NATIONAL ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

K.R.NAGAR, KOVILPATTI – 628 503

www.nec.edu.in

REGULATIONS – 2013

DEPARTMENT OF

MECHANICAL ENGINEERING

CURRICULUM AND SYLLABUS OF

B.E. – MECHANICAL ENGINEERING

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 (PEO)

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 (PO)

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

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization in Mechanical Engineering to the solution of complex engineering problems.
2. Identify, formulate, research literature, and analyze complex problems in Mechanical Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. 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.
4. 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.
5. 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.
6. 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.
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. 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.
11. 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.
12. 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.

REGULATIONS 2013

CURRICULUM AND SYLLABUS

B.E. MECHANICAL ENGINEERING

SEMESTER – I

Sl. No.	Course Code	Course Title	L	T	P	C
THEORY						
1.	SH100	Technical English – I	3	1	0	4
2.	SH101	Matrices and Differential Calculus	3	1	0	4
3.	SH102	Applied Physics	3	0	0	3
4.	SH103	Engineering Chemistry	3	0	0	3
5.	SH104	Fundamentals of Computing and Programming in C	3	0	0	3
6.	SH105	Engineering Graphics	2	3	0	4
PRACTICAL						
7.	SH106	C Programming Laboratory	0	0	3	2
8.	SH107	Physics and Chemistry Laboratory – I Part A – Physics Laboratory – I Part B – Chemistry Laboratory – I	0	0	3	2
9.	SH108	Engineering Practices Laboratory Part A – Mechanical and Civil Engineering Practices Part B – Electrical and Electronics Engineering Practices	0	0	3	2
Total Number of Credits :						**27**

SEMESTER – II

S.No.	Course Code	Course Title	L	T	P	C
THEORY						
1.	13A20	Technical English – II (***Common to all***)	3	0	0	3
2.	13A21	Integral Calculus and Transforms (***Common to all***)	3	1	0	4
3.	13A22	Materials Science (***Common to Mechanical and Civil***)	3	0	0	3
4.	13A23	Chemistry for Mechanical Engineering	3	0	0	3
5.	13A24	Engineering Mechanics (***Common to Mechanical and Civil***)	3	1	0	4
6.	13A25	Basic Electrical and Electronics Engineering (***Common to Mechanical and Civil***)	3	1	0	4
PRACTICAL						
7.	13A26	Computer Programming Laboratory (***Common to all***)	0	1	2	2
8.	13A27	Physics and Chemistry Laboratory – II (***Common to all***) Part A – Physics Laboratory – II Part B – Chemistry Laboratory – II	0	0	3	2
9.	13A28	Computer Aided Drafting and Modeling Laboratory (***Common to Mechanical and Civil***)	0	1	2	2
10.	13A29	English Language Skill Laboratory (***Common to all***)	0	0	3	2
		Total Number of Credits :				**29**

SEMESTER III

S. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	13ME31	Fourier Transforms and Complex Analysis	3	1	0	4
2	13ME32	Environmental Science and Engineering	3	0	0	3
3	13ME33	Engineering Thermodynamics	3	1	0	4
4	13ME34	Mechanics of Materials	3	1	0	4
5	13ME35	Manufacturing Technology – I	3	0	0	3
6	13ME36	Electrical Drives and Controls	3	1	0	4
PRACTICALS						
7	13ME37	Material Testing Laboratory	0	0	3	2
8	13ME38	Electrical Engineering Laboratory	0	0	3	2
9	13ME39	Communication skills and Technical Seminar	0	0	3	2
			18	**4**	**9**	**28**
		Total Number of Credits				**28**

SEMESTER IV

S. No	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	13ME41	Probability, Statistics and Numerical Methods	3	1	0	4
2	13ME42	Fluid Mechanics and Machinery	3	1	0	4
3	13ME43	Kinematics of Machinery	3	1	0	4
4	13ME44	Manufacturing Technology – II	3	1	0	4
5	13ME45	Engineering Materials and Metallurgy	3	0	0	3
6	13ME46	Electronics and Microprocessor	3	0	0	3
PRACTICALS						
7	13ME47	Fluid Mechanics and Machinery Laboratory	0	0	3	2
8	13ME48	Manufacturing Technology Laboratory	0	0	3	2
			18	**4**	**6**	**26**
					Total Number of Credits	**26**

SEMESTER V

S. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	13ME51	Thermal Engineering	3	1	0	4
2	13ME52	Design of Machine Elements	3	1	0	4
3	13ME53	Dynamics of Machinery	3	1	0	4
4	13ME54	Computer Aided Design and Manufacturing	3	0	0	3
5	13ME55	Professional Ethics and Human values	3	0	0	3
6	13ME56	Instrumentation and Control systems	3	0	0	3
PRACTICAL						
7	13ME57	Computer Aided Design and Manufacturing Laboratory	0	0	3	2
8	13ME58	Thermal Engineering Laboratory	0	0	3	2
			18	**3**	**6**	**25**
					Total Number of Credits	**25**

SEMESTER VI

S. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	13ME61	Heat and Mass Transfer	3	1	0	4
2	13ME62	Design of Transmission Systems	3	1	0	4
3	13ME63	Finite Element Analysis	3	1	0	4
4	13ME64	Engineering Metrology and Quality Control	3	0	0	3
5	13ME65	Fluid Power Systems	3	0	0	3
6		Elective –I	3	0	0	3
PRACTICAL						
7	13ME67	Heat Transfer Laboratory	0	0	3	2
8	13ME68	Metrology and Measurements Laboratory	0	0	3	2
9	13ME69	Comprehension	0	0	3	1
			18	**3**	**9**	**26**
					Total Number of Credits	**26**

SEMESTER VII

S. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	13ME71	Principles of Management	3	0	0	3
2	13ME72	Operations Research	3	1	0	4
3	13ME73	Automobile Engineering	3	0	0	3
4	13ME74	Power Plant Engineering	3	0	0	3
5		Elective – II	3	0	0	3
6		Elective – III	3	0	0	3
PRACTICAL						
7	13ME77	Computer Aided Simulation and Analysis Laboratory	0	0	3	2
8	13ME78	Automation and Dynamics Laboratory	0	0	3	2
9	13ME79	Project Work Phase - I	0	0	3	2
					Total Number of Credits	**25**

SEMESTER VIII

S. NO	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	13ME81	Sociology and Global issues	3	0	0	3
2		Elective – IV	3	0	0	3
3		Elective – V	3	0	0	3
4		Elective – VI	3	0	0	3
PRACTICAL						
5	13ME87	Project Work Phase – II	0	0	18	6
		TOTAL CREDITS				**18**

CORE ELECTIVES

(A Minimum of Four Electives to be opted from the following modules)

S. No.	CODE NO.	COURSE TITLE	L	T	P	C
THERMAL MODULE						
1.	13MEAA	Advanced Internal Combustion Engines	3	0	0	3
2.	13MEAB	Renewable Sources Of Energy	3	0	0	3
3.	13MEAC	Solar Photovoltaic Fundamentals and Applications	3	0	0	3
4.	13MEAD	Design of heat Exchanger and Pressure Vessel	3	0	0	3
5.	13MEAE	Refrigeration and Air conditioning	3	0	0	3
6.	13MEAF	Solar Energy and Utilization	3	0	0	3
7.	13MEAG	Thermal Turbo Machines	3	0	0	3
8.	13MEAH	Applied Computational Fluid Dynamics and Finite Element Analysis	3	0	0	3
MANUFACTURING MODULE						
9.	13MEBA	Composite Materials	3	0	0	3
10.	13MEBB	Non Destructive Testing for Welded structures	2	0	2	3
11.	13MEBC	Maintenance Engineering	3	0	0	3
12.	13MEBD	Advanced Computer Aided Manufacturing	3	0	0	3
13.	13MEBE	Quality Control of Welded structures	2	0	2	3
14.	13MEBF	Quality Assurance for Welded structures	2	0	2	3
15.	13MEBG	Product Design And Costing	3	0	0	3
16.	13MEBH	Creativity, Innovation and Product development	3	0	0	3
17.	13MEBJ	Unconventional Machining Processes	3	0	0	3
18.	13MEBK	Process Planning and Cost Estimation	3	0	0	3
19.	13MEBL	Quality Control and Reliability Engineering	3	0	0	3
20.	13MEBM	Production Planning and Control	3	0	0	3
21.	13MEBN	Industrial Safety Engineering	3	0	0	3

DESIGN MODULE						
22.	13MECA	Vibration Control	3	0	0	3
23.	13MECB	Piping Design Engineering	3	0	0	3
24.	13MECC	Advanced Modeling Techniques	2	0	2	3
25.	13MECD	New Product Design and Development	3	0	0	3
26.	13MECE	Industrial Tribology	3	0	0	3
27.	13MECF	Design of Jigs, Fixtures and Press Tools	3	0	0	3
28.	13MECG	Fundamentals of Nanotechnology	3	0	0	3
29.	13MECH	Industrial Robotics	3	0	0	3
30.	13MECJ	Aircraft Engineering	3	0	0	3
31.	13MECK	Mechatronics	3	0	0	3
32.	13MECL	Applied Hydraulics and Pneumatics	3	0	0	3
33.	13MECM	Design For Manufacturing and Assembly	3	0	0	3
MANAGEMENT MODULE						
34.	13MEDA	Total Quality Management	3	0	0	3
35.	13MEDB	Entrepreneurship Development	3	0	0	3
36.	13MEDC	Marketing Management	3	0	0	3
37.	13MEDD	Engineering Economics and Cost Analysis	3	0	0	3
38.	13MEDE	Project Management	3	0	0	3

TRANS DISCIPLINIARY ELECTIVES

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

SH100 **TECHNICAL ENGLISH – I** **L T P C**

(Common to all B.E. / B.Tech., Degree Programmes) **3 1 0 4**

COURSE OUTCOMES

The Student will

- apply basic grammar in Writing and Speaking.
- prepare formal Letter Writings.
- come out with proper pronunciation.
- speak confidently in interactions.
- develop interest to read any article.

UNIT I **12**

Language Focus: Technical Vocabulary, Word Formation, Concord, Tense (Present).
Writing: Leave Application Letter, Paragraph writing.
Listening: Listening to correct pronunciation of words.
Speaking: Self - Introduction, Greetings.

UNIT II **12**

Language Focus: Words often misspelled, Articles, Tense (Past)
Writing: Permission letters (In-plant training/Seminar/Workshop), Chart description.
Listening: Listening to the Sentences with correct stress and Intonation.
Speaking: Situational Conversations.

UNIT III **12**

Language Focus: Compound nouns, Tense (Future), Preposition, Comparative Adjectives.
Writing: Invitation Letter, Acceptance Letter, Declining Letter.
Listening: Listening to the conversations.
Speaking: One minute speech.

UNIT IV **12**

Language Focus: Modal verbs, Gerund, Infinitives, Voice.
Writing: Writing Instructions, Letters to Editor.
Listening: Listening to the different Tonal Expressions.
Speaking: Giving Opinions.

UNIT V **12**

Language Focus: 'If' Conditionals, 'Wh' questions, Question Tags.
Writing: Reading and Note - taking
Speaking: Group Discussion.
Reading: ERC, one word questions from the suggested book.

SUGGESTED ACTIVITIES

1. Matching words and meanings – Using words in context – Making sentences.
2. Exercises on gap filling and correction of errors on Concord (Subject – Verb Agreement).
3. Gap filling exercises using the appropriate Tense forms.
4. Exercises on transferring information from Graph to Text – Bar charts, Flow charts.
5. Making sentences using Modal verbs to express probability, compulsion, etc.
6. Exercises on Writing Instructions.
7. Exercises on framing Questions.
8. Other relevant classroom activities.

L: 45 T: 15 TOTAL: 60 PERIODS

BOOK SUGGESTED FOR READING

1. R.K.Narayanan, “Malgudi Days”, Indian Thought Publications, 1943.

REFERENCES

1. Rizvi. M. Ashraf, “Effective Technical Communication”, McGraw Hill Companies, 2005.
2. P.K.Dutt, G.Rajeevan and C.L.N. Prakash, “A Course in Communication Skills”, Cambridge University Press India, 2007.
3. Andrea.J.Rutherford, “Basic Communication Skills for Technology”, Pearson Education, 2nd Edition, 2007.

SH101 MATRICES AND DIFFERENTIAL CALCULUS L T P C
(Common to all B.E. / B.Tech., Degree Programmes) 3 1 0 4

COURSE OUTCOMES

- Ability to find inverse and integral powers of matrices and to perform transformations of matrices.
- Ability to find the evolutes of various curves.
- Ability to solve ordinary and partial differential equations.
- Ability to obtain constrained maxima and minima.

UNIT I MATRICES 12

Characteristic equation – Eigen values and Eigen vectors of a real matrix – Properties (excluding proofs); Cayley – Hamilton theorem (excluding proof) – Inverse and integral powers of a matrix using Cayley – Hamilton theorem; Diagonalisation of a matrix by orthogonal transformation; Quadratic form – Reduction of quadratic form to canonical form by orthogonal transformation.

UNIT II DIFFERENTIAL CALCULUS 12

Curvature in cartesian, parametric and polar forms; Centre, radius and circle of curvature; Evolutes.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 12

Partial derivatives; Total derivatives; Differentiation of implicit functions; Jacobians; Maxima and Minima - Method of Lagrangian multipliers.

UNIT IV ORDINARY DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients; Method of variation of parameters; Cauchy's and Legendre's linear equations; Simultaneous first order linear equations with constant coefficients.

UNIT V PARTIAL DIFFERENTIAL EQUATIONS 12

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

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

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

REFERENCES

1. Bali N. P. and Manish Goyal, "Text book of Engineering Mathematics", Laxmi Publications Private Limited, 7th Edition, Reprint, 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 Private Limited, 3rd Edition, 2007.
4. Veerarajan.T., "Engineering Mathematics for semester I and II", Tata McGraw Hill Education Private Limited, New Delhi, 3rd Edition, 2012.
5. Veerarajan.T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Private Limited, New Delhi, 2012.

SH102 **APPLIED PHYSICS** **L T P C**

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

COURSE OUTCOMES

The students will be able to

- gain knowledge on the properties of matter and hydrodynamics.
- study and apply the ultrasonic methods for industrial and medical field.
- understand Lasers and to identify the appropriate Laser technique for industrial and medical field.
- understand the different types, fabrication, losses of optical fibers and the applications of fiber optics in communication and instrumentation.
- understand the physical properties of photons and electrons and to study the different Electron Microscopes.

UNIT I PROPERTIES OF MATTER AND HYDRODYNAMICS 9

Properties of Matter

Stress, Strain, Hooke's law; Types of moduli of elasticity; Torsional pendulum – Determination of Rigidity modulus of a wire; Bending of beams – Expression for bending moment – Measurement of Young's modulus by uniform and Non- uniform bending – I Shaped girders.

Hydrodynamics

Stream line flow, Turbulent flow, Poiseuille's formula for flow of liquid through a capillary tube, Determination of coefficient of viscosity of a liquid.

UNIT II ULTRASONICS 9

Production – magnetostriction effect – magnetostriction generator – piezoelectric effect – piezoelectric generator; Detection of ultrasonic waves; Properties – Cavitations – Velocity measurement – acoustic grating; Industrial applications – drilling, welding, soldering and cleaning – SONAR - Non Destructive Testing – pulse echo system through transmission and reflection modes – A,B and C scan displays; Medical applications – Sonograms.

UNIT III LASERS 9

Principle of spontaneous emission and stimulated emission, Population inversion, Pumping, Einstein's A and B coefficients – derivation; Types of Lasers - CO_2 Laser, Nd-YAG Laser, Semiconductor Laser (Homojunction); Determination of wavelength of Laser using grating and Particle size; Applications of Lasers: Industrial applications – Welding, Cutting and Heat treatment; Medical applications; Holography (construction and reconstruction).

UNIT IV FIBER OPTICS AND ITS APPLICATIONS 9

Principle and propagation of light in optical fibers; Numerical aperture and Acceptance angle; Types of optical fibers – material, refractive index and mode; Double crucible technique of fiber drawing; Splicing – fusion splicing; Loss in optical fiber – attenuation, dispersion and bending; Fiber optical communication system (Block diagram); Advantages and Applications of optical fiber; Fiber optic sensors – temperature and displacement; Endoscope.

UNIT V QUANTUM PHYSICS AND MICROSCOPY 9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh Jean's Law from Planck's theory; Photoelectric effect – Law of Photoelectric effect – Photoelectric equation; Matter Waves – De Broglie wavelength - Schrodinger's wave equation – time independent and time dependent equations – Particle in one dimensional box; Heisenberg's Uncertainty principle; Linear Harmonic oscillator; Electron microscope – scanning electron microscope – transmission electron microscope.

TOTAL: 45 PERIODS

TEXT BOOKS

1. R.K.Gaur and S.C.Gupta, “Engineering Physics”, Dhanpat Rai Publications, New Delhi, 2009.
2. M.Arumugam, “Engineering Physics”, Anuradha Publishers, 2010.

REFERENCES

1. David Halliday, Robert Resnick, Jearl Walker, “Fundamentals of Physics”, John Wiley and Sons, Inc., USA, 9th Edition, 2013.
2. Arthur Beiser, “Concepts of Modern Physics”, McGraw Hill Publications Private Limited, 5th Edition, 2008.
3. Richard P.Feynmann, Robert B.Leighton and Mathew Sands, “Feynmann’s Lectures on Physics”, Addison Wesley Publication, USA, 2010.
4. Yoav Peleg, Reuven Pnini, Elvahu Zaarur, Eugene Hecht, “Schaum’s Outline of Quantum Mechanics”, McGraw Hill Companies Limited, USA, 2nd Edition, 2010.

SH103 ENGINEERING CHEMISTRY L T P C
(Common to all B.E. / B.Tech., Degree Programmes) 3 0 0 3

COURSE OUTCOMES

The students will be able to

- select suitable water treatment techniques for industrial and domestic purpose.
- acquire knowledge of electrochemistry.
- apply the contextual knowledge of adsorption techniques for industrial applications.
- synthesize polymers for domestic and industrial applications.
- understand the knowledge of nano materials for their applications in Science and Engineering.

UNIT I WATER TREATMENT 9

Hardness: types of hardness, estimation of hardness of water – EDTA method – problems; disadvantages of hard water: scales and sludges – disadvantages of scales and sludges – boiler corrosion – priming and foaming – caustic embrittlement; domestic water treatment: screening, sedimentation, coagulation, filteration, disinfection – chlorine – UV method; water softening: demineralization process; desalination: definition, reverse osmosis.

UNIT II ELECTRO ANALYTICAL TECHNIQUES 9

Electrode potential: definition, measurement of electrode potential, Nernst equation – problems; EMF: definition, measurement of EMF – Poggendorff's method; reference electrode: standard hydrogen electrode, calomel electrode, glass electrode – measurement of pH using glass electrode; CO_2 sensing electrode; conductometric titrations: acid-base titration (HCI vs NaOH); potentiometric titrations: redox titration (Fe^{2+} vs $K_2Cr_2O_7$), precipitation titration (Ag^+ vs NaCl).

UNIT III CATALYSIS AND SURFACE PHENOMENA 9

Types of catalysis – homogeneous catalysis – heterogeneous catalysis, mechanism of catalytic action - contact theory, catalytic promoters, catalytic poison; enzyme catalysis: Michaelis-Menton equation; adsorption: definition, types – physical adsorption – chemical adsorption – differences between physical and chemical adsorption; adsorption isotherms: definition, Frendlich and Langmuir adsorption isotherms, applications of adsorption.

UNIT IV ENGINEERING POLYMERS 9

Polymerization – types of polymerization – addition – free radical addition polymerization mechanism – copolymerization – condensation polymerization; plastics: classification – thermoplastics and thermosetting plastics, preparation, properties and uses of commercial plastics – PVC, teflon, perlon – U, backelite; rubber: vulcanization of rubber, synthetic rubber – butyl rubber, SBR; composites: definition, types of composites – polymer matrix composites – FRP.

UNIT V NANO MATERIALS 9

Nanoparticles: definition, carbon nanotubes (CNT), types of carbon nano tubes – single walled and multi walled carbon nanotubes – fullerene; synthesis of carbon nanotubes: chemical vapour deposition – laser ablation – arc-discharge method; properties of CNT: mechanical, electrical, thermal and optical properties; applications of carbon nanotubes in chemical field, medicinal field, mechanical field and current applications.

TOTAL: 45 PERIODS

TEXT BOOKS

1. P.C.Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 15th Edition, 2005.
2. S.S.Dara, "A text book of Engineering Chemistry", S. Chand and Company Limited, New Delhi, 12th Edition, 2006.

REFERENCES

1. J.Hammer Mark, "Water and Waste water Technology", Prentice Hall, New Arrivals, 2012.
2. G.Whitmore, "Electrochemistry and its Applications", Sarup book publishers, New Delhi, 2009.
3. G.Whitmore, "Adsorption and Catalysis", Sarup Book Publishers, New Delhi, 2008.
4. Fred.Bilmayer, "Text book of Polymer Science", Wiley, 1st Edition, 2007.
5. T.Pradeep, "Nano – The Essential", Tata McGraw Hill Education Private Limited, New Delhi, 2012.
6. S.C.Bhatia, "Engineering Chemistry", CBS Publishers and Distributors, 1st Edition, 2011.

SH104 FUNDAMENTALS OF COMPUTING AND PROGRAMMING IN C L T P C
(Common to all B.E. / B.Tech., Degree Programmes) 3 0 0 3

COURSE OUTCOMES

- Learn the major components of a computer system.
- Formulate the algorithms and analyze their complexity.
- Identify the correct and efficient ways of solving problems.
- Acquire knowledge about dynamic memory allocation, modular programming and data organization.
- Develop real time applications using the power of C language features.

