, “Failure Mode and Effect Analysis”, ASQ Quality Press, 2003.
5. Kevin Otto, Kristin Wood, “Product Design Techniques in Reverse Engineering and New Product Development”, Pearson Education (LPE), 2001.

15ME16L	DESIGN OF EXPERIMENTS	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Select suitable techniques for design of experiments in an engineering product design and evaluation. (K4).

Importance of Experiments, Experimental Strategies, Basic principles of Design, Terminology, ANOVA, Steps in Experimentation, Sample size, Single Factor experiments – Completely Randomized design, Randomized Block design, Statistical Analysis, Multifactor experiments – Two and three factor full Factorial experiments, 2^K factorial Experiments, Confounding and Blocking designs, Fractional factorial design, Taguchi’s approach - Steps in experimentation, Design using Orthogonal Arrays, Data Analysis, Robust Design.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Linda C Schmidt, George E Dieter, “Engineering design”, McGraw-Hill Education, 2015.
2. Jiju Antony, “Design of Experiments for Engineers and Scientists”, Elsevier, 2014.
3. Paul G Mathews, “Design of Experiments with MINITAB”, ASQ Quality Press, 2005.
4. Ronald Fisher, “The Design of Experiments”, Hafner Press, 8th Revised edition, 1972.

15ME17L	**TAGUCHI METHODS**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Apply Taguchi methods in design of experiments (K4).

Overview of Design of Experiments and Taguchi approach - common experiments and methods of analysis. Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design - control and noise factors, S/N ratios, parameter design, Multilevel experiments, Multi response optimization – case studies.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Krishnaiah K and Shahabudeen P, “Applied Design of Experiments and Taguchi Methods”, PHI learning private Ltd., 2012.
2. Khosrow Dehnad, “Quality Control, Robust Design and the Taguchi Method”, Springer, 2012.
3. Ranjit K Roy, “A Primer on the Taguchi Method”, 2nd Edition, Society of Manufacturing Engineers, 2010.
4. Ranjit K Roy, “Design of Experiments using the Taguchi Approach”, John Wiley & sons, Inc., 2001.
5. Nicolo Belavendram, “Quality by Design; Taguchi techniques for industrial experimentation”, Prentice Hall, 1995.

15ME18L	**NATURAL FIBER COMPOSITES**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Predict the characteristics of different natural fibers and its composites (K4).

Fundamentals of natural fiber composite materials: Natural fibers-bio diversity-extraction methods-polymer matrix-composite fabrication methods. Pre-processing methods of

natural fibers: Introduction-Chemical agents used for natural fiber surface modification-treatment procedures. Characterization of natural fibers: FTIR spectrography, SEM topography and other testing methods- investigations. Applications in Automotive Industry.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Campilho R D S G, “Natural Fiber Composites”, CRC Press, 2015.
2. Alma Hodzic, Robert Shanks, “Natural Fibre Composites: Materials, Processes and Properties”, Woodhead Publishing, 2014.
3. Douglas D Stokke, Qinglin Wu, Guangping Han, “Introduction to Wood and Natural Fiber Composites”, John Wiley & Sons, 2013.
4. Ning Hu, “Composites and their properties”, Intech, 2012.
5. Adel zaki el-sonbati, “Thermoplastic-composite materials”, InTech, 2012.
6. John cuppoleeti, “Metal, ceramic and polymeric composites for various uses”, Intech, 2011.
7. Frederick T Wallenberger, Norman Weston, “Natural Fibers, Plastics and Composites”, Springer Science & Business Media, 2011.
8. Brahim Attaf, “Advances in composite materials-eco design and analysis”, Intech, 2011.
9. Pickering K, “Properties and Performance of Natural-Fibre Composites”, Elsevier, 2008.

15ME19L	OPTIMIZATION IN SCHEDULING	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Choose various objectives, constraints and parameters of scheduling environment (K4).

CO2: Apply evolutionary algorithms to scheduling problems with single and multi-objectives (K4).

Scheduling fundamentals **7**

Single machine scheduling - Measures of performance -Shortest processing time (SPT) -Rule to minimize Mean flow time - Weighted mean flow time - Earliest Due Date - Rule to minimize maximum lateness - Model to minimize total tardiness. Branch and Bound technique - Hodgson’s algorithm- Parallel processor in single machine scheduling. Application of scheduling Software.

Optimization in Scheduling **8**

Flow shop and Job shop scheduling- Evolutionary algorithms – Johnson’s algorithm. GA –application to scheduling problems - structure – Binary coded and real coded – parameters- crossover, mutation, local optimal, global optimal. Single and multi objective optimization.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Alessandro Agnetis, Jean-Charles Billaut, Stanisław Gawiejnowicz, Dario Pacciarelli, Ameur Soukhal, “Multiagent Scheduling: Models and Algorithms”, Springer Science & Business Media, 2014.
2. Panneerselvam R, “Production and Operations Management”, PHI Learning Pvt. Ltd., 2012.
3. Jacek Błażewicz, Klaus H Ecker, Erwin Pesch, Günter Schmidt, Jan Weglarz, “Handbook on Scheduling: From Theory to Applications”, Springer Science & Business Media, 2007.
4. Rajendran Saravanan, “Manufacturing Optimization through Intelligent Techniques”, CRC Press, 2006.
5. Joseph Y-T Leung, “Handbook of Scheduling: Algorithms, Models, and Performance Analysis”, CRC Press, 2004.

15ME20L	FUNCTIONAL MATERIALS FOR ENERGY CONVERSION	L	T	P	C
		1	0	0	1

COURSE OUTCOME

Upon completion of the course, the students will be able to

CO1: Select functional materials for energy conversion and storage. (K4)

Procedure for functional material development. Review of materials developed/available. Need for functional materials, synthesis methods, energy application. Design philosophy of functional materials, Nanostructures and Advanced Materials for solar energy conversion, fuel cell and energy storage.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. David Munoz-Rojas, Xavier Moya, “Materials for Sustainable Energy Applications: Conversion, Storage, Transmission, and Consumption”, Pan Stanford Publishing, 2016.
2. Kilner J A, Skinner S J, Irvine S J C, Edwards P P**, “**Functional Materials for Sustainable Energy Applications”, Woodhead Publishing Limited, 2012

15ME21L	DESIGN FOR MANUFACTURABILITY	L	T	P	C
		1	0	0	1

COURSE OUTCOME

Upon completion of the course, the students will be able to

CO1: Apply the concepts of design for manufacturability. (K4).

Review of Tolerances, Limits and Fits. Influences of materials Space factor, Size and Weight on form design. Design for machining, casting, forging and welding.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. David M Anderson, “Design for Manufacturability: How to Use Concurrent Engineering to Rapidly Develop Low-Cost, High-Quality Products for Lean Production”, CRC Press, 2014.
2. Chitale A K, Gupta R C, “Product Design and Manufacturing”, PHI Learning Pvt. Ltd., 2013
3. David M Anderson, “Design for Manufacturability & Concurrent Engineering: How to Design for Low Cost, Design in High Quality”, Design for Lean Manufacture, and Design Quickly for Fast Production, CIM Press, 2004
4. Boothroyd G, Dewhurst P and Knight W, “Product Design for Manufacture and Assembly”, Marcell Dekker, 2002
5. Harry Peck, “Designing for Manufacture”, Pitman Publishing, 1983
6. Chitale A K and Gupta R C, “Product Design and Manufacturing”, PHI 2007
7. Bralla J G, “Hand Book of Product Design for Manufacturing”, McGraw Hill Publications, 2000

15ME22L	**PROJECT MANAGEMENT**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

COURSE OUTCOME

Upon completion of the course, the students will be able to

CO1: Develop a project with a calendar, start date and scheduling method (K4).

Principles - Introduction to MS project - Taking a first look at project – Starting Project, Entering information, Changing views, Creating a new project: Gathering information, Opening a project file, Establishing basic project information, Looking at project calendars, Entering tasks, Adding subtasks, Saving project files, Working with project outline – Adjusting tasks in an outline, Copying tasks.

Creating resources and assigning costs: Understanding resources, Creating resource list, Modifying resource information, Using resources and tasks, Handling unusual cost situations.

L:15; TOTAL: 15 PERIODS

REFERENCES

1. Nancy Muir, “Project 2010 for Dummies”, John Wiley & Sons, 2010.
2. Sham Dayal, “Earned Value Management Using Microsoft Office Project: A Guide for Managing Any Size Project Effectively”, J. Ross Publishing, 2008.
3. Frederick B Plummer, “Project Engineering: The Essential Toolbox for Young Engineers”, Butterworth-Heinemann, 2007.
4. Elaine Marmel, “Microsoft Office Project 2007”, Wiley Publishing Inc, 2007.

15ME23L	Design a Startup	L	T	P	C
		1	0	0	1

COURSE OUTCOMES

Upon completion of the course, the students will be able to design a startup

Module 1: What is Design Thinking and It's importance for startup Creation

Innovation and Design thinking. Managing the New Product Development using Design Thinking. A Detail Analysis of Entrepreneurs vs Innovators.

Module 2: Discovery of Real World Problems

Problem Identification Tackle Wicked Problems. Obstacles to Problem Solving. Empathy in Design Thinking. The role of empathy in the design thinking process and the tools we can use. Empathizes with Your Users. How do we learn what people want? How to employ ethnographic and analysis methods, such as interviews, focus groups, and surveys.

Module 3: Defining Problem Statement. Cause and Effect of a Problem

Module 4: What is creative thinking, critical thinking and other types of thinking

Design Thinking as a Problem-Solving tool Learn to solve problems like a designer.

Module 5: Fuzzy Front end of Innovation and Ideation

What is Ideation and Essential Ideation Techniques. Managing Fuzzy Front end of Innovation. Impact and purpose of this ideas Present the ideas in this course together with the team and show how Startups or Intrapreneurs can create impact from ideas. Measuring impact and the value created through creativity.

Module 6: Idea to Concept to PoC

Module 7: Get Started with Prototyping. Start with Low-Fi Prototype and move on to develop a MVP

Why prototyping is so important in Design Thinking. How to prototype early and fast, as well as test your prototypes so as to reduce risks and accelerate organizational learning.What is lean Startup Methodology and how to develop MVP.

Module 8: Embracing Failure

Experiment to Innovate. Inculcate a culture that embraces failure. Teach students how to "Fail fast, fail cheap, fail often and Learn Fast.

Module 9: Group Presentation

REFERENCES

Roger L Martin, "The Design of Business", Harvard Business Review Press; Third Edition, 2009
Tim Brown, "Change by Design", Harper Business, 2013

15ME24L CDIO APPROACH IN PRODUCT DESIGN AND PROJECT MANAGEMENT **L T P C 1 0 0 1**

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: design the products in systematic approach using CDIO principle (K3).

CO2: apply project management tools in product design (K3).

Conceive – Data collection and analysis – Context study- **Design** – Concept Synthesis – Validation of concept – Detail Design – Virtual Prototyping and CAE– **Implement** – Physical Prototyping – Validating the Design – Field Testing - Design Modifications – **Operate** – Endurance test – Tool Development - Process Planning -Costing –Preparation of Operation and Maintenance manual – **Project Management** - Project Planning - House of Quality – Work break down structure - Gantt Chart – Resource Histogram – FAST diagram – Kanban chart.

L: 15; TOTAL: 15 PERIODS

REFERENCES

1. Linda C Schmidt, George E Dieter, “Engineering design”, McGraw-Hill Education, 2015.
2. David H Myszka, “Machines and Mechanisms, Applied Kinematic Analysis”, Pearson, 2012.
3. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development”, Tata McGraw-Hill Education, 4th Edition, 2009.
4. Kevin Otto, Kristin Wood, “Product Design”, Pearson Education, Indian Reprint, 2004.
5. Industrial Designers Society of America, “Design Secrets; Products”, Rockport Publishers, Year: 2001

15ME25L DIGITAL MANUFACTURING **L T P C 1 0 0 1**

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Explain the importance and architecture of digital manufacturing (K2).

CO2: Discuss about various digital fabrication techniques (K2).

Introduction - Overview of manufacturing process - Conventional manufacturing techniques - advantages – Limitations, Overview of Industry 4.0 - Digital Manufacturing (DM) techniques – Introduction - need, benefits- concept of DM - design centered, manufacturing centered and control centered DM - components and Architecture-elevation of product design, manufacturing and marketing- Product life cycle.

Link between Digital Manufacturing and Digital fabrication- benefits of CAD Types of digital fabrication techniques- CNC machining, 3D printing, Fused deposition modeling, Laser cutting, Stereo-lithography, Selective laser sintering, Powder printer. Applications of DM in Engineering and Medical field - challenges - case studies.

L: 15; TOTAL: 15 PERIODS

REFERENCES

1. Zude Zhou, Shane (Shengquan) Xie, Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer-Verlag London Limited, 2012.
2. Ian Gibson, David Rosen, Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Springer-Verlag New York, 2015.
3. https://en.wikipedia.org/wiki/Digital_modeling_and_fabrication
4. https://en.wikipedia.org/wiki/3D_printing
5. https://www.journals.elsevier.com/additive-manufacturing
6. Progress in Additive Manufacturing- https://www.springer.com/journal/40964

15ME26L CODES AND STANDARDS L T P C
1 0 0 1

COURSE OUTCOMES

Upon completion of the course, the students will be able to

CO1: Understand how to use codes and standards in drawings and for designing components (K2).

CO2: Understand how code is used in manufacturing and inspection (K2).

Introduction to Codes and Standards

Material Specifications as per IS and ASTM – Welding electrodes as per AWS – welding quality management system as per ISO 3834.

Codes in Engineering Design

Application of standards in Engineering drawing – Design of machine elements - Shafts- Springs- Structural members, Limits fits and tolerance.

Codes in Manufacturing

Manufacturing and inspection Structural components as per AWSD1.1 - Manufacturing and inspection of pressure parts – Welding procedure qualification – welder qualification – welding defects.

L: 15; TOTAL: 15 PERIODS

REFERENCES

1. Indian standards for Springs, Shaft, Engineering Drawings and Structural Members
2. IS 2062, ASME SEC VIII, ISO 3834, ISO 5817, ASME SEC IX

B.E. – MECHANICAL ENGINEERING

OPEN ELECTIVE COURSES

Open Elective Course (OEC)
Group - I (Inter-disciplinary courses)

15ID01E	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: analyze various global trends and identify the scope of a new product (K4)
CO2: perform requirement analysis and convert the requirements into design specification (K4)
CO3: translate conceptual idea into detailed design (K6)
CO4: create prototype to demonstrate the product (K6)
CO5: perform sustenance engineering to improve the longevity of the product (K6)

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision: Types of various trends affecting product decision - Social Trends-Technical Trends- Economical Trends- Environmental Trends- Political/ Policy Trends- PESTLE Analysis.