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

Structure of C Program – Keywords, Constants, Variables and Data Types – Operators and Expressions – Managing Input and Output operators – Decision Making – Branching and Looping.

UNIT III FUNCTIONS, ARRAYS AND POINTERS 9

Functions: User-defined functions – Definitions – Declarations - Call by reference – Call by value. Arrays: Declaration – Definition – Multidimensional Arrays – Functions with array as arguments. Pointers: Initialization – Pointers as Arguments – Pointers to Pointers – Dynamic Memory Management Functions.

UNIT IV STRUCTURES AND UNIONS 9

Derived types – Structures: Declaration – Definition – Initialization of structures – Accessing structures – Nested structures – Arrays of structures – Structures and functions – Pointers to structures – Self-referential structures – Unions.

UNIT V FILE HANDLING 8

File structure – binary and text files – File handling functions – File I/O — File Manipulations.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", Oxford University Press, 1st Edition, 2009.
2. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India), 2011.

REFERENCES

1. Ashok.N.Kamthane, "Computer Programming", Pearson Education (India), 2008.
2. Stephen G.Kochan, "Programming in C", Pearson Education (India), 3rd Edition, 2005.
3. Brian W.Kernighan and Dennis M.Ritchie, "The C Programming Language", Pearson Education Inc., 2005.

SH105 **ENGINEERING GRAPHICS** **L T P C**

(Common to all B.E. / B.Tech., Degree Programmes) **2 3 0 4**

COURSE OUTCOMES

- Students will be able to use the drawing instruments effectively.
- An ability to draw the basic engineering curves and problems related to projections of points, straight lines, planes and solids.
- Able to apply the knowledge acquired on practical applications of sectioning and development of solids.
- Able to draw simple solids and its sections in isometric view and projections and also to draw its perspective views.

Drawing Instruments – IS specifications on lines – drawing sheets – Printing letters and dimensioning – scales (not for examination) – First angle projection should be followed.

UNIT I PLANE CURVES 12

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloids – Epi and Hypo cycloids - construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES 12

Projection of points and straight lines located in the first quadrant – Traces – Determination of true lengths and true inclinations.

Projection of regular polygonal surfaces and circular lamina inclined to any one reference plane.

UNIT III PROJECTION OF SOLIDS 12

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

UNIT IV SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 12

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – obtaining true shape of section.

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinder and cone – Development of lateral surfaces of solids with cylindrical cutouts, perpendicular to the axis.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 12

Principles of isometric projection – isometric scale – isometric projections of simple solids – cube – prisms, pyramids, cylinder and cone in simple position only, truncated prisms, pyramids, cylinders and cones.

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

TOTAL: 60 PERIODS

Note: In end semester examination from each unit one question with either or pattern may be asked. No short questions.

TEXT BOOK

1. N.D. Bhatt, “Engineering Drawing”, Charotar Publishing House, 46th Edition, 2003.

REFERENCES

1. K.V.Natrajan, “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2006.
2. M.S.Kumar, “Engineering Graphics”, D.D. Publications, 2007.

3. K.Venugopal and V.Prabhu Raja, “Engineering Graphics”, New Age International Private Limited, 2008.
4. M.B.Shah and B.C.Rana, “Engineering Drawing”, Pearson Education, 2005.
5. K.R.Gopalakrishnan, “Engineering Drawing” (Vol. I & II), Subhas Publications, 1998.
6. Dhananjay A.Jolhe, “Engineering Drawing with an Introduction to AutoCAD”, Tata McGraw Hill Publishing Company Limited, 2008.
7. Basant Agarwal and Agarwal.C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

SH106 **C PROGRAMMING LABORATORY** **L T P C**

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

COURSE OUTCOMES

- Acquire logical thinking and problem solving skills.
- Implement the algorithms and analyze their complexity.
- Identify the correct and efficient ways of solving problems.
- Acquire hands on practice in dynamic memory allocation, modular programming and data organization.
- Implement real time applications using the power of C language features.

LIST OF EXPERIMENTS

1. Solve problems such as temperature conversion, student grading, interest calculation.
2. Finding the 2's complement of a binary number.
3. Generation of the first 'n' terms of the Fibonacci sequence and prime sequence.
4. Computing Sine series and Cosine series.
5. Given distance traveled by a vehicle as $\mathbf{d = ut + 1/2at^2}$, where 'u' and 'a' are the initial velocity and acceleration. Calculate the distance traveled for different time intervals.
6. Solving the roots of a quadratic equation.
7. Designing a simple arithmetic calculator. (Use switch statement)
8. Performing the following operations: (Use loop statement)
    i. Generate Pascal's triangle.
    ii. Construct a Pyramid of numbers.
9. Performing the following operations to a string:
    i. To insert a sub-string into main string at a given position.
    ii. To delete 'n' characters from a given position in a string.
    iii. To replace a character of string either from beginning or ending or at a specified location.
10. Performing the following operations: (Use arrays)
    i. Matrix addition.
    ii. Transpose of a matrix.
    iii. Matrix multiplication by checking compatibility.
11. Performing the following operations: (Use recursive functions)
    i. To find the factorial of a given integer.
    ii. To find the GCD (Greatest Common Divisor) of two given integers.
    iii. To solve Towers of Hanoi problem.
12. Performing the Student Information Processing using File Handling concepts.

TOTAL: 45 PERIODS

SOFTWARE REQUIREMENTS

- Turbo C/ ANSI C Compiler
- Gcc compiler

SH107	PHYSICS AND CHEMISTRY LABORATORY – I	L	T	P	C
	(Common to all B.E. / B.Tech., Degree Programmes)	0	0	3	2

PART A – PHYSICS LABORATORY – I

COURSE OUTCOMES

At the end of the Laboratory classes, the students are able to

- develop collaborative learning skills and to add some of their own ideas to the experiments and their explanations.
- understand the optical properties, mechanical properties and electrical properties.

LIST OF EXPERIMENTS

1. (a) Particle size determination using Diode Laser.
   (b) Determination of Laser parameters – Wavelength, and angle of divergence.
   (c) Determination of Numerical aperture and acceptance angle of an optical fiber.
2. Determination of thickness of a thin wire – Air wedge method.
3. Determination of velocity of sound and compressibility of the liquid – Ultrasonic Interferometer.
4. Determination of Dispersive power of a prism using Spectrometer.
5. Determination of Young's modulus – Non-uniform bending method.
6. Determination of coefficient of viscosity of liquid – Poiseuille's method.
7. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.

• A minimum of FIVE experiments shall be offered.

PART B - CHEMISTRY LABORATORY – I

COURSE OUTCOMES

The student

- can estimate the amount of hardness and acidity present in the water sample.
- gain knowledge about the estimation of nickel in an alloy.
- quantify the electrolyte by measuring the conductance and pH.

LIST OF EXPERIMENTS

1. Estimation of hardness of Water sample by EDTA method.
2. Estimation of acidity of Water sample.
3. Estimation of Nickel by EDTA method.
4. Conductometric titration (HCl Vs NaOH).
5. Conductometric titration ($BaCl_2$ Vs Na_2SO_4).
6. pH metric titration (HCl Vs NaOH).
7. Determination of molecular weight and degree of polymerization using Viscometry.

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

TOTAL: 45 PERIODS

SH108 **ENGINEERING PRACTICES LABORATORY**
(Common to all B.E. / B.Tech., Degree Programmes)

L T P C
0 0 3 2

COURSE OUTCOMES

- Students will be able to prepare the pipe connections and identify the various components used in plumbing.
- An ability to prepare simple wooden joints using wood working tools.
- An ability to prepare simple lap, butt and tee joints using arc welding equipments.
- An ability to prepare simple components using lathe and drilling machine.

PART A – MECHANICAL AND CIVIL ENGINEERING PRACTICES

I **PLUMBING WORKS**: **5**

Study of components related to plumbing.
Hands-on-exercise:
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

II **CARPENTRY PRACTICES:** **6**

Study of the joints in roofs, doors, windows and furniture.
Hands-on-exercise:
Wood work, joints by sawing, planning and cutting.

III **WELDING:** **5**

Study of the tools used in welding Gas welding practice.
Preparation of butt joints, lap joints and tee joints using arc welding.

IV **BASIC MACHINING:** **7**

(a) Simple Turning and Taper turning.
(b) Drilling Practice.

REFERENCES

1. Ramesh Babu.V., "Engineering Practices Laboratory Manual", VRB Publishers Private Limited, Chennai, Revised Edition, 2013 – 2014.
2. Jeyachandran.K., Natarajan.S. and Balasubramanian.S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
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.

PART B – ELECTRICAL AND ELECTRONICS ENGINEERING PRACTICES

COURSE OUTCOMES

- An ability to develop familiarity with rudimentary measurement equipment – signal generators, oscilloscopes, multimeters and power supplies.
- Ability to demonstrate and evaluate the parameters of basic electronic components (wires, resistors, capacitors, diodes etc.) based on their physical parameters and dimensions.
- Define, describe, and analyze fundamentals of Boolean algebra and digital logic gates.
- An ability to predict qualitatively and quantitatively compute the steady state AC responses of basic circuits using the phasor method.
- Gain experience in the documentation of measurements and procedures as well as the preparation of formal reports.

I ELECTRICAL ENGINEERING PRACTICE 10

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 an electrical equipment.

II ELECTRONICS ENGINEERING PRACTICE 12

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.

TOTAL: 45 PERIODS

REFERENCES

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

13A20 **TECHNICAL ENGLISH – II**

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

L T P C
3 0 0 3

COURSE OUTCOMES

The student will be able to

- apply correct form of language while Speaking and Writing.
- prepare his own Professional letter writings.
- interpret any passage after listening.
- interact at different situations fluently.

UNIT I **10**

Language Focus: Homonyms, Different grammatical forms of the same word, correct usage of words / phrases.
Writing: Recommendation writing.
Listening: Interpreting Poetic lines.
Speaking: Telephone English.

UNIT II **9**

Language Focus: Cause and Effect, Phrasal Verbs.
Writing: Quotation letter, Clarification Letter, Placing orders, Complaint Letter.
Listening: Conversations.
Speaking: Asking questions.

UNIT III **9**

Language Focus: Idioms and Phrases with animal names.
Writing: Checklist, Process Description.
Speaking: Presentations.

UNIT IV **9**

Language Focus: Technical Definitions, Transformation of Sentences.
Writing: Job Application Letter, Curriculum Vitae, Bio-data, Resume.
Speaking: Mock Interview.

UNIT V **8**

Language Focus: British and American Vocabulary, Numerical Expressions.
Writing: E-mail Writing, Report Writing.
Speaking: Group Discussion.

SUGGESTED ACTIVITIES

1. Making sentences using different grammatical forms of the same word.
2. Exercises on combining sentences using Cause and Effect expressions.
3. Writing Formal Letters.
4. Writing exercises on Recommendations.
5. Exercises on Idioms and Phrases.
6. Exercises on preparing letter of Job Application with annexure.
7. Exercises on British and American English words with meanings.

TOTAL: 45 PERIODS

BOOK SUGGESTED FOR READING

1. A.P.J.Abdul Kalam, Arun Tiwari, “Wings of Fire”, an Autobiography, University Press Private Limited India, 1999, 30th Impression, 2007.

REFERENCES

1. T.M.Farhathullah, “Communication Skills for Technical Students”, Orient Longman Private Limited, 2002.
2. K.R.Lakshmi Narayanan, “English for Technical Communication”, SciTech Publications, 1999.
3. Jack.C.Richards, Jonathan Hull and Susan Protor, “English for International Communication”, Cambridge University Press, 3rd Edition, 2004.

13A21 INTEGRAL CALCULUS AND TRANSFORMS
(Common to all B.E. / B.Tech., Degree Programmes)

L T P C
3 1 0 4

COURSE OUTCOMES

- Ability to find area and volume of objects using double and triple integrals.
- Ability to analyze the concepts related to vector calculus and to apply them in engineering field.
- Ability to perform the ideas of Laplace transform and Z-transform in their respective engineering subjects.

UNIT I MULTIPLE INTEGRALS 12

Double integration – Cartesian and polar coordinates; Change of order of integration; Change of variables between cartesian and polar coordinates; Triple integration in cartesian coordinates; Area as double integral; Volume as triple integral.

UNIT II VECTOR CALCULUS 12

Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields; Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

UNIT III LAPLACE TRANSFORM 12

Definition of Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – Derivatives and Integrals of Transform – Transform of derivatives and integrals – Transform of unit step function and impulse function – Transform of periodic function – Initial and final value theorems.

UNIT IV INVERSE LAPLACE TRANSFORM 12

Definition of Inverse Laplace transform – Convolution theorem – Solution of linear ordinary differential equations of second order with constant coefficients using Laplace transformation techniques and solution of simultaneous differential equations of first order with constant coefficients using Laplace transformation techniques.

UNIT V Z – TRANSFORM 12

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Formation of difference equations – Solution of difference equations using Z-transform.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

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

REFERENCES

1. Bali.N.P. and Manish Goyal, "Text book of Engineering Mathematics", Laxmi Publications Private Limited, 7th Edition, 2008.
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 Private Limited, 3rd Edition, 2007.
4. Veerarajan.T., "Engineering Mathematics for semester I & II", Tata McGraw Hill Education Private Limited, 3rd Edition, New Delhi, 2012.
5. Veerarajan.T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Private Limited, New Delhi, 2012.

13A22 **MATERIALS SCIENCE**
(Common to Mechanical and Civil)

L T P C
3 0 0 3

COURSE OUTCOMES

The Student will

- identify the crystal lattices, their structures and how the structure influences its major properties at different levels.
- choose the major functional and structural properties required for specific applications of conducting materials
- check the parameters that satisfy the superconducting behaviours.
- relate technology to the physics of semiconductor devices.
- understand the physics underlying the magnetic behaviour of materials.
- Explain the mechanism by which electric field interacts with materials and their applications
- suggest materials based concepts to improve the properties and performance under given circumstances.

UNIT I CRYSTAL PHYSICS 9

Lattice, Unit cell, Bravais lattice, Lattice planes; Miller indices – d-spacing in cubic lattice; Calculation of number of atoms per unit cell, Atomic radius, Coordination number and Packing factor for SC, BCC, FCC and HCP structures; Crystal defects – point, line and surface defects; Burger vector.

UNIT II CONDUCTING MATERIALS AND SUPERCONDUCTORS 9

Conductors

Band theory of solids - Distinguish between conductors, semiconductors and insulators on the basis of band theory of solids; Classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann Franz law – Lorentz number – Draw backs of classical theory; Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

Superconductors

Superconductivity: Properties – Meissner effect – Isotopic effect; Types of super conductors – Type I and Type II superconductors; Applications of superconductors – Magnetic levitation.

UNIT III SEMICONDUCTORS 9

Intrinsic semiconductor – carrier concentration derivation – Fermi level – variation of Fermi level with temperature – electrical conductivity – bandgap determination; Extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration; Hall effect – Determination of Hall coefficient – Applications.

UNIT IV MAGNETIC MATERIALS AND DIELECTRIC MATERIALS 9

Magnetic materials

Origin of magnetic moment, Bohr magneton, Dia and Para magnetism, Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials; Anti-ferromagnetic materials.

Dielectric materials

Electrical susceptibility, dielectric constant, Types of Polarization – electronic, ionic, orientation and space charge polarization – frequency and temperature dependence of polarization; Internal field – Clausius-Mosotti relation (derivation); dielectric loss, dielectric breakdown, Uses of dielectric materials in capacitor and transformer.

UNIT V NEW ENGINEERING MATERIALS 9

Metallic glasses: preparation, properties and applications; Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA; Nano materials: synthesis – chemical vapor deposition – sol-gels – ball milling; properties of nano particles and applications; Solar cell – PN junction solar cell – Conversion efficiency and solar concentration – Hetero junction solar cell; Classification of Biomaterials and its applications.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Charles Kittel, "Introduction to Solid State Physics", John Wiley and Sons, Singapore, 7th Edition, 2007.
2. Charles P.Poole and Frank J.Ownen, "Introduction to Nanotechnology", Wiley India, 2007.

REFERENCES

1. B.N.Sankar and S.O.Pillai, "Engineering Physics", New Age International Publishers, New Delhi, 2009.
2. M.Arumugam, "Materials Science", Anuradha publications, Kumbakonam, 2010.
3. Donald A.Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill Publication, New Delhi, 3rd Edition, 2007.
4. M.Ali Omar, "Elementary Solid State Physics", Pearson Education Inc., 4th Edition, 1999.

13A23 CHEMISTRY FOR MECHANICAL ENGINEERING

L	T	P	C
3	0	0	3

COURSE OUTCOMES

The students can

- apply thermodynamic concepts for the given thermal system.
- apply the concept of phase rule for the manufacture of engineering materials.
- extend and deepen the knowledge on different types of fuels and flue gas composition.
- select proper engineering materials for desired engineering application.
- choose proper analytical technique to analyse the engineering material.

UNIT I THERMODYNAMICS 9

Terminology; internal energy – zeroth law; first law of thermodynamics: mathematical form of first law – limitations; reversible isothermal expansion of an ideal gas; heat capacity: definition, relationship between C_v and C_p; Kirchoff's equation; enthalpy; entropy: entropy change in reversible and irreversible process; free energy: Gibbs free energy – Helmholtz work function; second law of thermodynamics; Gibbs-Helmholtz equation – derivation – problems; Van't-Hoff isotherm: Derivation – Van't-Hoff isocore – problems.

UNIT II PHASE RULE AND POWDER METALLURGY 9

Phase rule: statement – explanation of terms involved, phase rule for two component alloy system; thermal analysis; construction of phase diagram; application – simple eutectic system – Pb-Ag system, compound formation with congruent melting point, Zn-Mg system; powder metallurgy: preparation – mechanical pulverization – atomization – chemical reduction – electrolytic process – decomposition – mixing and blending – compacting – sintering – advantages and limitations of powder metallurgy.

UNIT III FUELS AND COMBUSTION 9

Solid fuel: coal, analysis of coal – proximate and ultimate analysis – significance; coke: manufacture – Otto-Hoffman method; Liquid Fuel: synthetic petrol – Fischer-Tropsch method – Bergius process – cracking – catalytic cracking methods – fixed bed – fluidized bed; knocking – octane number – improvement of antiknocking characteristics of fuel; Gaseous fuel: composition, production and uses of producer gas, water gas and natural gas; Combustion: gross and net calorific values, theoretical calculation of calorific values – Dulong's formula, calculation of minimum amount of air for combustion – problems; flue gas analysis – Orsat apparatus.

UNIT IV ENGINEERING MATERIALS 9

Refractories: characteristics, classification – acidic, basic and neutral refractories; properties – refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling; lubricants: functions of lubricants, mechanism of lubrication, properties: viscosity index, flash and fire point, oiliness, aniline point, cloud and pour point; solid lubricants: graphite, molybdenum sulphide – abrasives: definition – Moh's scale – classification – natural abrasives – diamond, corundum, emery, quartz, garnet – synthetic abrasives – silicon carbide – boron carbide.

UNIT V ANALYSIS OF MATERIALS 9

Microscopic analysis: Scanning Electron Microscopy (SEM): principle – instrumentation (block diagram only) – applications; Tunneling Electron Microscopy (TEM): principle – instrumentation (block diagram only) – applications; thermogravimetry (TG): definition, instrumentation (block diagram only), characteristics of thermogram, factors influencing thermogravimetry, analyzing limestone thermogram, applications; Atomic Absorption Spectroscopy (AAS): principle – instrumentation (block diagram only), estimation of nickel by AAS; flame photometry: principle – instrumentation (block diagram only), estimation of sodium by flame photometry.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Jain.P.C. Monika Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company Private Limited, New Delhi, 15th Edition, 2005.
2. Dara.S.S., “A Text book of Engineering Chemistry”, S.Chand Company Private Limited, New Delhi, 12th Edition, 2003.

REFERENCES

1. Puri Sharma Pathania, “Principles of Physical Chemistry”, Vishal Publication and Company, 42nd Edition, 2007.
2. J.Rajaram and J.C.Kuriacose, “Thermodynamics”, McMillan India Limited, New Delhi, 1993.
3. Skoog, Holler, Crouch, “Instrumental Analysis”, Cengage Learning India Private Limited New Delhi, 2011.
4. R.K.Rajput, “Engineering Materials and Metallurgy”, S.Chand Publishers, 1st Edition, 2008.
5. Morris Sylvin, “Phase Rule and its application”, Sarup book publishers, 2010.

13A24 **ENGINEERING MECHANICS**
(Common to Mechanical and Civil)

L T P C
3 1 0 4

COURSE OUTCOMES

- An ability to use the basic concept of force systems and solve problems.
- An ability to implement the knowledge acquired in supports, reactions, equilibrium of rigid bodies for solving problems.
- The students gain an ability to predict centre of gravity, moment and product moment of inertia of simple configurations.
- An ability to solve practical problems on Projectiles, Newton's laws, work-energy and impulse momentum.
- An ability to apply the principles of friction and rigid body dynamics to analyze and solve problems.

UNIT I BASICS AND STATICS OF PARTICLES 12

Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – 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 12

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – 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 – Varignon's theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section – Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem.

UNIT IV DYNAMICS OF PARTICLES 12

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 12

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: 15 TOTAL: 60 PERIODS

TEXT BOOK

1. Beer. F.P. and Johnson Jr. E.R., "Vector Mechanics for Engineers", Vol.1 Statics and Vol. 2 Dynamics, McGraw Hill International Edition, 9th Edition, 2010.