Introduction to Product Development Methodologies and Management: Overview of Products and Services- Types of Product Development- Overview of Product Development methodologies - Product Life Cycle and PLM - Product Development Planning and Management .

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering: Types of Requirements- Requirement Engineering- Analysis -Traceability Matrix and Analysis- Requirement Management

System Design and Modeling: Introduction to System Modeling- Introduction to System Optimization- System Specification-Sub-System Design- Interface Design.

UNIT III DESIGN AND TESTING 9

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques - Concept Screening and Evaluation - Concept Design - S/W Architecture - Hardware Schematics and simulation

Detailed Design: Component Design and Verification - High Level Design/Low Level Design of S/W Programs - S/W Testing-Hardware Schematic - Component design - Layout and Hardware Testing.

UNIT IV IMPLEMENTATION AND INTEGRATION 9

Prototyping: Types of Prototypes -Introduction to Rapid Prototyping and Rapid Manufacturing.

System Integration- Testing- Certification and Documentation: Introduction to Manufacturing/Purchase and Assembly of Systems- Integration of Mechanical, Embedded and S/W systems- Introduction to Product verification and validation processes - Product Testing standards, Certification and Documentation.

UNIT V SUSTENANCE ENGINEERING AND BUSINESS DYNAMICS 9

Sustenance - Maintenance and Repair – Enhancements Product End of Life (EoL): Obsolescence Management-Configuration Management - EoL Disposal.

The Industry - Engineering Services Industry overview - Product development in Industry versus Academia

The IPD Essentials - Introduction to vertical specific product development processes - Product development Trade-offs - Intellectual Property Rights and Confidentiality- Security and configuration management

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development “, Tata McGraw-Hill Education, 4th Edition, 2009, ISBN-10-007-14679-9.
2. George E Dieter, Linda C Schmidt, “Engineering Design”, McGraw-Hill International Edition,4th Edition, 2009, ISBN 978-007-127189-9

REFERENCES

1. Kevin Otto, Kristin Wood, “Product Design”, Indian Reprint 2004, Pearson Education, ISBN 9788177588217
2. Yousef Haik, Shahin T M M, “Engineering Design Process”, Cengage Learning,2nd Edition Reprint, 2010, ISBN 0495668141
3. Clive L Dym, Patrick Little, “Engineering Design: A Project-based Introduction”, John Wiley & Sons, 3rd Edition, 2009, ISBN 978-0-470-22596-7
4. Kevin Otto & Kristin Wood, “Product Design Techniques in Reverse Engineering and New Product Development”, Pearson Education (LPE), 2001.
5. James R Evens, William M Lindsay “The Management and control of Quality” Pub:son south-western(www.swlearning.com), 6th edition.
6. AmitavaMitra, “Fundamentals of Quality control and improvement” Pearson Education Asia, 2nd edition, 2002.
7. Montgomery D C, “Design and Analysis of experiments”, John Wiley and Sons, 2003.
8. Phillip J Rose, “Taguchi techniques for quality engineering”, McGraw Hill, 1996.
9. Reddy G B, “Intellectual Property Rights and the Law”, Gogia Law Agency, 7th Edition Reprint, 2009.
10. Subbaram N R, “Demystifying Intellectual Property Rights”, Lexisexis Butterworths Wadhwa, 1st Edition, 2009.

15ID02E DISASTER MANAGEMENT L T P C

3 0 0 3

COURSE OUTCOMES

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

CO1: classify the various types of disaster. (K2)
CO2: interpret various natural and manmade disasters. (K2)
CO3: choose a Hazard Assessment procedure. (K3)
CO4: construct the protection measures against Disaster. (K3)
CO5: apply Science and Technology in Disaster Management. (K3)

UNIT I INTRODUCTION TO DISASTER 8

Hazard, risk, vulnerability, disaster significance, nature, importance, dimensions and scope of disaster management - national disaster management frame work- financial arrangements- disaster- management cycle**.**

UNIT II SOURCES OF DISASTER 10

Natural disasters- significance, nature, types and effects - floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves, climatic change - global warming - sea level rise - ozone depletion. Manmade disasters- nuclear , chemical, biological, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents and sea accidents.

UNIT III DISASTER MITIGATION AND HAZARDS ASSESMENT 10

Factors affecting damage – types, social status, habitation pattern, physiology and climate - Factors affecting mitigation measures - prediction – preparation - communication - area and accessibility - population - physiology and climate - Vulnerability Assessment and seismic strengthening of buildings - Vulnerability Assessment of Buildings procedure - Hazard Assessment-Visual Inspection and Study of Available Documents

UNIT IV DISASTER MANAGEMENT 9

Disaster management - efforts to mitigate natural disasters at national and global levels - international strategy for disaster reduction- Rescue ,relief And Rehabilitation, Role Of National And International Agencies In Disaster Management-National Disaster Policy Of India (Salient Features).

UNIT V APPLICATIONS OF SCIENCE AND TECHNOLOGY AND CASE STUDIES 8

Applications of Science and Technology (RS, GIS, GPS) - Early Warning And Prediction Systems- Earthquake, cyclone, landslides, fire accidents, accidents- case studies

L: 45; TOTAL: 45 PERIODS

TEXTBOOKS

1. S.K.Singh, S.C. Kundu, Shobha Singh A ,"Disaster management", William Publications, New Delhi, 1997.
2. Vinod K Sharma, "Disaster Management", IIPA, New Delhi, 1995

REFERENCE

1. Annual Report, 2009-10,Ministry of Home Affairs, GOI

15ID03E	**ENERGY ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OUTCOMES

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

CO1: explain the operation of Solar Thermal application and Solar Photovoltaic. (K2)
CO2: explain the operation of wind energy systems. (K2)
CO3: describe the concepts of various Bio-Energy Conversion techniques. (K2)
CO4: illustrate the concepts of other conventional and nonconventional power plants. (K2)
CO5: explain the concepts of hydrogen and fuel cell technology. (K2)

UNIT I INTRODUCTION TO SOLAR ENERGY 9

Sun - Earth Geometry, solar radiation, Solar Collectors - Application of solar thermal systems. Direct Electricity Conversion - Types of Solar cell - Solar Photovoltaic system and types.

UNIT II WIND ENERGY 9

Wind energy potential, Principle of wind energy conversion; Basic components, types and their constructional features; design considerations: wind data and site selection.

UNIT III BIO-ENERGY 9

Biomass: sources, characterization, principles of energy transfer technologies. Biogas: Feedstock, types of Biogas plant- parameters affecting biogas production.

UNIT IV OTHER POWER PLANTS 9

Layout of Hydel - thermal - Nuclear - Gas turbine - Diesel - MHD- Geo thermal - OTEC - Tidal Power Plants.

UNIT V HYDROGEN AND FUEL CELLS 9

Energy carrier: Types - Hydrogen: generation, storage, transport and utilization - thermal energy storage: Principle and utilization - Fuel cells: Technologies, types and applications.

L:45; TOTAL:45 PERIODS

TEXT BOOKS

1. Soteris Kalogirou, “Solar Energy Engineering: Processes and Systems”, Academic Press, 2014.
2. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K, 3rd Edition, 2012.