REFERENCES

1. Rajasekaran.S., Sankarasubramanian.G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Private Limited, 3rd Edition, 2010.

2. Hibbeller.R.C., “Engineering Mechanics”, Vol.1 Statics, Vol.2 Dynamics, Pearson Education Asia Private Limited, 12th Edition, 2010.
3. Irving H. Shames, “Engineering Mechanics – Statics and Dynamics”, Pearson Education Asia Private Limited, 4th Edition, 2003.
4. Ashok Gupta, “Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)”, Pearson Education Asia Private Limited, 2002.
5. Palanichamy.M.S., Nagam.S., “Engineering Mechanics – Statics and Dynamics”, Tata McGraw Hill, 2001.

13A25 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
(Common to Mechanical and Civil)

L T P C
3 1 0 4

COURSE OUTCOMES

- Describe the basic concepts of electric circuits and measuring instruments.
- Discuss the principle of electrical machines.
- Summarize the concepts of semiconductor devices and electronic circuits.
- Solve basic binary operations and code conversion techniques using the logic gates.
- Explain the fundamentals of communication engineering.

UNIT I ELECTRICAL CIRCUITS AND MEASUREMENTS 12

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Wattmeters and Energy meters.

UNIT II ELECTRICAL MACHINES 12

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, Single Phase Induction Motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS 12

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 12

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations. Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

1. R.S.Sedha, "Applied Electronics", S.Chand and Company, 2006.
2. V.N.Mittle, "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.

REFERENCES

1. Gnanavadivel, C.Senthilkumar, A.Vijaykumar, S.Joseph Gladwin, "Basic Electrical and Electronics Engineering", Anuradha Publishers, 2011.
2. Muthusubramanian.R, Salivahanan.S and Muraleedharan.K.A., "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, 2nd Edition, 2006.
3. Nagsarkar.T.K. and Sukhija.M.S, "Basics of Electrical Engineering", Oxford press, 2005.
4. Premkumar.N., "Basic Electrical Engineering", Anuradha Publishers, 2003.
5. Mahmood Nahvi and Joseph A.Edminister, "Electric Circuits", Schaum Outline Series, McGraw Hill, 2002.
6. Mehta V.K., "Principles of Electronics", S.Chand and Company Limited, 1994.

13A26 **COMPUTER PROGRAMMING LABORATORY**
(Common to all B.E. / B.Tech., Degree Programmes)

L	T	P	C
0	1	2	2

COURSE OUTCOMES

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

- Demonstrate how to use the UNIX Shell commands.
- Use the Shell programming constructs.
- Learn tracing mechanisms (for debugging), user variables, Shell variables, read-only variables, positional parameters, reading input to a Shell script.
- Test on numeric values, test on file type, and test on character strings using shell scripts.
- Write moderately complex Shell scripts and make them executable.

Execute programs written in C under UNIX environment.

LIST OF EXPERIMENTS

1. Study of UNIX OS, vi Editor.

2. Use of Basic UNIX Shell Commands:
   ls, mkdir, rmdir, cd, cat, banner, touch, file, wc, sort, cut, grep, dd, dfspace, du, ulimit.

3. Shell Programming:
   i. Interactive shell scripts
   ii. Positional parameters
   iii. Arithmetic Operators
   iv. if-then-fi, if-then-else-fi, nested if-else
   v. Logical operators
   vi. if - elif, case structure
   vii. while, until, for loops, use of break
   viii. Metacharacters

4. Shell scripts for the following:
   i. Showing the count of users logged in
   ii. Printing column wise list of files in your home directory
   iii. To count lines, words and characters in its input (do not use wc)

5. C Programming on UNIX:
   i. Dynamic Storage Allocation
   ii. Pointers
   iii. Functions
   iv. File Handling

TOTAL: 45 PERIODS

SOFTWARE REQUIREMENTS

- UNIX/LINUX OS
- Gcc compiler

13A27 PHYSICS AND CHEMISTRY LABORATORY – II
(Common to all B.E. / B.Tech., Degree Programmes)

L	T	P	C
0	0	3	2

PART A - PHYSICS LABORATORY – II

COURSE OUTCOMES

At the end of the Laboratory classes, the students

- demonstrate and report the elastic behaviour of materials
- demonstrate the interference property of light waves
- demonstrate the diffraction property of light waves
- measure the thermal properties of conducting materials
- identify the substance that deforms continuously when subjected to shearing stress.

LIST OF EXPERIMENTS

1. Determination of Young's modulus – Uniform bending method.
2. Determination of Band Gap of a semiconductor material.
3. Determination of Hall Co-efficient.
4. Determination of Radius of curvature of a Plano convex lens using Newton's rings Method.
5. Determination of wavelength of mercury spectrum using spectrometer and grating
6. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
7. Torsional pendulum – Determination of Moment of Inertia of the disc and Rigidity modulus of the material of the wire.

• ***A minimum of FIVE experiments shall be offered.***

PART B - CHEMISTRY LABORATORY – II

COURSE OUTCOMES

The student

- can estimate the amount of alkalinity and Dissolved Oxygen (DO) present in the water sample.
- gain knowledge in the estimation of copper in an alloy and iron in rust.
- quantify electrolyte and ion by measuring the conductance and emf.

LIST OF EXPERIMENTS

1. Estimation of copper in brass by EDTA method.
2. Determination of Dissolved Oxygen (DO) in water (Winkler's method)
3. Estimation of alkalinity of Water sample
4. Estimation of Fe^{2+} ion in rust by Dichrometry
5. Conductometric titration (Mixture of acids vs NaOH)
6. Potentiometric Titration (Fe^{2+} vs $K_2Cr_2O_7$)
7. Estimation of Fe^{2+} ion by spectrophotometry.

TOTAL: 45 PERIODS

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

13A28 COMPUTER AIDED DRAFTING AND MODELING LABORATORY
(Common to Mechanical and Civil)

L	T	P	C
0	1	2	2

COURSE OUTCOMES

- An ability to use software for constructing curves, solids.
- An ability to create orthographic views and sectional view of the solids.
- An ability to create plan of residential building.
- An ability to draw isometric and pictorial views.

List of exercises using software capable of Drafting and Modeling

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola involutes using Bspline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

TOTAL: 45 PERIODS

***Note*: Plotting of drawings must be made for each exercise and attached to the records written by students.**

List of Equipments for a batch of 30 students

1. Pentium IV computer or better hardware with suitable graphics facility – 30 Nos.
2. Licensed software for Drafting and Modeling – 30 Licenses
3. Laser Printer or Plotter to print / plot drawings – 2 Nos.

13A29 ENGLISH LANGUAGE SKILL LABORATORY
(Common to all B.E. / B.Tech., Degree Programmes)

L	T	P	C
0	0	3	2

COURSE OUTCOMES

The Student will

- improve their pronunciation skill.
- gather information from any speech.
- imbibe the stress and intonation of the native speakers' accent.

1. Micro Skills

- Spotting the Homonyms / Silent letter words / mispronounced words
- Identifying the missing words in native speech
- Finding the cluster words
- Marking correct punctuation
- Marking word chunks
- Identification of sentences

2. Content Comprehension and making inferences

- Listening to audio files of Speech, Poetry, Recent Issues, News clippings, etc
    a. True / False
    b. Multiple Choice Questions
    c. Filling the blanks
    d. Filling the charts

3. Listen and Act

- Drawing the map using audio
- Picture completing task
- Transferring data to Graph

4. Interpreting the video clippings

5. Listening to Conversations

TOTAL: 30 PERIODS

13ME31 FOURIER TRANSFORMS AND COMPLEX ANALYSIS L T P C
3 1 0 4

COURSE OUTCOMES

On the successful completion of the course, the student should be able to,

- Perform Fourier series analysis of the functions.
- Implement the properties of Fourier transforms and Compute the Fourier transforms of various functions.
- Calculate the Fourier series solution of Wave and Heat equations.
- Grasp analytic functions and their properties and be introduced to the host of conformal mappings with suitable examples that have direct applications.
- Understand the basics of complex integration and the concept of contour integration encountered in practice.

UNIT I FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range Sine series – Half range Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT II FOURIER TRANSFORMS 12

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

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Solutions of one dimensional wave equation – One dimensional equation of heat conduction– Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

UNIT IV ANALYTIC FUNCTIONS 12

Functions of a complex variable – 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 V COMPLEX INTEGRATION 12

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proofs) – Taylor's and Laurent's 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).

L: 45, T: 15, TOTAL: 60 PERIODS

TEXT BOOKS

1. Grewal, B.S, "Higher Engineering Mathematics", Khanna Publishers, Delhi, 40th Edition, 2007.
2. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", Laxmi Publications Private Limited, 7th Edition, Reprint 2010.

REFERENCES

1. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2007.
2. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", Narosa Publishing House Private Limited, 3rd Edition, 2007.
3. T.Veerarajan "Transforms and Partial Differential Equations", Tata McGraw-Hill Education Private Limited, updated Edition, 2012.

13ME32 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
(Common to all B.E./B.Tech. Degree Programmes) **3 0 0 3**

COURSE OUTCOMES

Upon successful completion of course the student will be able to

- Understand the various ecosystem and biodiversity
- Classify the different types of natural resources and identify the role of individual in conservation of resources
- Identify and analyse the causes, effects and control measures of environmental pollution
- Identify the different types of environmental hazards and their management
- Analyse the social issues related to the environment and how human population affect the environment

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 9

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers– energy flow in the ecosystem – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) aquatic (pond) ecosystems. Field study of simple ecosystems –pond and forest. Introduction to biodiversity: definition - genetic, species and ecosystem diversity – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values –India as a mega-diversity nation – hot spots of biodiversity –threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation. Field study of common plants, insects, birds.

UNIT II NATURAL RESOURCES 9

Forest resources: Use and over-exploitation, deforestation, case studies- dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide Problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, case studies – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT III ENVIRONMENTAL POLLUTION 9

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Noise pollution (e) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – e-Waste: Definition-dimension of the problem - source-toxic Substances in e-waste - risks related to toxic substances–environmental problems-role of an individual in prevention of pollution.

UNIT IV ENVIRONMENTAL HAZARDS 9

Environmental hazards**:** Definition – Hazard- Types-Natural and man-made hazards – Natural hazards: Causes, effect and management of Earthquake, Flood, Landslide, Cyclones and Tsunami; Man-made Hazards**:** Hazards due to dams and reservoirs, hazards due to nuclear power plant, Industrial hazards. Case study: Chernobyl disaster, Bhopal gas tragedy.

UNIT V SOCIAL ISSUES, HUMAN POPULATION AND THE ENVIRONMENT 9

Water conservation: 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 – Case studies.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Ravikrishnan. A., "Environmental Science and Engineering, Sri Krishna Hitech Publishing Company Private Limited, 2010.
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.

REFERENCES

1. Gilbert M.Masters, "Introduction to Environmental Engineering and Science", 2nd Edition, Pearson Education, 2004.
2. Rajagopalan. R, "Environmental Studies - From Crisis to Cure", Oxford University Press, 2005.
3. Natural Hazards – Local, National, Global: G. F. White (ed), Oxford University Press.

13ME33 ENGINEERING THERMODYNAMICS L T P C
3 1 0 4

COURSE OUTCOMES

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

- State and illustrate the first and second laws of thermodynamics.
- Identify and explain the concepts of entropy, enthalpy, specific energy, reversibility, and irreversibility.
- Apply the first and second laws of thermodynamics to formulate and solve engineering problems for (i) closed systems, (ii) open systems under steady state and transient conditions and (iii) power cycles.
- Use thermodynamic tables, charts, and relations to obtain appropriate property data to solve thermodynamics problems.

UNIT I BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS 12

Continuum - microscopic and macroscopic approach - thermodynamic system (closed and open system) - thermodynamic properties and equilibrium.

Point and Path functions - different modes of work - concept of temperature – heat - First law applied to systems and control volumes - steady and unsteady flow analysis.

UNIT II SECOND LAW OF THERMODYNAMICS 12

Kelvin-Planck and Clausius statements - reversible and irreversible processes - Carnot theorems - thermodynamic temperature scale, Clausius inequality and concept of entropy, principle of increase of entropy; availability and irreversibility.

UNIT III PROPERTIES OF PURE SUBSTANCES 12

Thermodynamic properties of pure substances in solid, liquid and vapour phases - phase-change processes of pure substances - thermodynamic property tables and charts for steam - use of compressibility chart.

UNIT IV THERMODYNAMIC CYCLES 12

Carnot cycle – Ideal Rankine cycle – Reheat and Regenerative cycles. Air standard Cycles – Otto, Diesel, Dual and Brayton cycles. Vapour compression refrigeration cycle.

UNIT V PSYCHROMETRY 12

Dry and atmospheric air – specific and relative humidity – dew point temperature – adiabatic saturation- wet bulb temperature – psychrometric chart – psychrometric processes.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOK

1. Yunus A. Cengel and Michael A. Boles, "Thermodynamics – An Engineering Approach", 7th Edition, Tata McGraw-Hill Education, 2011.

REFERENCES

1. Sonntag, Borgnakke and Van Wylen, "Fundamentals of Thermodynamics", 1st Edition, Wiley India Private Limited, 2010.
2. J.P.Holman, "Thermodynamics", McGraw-Hill Education, 1988.
3. R.K.Rajput, "A Textbook of Engineering Thermodynamics", 4th Edition, Laxmi Publications Private Limited, 2010.
4. P.K. Nag, "Engineering Thermodynamics", 5th Edition, the McGraw-Hill Companies, 2013.
http://nptel.ac.in/video.php?subjectId=112105123

13ME34 MECHANICS OF MATERIALS L T P C
3 1 0 4

COURSE OUTCOMES

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

- Understand and design simple load carrying members subjected to an axial, shear and thermal loading.
- Understand stress tensor and to analyze Bi-axial stresses using Mohr's circle.
- Assess stresses and deformations in beams and columns subjected to different loadings.
- Analyze and design springs, thin pressure vessels and shafts subjected to simple loadings.
- Design simple load carrying elements for engineering applications.

UNIT I STRESS STRAIN DEFORMATION OF SOLIDS 12

Rigid and Deformable bodies – Strength, Stiffness and Stability - Constitutive Law. Stresses - Tensile, Compressive and Shear. Poisson's ratio. Deformation of simple and compound bars under axial load, Volumetric strain, Thermal stress, Elastic constants - relationship between the elastic constants. Strain energy in Uni-axial loads.

UNIT II ANALYSIS OF STRESSES IN TWO DIMENSIONS 12

Stress tensor, Bi-axial stresses at a point – Stresses on inclined plane, Principal planes and stresses, Mohr's circle for biaxial stresses – Maximum shear stress. Evaluation of hoop stress and longitudinal stress in thin cylindrical and spherical shells.

UNIT III BEAMS 12

Shear force and Bending Moment diagrams for Cantilever, Simply supported and Overhanging beams under point load and UDL. Theory of simple bending and assumptions. Section Modulus – Flitched beams.

UNIT IV DEFLECTION OF BEAMS AND COLUMNS 12

Evaluation of beam deflection and slope: Double integration method, Macaulay Method and Moment-area Method for cantilever and simply supported beams under point load and UDL. Columns – End conditions – Equivalent length of a column – Euler's equation – Slenderness ratio – Rankine's formula for columns.

UNIT V TORSION 12

Analysis of torsion of circular bars, Shear stress distribution - Bars of Solid and hollow circular section, Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts. Strain energy in bending and torsion. Application of Open and closed coil helical springs – Maximum shear stress in spring section including Wahl's factor. Deflection of helical coil springs under axial loads.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

1. Hibbeler R.C., "Mechanics of Materials", 8th Edition, Prentice Hall, 2011.
2. Popov E.P, "Engineering Mechanics of Solids", 2nd Edition, Prentice-Hall of India, New Delhi, 2002.

REFERENCES

1. Ramamurtham. S., "Strength of Materials", 14th Edition, Dhanpat Rai Publications, 2011.
2. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co., New York, 1995.
3. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2003.
4. Ryder G.H, "Strength of Materials", 3rd Edition, Macmillan India Limited, 2002.
5. Beer F.P. and Johnston R," Mechanics of Materials", 3rd Edition, McGraw-Hill Book Co., 2002.
6. Bansal R. K, "Strength of Materials", Laxmi Publications, New Delhi, 2012.
7. Timoshenko S.P, "Elements of Strength of Materials", Tata McGraw-Hill, New Delhi, 2004.

13ME35 MANUFACTURING TECHNOLOGY – I

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

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

- Gain the knowledge about the various methods of casting and specific products fabrication
- Get the ability to identify and select respective metal joining process for the on hand task.
- Get aware on the metal forming methods and the respective machineries which are involved on those processes
- Gain knowledge on the process of sheet metal processing and its commercial applications
- Get aware on the polymer processing for various industrial and domestic applications.

UNIT I METAL CASTING PROCESSES 9

Sand casting – Sand moulds - Type of patterns – Pattern materials and allowances – Types of Moulding sand – Properties – Methods of Sand testing – Core making – Moulding machines – Types - Melting furnaces – Working principle of Special casting processes – Shell moulding, Investment casting – Pressure die casting – Centrifugal casting – CO_2 process – Sand Casting defects – Inspection methods.

UNIT II JOINING PROCESSES 9

Fusion welding processes – Types of Gas welding – Equipment used – Flame characteristics – Filler and Flux materials - Arc welding equipment - Electrodes – Principles of Resistance welding – Spot, butt, seam, percussion welding – Gas metal arc welding – Submerged arc welding – TIG welding.
Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Diffusion welding – Hardfacing – Thermal spraying – Weld defects – Brazing and soldering processes – Filler materials and fluxes.

UNIT III BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals – Forging processes – Types of Forging Machines – Typical forging operations – Rolling of metals – Types of Rolling mills - Flat strip rolling– Shape rolling operations – Defects in rolled parts - Principle of rod and wire drawing - Tube drawing - Principles of Extrusion – Types of Extrusion.

UNIT IV SHEET METAL PROCESSES 9

Sheet metal characteristics - Typical shearing operations, bending and drawing operations –Stretch forming operations – Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Explosive forming, Magnetic pulse forming and Super plastic forming.

UNIT V MANUFACTURING OF PLASTIC COMPONENTS 9

Types of plastics - Working principles and typical applications of - Injection moulding – Plunger and screw machines – Compression moulding, Transfer moulding - Typical industrial applications – Introduction to Blow moulding – Rotational moulding – Film blowing – Thermoforming - Bonding of Thermoplastics.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Hajra Choudhury, "Elements of Workshop Technology, Vol. I Manufacturing Processes", Media Promotors Private Limited, Mumbai, 15th Reprint, 2012.
2. Hajra Choudhury, "Elements of Workshop Technology, Vol. II Machine Tools", Media Promotors Private Limited, Mumbai, 13th Reprint, 2012.
3. S.Gowri, P.Hariharan and A.Suresh Babu, "Manufacturing Technology 1", Pearson Education, 2008.

REFERENCES

1. B.S. Magendran Parashar & R.K.Mittal, “Elements of Manufacturing Processes”, Prentice Hall of India, 2003.
2. P.N.Rao, “Manufacturing Technology”, 2nd Edition, Tata McGraw-Hill Publishing Limited, 2002.
3. P.C. Sharma, “A Text book of Production Technology”, 11th Edition, S.Chand and Company, 2008.
4. Begman, “Manufacturing Process”, 8th Edition, John Wiley & Sons, 2005.
5. Serope Kalpajian, Steven R.Schmid, “Manufacturing Engineering and Technology”, Pearson Education, Inc. 2002 (2nd Indian Reprint).
6. Beddoes.J and Bibby M.J, “Principles of Metal Manufacturing Processes”, Elsevier, 2006.
7. Rajput R.K, “A text book of Manufacturing Technology”, Lakshmi Publications, 2007.
8. Larry Jeffus, “Welding and Metal Fabrication”, Cengage Learning, 2012.

13ME36 ELECTRICAL DRIVES AND CONTROLS L T P C
3 1 0 4

COURSE OUTCOMES

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

- Describe the concept of basic concepts of different types of electrical machines and their performance.
- Discuss the construction, working Principle, characteristics and applications of single phase and three phase induction motor.
- Illustrate the various types of D.C. motor starters.
- Identify the importance of Speed control of DC series and shunt motors.
- Discriminate the various methods of speed control of A.C. Drives.

UNIT I INTRODUCTION 12

Basic Elements – Types of Electric Drives – factors influence the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors.

UNIT II DRIVE MOTOR CHARACTERISTICS 12

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound - single phase and three phase induction motors.

UNIT III STARTING METHODS 12

Types of D.C Motor starters – Typical control circuits for shunt and series motors –Three phase squirrel cage and slip ring induction motors.

UNIT IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES 12

Speed control of DC series and shunt motors – Armature and field control, Ward - Leonard control system - Using controlled rectifiers and DC choppers – applications.

UNIT V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES 12

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications**.**

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

1. Vedam Subramaniam, “Electric Drives (Concepts and Applications)”, Tata McGraw-Hill, 2001.
2. Nagrath.I.J. & Kothari.D.P, “Electrical Machines”, Tata McGraw-Hill, 1998.

REFERENCES

1. Pillai.S.K, “A first course on Electric drives”, Wiley Eastern Limited, 1998.
1. M.D.Singh, K.B.Khanchandani, “Power Electronics”, Tata McGraw-Hill, 1998.
2. H.Partab, “Art and Science and Utilisation of electrical energy”, Dhanpat Rai and Sons, 1994.

13ME37 MATERIALS TESTING LABORATORY L T P C
0 0 3 2

COURSE OUTCOMES

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

- Evaluate elastic constants experimentally for different materials subjected to direct, shear and bending
- Enumerate hardness and impact resistance of the materials before and after heat treatment
- Analyze, strength and stiffness of helical coil springs
- Examine the materials for engineering applications.