REFERENCES

1. Mukund R Patel, “Wind and Solar Power Systems”, CRC Press, 2nd Edition, 2006.
2. Hart A B and Womack, G J, “Fuel Cells: Theory & Applications”,Prentice Hall, 1997.
3. EI-Wakil M M,“Power Plant Technology”, Tata McGraw-Hill, 2010.
4. Khandelwal K C and Mahdi S S, “Biogas Technology” - A Practical Handbook, Tata McGraw Hill, 1986.
5. Duffie J A and Beckman W A, “Solar Engineering of Thermal Processes”, Wiley, 4th Edition, 2013.
6. Chetan Singh Solanki, “Solar Photovoltaics Fundamentals, Technologies and Applications”, Prentice Hall of India, 3rd Edition, 2015.

Group - II (Trans disciplinary courses)

15TD01E	INDIAN BUSINESS LAWS	L T P C 0 0 0 3

COURSE OUTCOMES

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

CO 1: explain the elements of a valid contract.

CO 2: discuss main provisions relating to Sale of Goods Act and Negotiable Instruments Act.

CO 3: explain provisions relating to incorporation and functioning of company and partnership firm.

CO 4: understand the fundamentals of Consumer Protection Act and Foreign Exchange Management Act.

CO 5: understand the basic knowledge of Information Technology Act and RTI Act.

UNIT I THE INDIAN CONTRACT ACT, 1872

Definition of a Contract and its essentials - Formation of a valid Contract - Offer and Acceptance, Consideration - Capacity to Contract - Free consent - Legality of object - Discharge of a Contract by performance - Impossibility and Frustration - Breach, Damages for breach of a contract - Quasi contracts - Special Contracts - Contract of Indemnity and Guarantee - Contract of Bailment and Pledge - Contract of Agency.

UNIT II THE SALE OF GOODS ACT, 1930

Definition of a Contract of Sale - Conditions and Warranties - Passing of Property - Right of Unpaid Seller against the Goods - Remedies for Breach - The Negotiable Instrument Act, 1881

Definition and characteristics - Kinds of negotiable instruments - Promissory Note - Bill of Exchange and Cheques - Holder and Holder in due course - Negotiation, Presentment, Discharge from Liability - Noting and Protest – Presumption - Crossing of Cheques - Bouncing of Cheques.

UNIT III THE COMPANIES ACT, 1956

Nature and Definition of a Company - Registration and Incorporation - Memorandum of Association - Articles of Association – Prospectus - Kinds of Companies - Directors: Their powers and duties – Meetings - Winding up - The Indian Partnership Act, 1932 - Definition of Partnership and its essentials - Rights and Duties of Partners: Types of Partners - Minor as a partner - Doctrine of Implied Authority - Registration of Firms - Dissolution of firms - Limited Liability Partnership Act, 2000.

UNIT IV THE CONSUMER PROTECTION ACT, 1986

Aims and Objects of the Act - Redressal Machinery and Procedure for complaints under the Act – Remedies – Appeals - Enforcement of orders and Penalties - Foreign Exchange Management Act 2000 - Definition and Main Provisions.

UNIT V THE INFORMATION TECHNOLOGY ACT

Definition, Digital Signature - Electronic Governance – Attribution - Acknowledgment and Dispatch of Electronic Records - Sense Electronic Records and Sense Digital Signatures - Regulation of Certifying Authorities Digital Signature Certificates - Duties of Subscribers - Penalties and Offences - The Right to Information Act, 2005 - Right to know - Salient Features of the Act - Obligation of Public Authority - Designation of Public Information Officer - Request for obtaining information - Duties of a PIO - Exemption from Disclosure of Information - Partial Disclosure of Information - Information Commissions - Powers of Information Commissions - Appellate Authorities – Penalties - Jurisdiction of Courts.

TEXT BOOKS

1. Kuchhal M.C, "Business and Industrial Laws", 3rd Edition, JBA Publishers, New Delhi, 2013.
2. Gulshan S.S, "Merchantile Law", 3rd Edition, JBA Publishers, New Delhi, 2007.

REFERENCES

1. Mulla D.F, "The Sale of Goods Act and the Indian Partnership Act", 10th Edition, LexisNexis Ltd., India, 2012.
2. Dabas J, "Negotiable Instruments Act", 2nd Edition, JBA Publishers, New Delhi, 2013.
3. Avtar S, "The Principles of Mercantile Law", 9th Edition, Eastern Book Company, India, 2011.

15TD02E LEADERSHIP AND PERSONALITY DEVELOPMENT L T P C
0 0 0 3

COURSE OUTCOMES

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

CO 1: identify the various leadership skills.
CO 2: understand group dynamics and factors influencing the team performance.
CO 3: describe the personality dimensions based on personality theories.
CO 4: explain personality determinants and personality types.
CO 5: apply effective training program for personality development.

UNIT I INTRODUCTION

Leadership – Meaning, Concepts and Myths about Leadership, Components of Leadership- Leader, Followers and Situations - Leadership Skills – Basic Leadership Skills - Building Technical Competency - Advanced Leadership Skills - Team Building for Work Teams - Building High Performance Teams.

UNIT II TEAMS AND LEADERSHIP

Assessing Leadership & Measuring Its Effects - Group- Nature, Size, Roles, Norms, Cohesion, and Stages of Group Development - Teams and their Leadership – Effective Team Characteristics and Team Building - Ginnetts Team Effectiveness Leadership Model.

UNIT III PERSONALITY

Personality - Meaning, Concept, Personality Patterns, Symbols of Self, Moulding the Personality Pattern, Persistence & Change - Personality & Personal Effectiveness - Psychometric Theories – Cattele and Big Five - Psychodynamic Theories - Carl Jung and MBTI - Transactional Analysi - Johari – Window - Personal Effectiveness.

UNIT IV PERSONALITY DETERMINANTS

Personality Determinants – Heredity and Environment – Types of personality.

UNIT V PERSONALITY TRAINING

Concept, Role, Need, Importance and types of personality Training - Understanding Process of Learning - Developing an Integrated Approach of Learning in Training Programme - Training Needs Assessment.

TEXT BOOKS

1. Yukl G, “Leadership in Organisations”, 8th Edition, Pearson Education Ltd., England, 2013.
2. Lall M, Sharma S, “Personal Growth Training & Development”, Kindle Edition, USA, 2009.

REFERENCES

1. Janakiraman B, “Training and Development”, Wiley Dream tech, Biztantra, 2005.
2. Pareek U, “Understanding Organizational Behaviour”, 2nd Edition, Oxford University Press, USA, 2007.

15TD03E INTERNATIONAL BUSINESS MANAGEMENT L T P C

0 0 0 3

COURSE OUTCOMES

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

CO 1: understand the global business environment.

CO 2: explain the impact of economic, legal, cultural, geographical and political factors on international business.

CO 3: discuss the issues and problems of Multinational Enterprises.

CO 4: discuss the role of various international financial institutions.

CO 5: discuss about important aspects of WTO and GATT agreement.

UNIT I INTERNATIONAL BUSINESS ENVIRONMENT

International Business Environment - Globalization - Forces, Meaning, Dimensions and Stages in Globalization - Trading Environment of International Trade - Tariff and Non-tariff Barriers - Trade Blocks.

UNIT II RISK ANALYSIS AND PRACTICES

Country Risk Analysis - Political, Social and Economic - Cultural and Ethical

practices - Responsibilities of International Business - Economic crisis in foreign countries.

UNIT III MULTINATIONAL ENTERPRISES

Managing Multinational Enterprises - Problems and Potential - Multinational Service Organizations - Indian companies becoming multinationals - Potential, Need and Problems.