LIST OF EXPERIMENTS

1. Tension test on a mild steel rod
2. Single shear and Double shear test on Mild steel and Aluminium rods
3. Torsion test on mild steel rod
4. Impact test on metal specimen: Charpy and Izod Test
5. Hardness test - Brinnell , Rockwell and Vickers Hardness Test.
6. Deflection test on Timber beams
7. Test on open coil and closed coil springs
8. Effect of hardening- Improvement in hardness and impact resistance of steels.
9. Tempering- Improvement Mechanical properties Comparison
   (i) Unhardened specimen
   (ii) Water quenched Specimen

LIST OF EQUIPMENTS (for a batch of 30 students)

1. Universal Tensile Testing machine – 1 No
2. Shear attachment – 1 No
3. Torsion Testing Machine – 1 No
4. Impact Testing Machine – 1 No
5. Brinell hardness Testing Machine – 1 No
6. Rockwell Hardness Testing Machine 1 No
7. Vickers hardness Testing Machine – 1 No
8. Spring Testing Machine for tensile and compressive loads – 1 No
9. Muffle Furnace – 1 No

TOTAL: 45 PERIODS

13ME38 ELECTRICAL ENGINEERING LABORATORY

L	T	P	C
0	0	3	2

COURSE OUTCOMES

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

- Describe the load characteristics of different DC machines
- Analyze the characteristics of AC rotating machines
- Illustrate the various types of starters for DC and AC machines
- Describe the characteristics of transformer
- Demonstrate the speed control practices associated with DC and AC machines

LIST OF EXPERIMENTS

1. Load test on DC Shunt & DC Series motor
2. O.C.C & Load Characteristics of DC Shunt and DC Series generator
3. Speed control of DC shunt motor (Armature, Field control)
4. Load test on single phase transformer
5. O.C & S.C Test on a single phase transformer
6. Regulation of an alternator by EMF & MMF methods
7. V curves and inverted V curves of synchronous Motor
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Load test on single phase Induction Motor
11. Study of DC & AC Starters

TOTAL: 45 PERIODS

13ME39 COMMUNICATION SKILLS AND TECHNICAL SEMINAR L T P C
(Common to all B.E./B.Tech. Degree Programmmes) 0 0 3 2

COURSE OUTCOMES

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

- Express themselves fluently and appropriately in social and professional contexts.
- Develop the sub-skills required for paper presentations and group discussions.
- Acquire the soft skills and interpersonal skills which will help them to excel in their workplace.

A) LANGUAGE FUNCTIONS (15 hrs)

1. Compare and contrast
2. Giving reasons
3. Reporting
4. Expressing agreement and disagreement
5. Evaluating different standpoints
6. Analyzing a problem and giving solution.
7. Describing daily routines, events, and weather
8. Describing Objects
9. Defending a point of view
10. Talking about future plans and intentions

Language Functions:

The teacher should build micro activities to develop the use of language required to handle these Sub-functions of communication. In the process, the learners should get used to the linguistic Elements needed for these functions.

B) SPEECH PRACTICE (15 hrs)

The themes are:

1. Cloning
2. Artificial satellites
3. Renewable sources
4. Telecommunication
5. Cyber Revolution
6. Space research
7. Polythene pollution
8. Fossil fuels
9. Safety measures in Automobiles.
10. Ecological threats
11. Water resources
12. Nuclear technology
13. Scientific farming
14. Thermal power plants
15. Nano Technology
16. Robotics
17. Artificial intelligence
18. Role of Fibre Optics
19. Exploration of Mars
20. Gas turbines
21. Indian space missions
22. Converting agricultural wastes for useful purposes
23. Developments in transportation
24. Scientific Farming
25. Impact of global warming
26. Desalination of water

27. Technology for national security
28. Industrial development and ecological issues
29. Recent trends in Automobiles
30. Hazards of E-waste
31. Mobile Jammer
32. Touch Screen Technology
33. Tidal Power
34. 3G Technology
35. Tsunami Warning System
36. Blue Tooth Technology

Seminar presentation on the themes allotted:

Each student should collect materials from Books, Internet, Journals and Newspapers for his/her theme and prepare a short Seminar Paper for 4 to 5 Pages. The presentation should be for 10 minutes using power point frames. It should be followed by a Viva Voce during which others should come forward to question, clarify, supplement or evaluate.

C) GROUP DISCUSSION / DEBATE (10hrs)

Grouping (each group consisting of 12 members)

Topics (12 topics – 3 topics to be selected by each group - to be practiced in cycles)

Group Discussion / Debate Topics:

1. Advertising is a legalized form of lying- Discuss.
2. Communicative competency in English is the golden key for success in the Global arena.
3. Is it just to force people to retire?
4. Attitude decides one's altitude in life.
5. Should an aspiring student go for a course which is in demand or for a course which he/she likes?
6. Is westernization a cultural degradation or enrichment?
7. Is Brain drain a threat to India?
8. Can Nuclear Energy be replaced by solar energy? – Discuss.
9. Do Mobile phones spoil the youth?
10. No two generations see eye to eye- Discuss.
11. Is scientific advancement a boon or a bane?
12. Does ragging develop friendship?

D) SPEAKING ON THE GIVEN PICTURE/DIAGRAM/CHART/TABLE (5 hrs)

RECORD LAY OUT:

Every student has to maintain a record in which he/she has to incorporate the following details.

- First page containing learner details and the topic of specialization
- Use of appropriate Language used in Language Function should be listed.
- Three news paper cuttings or journal or internet sources related to the specialized theme. (To be pasted on the pages)
- 10 Quiz questions of the specialized topic with expected answers.
- The seminar paper presented by the learner (to be pasted).
- Notes of observation - Lab. (Details about Interview skills – GD – Soft skills)
- The record should be duly signed by the course teacher and submitted to the External Examiner for verification during the semester practical.

TOTAL: 45 PERIODS

REFERENCES

1. Rizvi.M.Ashraf, "Effective Technical Communication", 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.

13ME41 PROBABILITY, STATISTICS AND NUMERICAL METHODS L T P C
3 1 0 4

COURSE OUTCOMES

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

- Understand the concepts of probability, random variables and their distributions.
- Apply the concepts of estimation (confidence intervals) and hypothesis testing for population averages and percentages.
- Analyze the appropriate tabular for displaying design of experiments.
- Use numerical techniques for solving linear system of equations and numerical integration problems.
- Demonstrate the utility of numerical techniques of ordinary differential equations.

UNIT I ONE DIMENSIONAL RANDOM VARIABLES AND ITS DISTRIBUTIONS 12

Discrete and continuous random variables –Moments, Moment generating functions and their properties - Discrete distributions: Binomial and Poisson – Continuous distribution: Normal distribution.

UNIT II TESTING OF HYPOTHESIS 12

Sampling distributions - Tests for single mean, Proportion, Difference of means (for large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes.

UNIT III DESIGN OF EXPERIMENTS 12

Completely randomized design – Randomized block design – Latin square design.

UNIT IV SOLUTION OF EQUATIONS AND NUMERICAL INTEGRATION 12

Solution of Algebraic and transcendental equations-Newton-Raphson method- Solutions of linear System of equations - Gauss Elimination method - Gauss-Jordan method – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Numerical integration using Trapezoidal and Simpson's rules for single and double integration.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Taylor's series method - Euler's methods - Fourth order Runge-Kutta method for solving first and second order equations – Adams- Bashforth and Milne's predictor-corrector methods for solving first order equations - Finite difference methods for solving second order equation.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

1. R.A. Johnson and C.B. Gupta, "Miller and Freund's Probability and Statistics for engineers", 7th Edition, Pearson Education (Asia), 2007.
2. Grewal, B.S. and Grewal,J.S., "Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, , 2004.

REFERENCES

1. R.E. Walpole, R.H. Myers, S.L. Myers and K Ye, "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education (Asia) , 2007.
2. M.R. Spiegel, J. Schiller and R.A. Srinivasan, "Schaum's Outlines Probability and Statistics", Tata McGraw Hill Edition, 2004.
3. Chapra S. C and Canale R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.
4. Gerald C. F. and Wheatley P. O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, , 2006.
5. P. Kandasamy, K. Thilagavathy and K. Gunavathy, "Numerical Methods", S.Chand & Co. Limited, New Delhi, 2003.
6. T.Veerarajan "Probablity Statistics and Random Process", 3rd Edition, Tata McGraw-Hill Education Private Limited, New Delhi, 2010.

13ME42 FLUID MECHANICS AND MACHINERY L T P C
3 1 0 4

COURSE OUTCOMES:
On Successful completion of the course, the students will be able to

- Use Euler's and Bernoulli's equations and the conservation of mass to determine velocities, pressures, and accelerations for incompressible fluids.
- Determine flow rates, pressure changes, minor and major head losses for viscous flows through pipes, ducts.
- Apply dimensional analysis techniques in fluid mechanics problems.
- Evaluate the performance of axial and radial turbines.
- Evaluate the operation and performance of centrifugal and reciprocating pumps.

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UNIT I INTRODUCTION 12

Units and Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equation, energy equation, momentum equation and moment of momentum equation. Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube

UNIT II FLOW THROUGH CIRCULAR CONDUITS 12

Laminar flow though circular conduits and circular annuli. Boundary layer concepts. Boundary layer thickness. Hydraulic and energy gradient. Darcy – Weisbach equation. Friction factor and Moody diagram - Commercial pipes - Minor losses - Flow though pipes in series and in parallel.

UNIT III DIMENSIONAL ANALYSIS 10

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

UNIT IV HYDRAULIC TURBINES 13

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 13

Pumps: definition and classifications - Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principles, indicator diagram and work saved by air vessels and performance curves - cavitations in pumps - rotary pumps: working principles of gear and vane pumps.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

1. Streeter. V. L., and Wylie, "E.B., Fluid Mechanics", 9th Edition, McGraw Hill, 2010.
2. Rathakrishnan. E, "Fluid Mechanics", Prentice Hall of India, 2nd Edition, 2007.

REFERENCES

1. Ramamritham. S, "Fluid Mechanics, Hydraulics and Fluid Machines", Dhanpat Rai & Sons, Delhi, 2004.
2. Kumar. K.L., "Engineering Fluid Mechanics", 7th Edition, Eurasia Publishing House Private Limited, New Delhi, 1995.
3. Bansal. R.K., "Fluid Mechanics and Hydraulics Machines", 9th Edition, Laxmi Publications Private Limited, New Delhi. 2011.
4. P. N Modi and S. M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 19th Edition, Standard Book House, 2013.

13ME43 KINEMATICS OF MACHINERY L T P C
3 1 0 4

COURSE OUTCOMES

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

- Understand the concept of machines, mechanisms and related terminologies.
- Analyse a mechanism for displacement, velocity and acceleration at any point in a moving link
- Understand the role of friction in drives and brakes.
- Understand the theory of gears, gear trains and cams

UNIT I BASICS OF MECHANISMS 7

Definitions – Link, Kinematic pair, Kinematic chain, Mechanism, and Machine - Degree of Freedom – Mobility - Kutzbach criterion (Gruebler's equation) - Grashoff's law- Kinematic Inversions of four-bar chain and 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), Steering gear for automobile.

UNIT II KINEMATIC ANALYSIS 15

Displacement, velocity and acceleration analysis of simple mechanisms (Single slider crank mechanism and four bar mechanism) - Graphical Methods for relative velocity and acceleration polygons - Coincident points – Coriolis acceleration - Approximate analytical expression for displacement, velocity and acceleration of piston of reciprocating engine mechanism.

UNIT III FRICTION DRIVES 13

Belt and rope drive – Open and cross belt drive – Belt materials – Creep and slip - Ratio of tensions – Effect of centrifugal force – condition for maximum power – Friction in Journal Bearing - Flat pivot bearing - Friction clutches – Single plate –Multi plate -Brakes - Shoe brake and Internal Expanding brake only.

UNIT IV KINEMATICS OF CAMS 11

Types of cams and followers - Displacement diagrams - Parabolic, Simple harmonic and uniform acceleration and retardation motions - Graphical construction of displacement diagrams and layout of plate cam profiles for reciprocating and oscillating motions with Knife-edge, roller and flat- faced followers - circular arc and tangent cams - Pressure angle and undercutting.

UNIT V GEARS 14

Types - Spur gear terminology and definitions – Pressure angle and undercutting - Law of gearing – Length of path of contact and contact ratio - Gear profiles (involute and cycloid) – Interference and undercutting – Minimum number of teeth to avoid interference - Gear trains – Simple, compound and Epicyclic gear trains - Differentials.

L: 45 T: 15 TOTAL: 60 PERIODS

TEXT BOOKS

1. Ambekar A. G., "Mechanism and Machine Theory", 1st Edition, Prentice Hall of India, New Delhi, 2009.
2. Uicker J.J., Pennock G.R., Shigley J.E., "Theory of Machines and Mechanisms", Indian Edition, Oxford University Press, 2003.

REFERENCES

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 3rd Edition, 2005.
2. Ramamurti,V., "Mechanism and Machine Theory", 2nd Edition, Narosa Publishing House, 2005.
3. Ghosh.A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East- West Private Limited, New Delhi, 1998.
4. Rao.J.S and Dukkipati R.V, "Mechanism and Machine Theory", Wiley-Eastern Limited, New Delhi, 1992.
5. Rattan.S.S, "Theory of Machines", Tata McGraw -Hill Publishers, New Delhi, 2009.

BIS Codes of Practice/Useful Websites

1. IS 2458 : 2001, Vocabulary of Gear Terms – Definitions Related to Geometry
2. IS 2467 : 2002 (ISO 701: 1998), International Gear Notation – Symbols for Geometric Data.
3. IS 5267 : 2002 Vocabulary of Gear Terms – Definitions Related to Worm Gear Geometry.
4. IS 5037 : Part 1 : 2004, Straight Bevel Gears for General Engineering and Heavy Engineering - Part 1: Basic Rack.
5. IS 5037 : Part 2 : 2004, Straight Bevel Gears for General Engineering and Heavy Engineering - Part 2: Module and Diametral Pitches

13ME44 MANUFACTURING TECHNOLOGY – II L T P C
3 1 0 4

COURSE OUTCOMES

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

- Gain the basic knowledge about the metal removal process and respective industrial standards
- Gain the knowledge about the centre lathe, its accessories and relative operations which are performed in machine shop.
- Aware on the constructional features and operating methods of various special purpose machine tools
- Gain knowledge on surface machining processes, design and fabrication of important machine elements
- Gain knowledge on CNC machining, respective equipment and its parts also will get ability to develop CNC programs for machining of materials

UNIT I THEORY OF METAL CUTTING 10

Introduction: material removal processes, types of machine tools - cutting tool geometry – theory of metal cutting: orthogonal cutting- chip formation, cutting tool materials, tool wear, tool life, cutting fluids.

UNIT II CENTRE LATHE AND SPECIAL PURPOSE LATHES 14

Centre lathe, constructional features, various operations, taper turning and thread cutting methods, machining time and power estimation. Capstan and turret lathes – Turret Indexing mechanism, bar feeding mechanism. Single spindle automatic lathes- Introduction to copying systems and transfer machines.

UNIT III SPECIAL MACHINE TOOLS 12

Reciprocating type: shaper, planer, slotter - Milling types, milling cutters, operations : drilling, Reaming, Boring, Tapping - Sawing machine: hack saw, band saw, circular saw, broaching machines: broach construction – push, pull, surface and continuous broaching machines

UNIT IV ABRASIVE PROCESSES AND GEAR CUTTING 12

Abrasive processes: grinding wheel – specifications and selection, types: cylindrical grinding, surface grinding, centreless grinding – honing, lapping, polishing and buffing - abrasive jet machining - Gear cutting - generation, shaping, hobbing.

UNIT V CNC MACHINE TOOLS AND PART PROGRAMMING 12

Numerical control (NC) machine tools – CNC: types, constructional details, special features – structural members – slide ways – linear bearings – ball screws – spindle drives and feed drives. Part programming fundamentals – manual programming – computer assisted part programming**.**

L: 53 T: 07 TOTAL: 60 PERIODS

TEXT BOOKS

1. Hajra Choudry, “Elements of Work Shop Technology – Vol. II”, Media Promoters, 2010.
2. HMT – “Production Technology”, Tata McGraw-Hill, 1998.

REFERENCES

1. Rao, P.N. “Manufacturing Technology”, Metal Cutting and Machine Tools Volume 2, Tata McGraw –Hill, New Delhi, 3rd Edition, 2013.
2. P.C. Sharma, “A Text Book of Production Engineering”, S.Chand and Company Limited, 11th Edition, 2008.
3. Shrawat N.S. and Narang J.S, “CNC Machines’, Dhanpat Rai & Co., 2002.
4. P.N.Rao, “CAD/CAM Principles and Applications”, Tata Mc Graw Hill, 2007.
5. Milton C.Shaw, “Metal Cutting Principles”, Oxford University Press, 2nd Edition, 2012.
6. Rajput R.K, “A Text book of Manufacturing Technology”, Laxmi Publications, 2007.
7. Philip F.Ostwald and Jairo Munoz, “Manufacturing Processes and systems”, John Wiley and Sons, 9th Edition, 2011.

8. Mikell P.Groover, “Fundamentals of Modern Manufacturing, Materials, Processes and Systems”, John Wiley and Sons, 3rd Edition, 2011.
9. Chapman. W.A.J and S.J.Martin, “Workshop Technology”, Part III, Viva Books Private Ltd., 2006.
10. Larry Jeffus, “Welding and Metal Fabrication”, Cengage Learning, 2012.

13ME45 ENGINEERING MATERIALS AND METALLURGY L T P C
3 0 0 3

COURSE OUTCOMES

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

- Attain the knowledge on structure and properties of materials.
- Attain skill to use phase diagrams and know presence of various phases with the addition of alloying elements.
- Attain the capability to test various properties of materials. Also obtain knowledge to select appropriate materials for different applications and environmental conditions.
- Obtain knowledge on different heat-treatment procedures for various materials.
- Acquire knowledge about plastics, ceramics and composites which are replacing metallic materials in several machineries.

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Review of crystal structures – Lattices – Grain size measurement – ASTM Standard. Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectic, peritectic, eutectoid and peritectroid reactions, Iron – Iron carbide equilibrium diagram. Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) and classification of steel.

UNIT II MECHANICAL PROPERTIES AND TESTING 9

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and charpy, fatigue and creep test – Introduction to ASTM Standards.

UNIT III HEAT TREATMENT 9

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

UNIT IV FERROUS AND NON FERROUS METALS 9

HSLA - maraging steels, stainless and tool steels – cast iron microstructure, properties and application. Gray, white, malleable, spheroidal-graphite and alloy cast irons. Ferrous powders and sintering. Copper and Copper alloys – Brass, Bronze and Cupronickel – Aluminum and Al-Cu alloys – precipitation strengthening treatment – Bearing alloys. Non-ferrous powders-Al, Cu, Si and sintering.

UNIT V NON-METALLIC MATERIALS 9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics – Properties and applications of Al_2O_3, SiC, SiC, Si_3, N_4, PSZ and Sialon – Fibre and particulate reinforced composites.

TOTAL: 45 PERIODS

TEXT BOOK

1. Kenneth G.Budinski and Michael K.Budinski "Engineering Materials" 9th Indian Reprint, Prentice-Hall of India Private Limited, 2009.

REFERENCES

1. Callister.S & R. Balasubramaniam, "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", McGraw Hill Book Company, 2nd Edition, 2008.

13ME46 ELECTRONICS AND MICROPROCESSOR **L T P C**
3 0 0 3

COURSE OUTCOMES

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

- Summarize the fundamental concepts of Rectifier & Power Supply Circuits
- Acquire knowledge about transistor biasing, amplifiers and negative feedback concepts
- Demonstrate Boolean functions using K-map, counter using flip flop
- Generalize the Architecture of 8085 Microprocessors
- Illustrate the concept of Assembly language and interfacing programs

UNIT I RECTIFIERS AND POWER SUPPLY CIRCUITS **9**

Half wave and Full wave rectifier analysis - Inductor filter – Capacitor filter – Series voltage regulator – Switched mode power supply

UNIT II TRANSISTORS AND AMPLIFIERS **9**

Bipolar junction transistor- CB, CE, CC configuration and characteristics-Biasing circuits - Class A,B and C amplifiers - Configuration and characteristic of FET and SCR - Concept of Negative feedback-Voltage / current, series/shunt feedback

UNIT III DIGITAL ELECTRONICS **12**

Basic digital circuits AND - OR - NAND - NOR - EX-OR - EX-NOR operations- Representation and simplification of logic functions using K Map - Four variable -Don't care conditions - Flip-flops - SR, JK, D, T, and Master-Slave JK – Characteristic table and equation , Realization of one flip flop using other flip flops Asynchronous and Synchronous Up/Down counter

UNIT IV 8085 MICROPROCESSOR **9**

Block diagram of microcomputer-Architecture of 8085 - Pin configuration - Instruction set-Addressing modes - Simple programs using arithmetic and logical operations

UNIT V INTERFACING AND APPLICATIONS OF MICROPROCESSOR **6**

Basic interfacing concepts - Interfacing of Input and Output devices - Applications of microprocessor Temperature control, Stepper motor control and Traffic light control

TOTAL: 45 PERIODS

TEXT BOOKS

1. David A. Bell, "Electronic Devices & Circuits", 5th Edition, Prentice Hall of India/Pearson Education, 8th printing, 2008.
2. Milman and Halkias, "Integrated Electronics", 2nd Edition, Tata Mc Graw-Hill publishers, 2011.
3. Ramesh Goankar, "Microprocessor Architecture Programming and Applications with 8085", 5th Edition, Penram International, 2011.
4. M. Morris Mano, "Digital Principles and System Design", 4th Edition, Prentice Hall, 2011.

REFERENCES

1. Malvino and Leach, "Digital Principles and Applications", 6th Edition, Tata McGraw-Hill, 2006.
2. Mehta V.K, "Principles of Electronics", 11th Edition, S. Chand and Company Limited, 2010.
3. Dougles V.Hall, "Microprocessor and Interfacing", 3rd Edition, Tata Mc-Graw Hill, 2012.

13ME47 FLUID MECHANICS AND MACHINERY LABORATORY

L	T	P	C
0	0	3	2

COURSE OUTCOMES

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

- Apply Bernoulli's equations in flow experiments to determine the coefficient of discharge.
- Determine flow rates, pressure changes, and minor and major head losses for viscous flows through pipes.
- Evaluate the performance of turbines.
- Evaluate the operation and performance of different types of pumps

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of losses in pipes.
5. Conducting experiments and drawing the characteristic curves of single and multi stage Centrifugal pump.
6. Conducting experiments and drawing the characteristic curves of Reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel turbine.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.
11. Study on Bernoulli's theorem apparatus.

LIST OF EQUIPMENTS

1. Orifice meter setup
2. Venturi meter setup
3. Rotameter setup
4. Pipe Flow analysis setup
5. Centrifugal pump/submergible pump setup
6. Reciprocating pump setup
7. Gear pump setup
8. Pelton wheel setup
9. Francis turbine setup
10. Kaplan turbine setup
11. Bernoulli's theorem apparatus

Quantity: One each.

TOTAL: 45 PERIODS

13ME48 MANUFACTURING TECHNOLOGY LABORATORY L T P C
0 0 3 2

COURSE OUTCOMES

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

- Gain hands on experience on working of general purpose machine tools and on various manufacturing processes.
- Gain practical hand on exposure to students in the various metal cutting operations using commonly used machine tools.

(Atleast minimum of 2 exercises in each section and put together 12 exercises)

UNIT I LATHE

1.1. Facing, plain turning and step turning.
1.2. Taper turning using compound rest, Tailstock set over, etc.
1.3. Single and Multi-start V thread, cutting and knurling.
1.4. Boring and internal thread cutting.

UNIT II WELDING AND SHEET METAL WORK EXCERCISES

2.1. Horizontal, Vertical and overhead welding.
2.2. Gas Cutting, Gas Welding.
2.3. Fabrication of sheet metal tray/ funnel.

UNITIII PREPARATION OF SAND MOULD

3.1. Mould with solid, split patterns.
3.2. Mould with loose-piece pattern.

UNIT IV SPECIAL MACHINES PART - I

4.1. Two or More Measurements in Metal Cutting Experiment (Example: Shear Angle, Cutting Force, Tool Wear etc.)
4.2. One or More Exercises in Shaper, Slotter, Planner, Drilling, Milling Machines (Example: Round to Square, Dovetail in shaper, Internal keyway cutting in Slotter, Round to square in Planner, Drilling, reaming and tapping in Drilling machine, Gear Milling and Keyway milling in Milling machine.)
4.3. Two or More Exercises in Grinding / Abrasive machining (Example: Surface Grinding, cylindrical Grinding.)

UNIT V SPECIAL MACHINES PART - II

5.1. Two or More Exercises in Assembly of Machined Components for different fits. (Example: Parts machined using Lathes, Shapers, Drilling, Milling, and Grinding Machines etc.)
5.2. One or More Exercises in Capstan or Turret Lathes.
5.3. One or More Exercises in Gear Machining (Example: Gear Milling, Gear Hobbing etc.)

TOTAL: 45 PERIODS

LIST OF EQUIPMENTS

1. **Centre Lathe with accessories**	15
2. **Welding**	
2.1 Arc welding machine	04
2.2 Gas welding machine	01
2.3 Brazing machine	01

3. **Sheet Metal Work facility**

3.1 Hand Shear 300mm	01
3.2 Bench vice	05
3.3 Standard tools and calipers for sheet metal work	05

4. **Sand moulding Facility**

4.1 Moulding Table	05
4.2 Moulding boxes, tools and patterns	05

5. **Plastic Moulding**

5.1 Injection Moulding Machine	01

6. **Special Machines Part I and II**

6.1. Turret and Capstan Lathes	01
6.2. Horizontal Milling Machine	01
6.3. Vertical Milling Machine	01
6.4. Surface Grinding Machine	01
6.5. Cylindrical Grinding Machine	01
6.6. Shaper	02
6.7. Slotter	01
6.8. Planner	01
6.9. Radial Drilling Machine	01
6.10. Tool Dynamometer	01
6.11. Gear Hobbing Machine	01
6.12. Tool Makers Microscope	01

13ME51 **THERMAL ENGINEERING**

L	T	P	C
3	1	0	4

COURSE OUTCOMES

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

CO1: Explain the concept of turbo machinery systems.
CO2: Identify and explain the various parts of IC engines and also compute the performance of the IC engine and the effect of emission on environment.
CO3: Estimate the performance of steam turbines and explain the basic concept of boilers.
CO4: Express the working Principle of reciprocating compressors and also study its performance.
CO5: Evaluate the performance of Refrigeration and explain the basics of Air conditioning systems.

UNIT I BASIC TURBO SYSTEMS 12

Turbo Machine: Basic concept and significant, Rotary Compressors, Fan, blowers - types, working principles, losses and performance curves, Flow through nozzles, Effect of friction in flow passages.

UNIT II INTERNAL COMBUSTION ENGINES 12

Classification, Components and their functions, two and four stroke engines-Valve and Port timing diagram, Actual and theoretical PV diagram– Fuel Properties–Combustion stages in SI and CI engines, Fuel Injection system, Lubrication, Cooling and Ignition Systems – Performance calculation & Heat Balance Test - Emissions in IC engines – Effects on Environment.

UNIT III STEAM TURBINES AND BOILERS 12

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 & Accessories – Emission –EPA Regulation - Exhaust filter.

UNIT IV RECIPROCATING AIR COMPRESSORS 12

Reciprocating Compressor - Classification and working principle, work of compression with and without clearance - Multistage air compressor and inter cooling - Performance calculation.

UNIT V REFRIGERATION AND AIR CONDITIONING 12

Refrigeration system - VCR cycle – Performance calculations - working principle of Vapour Absorption system–Green refrigerants - Special refrigeration application; Air Conditioning: Types – Factors affecting comfort in air conditioning – Process Air conditioning.

L: 45; T: 15; TOTAL: 60 PERIODS

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

TEXT BOOKS:

1. Rajput. R. K.,"Thermal Engineering", Laxmi Publications, Ltd., 9th Edition, 2013.
2. Kothandaraman.C.P., Domkundwar.S, Domkundwar.A.V., "A course in Thermal Engineering", Dhanpat Rai & sons, 5th Edition, 2002.

REFERENCES:

1. Arora.C.P, "Refrigeration and Air Conditioning", Tata McGraw-Hill Publishers, 2nd Edition, 2008.
2. Ganesan V. "Internal Combustion Engines",Tata McGraw-Hill Publishers, 3rd Edition, 2007.
3. Rudramoorthy. R, "Thermal Engineering ", Tata McGraw-Hill, New Delhi, 2003.
4. http://nptel.ac.in/courses/112105128/11
5. http://nptel.ac.in/video.php?subjectId=108105058

13ME52 **DESIGN OF MECHINE ELEMENTS** **L T P C**
3 1 0 4

COURSE OUTCOMES

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

CO1: Apply stress analysis theory, fatigue theory and appropriate criteria of failure to the design of simple machine elements
CO2: Design a shaft for any specific application with appropriate selection of keys andcoupling
CO3: Solve problems on joints under different loading condition.
CO4: Select and design suitable energy storing devices for any given application.
CO5: Choose proper bearing for specific application

UNIT I STEADY AND VARIABLE STRESSES IN MACHINE MEMBERS 12

STRESS ANALYSIS: Types of stresses, mechanical properties of materials, static stress equation in axial, bending and torsional loading, theories of failure, factor of safety. COMBINED STRESSES: Combination of normal stresses, eccentric loading of members, combination of normal and shear stresses, principal stresses,

VARIABLE LOADS: Mechanism of fatigue failure (in brief)-fatigue limit and fatigue strength, S-N curves, types of stress variations, terminology, stress raisers, stress concentration factor, notch sensitivity factor, factors affecting fatigue limit, finite life, equivalent stress, combined variable stress.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 12

DESIGN OF SHAFTS AND COUPLINGS: Design of shafts and rods for fatigue loading based on Soderberg, Goodman and Gerber equations, Forces on shafts due to gears, belts and chains, estimation of shaft size based on strength and critical speed. Design of square keys- Couplings-types and applications, use of standards, design and selection of rigid couplings, flexible flange couplings.

UNIT III DESIGN OF FASTNERS AND WELDED JOINTS 12

Design of knuckle joints. Threaded fastners - Design of bolted joints including eccentric loading – Design of welded joints for pressure vessels and structures - theory of bonded joints.

UNIT IV DESIGN OF SPRINGS 12

Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs - Belleville springs.

UNIT V DESIGN OF BEARINGS 12

SLIDING CONTACT BEARINGS: Theory of lubrication, hydrodynamic bearings, Sommerfield number, design of hydrodynamic bearings.

ROLLING CONTACT BEARINGS: Static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove and angular contact ball bearings.

L:45; T:15; TOTAL:60 PERIODS

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

TEXT BOOKS:

1. Juvinall R.C, and Marshek K.M, “Fundamentals of Machine Component Design”, John Wiley & Sons, Third Edition, 2002.
2. Bhandari V.B, “Design of Machine Elements”, Tata McGraw-Hill Book Co, 2003.

REFERENCES:

1. Norton R.L, “Design of Machinery”, Tata McGraw-Hill Book Co, 2004.
2. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.

3. Ugural A.C, “Mechanical Design – An Integral Approach, McGraw-Hill Book Co, 2004.
4. Spotts M.F., Shoup T.E., “Design and Machine Elements” Pearson Education, 2004.

STANDARDS

1. IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 1: Construction.
2. IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 2: Friction and Wear.
3. IS 10260: Part 1: 1982 Terms, definitions and classification of Plain bearings Part 3: Lubrication.

13ME53 **DYNAMICS OF MACHINERY**

L	T	P	C
3	1	0	4

COURSE OUTCOMES

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

- CO1: solve problems on dynamic forces and torques in reciprocating engines.
- CO2: compute the unbalanced forces in single and multi-cylinder engines
- CO3: calculate the natural frequency of simple vibratory system.
- CO4: determine the amplitude of the forced vibration caused by various means.
- CO5: Identify suitable governor for a particular application and describe the basic concepts in gyroscope

UNIT I FORCE ANALYSIS AND FLYWHEEL 12

Inertia force and Inertia torque - D' Alemberts Principle -Dynamic force analysis-dynamic analysis in reciprocating engines- -equivalent masses - crank shaft torque- engine shaking forces-Turning moment diagrams for steam engine, I.C. Engine and multi cylinder engine.- coefficient of Fluctuation of energy, coefficient of Fluctuation of speed -flywheels of engines.

UNIT II BALANCING 12

Static and dynamic balancing - Balancing of rotating masses - single and multiple planes- balancing of reciprocating masses – primary and secondary balancing of reciprocating masses. graphical methods. Unbalanced forces and couples –multi cylinder, in -line engines for primary and secondary balancing-locomotive balancing – hammer blow, swaying couple, variation of tractive force.

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 - Transverse loads, vibrations of beams with concentrated and distributed loads- Dunkerly's method. Types of Damping - Damped free vibration – logarithmic decrement- 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

UNIT V GOVERNORS and PRECESSION 12

Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung governors. Sensitiveness, isochronism and hunting–effort and power of a governor. Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car and ships.

L:45; T:15; TOTAL:60 PERIODS

TEXT BOOKS:

1. Bevan T, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, New Delhi, 2005.
2. Rattan S S, "Theory of Machines", 3rd Edition, Tata Mc Graw Hill, New Delhi, 2009.

REFERENCES:

1. Shigley J E and Uicker J J, “Theory of Machines and Mechanisms”, McGraw Hill, New Delhi, 1996.
2. Ballaney P L, “Theory of Machines and Mechanisms”, Khanna Publishers, New Delhi, 2005.
3. Ghosh and Mallick A K, “Theory of Machines and Mechanisms”, Affiliated East West Private Limited New Delhi, 1988.
4. Rao J S and Dukkipatti R V, “Mechanism and Machine Theory”, New Age International Limited, New Delhi, 1992.

13ME54 COMPUTER AIDED DESIGN AND MANUFACTURING

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Explain the basic concept of 2D and 3D CAD graphical manipulations.
CO2: Explain basic concept of various solid modeling techniques
CO3: Write simple 2D CNC Programming with Subroutines through Manual Part Programming
CO4: Write simple APT programs using subroutines concepts.
CO5: Describe the working principles of various rapid prototyping systems.

UNIT I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS 9

Introduction of CAD Tools, input, Output primitives. 2-D & 3-D transformation (Translation, scaling, rotation), windowing, view ports, clipping, transformation.

UNIT II SOLID MODELING 9

Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations - constructive solid geometry - user interface for solid modeling. open GL data exchange standards – IGES, STEP etc– communication standards.

UNIT III MANUAL PART PROGRAMMING 9

Basic components of an NC system, NC motion control, interpolation, part programming formats, manual part programming, NC coding systems (ISO and EIA)-NC words, macro statements, coordinate system, structure of a part program, G & M codes, tool length compensation, cutter radius and tool nose radius compensation, do-loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre. Writing simple 2D manual part programming.

UNIT IV COMPUTER AIDED PART PROGRAMMING 9

APT programming: APT language structure, APT geometry: definition of point, time, vector, circle, plane, patterns and matrices. APT motion commands: setup commands, point-to- point motion commands, continuous path motion commands. Post processor commands, complication control commands. Macro-subroutines, part program preparation for typical examples.

UNIT V INTRODCUCTION TO RAPID PROTOTYPING SYSTEMS 9

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

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS) - Process, working principle, Applications, Advantages and Disadvantages. Three dimensional Printing (3DP)- Process, working principle, Applications, Advantages and Disadvantages. Introduction to Rapid Tooling (RT) - Conventional Tooling Vs RT, Need for RT. Rapid Tooling

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS:

1. Ibrahim Zeid, CAD/CAM, Theory and Practice, Tata Mc Graw Hill, 2010.

2. CAD/CAM: Theory and comcepts, Chandandeep Grewal and kuldeep sareen, 2nd Edition, S.Chand Publications, 2007.
3. CAD/CAM: Concepts of Application, Alavala, Chennakesava .R, 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, E. Micheal, Geometric Modelling, John Wiley & Sons, 1995
3. Hill Jr, F.S., Computer Graphics using open GL, Pearson Education, 2003
4. CAD/CAM by Groover and Zimmers,
5. CAD/CAM , P.N. Rao Tata McGraw-Hill Company Limited, New Delhi.
6. Numerical Control of Machine Tools by Yoram Koren and Joseph Ben-Uri, Khanna Publishers, Delhi.

13ME55 PROFESSIONAL ETHICS AND HUMAN VALUES

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: recognize the core values that shape the ethical behavior of an engineer
CO2: expose awareness on professional ethics and human values.
CO3: distinguish their role in technological development

UNIT I HUMAN VALUES 9

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

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw-Hill, New York 1996.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.
3. Charles D. Fleddermann, “Engineering Ethics”, Pearson Education / Prentice Hall, New Jersey, 2004 (Indian Reprint)

REFERENCES:

1. 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)
2. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003.
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.

13ME56 INSTRUMENTATION AND CONTROL SYSTEMS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Analyze the characteristics of measuring instruments.

CO2: Demonstrate the working of pressure, flow, vibration and temperature measuring instruments.

CO3: Explain the working of sensors.

CO4: Recognize the basic principle of control systems.

CO5: Discuss the importance of mechanical and electrical system.

UNIT I CONCEPT OF MEASUREMENT 9

General concept – Generalized measurement system-Units and standards-measuring instruments-sensitivity, readability, range of accuracy, precision-static and dynamic response-repeatability-systematic and random errors-correction, calibration, interchangeability. Selection of measuring instruments-limits, fits and tolerances-Tolerance grads and allocation of tolerance

UNIT II PRESSURE AND FLOW MEASUREMENT 9

Manometer, elastic transducer, elastic diaphragm transducer – pressure cell, bulk modulus pressure gauge – Mc Leod gauge – thermal conductivity gauge, calibration of pressure gauge, flow measurement – turbine type meter, hotwire anemometer, magnetic flow meter; liquid level sensors, light sensors, selection of sensors.

UNIT III VIBRATION AND TEMPERATURE 9

Elementary accelerometer and vibrometer – seismic instrument for acceleration – velocity measurement, piezo electric accelerometer, 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 VARIABLES AND MEASUREMENT SIGNALS 9

Three stages of generalized measurement system – mechanical loading – static characteristics of instruments- factors considered in selection of instruments – commonly used terms, error analysisand classification – sources of error – frequency response – displacement transducers – potentiometer, strain gauge – orientationof strain gauge, LVDT – variable reluctance transducers, proximity sensors, capacitance transducers, tacho generator; smartsensors, integrated sensors, radio telemetry, torque measurements, precision systems like video discs and drives, laser printer etc.,

UNIT V CONTROL SYSTEM PRINCIPLE 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.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Beckwith T G and Buck N L, “Mechanical Measurements”, Addition Wesley Publishing Company Limited, 1995.
2. Gopal M, “Control Systems – Principles and Design”, Tata McGraw Hill Co. Ltd., New Delhi, 2002.

REFERENCES:

1. Jain R K, “Mechanical and Industrial Measurements”, Khanna Publishers, Delhi, 1999.
2. Rangan, Mani and Sharma, “Instrumentation”, Tata McGraw Hill Publishers, New Delhi, 2004.
3. Nagarath I J 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.

13ME57	COMPUTER AIDED DESIGN AND MANUFACTURING LABORATORY	L	T	P	C
		0	0	3	2

COURSE OUTCOMES

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

CO1: Develop Part modeling, Assembly and detailing of practical engineering components.

CO2: Apply the concept of Geometric dimensioning and tolerance to create manufacturing drawing with bill of materials.

CO3: Develop a Part model of existing physical component with a aid of manual measuring instruments.

CO4: Develop a virtual product for the new concepts/ ideas.

CO5: Generate CL data using CAM software

CO6: Perform simple operations in CNC Lathe and Milling machines

LIST OF EXERCISES

COMPUTER AIDED DESIGN LABORATORY

PART A - 2D to 3D Conversion

1. Part modeling, Assembly and Detailing of Screw Jack
2. Part modeling, Assembly and Detailing of Flange Coupling
3. Part modeling, Assembly and Detailing of Knuckle Joint
4. Part modeling, Assembly and Detailing of Plummer Block

PART B – Reverse Engineering

1. 3D Modeling of given physical components – Connecting Rod
2. 3D Modeling of given physical components – Spur Gear
3. 3D Modeling of given physical components – Piston

PART C – New Product Development

1. Develop a new product for given concept /ideas - I
2. Develop a new product for given concept /ideas- II

COMPUTER AIDED MANUFACTURING LABORATORY

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

1. Facing
2. Curve following
3. Pocket milling
4. Drilling
5. Step Turning
6. Taper turning.

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P:45 TOTAL: 45 PERIODS

13ME58 **THERMAL ENGINEERING LABORATORY**

L	T	P	C
0	0	3	2

COURSE OUTCOMES

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

CO1: Examine the properties of oil using various apparatus.
CO2: Evaluate and identify the optimum load which gives maximum efficiency in IC engines.
CO3: Demonstrate the calculation of Indicated power and frictional power by Morse method and retardation method in IC engines respectively.
CO4: Design & Conduct experiments on ICE to investigate & compare the performances.
CO5: Characterize different type of Oil//Fuels.

Course Content: (Minimum 12 experiments to be conducted)

- Study of Energy Balance and Mass Balance in Engines
- Characterization of Oil/Fuel

LIST OF EQUIPMENTS (for a batch of 30 students)

1. I.C Engine – 2 stroke and 4 stroke model 1 set
2. Red Wood Viscometer 1 No.
3. Apparatus for Flash and Fire Point 1 No.
4. Four stroke Diesel Engine with mechanical loading. 1 No.
5. Four stroke Diesel Engine with hydraulic loading. 1 No.
6. Four stroke Diesel Engine with electrical loading. 1 No.
7. Multi-cylinder Petrol Engine 1 No.
8. Single cylinder Petrol Engine 1 No.
9. Data Acquisition system with any one of the above engines 1 No.
10. Saybolt Viscometer 1 No.

P:45 TOTAL: 45 PERIODS

13ME61 **HEAT AND MASS TRANSFER**

L	T	P	C
3	1	0	4

COURSE OUTCOMES

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

CO1: Apply the concept of one dimensional steady and transient heat conduction through various coordinates systems.
CO2: Manipulate the concept of convection with the flow of fluids in different elements.
CO3: Identify the basic laws and applications of phase change heat transfer.
CO4: Apply the concept of radiation to solve problems in heat transfer system.
CO5: Illustrate the concept of diffusion and convective mass transfer in thermal systems.