UNIT IV INTERNATIONAL FINANCIAL MANAGEMENT

Introduction to International Financial Management - Balance of Trade and Balance of Payment - International Monetary Fund, Asian Development Bank and World Bank - Financial Markets and Instruments - Introduction to Export and Import Finance - Methods of Payment in International Trade.

UNIT V INTERNATAIONAL AGREEMENT

General Agreement on Trade and Tariffs, (GATT) - World Trade Organization - Seattle and Doha Round of Talks - Dispute Settlement Mechanism under WTO - Problems of Patent Laws - International Convention on Competitiveness - Global Sourcing and its Impact on Indian Industry - Globalization and Internal Reform Process.

TEXT BOOKS

1. Bhalla V.K, Shivaramu S, “International Business Environment”, 9th Edition, Anmol Publications Pvt. Ltd., Delhi, 2005.
2. Apte P.G, “International Financial Management”, 5th Edition, Tata McGraw Hill, India, 2008.
3. Cherulinam F, “International Business”, 5th Edition, Prentice Hall of India, New Delhi, 2010.

REFERENCES

1. Rao, Rangachari, “International Business”, Himalaya Publishing House, New Delhi, 2010.
2. Hill C, “International Business”, 10th Edition, Tata McGraw Hill Education, New Delhi, 2014.
3. Daniels J.D, “International Business Environment”, 15th Edition, Prentice Hall of India, New Delhi, 2014.

15TD04E BASICS OF MARKETING L T P C
0 0 0 3

COURSE OUTCOMES

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

CO 1: describe the basic concepts of marketing.
CO 2: discuss the significance of consumer behavior and market segmentation.
CO 3: discuss brand, trade mark, after- sales service and product life cycle concepts.
CO 4: formulate strategies for pricing and channels of distribution.
CO 5: analyze and selection of best promotional technique.

UNIT I INTRODUCTION

Nature and Scope of Marketing - Importance of Marketing – Concepts: Traditional and Modern - Selling Vs. Marketing - Marketing Mix - Marketing Environment.

UNIT II CONSUMER BEHAVIOR AND MARKET SEGMENTATION

Nature, Scope and Significance of Consumer Behavior - Market Segmentation - Concept and Importance - Bases for Market Segmentation.

UNIT III PRODUCT PLANNING

Concept of Product - Consumer and Industrial Goods - Product Planning and Development - Packaging - Role and Functions - Brand Name and Trade Mark - After-Sales Service - Product Life Cycle Concept.

UNIT IV PRICING AND PHYSICAL DISTRIBUTION

Price - Importance of Price in the Marketing Mix - Factors Affecting Price of a Product/Service - Discounts and Rebates - Distribution Channels - Concept and Role - Types of Distribution Channels - Factors Affecting Choice of a Distribution Channel - Retailer and Wholesaler - Distributions Channels and Physical Distribution.

UNIT V PROMOTION

Definition - Methods of Promotion - Optimum Promotion Mix - Advertising Media - Their Relative Merits and Limitations - Characteristics of an Effective Advertisement - Personal Selling - Selling as a Career - Classification of a Successful Sales Person - Functions of Salesman.

TEXT BOOKS

1. Etzel M.J, Walker B.J, Stanton W.J, “Fundamentals of Marketing”, 13th Edition, McGraw Hill, New York, 2004.
2. Tanner J, Raymond M, “Principles of Marketing”, University of Minnesota Libraries Publishing, New York, 2015.

REFERENCES

1. Rajan Nair N, Varma M.M, “Marketing Management”, 2nd Edition, S.Chand & Sons, New Delhi, 2005.
2. Ramaswamy V.S, Namakumari S, “Marketing Management", 3rd Edition, Macmillan India Limited, London, 2002.

15TD05E RETAILING AND DISTRIBUTION MANAGEMENT L T P C
0 0 0 3

COURSE OUTCOMES

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

CO 1: explain the concepts of retailing and distribution management.
CO 2: analyze and solve retailers' problems to make decisions in retail organizations.
CO 3: plan and formulate strategy for retail management process.
CO 4: discuss about various distribution technology and stores management.
CO 5: analyze the issues and challenges in Logistic Management

UNIT I INTRODUCTION

Meaning and Nature of Distribution and Retail Industry - Future of Retailing and Distribution in India - Distribution Channels – Concept, Role and Types - Factors Affecting Choice of Distribution Channel.

UNIT II TYPES OF RETAILING

Stores Classified by Owners - Stores Classified by Merchandising Categories - Wheel Of Retailing - Traditional Retail Formats Vs. Modern Retail Formats in India - Store and Non-Store Based Formats - Cash and Carry Business - Retailing Models – Franchiser Franchisee, Directly Owned - Wheel of Retailing and Retailing Life Cycle – Issues in Retailing.

UNIT III MANAGEMENT OF RETAILING OPERATIONS

Meaning - Functions of Retail Management - Strategic Retail Management Process - Retail Planning - Importance and Process - Developing Retailing Strategies.

UNIT IV TECHNOLOGY IN DISTRIBUTION

Bar-Coding – RFID – Electronic Payment Systems - Store Administration - Floor Space Management – Managing Store Inventories and Display Action Plans - Pricing Strategies and Location Strategies.

UNIT V LOGISTICS OF RETAIL MANAGEMENT

Components and Functions; Distribution Related Issues and Challenges - Gaining Competitive Advantage through Logistics Management.

TEXT BOOKS

1. Agrawal D. K., “Distribution & Logistics Management: A Strategic Marketing Approach”, Macmillan Publishers India Limited, New Delhi, 2007.
2. Berman B, Evans J.R, “Retail Management – A Strategic approach”, 12th Edition, Pearson Education Ltd., England, 2013.
3. Cox R, Brittan P, “Retailing an introduction, Financial Times Management”, 5th Edition, Pearson Education Limited, England, 2004.

REFERENCES

1. Rushton A, Croucher P, Baker P, “The Handbook of Logistics & Distribution

Management", Kogan Page Limited, London, 2006.
2. Coughlan A.T, Anderson E, Stern L.W, El-Ansary A.I, "Marketing Channels", 7th Edition, Prentice Hall, New Jersey, 2006.
3. Sinha P. K, Uniyal D.P, "Managing Retailing", Oxford University Press, India, 2007.

15TD06E INTERNATIONAL ECONOMICS L T P C
0 0 0 3

COURSE OUTCOMES

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

CO 1: discuss the impact of globalization.
CO 2: identify and analyze different theoretical models of international economics in light of 'real world' situations.
CO 3: examine the consequences of trade policies.
CO 4: explain the importance of international financial markets.
CO 5: discuss the important aspects of international banking.

UNIT I INTRODUCTION

Background of International Business Economics - Globalization and International Business – The Emergence of Global Institutions – Drivers of Globalizations - The Globalization Debate.

UNIT II THE INTERNATIONAL TRADE THEORY

The Law of Comparative Advantage – The Demand and Supply, Offer Curves - The Terms of Trade – Factor Endowments and the Heckscher – Ohlin Theory – Implications of Trade Theories - Economics of Scale - Imperfect Competition.

UNIT III INTERNATIONAL TRADE POLICY

Trade Restrictions - Tariffs, Non –Tariff Trade Barriers - Tariff Vs. Quota - The New Protectionism – Economic Integration - Custom Unions and Free Trade Areas - Major Regional Trade Agreements - Foreign Exchange Market – Types of Foreign Exchange Transactions – Reading Foreign Exchange Quotations – Forward and Futures Market – Foreign - Currency Options – Exchange Rate Determination – Arbitrage – Speculation and Exchange - Market Stability.