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 (real time applications)

UNIT II CONVECTION 12

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

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 12

Nusselts theory of condensation-pool and flow boiling - Heat Exchanger Analysis–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:45; T:15; 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 M.N, “Heat Transfer”, McGraw-Hill Book Co., 1994.
3. Nag P.K, “Heat Transfer”, Tata McGraw-Hill, New Delhi, 2002.
4. Holman J.P “Heat and Mass Transfer”, Tata McGraw-Hill, 2000.
5. Kothandaraman C.P “Fundamentals of Heat and Mass Transfer”, New Age International, New Delhi, 2008.

13ME62 **DESIGN OF TRANSMISSION SYSTEMS** **L T P C**
3 1 0 4

COURSE OUTCOMES

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

CO1: Analyze, design and select flexible drive system for any given application
CO2: Formulate design procedures for power transmission between two non-parallel shafts.
CO3: Construct ray diagram and kinematic arrangement of gears to design multi speed gear box.
CO4: Design power screws to transmit power in machine elements.
CO5: Identify, evaluate and compare the functions of different types of brakes, clutches and cams.

UNIT I DESIGN OF TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS 12

Selection of V Belts And Chains: V belts for given power and velocity ratio, selection of micro V-belts, timing belts. Selection of roller chain and power speed ratio, silent chain.
Selection of Belts for Spindle Drive and Feed Drive in Application for CNC Machine Tools: Poly Vee Belts, HTD belts, V-belts of 3V, 5V and 8V types.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 12

Design of Gears: Review of gear fundamentals, interference, gear forces, determining dimensions of a spur gear pair. Design of helical gears-parallel axis helical gear, normal and transverse planes, helix angles, equivalent number of teeth, determining dimension of helical gear pair. Nomenclature of straight and bevel gears.
Worm Gears: Nomenclature, thermal capacity, efficiency, design of a pair of worm gears.

UNIT III DESIGN OF GEAR BOXES 12

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

UNIT IV DESIGN OF POWER SCREWS 12

Power Screws: Forms of threads, force analysis, square and trapezoidal threads, collar friction, design of power screws (for screw jack, lathe, etc.,) selection of ball screws.

UNIT V DESIGN OF CAM, CLUTCHES AND BRAKES 12

Friction Drives: Clutches - role of clutches, positive and gradually engaged clutches, toothed claw clutches, design of single plate and multiple plate clutches, variable speed drives, types and selection.
Brakes: Role of brakes-types of brakes-self energizing and de-energizing brakes. Design of internally expanding shoe brakes - calculation of heat generation and heat dissipation in brakes.

L:45; T:15; TOTAL:60 PERIODS

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

TEXT BOOKS:

1. Robert L Norton, “Machine Design - An Integrated Approach”, Pearson Education, New Delhi, 2003.
2. Shigley and Mische, “Mechanical Engineering Design”, McGraw Hill, Inc., New Delhi, 2000.

REFERENCES:

1. Robert L Mortt, “Machine Elements in Mechanical Design”, Macmillan Publishing Co., London, 1992.
2. Maitra G M, “Handbook of Gear Design”, Tata McGraw Hill, New Delhi, 1998
3. Faculty of Mechanical Engineering, PSG College of Technology, “Design Data Book”, M/s DPV Printers, Coimbatore, 2000.
4. V B Bhandari, “Design of Machine Elements”, Tata McGraw Hill Publishing Co .Ltd, New Delhi, 2003.
5. Prabhu T J, “Design of Transmission Elements”, Mani offset, Chennai, 2003.
6. Darle W Dudley, “Hand Book of Practical Gear Design”, CRC Press, Florida, 2002.
7. Allen S Hall and Alfred R Holowenko, “Schaum's Outlines of Theory and Problems of Machine Design”, Tata Mcgraw-Hill, 2006.

13ME63 **FINITE ELEMENT ANALYSIS** **L T P C**
3 1 0 4

COURSE OUTCOMES

Upon successful 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.
- CO2: Analyze one dimensional Engineering problems using finite element method.
- CO3: Select suitable 2D Element to solve structural problem under plane stress and plane strain condition
- CO4: Apply the principles of axisymmetric and Isoparametric in Mechanical Engineering problems.
- CO5: Formulate and solve basic problems in heat transfer and fluid mechanics

UNIT I FEA BASICS AND APPROXIMATION METHODS 12

Basic concepts of FEA-Engineering analysis- General procedure for FEA-discretization – Strain- displacement and stress – Strain relationship-Elasticity equations-Weighted residual method- Application to 1D structural and heat transfer problem- Variational method-Rayleigh Ritz method - Weak formulation method-Application to structural 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 matrix, element stiffness matrix, load vectors, Stress calculations, temperature effects-Plane problems of elasticity, Example problems in plane stress and plane strain application - Four noded rectangular element-Shape function, Strains and stresses, Application to solid mechanics problems.

UNIT IV AXISYMMETRIC AND ISOPARAMATRIC ELEMENT FORMULATION 12

Axisymmetric formulation- Shape function, Element matrices, temperature effects, Stress calculations, Applications to cylinders under internal pressure and rotating discs- Need for Isoparametric formulation- Four noded quadrilateral element - Shape function, Element matrices , Stress calculation-Coordinate transformation- Numerical Integration

UNIT V FEA APPPLICATIONS IN HEAT TRANSFER AND DYNAMICS 12

1D heat transfer-Element equations-Application to 1D heat transfer problems- Application to heat transfer in 2D - Vibrational problems - Equation of motion based on weak form ,Longitudinal vibration of bars, Transverse vibration of beams, Consistent and Lumped mass matrices for bar and beam element, Simple problems on free vibration of bar and beam.

L:45; T:15; TOTAL:60 PERIODS

TEXT BOOK:

1. P.Seshu, “Text Book of Finite Element Analysis”, Prentice-Hall of India, Private Limited, New Delhi, 2010. ISBN-978-203-2315-5

REFERENCES:

1. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International Editions (Engineering Mechanics Series), 1993. ISBN-0-07-051355-4
2. Chandrupatla & Belagundu, "Introduction to Finite Elements in Engineering", 3rd Edition, Prentice-Hall of India, Eastern Economy Editions. ISBN-978-81-203-2106-9
3. David V.Hutton,"Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition 2005. ISBN-0-07-239536-2
4. Cook, Robert.D. Plesha, Michael.E & Witt, Robert.J. "Concepts and Applications of Finite Element Analysis", Wiley Student Edition, 2004. ISBN-10 81-265-1336-5

13ME64 ENGINEERING METROLOGY AND QUALITY CONTROL

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Demonstrate the working and use of linear and angular measurement systems.
CO2: Explain the working principle of form measuring instruments.
CO3: Discuss the application of laser and computer aided inspection in metrology.
CO4: Select suitable measuring instruments to measure mechanical parameters.
CO5: Adopt Quality control techniques

UNIT I LINEAR AND ANGULAR MEASUREMENT 9

Definition of metrology-Linear measuring instruments: Basic design principles, Vernier, micrometer, Slip gauges and classification, interferometery, optical flats, limit gauges- Comparators: Mechanical, pneumatic and electrical types, applications.
Angular measurements: -Sine bar, optical bevel protractor, angle Decker – Taper measurements.

UNIT II FORM MEASUREMENT 9

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

UNIT III LASER AND ADVANCES IN METROLOGY 9

Precision instruments based on laser-Principles- laser interferometer-application in linear, angular measurements and machine tool metrology. Coordinate measuring machine (CMM)- Constructional features – types, applications – digital devices- computer aided inspection.

UNIT IV STATISTICAL QUALITY CONTROL 9

Process capability, steps in using control charts, basic principles of lot sampling – sampling inspection, single and double sampling, determination of sample size, Operating Characteristic curves (OC), Average Outgoing Quality (AOQ). Design Of Inspection Tools - Design of tool for inspection: gauging design of plug, snap gauges, thread gauges.

UNIT V QUALITY CONTROL CHARTS 9

Types, Manufacturing specifications, P CHART, np chart, cc chart, u chart, X and R chart-Solving problems using the charts. Design of tool for inspection, Design of plug, snap, thread gauges.

L:45 TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jain R.K., “Engineering Metrology”, Khanna Publishers, 2009
2. Alan S. Morris, “The Essence of Measurement”, Prentice Hall of India, 1997

REFERENCES:

1. Gupta S.C, “Engineering Metrology”, Dhanpat rai Publications, 2005
2. Jayal A.K, “Instrumentation and Mechanical Measurements”, Galgotia Publications 2005.
3. Beckwith T.G, and N. Lewis Buck, “Mechanical Measurements”, Addison Wesley, 1991.
4. Donald D Eckman, “Industrial Instrumentation”, Wiley Eastern, 1985.

13ME65 **FLUID POWER SYSTEMS**

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Identify the fluid power symbols and select suitable fluid for different applications.
CO2: Select appropriate fluid power driving system and actuators for any given application.
CO3: Select appropriate fluid power control elements to automate any simple machine. Read, construct, analyze and design the fluid power circuit for any real time application.
CO4: Acquire knowledge on designing of PLC Circuit and real time application of hydraulic & Pneumatic circuits.

UNIT I FUNDAMENTALS OF FLUID POWER SYSTEMS 9

Introduction to oil hydraulics and pneumatics, their structure, advantages and limitations, Properties of fluids, Fluids for hydraulic systems, governing laws, distribution of fluid power, ISO symbols, energy losses in hydraulic systems

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 9

Applications, Basic types and constructions of Hydraulic pumps and motors, Pump and motor analysis, Performance curves and parameters, Hydraulic actuators, types and constructional details, lever systems.

UNIT III FLUID POWER CONTROL SYSTEMS 9

Construction of Control Components: Direction control valves, Shuttle valve – check valve – pressure control valves – pressure reducing valve, sequence valve, Flow control valves – Fixed and adjustable, electrical control solenoid valves, Proportional control valves and servo valves and its application.

UNIT IV DESIGN OF FLUID POWER CIRCUITS 9

Design and analysis of typical hydraulic circuits, Regenerative circuits, high low circuits, Synchronization circuits, and accumulator sizing, Intensifier circuits, Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits, Sequential circuit design for simple applications using cascade method, accessories used in fluid power system, filtration systems and maintenance of system.

UNIT V DESIGN OF PNEUMATIC SYSTEMS AND APPLICATION 9

Components of pneumatic systems; FRP, Direction, flow and pressure control valves in pneumatic systems, Development of single and multiple actuator circuits, Valves for logic functions; Time delay valve; Exhaust and supply air throttling; Examples of typical circuits using Displacement – Time and Travel-Step diagrams. Electro-pneumatic control and air-hydraulic control, Ladder diagrams, Applications in Assembly, Feeding, Metalworking, materials handling and plastics working

L:45 TOTAL: 45 PERIODS

TEXT BOOK:

1. Anthony Esposito, Fluid Power with Applications, Pearson Education 2014.

REFERENCES:

1. Majumdar S.R., Pneumatic Systems – Principles and Maintenance, Tata McGraw Hill, 2006.

2. Majumdar S.R., Oil Hydraulic Systems – Principles and Maintenance, Tata McGraw-Hill, 2006.
3. Illango. S & 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.

13ME67 **HEAT TRANSFER LABORATORY**

L	T	P	C
0	0	3	2

COURSE OUTCOMES

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

CO1: Conduct heat transfer experiments and analyze experimental data to understand Different modes of heat transfer.

CO2: Conduct experiments on different thermal systems like heat exchangers, air Conditioners, compressors etc., and analyze data to study the performance

LIST OF EXPERIMENTS (Minimum 12 Experiments to be conducted)

1. Thermal conductivity measurement by guarded plate method
2. Thermal conductivity of pipe insulation using lagged pipe apparatus
3. Natural convection heat transfer from a vertical cylinder
4. Forced convection inside tube
5. Heat transfer from pin-fin (natural & forced convection modes)
6. Determination of Stefan-Boltzmann constant
7. Determination of emissivity of a grey surface
8. Effectiveness of Parallel/counter flow heat exchanger
9. Effectiveness of compact heat exchanger
10. Determination of COP of a Vapour compression refrigeration system
11. Experiments on air-conditioning system
12. Performance test on single/two stage reciprocating air compressor.

P:45 TOTAL: 45 PERIODS

13ME68 METROLOGY AND MEASUREMENTS LABORATORY

L	T	P	C
0	0	3	2

COURSE OUTCOMES

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

CO1: Demonstrate the use and calibrate the different measuring instruments.

CO2: Demonstrate the use of different types of comparators.

LIST OF EXPERIMENTS

1. Calibration of Vernier / Micrometer / Dial Gauge
2. Checking Dimensions of part using slip gauges
3. Measurements of Gear Tooth Dimensions
4. Measurement of Taper Angle using sine bar
5. Measurement of tool angles using tool makers microscope
6. Measurement of straightness and flatness
7. Measurement of thread parameters
8. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical)
9. Measurement of Temperature using Thermocouple / Pyrometer
10. Measurement of Displacement (Strain Gauge / LVDT / Wheatstone Bridge)
11. Measurement of Force
12. Measurement of Torque
13. Measurement of Vibration / Shock

P:45 TOTAL: 45 PERIODS

13ME69 **COMPREHENSION** **L T P C**
0 0 3 1

COURSE OUTCOMES

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

CO1: apply the knowledge acquired during the earlier semesters to solve real life problems.

CO2: apply the basic mathematics, science and modern TQM tools to analyze and interpret results.

CO3: analyze the fundamentals of contemporary manufacturing systems and its impact on society and environment.

CO4: demonstrate and solve real life industrial problems and work in groups.

CO5: explain the structured engineering activities carried out in their projects and communicate effectively among their group members and other groups.

CO6: understand the technological and managerial changes in the global scenario and absorb them.

CO7: realize the need for continuous learning after analyzing the strength and weakness analysis.

CO8: plan and manage their projects and summarize effective project reports.

Exercises

Review of various courses learned in the previous semesters will be carried out by maintaining a work book by the students under the guidance of the staff members.

Group activities such as technical debate and presentation on fundamentals of contemporary manufacturing systems including materials, manufacturing process, product and process control, computer integrated manufacture and quality will be conducted.

Student group activities such as conducting experiments and accumulating data in the previous semester laboratory classes will be useful for analyzing and interpreting the results and communicating the outcomes of their work with a brief write up.

Real life industrial problems which they may face in their work place will be analyzed and solutions will be formulated. At least two such problems will be identified and solved by each group of students. The group of students will prepare and submit their project presentation through seminars.

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:45 TOTAL: 45 PERIODS

13ME71 **PRINCIPLES OF MANAGEMENT** **L T P C**
(Common to All branches) **3 0 0 3**

COURSE OUTCOMES

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

CO1: discuss the development of management thoughts and different types of Business Organization. (U)

CO2: practice the process of planning and decision making in an industrial situations. (Ap)

CO3: design the suitable selection process for a particular job description. (An)

CO4: apply different motivational techniques and leadership skills in the organization. (Ap)

CO5: justify the various controlling techniques and tools in the organization. (Ev)

UNIT I INTRODUCTION 9

Historical developments – approaches to management – Management and Administration – Development of Management Thoughts – Contribution of Taylor and Fayol – Functions of Management – Types of Business Organization, Meaning, features merits and demerits - Social responsibility.

UNIT II PLANNING 9

Nature and Purpose – Steps in Planning Process – Objectives – Setting Objectives – Process of Managing through Objectives – Strategies – Policies and Planning Premises – Forecasting – Importance, Methods of Forecasting - Decision-making, Decision making Process & Types of Decisions.

UNIT III FUNCTIONAL AREA OF ORGANISATION 9

Formal and Informal organization – Organization Chart – Structure and Process – Departmentation by different strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process - Techniques – HRD – Managerial Effectiveness.

UNIT IV DIRECTION 9

Objectives– Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Types of Communication – Barriers and Breakdown - Effective Communication - Electronic Media in Communication.

UNIT V CONTROLLING STRATEGIES 9

System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology– Computers in handling the information – Productivity – Problems and Management – Control of Overall Performance – Direct and Preventive Control – Reporting – The Global Environment – Globalization and Liberalization – International Management and Global theory of Management.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Harold Koontz & Heinz Weihrich, "Essentials of Management – An Internationtional Perspective", Tata Mcgraw Hill, 8th Edition, 2009.
2. Hellriegel, Slocum & Jackson, "Management – A Competency Based Approach", Thomson South Western, 11th Edition, 2008.
3. Andrew J. Dubrin, "Essentials of Management", Thomson South western, 9th Edition, 2011.

REFERENCES

1. Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall of India", 8th Edition, 2012.
2. Charles W.L Hill, Steven L McShane, "Principles of Management", Mcgraw Hill Education, Special Indian Edition, 2007.
3. Vijayaraghavan G.K & Sivakumar M. "Principles of Management", Lakshmi Publications, 1st Edition, 2012.
4. Ramachandran. S. "Principles of Management", Air Walk Publications, 1st Edition, 2012.

13ME72 OPERATIONS RESEARCH L T P C
3 1 0 4

COURSE OUTCOMES

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

CO1. formulate and solve the real world linear programming problems (LPP) using suitable tools. (Ap)
CO2. solve transportation, Assignments and travelling sales man problems. (Ap)
CO3. construct network and apply CPM and PERT techniques for project evaluation. (An)
CO4. select appropriate inventory models for given problems. (Ap)
CO5. select suitable replacement models and find the economic life of the items. (Ap)
CO6. solve the various queuing problems. (Ap)

UNIT I LINEAR MODEL 12

The phases of OR study – Mathematical formulation of L.P. Problems. Graphical solution methods– Simplex method - slack, surplus and artificial variables, two phase method, degeneracy and procedure for resolving degenerate cases.

UNIT II TRANSPORTATION, ASSIGNMENT AND TRAVELLING SALES MAN PROBLEMS 12

Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problems, Degeneracy in transportation problems, Applications of Transportation problems. Assignment Problems: Formulation, unbalanced assignment problems, Traveling salesman problems.

UNIT III NETWORK AND INVENTORY MODELS 12

CPM -Network construction, determining critical path, floats, project duration. PERT – Network Analysis. Cost trade off.

Types of Inventory- EOQ –ERL- Deterministic inventory problems – Price breaks - Stochastic inventory problems- selective inventory control techniques.

UNIT IV REPLACEMENT AND SEQUENCING MODELS 12

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 with two machines – problem with n jobs with three machines.

UNIT V QUEUING MODELS 12

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 T:15 TOTAL: 60 PERIODS

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

TEXT BOOKS

1. Taha H.A, "Operation Research", Pearson Education, 8th edition, 2007.
2. Wayne.L.Winston, "Operations research applications and algorithms", Thomson learning, 4th edition, 2007.

REFERENCES

1. Frederick.S.Hiller and Gerald.J.Lieberman, “Operations research concepts and cases”, TMH (SIE), 10th edition. 2016
2. Sharma. J.K., “Operations research theory and applications”, Macmillan India, 3rd Edition, 2007.
3. Hira and Gupta “Problems in Operations Research”, S.Chand and Co, 2002.
4. Panneerselvam, “Operations Research” Prentice Hall of India, 2003.
5. G Srinivasan, “Operations research principles and applications”, PHI (EEE) 2007.
6. Wagner, “Operations Research”, Prentice Hall of India, 2000.

13ME73 AUTOMOBILE ENGINEERING

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: describe different types of layout and chassis of an automobile and choose appropriate material for chassis and body. (U)

CO2: identify suitable auxiliary system for an engine to meet the requirements (Ap)

CO3: describe different transmission system of an automobile (U)

CO4: explore various types of steering, suspension and braking systems (Ap)

CO5: discuss present and future technologies in automobile. (An)

UNIT I VEHICLE STRUCTURE 9

Types of automobiles, vehicle construction and different layouts, types of chassis- conventional, semi integral, integral, importance of body design, selection of material for body construction and chassis.

UNIT II ENGINE AUXILIARY SYSTEMS 9

Electronically controlled gasoline injection system, electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), electronic ignition system, turbo and super chargers, engine emission control by three way catalytic converter system, emission norms.

UNIT III TRANSMISSION SYTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, over drive, transfer box, fluid flywheel –torque converter, propeller shaft, slip joint, universal joint, differential, rear axle, hotchkiss drive and torque tube drive.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and steering gear box, power steering- hydraulic and electric, front axle-types, suspension system- types, pneumatic and hydraulic braking systems, antilock braking system, electronic brake force distribution and traction control.

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, New Delhi, 13th Edition, 2013,
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.

13ME74	POWER PLANT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: explain the basic concept of power generation and its types and also compare different techniques for various applications. (An)

CO2: identify and explain the various components of steam power plants and estimate its performance. (An)

CO3: explain the concept and working of nuclear, hydel, and diesel power plant and analyze the environmental issues. (An)

CO4: estimate the energy cost and economy of different power plant. (An)

CO5: select an appropriate power generation system that meets desired sustainable energy, economical, environmental and social requirements. (Ap)

UNIT I INTRODUCTION TO POWER PLANTS 9

Power plants-Features - Components and layouts-Working principle of conventional and unconventional power plants – Site selection criteria for conventional power plant – Comparison of different power plants – Selection of suitable power generation techniques for large scale power production.

UNIT II STEAM POWER PLANT 9

Coal handling and preparation – Power plant boilers - Combustion equipment and firing methods- Ash handling systems-Electrostatic precipitator- Draught system-Condenser-Cooling tower- Performance calculation – Effects of emission on environment – pollution control methods.

UNIT III NUCLEAR POWER PLANT 9

Principles of nuclear energy-Types of reactor- reactor materials - Heat transfer techniques in nuclear reactors - Radiation shielding - Nuclear waste - types of waste and its disposal options - Radiation hazards and their prevention methods.

UNIT IV HYDRO AND DIESEL POWER PLANTS 9

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

UNIT V ECONOMICS OF POWER PLANTS 9

Economic terms in power plant– Economic methodologies – Cost models - Capital and Operating Cost of different power plants - Energy rates - Types of tariff - Load Curves – Factors affecting the economics of generation and distribution of power.

L: 45 TOTAL: 45 PERIODS

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

TEXT BOOKS

1. EI-Wakil M.M ,"Power Plant Technology", Tata McGraw-Hill, 2010, 1st edition
2. P.K. Nag, "Power Plant Engineering", Tata McGraw Hill, 4th Edition, 2014.

REFERENCES

1. Arora S.C and Domkundwar S, “A Course in Power Plant Engineering”, Dhanpat Rai, 2001.
2. K.K.Ramalingam, “Power Plant Engineering”, Scitech Publications, 2002.
3. G.R.Nagpal, “Power Plant Engineering”, Khanna Publishers, 1998.
4. R. K. Rajput, “A Text Book of Power Plant Engineering”, Laxmi Publications, 4th Edition, 2008.

13ME77	COMPUTER AIDED SIMULATION AND ANALYSIS LABORATORY	L	T	P	C
		0	0	3	2

COURSE OUTCOMES

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

CO1: model and analyze the structural components.(An)

CO2: model and conduct vibrational analysis in structural components.(An)

CO3: model and analyze thermal systems.(An)

CO4: simulate simple mechanisms.(An)

LIST OF EXERCISES

CO1: **21**

1. Analysis of structures having various sections, at different load conditions.
2. Stress analysis of rectangular plate with hole.
3. Stress analysis of an axisymmetric component.
4. Structural analysis of any type of bracket.
5. Design of experiment for any structural problem.

CO2: **9**

6. Modal analysis of beams and bracket.
7. Harmonic analysis of beams.
8. Vibrational anlysis of an automobile suspension system and wind tubine blade.

CO3: **9**

9. Analysis of one dimensional and two dimensional heat transfer problems**.**
10. Thermal stress analysis of a bar.
11. Design of experiments for thermal problems like heat exchangers and welded structures.

CO4:

12. Simulation of Hydraulic / Pneumatic cylinder using MATLAB

6

13. Modelling and Simulation of free vibration using MATLAB

P: 45 TOTAL: 45 PERIODS

TEXTBOOKS

1. Paleti Srinivas, Krishna Chaitanya Saambana and Rajesh Kumar Datti, "Finite Element Analysis using ANSYS 11.0", PHI, 2nd Edition, 2012.
2. Shailendra Jain, "Modelling and Simulation Using MATLAB Simulink", Wiley, 2011.

REFERENCES

1. Saeed Moaveni, Finite Element Analysis theory and applications with ANSYS, Pearson Prentise Hall, 3rd Edition, 2008.
2. Erdogan Madency, Ibrahim Guven, The Finite Element Method and Applications in Engineering using ANSYS, Springer, 2nd Edition, 2015.
3. ANSYS Verification Manual.
4. Alberta University ANSYS Tutorial.
5. Cornell University ANSYS Tutorial
6. http://www.mathworks.com
7. http://www.ansys.com

13ME78 AUTOMATION AND DYNAMICS LABORATORY

L	T	P	C
0	0	3	2

COURSE OUTCOMES

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

CO1: design, modeling and simulate the basic hydraulic and pneumatic circuits. (An)

CO2: control the process variables using computerized system. (An)

CO3: validate theoretical modeling by conducting experiments on control mechanism.(An)

CO4: evaluate the critical speed and inertia effects of the rotating structures and validate the analytical results experimentally. (An)

LIST OF EXPERIMENTS

AUTOMATION LABORATORY

1. Design and testing of fluid power circuits to control
   (i) Velocity (ii) direction (iii) force of single and double acting actuators.
2. Design of circuits with logic sequence by using pneumatic trainer kits.
3. Simulation of basic Hydraulic, Pneumatic and Electric circuits by using different simulation softwares.
4. Stepper motor interfacing with 8051 Micro controller -Full and half step resolution.
5. Servo controller interfacing for DC motor.
6. Computerized data logging system with control for process variables like pressure flow and temperature.

DYNAMICS LABORATORY

7. Motorized gyroscope – Study of gyroscopic effect and couple.
8. Governor - Determination of range sensitivity, effort for Porter Governor.
9. Governor -Determination of range sensitivity, effort for Proell Governor.
10. Cams – Cam profile drawing.
11. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
12. Balancing of rotating masses.

P: 45 TOTAL: 45 PERIODS

13ME79	PROJECT WORK PHASE - I	L	T	P	C
		0	0	3	2

COURSE OUTCOMES

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

CO1: propose an engineering based project to solve real time problems. (U)

CO2: identify, analyze and summarize appropriate list of literature/ product/patent reviews. (An)

CO3: formulate clearly a methodology and work plan to carry out the project. (Ap)

CO4: present the project outlining, the approach and expected results using good oral and written presentation skills. (An)

COURSE DESCRIPTION

Overview of state-of-the-art of technology, development and research in the project area - review of literature - problem identification - methodology, work plan - theoretical modeling and pre-design.

P: 45 TOTAL: 45 PERIODS

13ME81 SOCIOLOGY AND GLOBAL ISSUES

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: analyze the given social problems in rural and urban society. (An)

CO2: understand social hierarchic of power and its effect on society.(U)

CO3: critically examine social problems by considering the larger picture. (An)

CO4: view themselves as competent social actors with an understanding of how they can be catalysts for change (Ev)

UNIT I INTRODUCTION **9**

Basic social science concepts - Overview of sociological theories - Social stratification/inequality - Characteristics and Types - Causes and Reactions - Theoretical and Methodological Approaches - Rural and Urban Problems in India - Social Change in India - Discussion.

UNIT II FAMILY ISSUES **9**

Race and Religion inequality – Gender inequality – Divorce – Busyness - Lack of discipline - Financial pressures - Lack of communication - Negative media influences - Balance of work and family – Discussion

UNIT III POPULATION ISSUES IN HUMAN **9**

Population and poverty – Poverty and causes – World hunger and Poverty – Food dumping Effects of over consumption - Educational Inequality – Magnitude and causes of Illiteracy - Unemployment and underemployment - Environmental issues – Global warming and climate change - Discussion

UNIT IV ILLNESS AND HEALTH CARE ISSUES **9**

Global Health overview – Diseases – Medical Research – Health in the Media – Tobacco and alcohol – Obesity – Diabetes – Illicit Drugs market – Discussion

UNIT V TRADE, ECONOMY AND RELATED ISSUES **9**

Global Financial Crisis – WTO and its functions -– Corruption – Economic Democracy – Debt crisis – Free trade and Globalisation – Terrorism – Discussion

L: 45 TOTAL: 45 PERIODS

TEXTBOOKS

1. James William Coleman and Herold R. Kerbo, "Social Problems", Perason,10th edition, , 2008
2. Vic George and Robert M. Page, "Global Social Problems", Polity Press, 2010

REFERENCES

1. Joel Charon & Lee Garth Vigilant, "Social Problems", Thompson Wadsworth 2ND Edition**,** 2006.
2. McMullin, Julie, "Understanding Social Inequality", Don Mills, Ontario: Oxford University Press, 2nd Edition, 2010.

13ME87	PROJECT WORK PHASE - II	L	T	P	C
		0	0	18	6

COURSE OUTCOMES

Upon successful 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. (Ap)

CO2: apply appropriate tools to solve the real time problem. (Ap)

CO3: develop creative thinking and work as a team to carry out the project. (Ev)

CO4: organize, compile, analyse, report and discuss the outcomes of the project.(An)

COURSE DESCRIPTION

Fabrication of products/ testing setup of an experimentation unit/ apparatus/ small equipment, in a group and experimental verification of principles to manage complex Mechanical Engineering projects that are motivational, entrepreneurial and/or industry linked.

Materials and methods to analyze for arriving appropriate solutions for the selected real time problem.

Detailed design of innovative systems and their components with realistic constraints -Analysis of system performance, economics, and assessment of environmental impact- Experimental and/or theoretical analysis, Results and discussions, Presentation and Viva.

13MEAA ADVANCED INTERNAL COMBUSTION ENGINES

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Describe the types, operating parameter, Ideal and Real cycles of IC Engines.

CO2: Discuss about the gas exchange processes including flow of fuel, charging, swirl& squish.

CO3: Explain the mechanism of combustion in SI & CI Engines.

CO4: Explain the formation of different pollutants, measuring and controlling methods and emission norms.

CO5: Discuss the importance of heat transfer in Engine & recent developments in I.C Engines including alternate fuels and Engine Electronic Management

UNIT I INTRODUCTION 9

Historical Review – Engine Types – Design and operating Parameters; Cycle Analysis: Thermo -chemistry of Fuel – Air mixtures, Properties – Ideal Models of Engine cycles – Real Engine cycles – Factors responsible for differences – Computer Modeling.

UNIT II GAS EXCHANGE PROCESSES 9

Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging; Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flow.

UNIT III ENGINE COMBUSTION 9

S.I Engines: Stages of combustion - Combustion and Speed – Cyclic Variations – Ignition – Abnormal combustion - Fuel factors – MPFI, SI engine testing; CI Engines: Essential Features – Pressure Data – Fuel Spray Behavior – Ignition Delay – Mixing Formation and Control, Common Rail Fuel Injection System.

UNIT IV POLLUTANT FORMATION AND CONTROL 9

Nature and extent of problems – Pollutant - Sources and types - Formation of NOx - Hydro-carbon Emission Mechanism - Carbon Monoxide Formation - Particulate emissions - Methods of controlling Emissions - Methods of measurements - Indian Driving Cycles and emission norms.

UNIT V ENGINE HEAT TRANSFER AND RECENT TRENDS 9

Importance of heat transfer - Heat transfer and Engine energy balance - Convective heat transfer - radiation heat transfer - Engine operating characteristics; Fuel supply systems for S.I. and C.I engines -Gaseous fuels - LPG, CNG and Hydrogen; Modern Trends in IC Engines: Lean Burning and Adiabatic concepts - Rotary Engines - Modification in I.C engines to suit Bio – fuels - HCCI and GDI concepts - Plasma Ignition - Engine Electronics Management - Data Acquisition System – pressure pick up, charge amplifier PC for Combustion and Heat release analysis in Engines and different sensors.

L:45 TOTAL: 45 PERIODS

TEXT BOOKS:

1. Internal Combustion Engine Fundamentals – John B Heywood
2. Heinz Heisler, “Advanced Engine Technology,” SAE International Publications, USA, 1998
3. Ganesan V, “Internal Combustion Engines”, 3rd Edition, Tata McGraw-Hill, 2007

REFERENCES:

1. The Internal Combustion Engine in Theory and Practice: Vol. 1 & 2 – Charles Fayette Taylor.
2. Engineering Fundamentals of the Internal Combustion Engine—Willard W. Pulkrabek
3. Fundamentals of Internal Combustion Engines -- Gill P W.,Smith .J HZiury .E J
4. R.B.Mathur and R.P.Sharmal, " Internal Combustion Engines ".
5. Rowland S.Benson and N.D.Whitehouse, " Internal combustion Engines ", Vol.I and II, Pergamon Press, 1983.
6. Duffy Smith, "Auto fuel Systems ", The Good Heart Willox Company, Inc., 1987.

13MEAB RENEWABLE SOURCES OF ENERGY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Understand the concepts of solar thermal and its application
CO2: Be familiar with the concept of Energy conversion physics in PV.
CO3: Understand the concepts of extraction of Wind Energy.
CO4: Understand the concepts of various Bio-Energy Conversion techniques
CO5: Be familiar with the concepts of hydrogen and fuel cell technology.

UNIT I INTRODUCTION TO SOLAR ENERGY 9

Sun – Earth Geometry, solar radiation, Solar Thermal: Basic Concept, types, working principles of different collectors. Application of solar thermal systems.

UNITII DIRECT ELECTRICITY CONVERSION 9

Direct Electricity Conversion- types and working principle - Basic physics of photovoltaic - Solar photovoltaic system – types of pv systems– Applications and Contributions in Energy Scenario.

UNIT III 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.

UNITIV BIO-ENERGY 9

Biomass: sources, characterization, principles of energy transfer technologies. Biogas: Feedstock, types of Biogas plant- parameters affecting biogas production.

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

REFERENCES

1. "Solar Photovoltaics Fundamentals, Technologies and Applications", Second Edition byChetan Singh Solanki, Prentice Hall of India.
2. Sukhatme S.P., "Solar Energy", Tata McGraw Hill, 2008.
3. Mukund R. Patel, "Wind and Solar Power Systems", CRC Press, 1999.
4. Hart, A.B., and Womack, G. J.,"Fuel Cells: Theory & Applications", Prentice Hall, 1997.
5. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press,U.K, 1996.
6. Veziroglu, T.N., "Alternative Energy Sources", Vol 5 and 6, McGraw-Hill, 1990
7. Twidell, J.W. and Weir, A., "Renewable Energy Sources", EFN Spon Ltd., 1986.
8. Khandelwal K.C, Mahdi S.S., "Biogas Technology" -A Practical Handbook, Tata McGraw Hill, 1986.
9. Kreith, F and Kreider, J. F.," Principles of Solar Engineering", McGraw-Hill, 1978.

13MEAC	SOLAR PHOTOVOLTAIC FUNDAMENTALS AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: Understand the fundamentals of solar cells.

CO2: Recognize the various solar PV technologies and their up gradations along with their benefits.

CO3: Design and analyze on-grid and off-grid PV applications

CO4: Realize cost benefit analysis of PV installations

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 BOOK:

1. "Solar Photovoltaics Fundamentals, Technologies and Applications", Second Edition by Chetan Singh Solanki, Prentice Hall of India.

REFERENCES:

1. "Photovoltaic Systems", Second Edition by James P. Dunlop, American Technical Publishers
2. Solar Electricity:Engineering of Photovoltaic Systems" by Eduardo Lorenzo, PROGE NSA.
3. "SOLAR ENERGY - Renewable Energy and the Environment" Robert Foster, Majid Ghassemi, Alma Cota, CRC Press
4. www.pveducation.org

13MEAD	DESIGN OF HEAT EXCHANGER AND PRESSURE VESSEL	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: conceive a design based on the information provided for a particular application
CO2: learn the sizing of the equipment
CO3: predict the thermal behavior and carry out a stress analysis
CO4: come up with a mechanical design as per the relevant codes
CO5: do the cost economic analysis

UNIT I HEAT EXCHANGER INTRODUCTION 9

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 9

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, COOLING TOWERS 9

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 PRESSURE VESSEL INTRODUCTION, STRESSES IN PRESSURE VESSEL 9

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 9

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:45 TOTAL: 45 PERIODS

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

TEXT BOOKS:

1. SadikKakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press, 2002.
2. R.Mukherjee, "Practical thermal design of Shell & Tube Heat Exchanger", Begell House Inc
3. Somnath Chattopadhyay, "Pressure Vessel Design and Practice", CRC press, 2005
4. Henry H. Bedner,-"Pressure Vessels, Design Hand Book", CBS publishers and Distributors

REFERENCES:

1. Shah,R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.
2. T Kuppan, "Heat Exchanger design handbook", Marcel Dekker, INC, 2000
3. .M.Podhorsky, " Heat Exchanger: A Pratical approach to mechanical construction, Design and Calculations", Begell House, Inc, 1998
4. ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003
5. Stanley M Wales, Chemical Process equipment, selection and design, Butterworths Series in Chemical Engineering,1988
6. Dennis Moss, “Pressure Vessel Design Manual” Gulf professional Publishing, Third Edition 2004.

13MEAE REFRIGERATION AND AIR CONDITIONING L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1. analyze the performance of the simple and multi stage vapour compression refrigeration systems (An)

CO2. express the performance of the components and refrigerants used in the refrigeration systems (Ap)

CO3. illustrate the various unconventional refrigeration systems and the applications of the refrigeration systems (Ap)

CO4. select appropriate psychrometric processes for different Air conditioning systems (Ap)

CO5. perform cooling load calculations and elementary duct design (Ap)

UNIT I VAPOUR COMPRESSION REFRIGERATION CYCLE 9

Review of thermodynamic principles of refrigeration – Vapour compression refrigeration cycle – multistage and multiple evaporator systems – cascade system – Performance Analysis and COP comparison.

UNIT II SYSTEM COMPONENTS AND REFRIGERANTS 9

Compressors – (reciprocating and rotary compressors), Types of condensers, evaporators, cooling towers – Functional aspects. Refrigerants – properties – selection and applications of refrigerants - Eco friendly alternate refrigerants.

UNIT III UNCONVENTIONAL REFRIGERATION CYCLES 9

Air Refrigeration cycles- Solar cooling -Vapor Absorption system – Ejector jet, Steam jet refrigeration, thermo electric refrigeration. Applications of refrigeration systems – ice plant – cold storage plants – milk chilling plants.

UNIT IV AIR CONDITIONING SYSTEMS 9

Psychrometric processes - Grand and Room Sensible Heat Factors – bypass factor – air washers, Applications in summer, winter and all year air conditioning systems. Transport Air conditioning systems

UNIT V COOLING LOAD CALCULATION AND DUCT DESIGN OF AIR CONDITIONING SYSTEMS 9

Working principles – Centralized Air conditioning systems, Split, Ductable split, Packaged Air conditioning, VAV & VRV Systems.

Cooling load estimation- Solar Radiation-Heat Gain through Glasses, Heat Transfer through Walls and Roofs-Total Load Estimation, Duct Design by equal friction method, Indoor Air quality concepts.

L: 45 TOTAL: 45 PERIODS

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

TEXT BOOKS

1. Manohar Prasad, “Refrigeration and Air Conditioning”, New Age International, 3rd Edition, 2014.
2. Arora C.P., “Refrigeration and Air Conditioning”, Tata McGraw Hill, New Delhi, 3rd Edition 2009.

REFERENCES

1. Bill Whitman, Bill Johnson, John Tomczyck, "Refrigeration and Air Conditioning Technology", CENGAGE Learning Custom Publishing, 5th Edition, 2012.
2. Roy. J. Dossat, "Principles of Refrigeration", Pearson Education, 5th Edition, 2009.
3. Stoecker N.F. and Jones, "Refrigeration and Air Conditioning", TMH, New Delhi, 1982.
4. ASHRAE Hand book – HVAC Applications, American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc., Atlanta, USA, 2007.
5. NPTEL Link- http://nptel.ac.in/courses/112105129/ & http://nptel.ac.in/courses /112105128/

13MEAF SOLAR ENERGY AND UTILIZATION

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1. estimate solar energy potential and measure its availability (A_P)

CO2. describe and analyze the performances of different types of solar collectors (A_n)

CO3. demonstrate the various PV technology (A_p)

CO4. illustrate the various solar energy storage techniques (A_P)

CO5. describe the industrial applications of solar energy (A_P)

UNIT I SOLAR RADIATION 9

Source of radiation – Sun earth relationship- extra-terrestrial radiation.– Atmospheric attenuation – Terrestrial radiation-radiation on a horizontal surfaces and inclined planes - relations between monthly, daily and hourly radiation and components of the radiations–solar charts-Measurement of global, direct and diffuse solar radiation- pyroheliometer, pyranometer, pyrogeo meter, sunshine recorder – an overview of solar radiation data in India.

UNIT II SOLAR COLLECTORS 9

Design considerations – classification- Flat plate collectors-Temperature distributions- Heat removal rate- Useful energy gain – Losses in the collectors-efficiency of flat plate collectors – selective surfaces – tubular solar energy collectors– testing of flat plate collectors**.** Concentric collectors - Limits to concentration – concentrator mounting – tracking mechanism - performance analysis focusing solar concentrators: Heliostats.

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UNIT III PRINCIPLE OF SOLARCELLS 9

Conversion of Solar energy into Electricity - Photovoltaic effect, different types of Photovoltaic materials - Solar Cell – Module–Efficiency limits, Variation of efficiency with band-gap and temperature, I-V characteristics, Efficiency measurements, High efficiency cells, Recent developments in Solar Cells- applications.

UNIT IV ENERGY STORAGE 9

Sensible heat storage- latent Heat Storage – Chemical storage-Different type of Battery storage for electrical energy- hydrogen energy storage. Charging and discharging characteristics

UNIT V INDUSTRIAL APPLICATIONS 9

Solar Power Plant, Solar Desalination, Solar Water Heating, Solar Air Heating, Solar Drying, Solar Cooking, Solar Greenhouse technology: Fundamentals and applications

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Duffie, J. A. and Beckman, W. A., “Solar Engineering of Thermal Processes”,4th Edition, Wiley, 2013
2. Soteris Kalogirou, “Solar Energy Engineering”, Academic Press, 2009

REFERENCES

1. Sukhatme S P, “Solar Energy, 3rd Edition”, Tata McGraw-Hill Education, 2008
2. Chetan Singh Solanki “Solar Photovoltaics Fundamentals, Technologies and Applications”, Second Edition, Prentice Hall of India, 2011
3. G. N. Tiwari, “Solar Energy Fundamentals, Design, Modelling and Applications”, Narosa Publishing House Pvt. Ltd., 2004

4. H.P. Garg and J. Prakash, “Solar Energy- Fundamentals & Applications”, Tata McGraw-Hill, 2006
5. Soteris A. Kalogirou Solar thermal collectors and applications Progress in Energy and Combustion Science 30 (2004) 231–295

13MEAG THERMAL TURBO MACHINES

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1. discuss about Aero foils and Cascades under various flow conditions. (A_p)

CO2. examine the performance of Turbo machines using Thermodynamic principles. (A_n)

CO3. illustrate the performance of Turbo machines using fluid dynamics. (A_p)

CO4. select appropriate Turbo machine by considering the given application. (A_n)

CO5. illustrate recent developments of micro and macro turbomachines for power and cooling applications. (A_p)

UNIT I AEROFOIL THEORY 9

Aerofoils – types –standards; Stagnation and static property variations and their relations-Performances and losses in various flow conditions - cascade –methods and its applications.