UNIT IV WORLD FINANCIAL ENVIRONMENT

Global Foreign Exchange Markets – Economic Theories of Exchange - Rate Determination - International Regime for FDI and MNC - Consequences of Economic Globalization.

UNIT V INTERNATIONAL BANKING

Reserves, Debt and Risk - Nature of International Reserves – Demand for International Reserves – Supply of International Reserves – Gold Exchange Standard – Special Drawing Rights – International Lending Risk – The Problem of International Debt – Financial Crisis and The International Monetary Fund – Eurocurrency Market.

TEXT BOOKS

1. Krugman P.R, Obstfeld M, "International Economics Theory and Policy", 8th Edition, Prentice Hall, Boston, 2008.
2. Carbaugh R.J, "International Economics", 15th Edition, South Western College publication, USA, 2014.

REFERENCES

1. Daniels J, Radebaugh L, Sullivan D, Salwan P, "International Business", 12th Edition, Pearson Education, New Delhi, 2010.
2. Suranovic S, "International Economics: Theory and Policy", Flat World Knowledge, USA, 2010.

15TD07E INDIAN ECONOMY L T P C
0 0 0 3

COURSE OUTCOMES

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

CO 1: discuss the current economic development in India
CO 2: describe the key indicators of estimation of national income
CO 3: explain elementary concepts of economic planning and development in India
CO 4: discuss the concept of public finance and preparation of budget
CO 5: discuss the influence of infrastructure growth on economic development

UNIT I ECONOMIC DEVELOPMENT

Meaning - Measurement of Economic Development - Characteristic of underdeveloped and developed economies - Causes for Indian economic underdevelopment - Major issues in development - Strategies for economic development Import substitution and Export oriented strategies - Determinants of economic development.

UNIT II NATIONAL INCOME

The National Income and its estimates in India - Limitations of National income estimation - Trends in National income of India: Growth and Structure - Inter-state variations in National income - Income distribution - Measurement of poverty in India.

UNIT III ECONOMIC PLANNING

Planning and economic development in India - Planning models in India (Elementary concepts) - Capital formation - Growth of Public and Private sector in India – Industrial policies an assessment - Capital formation and domestic saving.

UNIT IV INDIAN PUBLIC FINANCE

Budgetary policies of the central government - Composition and trends in public revenue

and expenditure - Expenditure control and government consumption expenditure - concepts of Budgetary deficits and implications - state budget.

UNIT V INFRASTRUCTURE AND ECONOMIC DEVELOPMENT

Power and energy - Transport system in India's economic development - Communication system in India - Urban infrastructure - Science and technology - Private investment in infrastructure - Outlook and prospects.

TEXT BOOKS

1. Dutt R, Sundaram K.P.M, "Indian Economy", S.Chand and Co., New Delhi, 2006.
2. Agarwal A.N, Agarwal M.K, "Indian Economy: Problems of Development and Planning", 41st Edition, New Age International Ltd., New Delhi, 2016.

REFERENCES

1. Arvind P, "India:The Emerging Giant", Oxford University Press, USA, 2008.
2. Government of India, Economic Survey, (2010 -11 to 2014 -15).

15TD08E RURAL ECONOMICS L T P C
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COURSE OUTCOMES

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

CO 1: discuss the role and importance of agriculture in economic development of India.

CO 2: describe the impact of agricultural forming in rural employment, wage policy, technological change and green revolution.

CO 3: analyze the relationship between rural and urban society.

CO 4: recognize the formation and system of rural social institutions.

CO 5: compare the social changes in the rural society after modernization and globalization.

UNIT I INTRODUCTION

Nature and Scope of Rural Economy - Importance of Agriculture in Economic Development of India - Nature of Land Problems - Evolution of Policy – Land Tenure System - Land Reform Measures.

UNIT II AGRICULTURE AND FARMING

Agricultural Holdings - Fragmentation and Sub-Division of Holdings, Cooperative Farming- Rural Labour Problems - Nature of Rural Unemployment - Employment and Wage Policy - Sources of Technological Change and Green Revolution.

UNIT III RURAL SOCIETY

Rural Society Structure and Change - Village and its Social Organization - Indian Village and its Types - Rural-Urban Continuum and Rural-Urban Relationships.

UNIT IV RURAL SOCIAL INSTITUTIONS

Rural Social Institutions - Family, Property, Caste, Class, Agrarian Structure - Indebtedness and Poverty - Jajmani System - Religion, Village, Panchayat Raj and Community Development Programmes – Problems.

UNIT V SOCIAL CHANGES

Social Change in Rural India-Impact of Westernization - Secularization, Urbanisation, Industrialisation, Migration, Transportation, Modernization of Indian Rural Society - Post Modernization and Globalization and Indian Villages.

TEXT BOOKS

1. Carver T.N, “The Principles of Rural Economics”, Ginn and company, USA, 1911.
2. Desai A.R, “Rural Sociology in India”, 5th Edition, Popular Prakashan Ltd., Mumbai, 2011.

REFERENCES

1. Dube S.C., “India’s changing villages”, Psychology Press, UK, 2003.
2. Datt R, Sundharam K.P.M, Datt G, Mahajan A, “Indian Economy”, 72nd Edition, S.Chand & Co., New Delhi, 2016.
3. Chaudhari, C.M., “Rural Economics”, Sublime Publication, Jaipur, 2009.

15TD09E INTERNATIONAL TRADE L T P C
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COURSE OUTCOMES

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

CO 1: discuss the importance of international trade in developing countries.
CO 2: describe the impact of Trade agreements in international Business environment.
CO 3: explain the role of foreign exchange and their impact on trade and investment flows.
CO 4: discuss the benefits of Multinational Corporation in Internal Trade
CO 5: analyze the key role of globalisation in Indian economy.

UNIT I INTRODUCTION

International Marketing - Trends in International Trade - Reasons - Global Sourcing and Production Sharing - International Orientations - Internationalization Stages and Orientations - Growing Economic Power of Developing Countries – International Business Decision.

UNIT II INTERNATIONAL BUSINESS ENVIRONMENT

Trading Environment - Commodity Agreements – State Trading - Trading Blocks and Growing Intra-Regional Trade - Regional Groupings – SAARC, BRICS, ECM, ASEAN - Trade Liberalization - The Uruguay Round-Evaluation – UNCTAD – GATT – WTO.

UNIT III INTERNATIONAL FINANCIAL ENVIRONMENT

International Money and Capital Markets - Foreign Investment Flows – Pattern, Structure and Effects - Movements in Foreign Exchange and Interest Rates and their Impact on Trade and Investment Flows - Exchange Rate Mechanism and Arrangement.

UNIT IV MULTINATIONAL CORPORATIONS

Definition - Organizational Structures - Dominance of MNC's - Recent Trends - Code of Conduct - Multinationals in India - Issue in Investment, Technology Transfer, Pricing and Regulations - International Collaborations and Strategic Alliances.

UNIT V INDIA IN THE GLOBAL SETTING

India an Emerging Market - India in the Global Trade - Liberalization and Integration with Global Economy - Factors Favouring and Resisting Globalization - Trade Policy and Regulation in India - Trade Strategies - Export-Import Policy - Regulation and Promotion of Foreign Trade in India.

TEXT BOOKS

1. Daniels J.D, Radebaugh L.H, Sullivan D.P, "International Business: Environment and Operations", 12th Edition, Prentice Hall, USA, 2009.
2. Ricky W.G, Michael W.P, "International Business: A Managerial Perspective", Prentice Hall, USA, 2009.

REFERENCES

1. Bhattacharya B, Varshney R.L, "International Marketing Management", 25th Revised Edition, S. Chand & Sons, New Delhi, 2015.
2. Verma M.L, "International Trade", Common wealth Publisher, New Delhi, 2010.

15TD10E GLOBAL CHALLENGES AND ISSUES L T P C
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COURSE OUTCOMES

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

CO 1: understand the various global issues.
CO 2: demonstrate a reasonable understanding of environmental debates and issues.
CO 3: explain the developmental issues relating to food, health and energy.
CO 4: demonstrate the economical issues in international trade.
CO 5: describe the civilization issues relating to human rights and social justice.

UNIT I SECURITY ISSUES

Nuclear Issues - Global and South Asian Context - Small Weapons Proliferation and Internal Arms Race - Chemical and Biological Weapons – Terrorism - Causes, Consequences And Trends - Cyber Terrorism – Counter Terrorism.

UNIT II ENVIRONMENTAL ISSUES

Global Warming and Climate Change - Threats to Bio-Sphere and Space - Pollutions, De-Forestation, Solid, Chemical and Nuclear Wastes and their Management - Preserving the Green Cover and Wild Life.

UNIT III DEVELOPMENTAL ISSUES

Food Security - Poverty and Hunger - Energy Security - Supply and Demand - Traditional and Alternative Sources of Energy – ITER - Health Security – Health for all - Development Vs. Environment - Sustainable Development.

UNIT IV ECONOMIC ISSUES ON INTERNATIONAL TRADE

International Trade - GATT, WTO - Regional Associations - ECM, ASEAN, OPEC, BRICS - Financial Crisis - ASEAN, Mexico and Greece - Global Issues in Trade and Commerce.

UNIT V CIVILIZATION ISSUES

Human Rights - Issues Relating to Freedom of Speech and Expression - Right to Self Determination - Preservation of Cultures and Cultural Diversities - Rights of Women and Children - Dividends of Globalization and Social Justice – Good Governance.

TEXT BOOKS

1. Payne R, “Global Issues”, 4th Edition, Pearson Education Ltd., New York, 2013.
2. Owens P, Baylis J, Smith S, “The Globalization of World Politics”, 3rd Edition, Oxford University Press, USA, 2013.

REFERENCE

1. Chirco J.A, “Globalization: Prospects and Problems”, Sage Publications, New Delhi, 2013.

15TD11E INDIAN CULTURE AND HERITAGE L T P C
0 0 0 3

COURSE OUTCOMES

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

CO1: describe Indian culture, civilization and its features.
CO2: demonstrate stone age, Indian races and their contribution in pre-historic culture.
CO3: explain historical development of Indian culture.
CO4: explain the significance, conditions and development of Vedic culture.
CO5: analyze the advent of Islam and European culture.

UNIT I INTRODUCTION

Introduction to Culture - Meaning and Scope - Culture and Civilization - General Characteristics Features of Indian Culture - Geographical Impact on Indian Culture.

UNIT II PRE-HISTORIC CULTURE

Dravidian Culture - Old Stone Age - New Stone Age - Metal Age - Indian Races and their Contribution to Indian Culture.

UNIT III HISTORICAL DEVELOPMENT OF INDIAN CULTURE

Indus Valley Culture - City Planning - Social and Religious Conditions - Vedic and Later Vedic Cultures - Dharmasastras and Caste Systems - Comparison of Indus and Vedic Culture - Importance of Indus Valley and Vedic Cultures.

UNIT IV CULTURE IN SANGAM AGE AND POST SANGAM AGE

Sangam Literature - Society - Political and Economical Conditions - Trade - Religion and Fine Arts.

UNIT V ADVENT OF ISLAM AND EUROPEAN CULTURE

Impact on Indian Culture and Heritage – Reform Movements - Brahma Samaj, Ariya Samaj, Self Respect Movement – Post Colonial Development.

TEXT BOOKS

1. Luniya B.N, “Evolution of Indian Culture”, Lakshmi Narain Agarwal Publishers, Agra, 1986.
2. Jeyapalan N, “History of Indian culture”, Atlantic publishers, New Delhi, 2001.
3. Sharma H.C, “Indian Culture and Heritage”, Neha Publishers & Distributors, New Delhi, 2012.

REFERENCES

1. John G.A, “Dictionary of Indian Philosophy (Sanskrit-English)”, University of Madras, Madras, 1998.
2. Misra R.S, “Studies in philosophy and Religion”, Bharathiya Vidya Prakasans, Varanasi, 1991.
3. Misra S.K, “Culture and Rationality”, Sage publications India Pvt. Ltd., New Delhi, 1988.
4. Suda J.P, “Religious in India”, Sterling Publishers Pvt. Ltd., New Delhi, 1978.

15TD12E INDIAN HISTORY L T P C

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COURSE OUTCOMES

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

CO1: illustrate the basics of Indian cultural heritage.

CO2: describe interaction between Ancient Indian cultural heritage and Islamic culture.

CO3: demonstrate Innovation by rulers of medieval period in the area of

Administration, and their contact with the Europeans.

CO4: analyse modern Indian movements, Economic history and Impact of the British rule on India.

CO5: demonstrate the concepts of Indian National Movement and the history of freedom struggle in India.

UNIT I ANCIENTY INDIAN CULTURE

Ancient Indian Cultural Heritage - Social, Political, Legal and in the Area of Religion and Philosophy.

UNIT II LAW RELATING TO CULTURE

Law Givers and Dispute Resolution Systems in Ancient India (Administration of Justice in Ancient India - Pre-Islamic Period) - Law Relating to Culture - The Advent of Islam - Interaction between Ancient Indian Cultural Heritage and Islamic Culture - The Emergence of Synthetic Indian Culture.

UNIT III ADMINISTRATION IN ANCIENT INDIA

Innovation by Rulers of Medieval Period in the Area of General and Revenue Administration - District Administration - Court Systems - Indian Contact with the Europeans.

UNIT IV SOCIO-ECONOMIC HISTORY

Socio-Religious Reform Movements in Modern India and its Legal Culture - Economic History of India During British Period - Impact of the British Rule on India – Education.

UNIT V EUROPEAN CULTURE IMPACT

Impact of European Culture and Liberal Thought on India – The Indian National Movement - The History of Freedom Struggle in India upto 1947.

TEXT BOOKS

1. Sreenivasa M.H.V, “History of India Part I and II”, JBA Publishers, New Delhi, 2015.
2. Agarwal R.C, Bhatnagar M, “Constitutional Development and National Movement of India”, S. Chand Publishers, New Delhi, 2005.

REFERENCES

1. Altekar S, “State and Government in Ancient India”, Motilal Banarsidass Publishers, New Delhi, 2002.
2. Majumdur R.C, “History and Culture of the Indian People”, Vol. 2, The Age of Imperial Unity, Bharatiya Vidya Bhavan, New Delhi, 2001

15TD13E SUSTAINABLE DEVELOPMENT AND PRACTICES L T P C
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COURSE OUTCOMES

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

CO 1: recognize the sustainable development and the way to achieve the sustainable development.

CO 2: outline the concept, factors governing the sustainability and their linkages.

CO 3: explain the environmental impact assessment and environmental audit.

CO 4: describe the environmental planning and managing the resources.

CO 5: acquire the knowledge about the environmental problems and their solutions.

UNIT I SUSTAINABLE DEVELOPMENT

Need for Sustainability - Nine Ways to Achieve Sustainability - Economics as the Dismal Science - Population, Resources and Environment.

UNIT II CHALLENGES OF SUSTAINABLE DEVELOPMENT

Concept of Sustainability - Factors Governing Sustainable Development - Linkages among Sustainable Development, Determinants of Sustainable Development - Case Studies on Sustainable Development.

UNIT III ENVIRONMENT IMPACT ASSESSMENT AND AUDIT

Concepts-process-evaluation methodology-EIA and EMS integration-setting up of audit programme - typical audit process - carrying out the audit-benefits of environmental auditing-environmental audit programmes in India.

UNIT IV ENVIRONMENTAL PLANNING

Introduction - Perspective of Environmental Planning - land resource development planning - Planning and managing the natural resources - landscape ecological planning - information and decision of environmental planning - Land use policy in India.

UNIT V ENVIRONMENTAL EDUCATION

Knowledge about the environment - Knowledge about the environment and population growth -Knowledge about the solution and environmental problems - Environmental education (EE) – Strategies for EE – Models for future Environmental Education Systems.

TEXT BOOKS

1. Rogers P, Jalal K.F, Boyd J.A, “An Introduction to Sustainable Development”, Earth scan Publications Ltd., UK, 2006.
2. Santra S.C,” Environmental Science”, 3rd Edition, New Central Book Agency (P) Ltd., London, 2013.

REFERENCES

1. Stavins R.N. “Economics of the Environment: Selected Readings”, 5th Edition, W.W. Norton and Company, New York, 2005.
2. Sachs J.D, “The Age of Sustainable Development”, Columbia University Press, New York, 2015.

15TD14E	WOMEN IN INDIAN SOCIETY	L T P C
		0 0 0 3

COURSE OUTCOMES

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

CO1: Demonstrate historical perspective about women in Indian society.
CO2: Explain social problems of women.
CO3: Understand the legislation for women protection in India.
CO4: Demonstrate the involvement of women literacy, career and politics.
CO5: Analyse the role of NGO's in women empowerment.

UNIT I INTRODUCTION

A Historical Perspective - Early Vedic, Colonial and Modern Periods - Position of Women in Contemporary India.

UNIT II SOCIAL ISSUES

Issues of Girl Child - Female Infanticide and Foeticide, Sex Ratio, Child Marriage, Dowry and Property Rights - Women's Health and Birth Control - Reproduction - Violence against Women - Domestic Violence - Female Headed Households - Women in the Unorganized Sector of Employment - Women's Work- Status and Problems - Problems of Dalit Women.

UNIT III PROTECTIVE LEGISLATION FOR WOMEN

Protective Legislation for Women in the Indian Constitution - Anti Dowry, SITA, PNDT, And Prevention Sexual Harassment At Workplace (Visaka Case) - Domestic Violence (Prevention) Act.

UNIT IV WOMEN AND EDUCATION

Formal and Non-Formal Literacy - Post Literacy - Vocational Training - Dual Career Modernization – Women and Politics - Political Status - Global Movements and Indian Movements.

UNIT V ROLE OF NGO'S IN WOMEN EMPOWERMENT

Gender Economy - All India Women's Conference (AIWC) – Women's India Association (WIA) - National Council of Women in India (NCWIE) - Indian Association of Women's Studies – Women Development Cells - Self Help Groups.

TEXT BOOKS

1. Majumdar M, "Social Status of Women in India", Wisdom Press, New Delhi, 2012.
2. Harish R, Harishankar V.B, "Re-Defining Feminisms", Rawat Publications, Jaipur, 2011.

REFERENCES

1. Rathod P.B, "An Introduction to Women's Studies", ABD Publishers, Jaipur, 2010.
2. Ray R, "Hand Book of Gender", Oxford University Press, New Delhi, 2012.

15TD15E INDIAN CONSTITUTION L T P C
0 0 0 3

COURSE OUTCOMES

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

CO1: describe the basic understanding of the Indian Constitution.
CO2: understand the structure and functions of parliament.
CO3: demonstrate the organization and working of the Judiciary.
CO4: understand the structure and functions of state legislature.
CO5: understand the 73rd and 74th Constitutional Amendments.

UNIT I INDIAN CONSTITUTION

Salient Features - Preamble - Fundamental Rights – Directive Principles of State Policy - Fundamental Duties.

UNIT II PARLIAMENTARY SYSTEM

Powers and Functions of President and Prime Minister - Council of Ministers - The Legislature Structure and Functions of Lok Sabha and Rajya Sabha – Speaker.

UNIT III THE JUDICIARY

Organisation and Composition of Judiciary - Powers and Functions of the Supreme Court - Judicial Review – High Courts.

UNIT IV STATE GOVERNMENTS

Powers and Functions of Governor and Chief Minister – Council of Ministers - State Legislature.

UNIT V LOCAL GOVERNMENTS

73rd and 74th Constitutional Amendments – Federalism - Center – State Relations.

TEXT BOOKS

1. Basu D.D," Introduction to Indian Constitution", Prentice Hall of India, New Delhi, 2015.
2. Gupta D.C, "Indian Government and Politics", Vikas Publishing House, New Delhi, 2010.

REFERENCES

1. Pylee M.V, "Introduction to the Constitution of India", Vikas Publishing House, NewDelhi, 2011.
2. Kashyap S, "Our Constitution", National Book Trust, New Delhi, 2010.

15TD16E BIO MECHANICS IN SPORTS L T P C
0 0 0 3

COURSE OUTCOMES

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

CO1**:** discuss the basics of biomechanics in sports & movement technique accurately.
CO2**:** discuss the basics of linear kinematics and its applications in the field of sports.
CO3: demonstrate the linear kinematics in the field of sports.
CO4**:** discuss the basics of angular kinematics and its applications in the field of sports.
CO5: demonstrate the angular kinematics in the field of sports.

UNIT I INTRODUCTION

Meaning, Aim and Objectives, Importance of Biomechanics in Sports - Types of Motion Linear, Angular, Curvilinear and Circular Motion.

UNIT II LINEAR KINEMATICS

Speed, Velocity, Acceleration, Motion, Projectile Motion – Application of Linear Kinematics in The Field of Physical Education and Sports.

UNIT III ANGULAR KINEMATICS

Angular Speed - Angular Velocity - Angular Acceleration - Relationship between Linear and Angular Motion – Application of Angular Kinematics in the Field of Physical Education and Sports.

UNIT IV LINEAR KINETICS

Mass, Weight, Force, Pressure, Work, Power, Energy, Impulse, Momentum, Impact, Friction, Newton's Law of Motion - Law of Inertia and Types of Inertia.

UNIT V ANGULAR KINETICS

Levers, Equilibrium and Centre of Gravity – Friction and its Types, Centrifugal and Centripetal Force Bio Mechanical Principles Involved in Designing Sports Equipments.

TEXT BOOKS

1. Singh S.K, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2009.
2. McGinnis P.M, "Biomechanics of Sports and Exercise", 2nd Edition, Human Kinetics Publishers, USA, 2004.

REFERENCES

1. Saxena A, "Biomechanics in Sports", Neha Publishers & Distributors, New Delhi, 2011.
2. Heyward V.H, Gibson A.L, "Advanced Fitness Assessment and Exercise Prescription", 7th Edition, Human Kinetics, USA, 2014.