UNIT II TURBOMACHINES AND THERMODYNAMIC PRINCIPLES 9

Turbomachine – Classification; Application of Laws of thermodynamics, performance calculation. Total and stagnation efficiency. Single and multi stage, compounding.

UNIT III TURBOMACHINES AND DYNAMIC PRINCIPLE 9

Euler Turbine equation - Alternate form – components of energy transfer, Degree of reaction– effect of blade discharge angle; General analysis of Turbomachines – Effect of blade discharge angle on performance.

UNIT IV SELECTION OF TURBOMACHINES 9

Different types of turbines, compressors, blowers and fans, their applications. Dimensional analysis-performances of turbomachines using dimensionless parameters-Selection of turbomachines.

UNIT V LATEST DEVELOPMENTS IN TURBOMACHINES 9

Turbomachine blades for high temperature applications – cooling technologies –micro turbine –macro turbine - wind turbine – hydro turbine - case studies.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. S.M. Yahya, “Turbines, Compressors & Fans”, Tata-McGraw Hill Co., 2nd Edition 2002.
2. William W. Perg, “Fundamentals of Turbomachinery” John Wiley & Sons, Inc. 2008.
3. Earl Logan, Jr., “Hand book of Turbo machinery”, Marcel Dekker Inc., 1992.
4. R.S.Johnson, “Fluid Mechanics and Theory of flight”, Ventus publication, 2012.

REFERENCES

1. V. Kadambi and Manohar Prasad, “An Introduction to energy conversion”, Volume III – Turbo machinery, New Age International Publishers (P) Ltd.
2. Ganesan, V.,“Gas Turbines”, Tata McGraw Hill Pub. Co., 1999.
3. Gopalakrishnan.G and Prithvi Raj.D, “A Treatise on Turbo machines”, Scitech Publications India Pvt. Ltd., 2002.
4. Weng shilie, “Basis For Thermal Energy and Dynamic Machine”, Higher Education Press, 2004
5. D.G. Wilson, T. Korakianitis, “The design of high-efficiency turbo machinery and gas turbines”, Prentice Hall, 1998.
6. R. Logan, R. Ramendra , “Handbook of Turbomachinery”, Marcel-Dekker, 1998.
7. H.Glauret, “The Elements of aerofoil and air screw theory” Cambridge University press, 2nd Edition.

13MEAH	APPLIED COMPUTATIONAL FLUID DYNAMICS AND FINITE ELEMENT ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: solve the engineering problems using various computational techniques

CO2: demonstrate major theories, approaches and methodologies used in CFD/FEM;

CO3: implement Computational Fluid Dynamics methods (e.g. boundary conditions, turbulence modeling etc.) by using commercial CFD codes;

CO4: gain experience in the application of CFD/FEM analysis to real engineering designs.

CO5: perform Pressure, Velocity, stress, thermal and modal analysis using software's

CO6: get Proficiency in engineering design

CO7: conduct an engineering project

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9

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 9

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 9

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 Modelling External Flow – Flow over a circular cylinder, simple car and an aeroplane

UNIT IV APPLIED PROJECTS CFD – II 9

Radiation problems - Heat Transfer distribution – Porous media – Pump – Fan – Gaseous Combustion – Particle Study – Multi phase problems

UNIT V APPLIED PROJECTS FEA 9

Stress – Strain – FOS – Machine elements under Static Structural Loads – Modal Analysis – Thermal Analysis – Vibrations - Non-Linear Analysis.

L: 45 TOTAL: 45 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 Heng Yeoh, "Computational Fluid Dynamics A Practical Approach" Butterworth-Heinemann, First Edition 2008
3. Anderson "Computational Fluid Dynamics The Basics with Application" Mcgraw Hill

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.

13MEBA **COMPOSITE MATERIALS** **L T P C**
3 0 0 3

PRE-REQUISITE:
Basic knowledge in Materials Science

COURSE OUTCOMES
Upon successful completion of this course, the students will be able to
CO1: Describe the classification and basic anatomy of composite materials (Unit-I)
CO2: Describe the micromechanics and processing methods of MMC and PMC (Unit-II & III)
CO3: Practice the characterization of composite materials (Unit-IV)
CO4: Predict failure and design joints in composite materials based on FEM (Unit-V)

UNIT I INTRODUCTION TO COMPOSITE MATERIALS 9
Fundamentals of composites - need for composites –- classification of composites –Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Ceramic matrix composites (CMC) – Reinforcement – Particle reinforced composites, Fibre reinforced composites- Enhancement of properties-Applications.

UNIT II METAL MATRIX COMPOSITES (MMC) AND POLYMER MATRIX COMPOSITES (PMC) 9
MMC – Introduction – processing - microstructure characterization - micromechanics and mechanics of deformation – applications – PMC – introduction – types – fillers – manufacturing processes.

UNIT III FABRICATION PROCESSES 9
Fundamentals - bag moulding - compression moulding pultrusion-filament winding - other manufacturing process - quality inspection and non-destructive testing.

UNITIV TESTING OF COMPOSITES 9
Introduction to micro-mechanics-unidirectional lamina - laminates – inter-laminar stresses - static mechanical properties - fatigue properties - impact properties - environmental effects - fracture mechanics and toughening mechanisms, damage prediction, failure modes.

UNITV FAILURE PREDICTIONS 9
Failure predictions - design considerations - joint design - codes - design examples - optimization of laminated composites - application of FEM for design and analysis of laminated composites.

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

13MEBB **NON DESTRUCTIVE TESTING FOR WELDED STRUCTURES**

L	T	P	C
2	0	2	3

COURSE OBJECTIVES:

- To provide the personnel with full theoretical and practical knowledge of Penetrant Testing method, ultrasonic Testing, magnetic particle testing, radiographic film interpretation and related standards.
- At the end of the course, the student will be able to undertake Penetrant testing, magnetic particle Testing, Radiography testing film interpretation and Ultrasonic Testing , interpret and evaluate results as per standards.

UNIT I PENETRANT TESTING 7

Introduction & Physics - Penetrant Groups, Types of Developers - Testing techniques - Stages of Penetrant Testing - Inspect ion Procedures - Selection of Techniques Evaluation of Test Equipment, consumables

UNIT II ULTRASONIC TESTING 12

Introduction to UT - Physics of UT. UT equipment – Probes – purpose, how to use them; cables, connectors, couplants. calibration blocks, reference blocks purpose, how to use them; cables, connectors, couplants. Test Techniques - Pulse echo, through transmission, resonance techniques and applications, test variables. Testing - calibration of test equipment - Discontinuities, Distance Amplitude Correction (DAC) curve. Testing techniques - method of scanning, scanning pattern, selection of parameters, Testing of Raw material, weld, casting

UNIT III MAGNETIC PARTICLE TESTING 4

Physics of Magnetism - magnetization techniques - magnetic fields - test equipment, accessories, media - Fluorescent, non fluorescent consumables, systems check. TECHNIQUES Testing techniques, interpretation, demagnetisation

UNIT IV RADIOGRAPHIC TESTING FILM INTERPRETATION 8

Overview of RT - Interaction of Radiation with Matter - Radiation safety Sources of Radiation and their characteristics - Film Radiography - Film Processing. Sensitivity & Definition, I.Q.Is, Other Accessories Techniques in radiography. Manufacturing processes and discontinuities Interpretation & Evaluation of Radiographs , Acceptance Standards Radiographic artifacts

UNIT V CODES AND STANDARDS 2

Codes, Procedures, and Written Practices - Penetrant Testing, Ultrasonic Testing, magnetic particle testing Radiographic Report generation

UNIT VI NDT PRACTICAL 12

Practical 1 -PT - Pre-cleaning, etching, Testing - Testing - fluorescent type, visible, comparison of consumables, qualifying of consumables
Practical 2 - RT - Familiarization with equipment
Practical 3 RT - calculation of geometric unsharpness – source strength calculations - safe distance -.calibration of densitometer
Practical 4 RT - evaluation of radiographs
Practical 5 RT - evaluation of radiographs
Practical 6 MT - Testing of welds – Qualification of equipments
Practical 7 UT - familiarity of equipment. - Thickness measurement, sizing of machined reflector,– Raw material Testing
practical 8 UT - calibration of equipment
Practical 9 -UT - DAC - plate 25 , 50 mm
Practical 10 UT weld testing - plate

Practical 11 – UT weld testing - plate
Practical 12 – UT weld testing – plate

REFERENCES:

1. **Nondestructive Testing Handbook, Third Edition: Vol 2, Liquid Penetrant Testing, published by ASNT**
2. **Nondestructive Testing Handbook, Third Edition: Vol 7, Ultrasonic Testing published : ASNT, USA**
3. **Nondestructive Testing Handbook, Third Edition: Vol 8, Magnetic Testing published by ASNT, USA**
4. **Nondestructive Testing Handbook Third Edition: Vol. 4 Radiographic Testing published by ASNT USA**
5. **ASM Metals Handbook Vol 17 –Non destructive testing, published by ASM, USA**
6. **ASME Sec V, 2013 Non destructive testing, publ ASME**
7. **Introduction to the Non-Destructive Testing of Welded Joints - Second edition by Halmshaw, published by Woodside publications**
8. **ASTM E165 Standard Practice for Liquid Penetrant Examination for General Industry**
9. **ASTM E-94 Standard Guide for Radiographic Examination**
10. **ASTM E-747 Standard Practice for Design, Manufacture and Material Grouping Classification of Wire image Quality Indicators (IQI) used for Radiology .**
11. **Industrial Radiography, Image forming Techniques published in Internet by GE Inspection Technologies**
12. **ASTM -709 Standard Guide for Magnetic Particle Testing**
13. **ASTM A-435 Standard Specification for Straight-Beam Ultrasonic Examination of**
14. **Steel Plates**
15. **ASTM A-578 Standard Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications**
16. **ASTM E–797 Practice for Measuring Thickness by Manual Ultrasonic Pulse-Echo Contact Method**

TOTAL: 45 PERIODS

13MEBC **MAINTENANCE ENGINEERING**

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

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

CO1: Describe the historical development of maintenance principles and techniques.

CO2: Apply the concept and principle of maintenance processes based on the industry Configuration.

CO3: Select, apply and appraise condition monitoring techniques including vibration, thermal Techniques and lubricant analysis.

CO4: Identify and apply the various repair methods for basic machine elements.

CO5: Identify repair methods for material handling equipment.

UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems –Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability –Maintenance organization – Maintenance economics.

UNIT II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

UNIT III CONDITION MONITORING 9

Condition Monitoring – Cost comparison with and without CM – On-load testing and off load testing – Methods and instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis

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 fault location methods – Sequential fault location.

UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 9

Repair methods for Material handling equipment - Equipment records –Job order systems - Use of computers in maintenance.

L:45 TOTAL: 45 PERIODS

TEXT BOOKS:

1. Srivastava S.K., “Industrial Maintenance Management”, - S. Chand and Co., 1981
2. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co.,1995

REFERENCES:

1. White E.N., “Maintenance Planning, Control and Documentation”, Gower Press, 1979.
2. Garg M.R., “Industrial Maintenance”, S. Chand & Co., 1986.
3. Higgins L.R.,Keith Mobley “Maintenance Engineering Hand book”, McGraw Hill, 7th Edition, 2008.
4. Armstrong, “Condition Monitoring”, BSIRSA, 1988.
5. Davies, “Handbook of Condition Monitoring”, Chapman &Hall, 2012.
6. “Advances in Plant Engineering and Management”, Seminar Proceedings - IIPE,1996.

13MEBD **ADVANCED COMPUTER AIDED MANUFACTURING** **L T P C**
3 0 0 3

COURSE OUTCOMES

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

CO1: Recognize the concept and need of APT, NC and CNC Part Programming.

CO2: Develop Simple 2D CNC Programming with Subroutines through Manual Part Programming or Computer Aided Part Programming Techniques.

CO3: Operate CNC Machining through Integration of CAD/CAM software.

CO4: Describe DNC, FMS and Robot technology and also perform simple manufacturing system simulation.

UNIT I COMPUTER NUMERICAL CONTROL 9

Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre-features and applications, Automatic tool changers and Multiple pallet system, types of control systems, CNC controllers, General information on CAM, APT, NC manual part programming, Introduction to CAD/CAM software.

UNIT II NUMERICAL CONTROL CODING AND PROGRAMMING 9

Basic components of an NC system, NC motion control, interpolation, part programming formats, manual part programming, NC coding systems (ISO and EIA)-NC words, macro statements, Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre. Writing simple 2D manual part programming.

UNIT III FEATURES OF CNC, DNC AND DISTRIBUTED NUMERICAL CONTROL 9

Computer Numerical Control (CNC) and DNC: Features of CNC, Elements of CNC machines, the machine control unit for CNC, CNC softwares, direct numerical control, and Distributed numerical control (DNC). Introduction to post processers, general structure and functions of post processor, DAPP based post processer.

UNIT IV CNC TURNING AND MILLING CENTERS 9

Features and selections of CNC turning and milling centers. Practice in part programming and operation of CNC turning machines using NC and APT programming using subroutine techniques and cycles. Practice in part programming and operating a machining center, tool planning and selection of sequence of operations, tool setting on machine.

UNIT V FMS AND ROBOTICS 9

Introduction to FMS, components, applications, benefits, FMS layout, FMS planning and implementation issues. Introduction to robot programming and its languages. Robot simulation using software. Robot path control, preparation of various reports and routs sheets, simulation of simple manufacturing system using any one software.

L:45 TOTAL : 45 PERIODS

REFERENCES:

1. Computer control of manufacturing systems, Yoram Koren, Mc Graw Hill, 1983.
2. Computer Aided Design Manufacturing, K.Lalit Narayan, K. Mallikarjuna Rao and M.M.M.Sarcar, PHI, 2008.

3. CAD/CAM Principles and Applications, P.N. Rao, Tata Mc Graw Hill
4. Steve Krar and Arthar Gill, CNC Technology and Programming, McGraw Hill Pub. Company, New Delhi.
5. Mikell P. Grover, Automation, Production Systems and Computer-Integrated Manufacturing, Pearson Education, New Delhi.
6. Warren.S .Seames, Computer Numerical Control: Concepts and Programming, 4th edition, Delmar Thomson Learning Inc., 2002.
7. CAD/CAM Theory and practice, McGraw Hill, International Edition, 2007.
8. Principles of Computer Aided Design and Manufacturing, Farid Amirouche, Pearson
9. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency, 2002.

13MEBE QUALITY CONTROL OF WELDED STRUCTURES

L	T	P	C
2	0	2	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.

CO2: Assess the quality of the welded structure and acquires skills to work as a welding inspector.

CO3: Apply ASME standards to assess the mechanical properties of the weldments for the Welding procedure Specification (WPS) and Welder qualification (WQR).

CO4: Practice Visual testing, LPT, MPT, RT and UT to detect defects in weldments.

UNIT I INTRODUCTION TO WELDING PROCESSES 6

Introduction to welding processes- principle -fusion welding - SMAW, SAW, MIG, TIG– equipments – welding techniques.

Welding inspection-weld defects-formation- preventing defects and rectification – weld repair techniques.

UNIT II INTRODUCTION TO QUALITY IN WELDED STRUCTURES 7

Introduction to quality and welded fabrication – quality assurance - quality control – role and responsibilities of a welding inspector.

Quality assurance plan – contents- basis of preparation – implementation - manufacturing quality plan – quality control plan (OCP)

UNIT III QUALITY CONTROL IN WELDING 16

Raw Material Inspection – Types of raw material – plates – pipes, tubes – standard sections – importance of raw material properties for design –ensuring techniques - technical delivery condition document (TDCs) - Indian standard, – raw material standard sizes

Mechanical testing – tensile, bend, hardness, impact– practices as per codes and standards. Chemical testing – ladle testing – product testing

Weld symbols, - Types of welds, types of joints - Edge preparation- purpose - types – comparison of different edge preparations.

Weld fit-up - weld backing - metallic and non-metallic– integral– removable backing - testing of fit up Visual Inspection of welds –visual testing – gadgets for visual testing – types of weld gages and their application – visual acceptance as per codes and standards – surface defects in welding

PT, MPT, RT, UT -Principle – consumables – testing techniques – advantages –Limitations - Application and Codes.

UNIT IV QUALIFICATION OF WELDING PROCEDURE AND PERFORMANCE 4

Welding procedure Specification (WPS) – purpose– material classification P nos – G nos - WPS as per ASME – establishing WPS – tests for WPS qualification – writing PQR – limits of qualification

Welder qualification (WQR) as per ASME – welding positions - qualifying a welder – Establishing a WQR – limits of qualification

UNIT V PRACTICAL SESSIONS 12

Manufacturing quality Plan evaluation

Study of a typical product drawing - study a MQP for the product – establish the number of tests, documents to be prepared for a product –report preperation

Raw Material TC Reading

Reading IS standard for plate, pipe, rolled sections – preparing list of tests required for the product – reading TC and evaluate whether it meets the standard

Reading Weld Symbols

Reading drawing and establish the types and lengths of welds in the assembly – position of welds –weld document preperation (welding plan)

Welding Procedure Specification (WPS)

Study Procedure qualification record and check its completeness - studying WPS and identify whether it is suitable for particular product

Welders Qualification Evaluation

WQR reading – read welder qualification record and check if the welder is suitable for a particular weld.

Weld Visual inspection & PT

Evaluation of weld and identification of surface defects – size the weld and establish the acceptance for a particular product –report preperation - Penetrate testing

Weld inspection - RT evaluation

RT weld radiograph interpretation

TOTAL: 45 PERIODS

REFERENCES:

1. R Halmshaw, "Introduction to the Non-Destructive Testing of Welded Joints"- 2nd Edition ,Woodhead Publishing, 1997.
2. Little R.L, "Welding and Welding Technology" - Tata McGraw Hill Publishing Ltd, New Delhi, 1989.
3. Welding handbook Vol 1 publisher American welding society
4. Pocket book for visual inspection http://www.aws.org/files/205/2009011/AWSPHB~2.PDF
5. Certification Manual for Welding Inspectors by Hobart school of welding
6. Modern welding technology by Howard Cary
7. Metals Handbook vol 6 Welding, brazing, and soldering by ASM
8. Parmer R.S, "Welding Engineering and Technology", 2nd Edition, Khanna publishers, Delhi, 2010.

13MEBF	QUALITY ASSURANCE FOR WELDED STRUCTURES	L	T	P	C
		2	0	2	3

COURSE OUTCOMES

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

CO1: Explain the various welding processes, welding defects and weld repair techniques.
CO2: Describe the quality system practiced in welding process.
CO3: Express the importance of design, mechanical testing and weld symbols.
CO4: Prepare welding procedure specification and welder qualification record.
CO5: Produce product drawing and practice visual inspection of weld joints.

UNIT I INTRODUCTION TO WELDING PROCESSES 9

Introduction to welding processes – Types - Fusion Welding Processes – SMAW, TIG, MIG ,SAW– principle - equipment's –welding techniques - welding inspection. Advanced welding processes – resistance, friction, plasma, laser, and electron Beam welding - principle - equipment's –welding techniques - welding inspection. Weld defects - defect rectification – weld repair techniques.

UNIT II INTRODUCTION TO QUALITY ASSURANCE 9

Introduction to Quality - welded fabrication – Quality assurance - Quality control – role and responsibilities of a welding inspector. Quality assurance Plan – manufacturing quality plan – preparation – contents - quality control plan. Introduction to Quality System: ISO 9001 – aspects covered in quality system – types of documents and records. Introduction to Quality systems for laboratories: ISO/ IEC 17025 – difference between ISO 9001 and ISO IEC 17025

UNIT III QUALITY CONTROL IN WELDING 9

Raw Material Inspection – Types – plates , pipes, tubes – standard sections –properties - important for design – technical delivery condition document - Indian standard – standard sizes. Mechanical testing – tensile, bend, hardness testing, impact testing practices – chemical testing – ladle testing – product testing – practices. Weld symbols - types of welds - types of joints - edge preparation - types of edge preparations – purpose – comparison. Weld fit-up - weld backing - metallic and non-metallic backing – integral backing – removable backing - testing.

UNIT IV QUALIFICATION OF WELDING PROCEDURE AND PERFORMANCE 9

Welding Procedure Specification (WPS) - purpose – material classification P nos – G nos - WPS as per ASME – establishing a WPS – tests for a WPS qualification – writing PQR – limits of qualification. Welder Qualification Record (WQR) as per ASME – welding positions - qualification of welder – Establishing a WQR – limits of qualification. Visual Inspection of welds – visual testing – gadgets for visual testing – types of weld gages and their application – visual acceptance – surface defects in welding

UNITV PRACTICAL SESSIONS 9

Manufacturing quality plan evaluation -Typical product drawing - study a MQP for the product – establish the number of tests, documents - prepare the reports. Raw Material TC Reading- Read a IS standard for plate, pipe, rolled sections – prepare a list of tests – read a TC and evaluate. Reading Weld Symbols - read a drawing and establish the types and lengths of welds in the assembly – position of welds – prepare weld documentation (weldingplan). Welding Procedure Specification (WPS) - Procedure qualification record and check its completeness – study a WPS and identify whether it is suitable for a particular product –

Welder Qualification Evaluation – WQR reading – read welder qualification record and check. Weld visual inspection - Evaluate a weld and identify the surface defects – size the weld and establish the acceptance – make a report.

TOTAL: 45PERIODS

REFERENCES:

1. Welding handbook Vol 1 publisher American welding society
2. Pocket book for visual inspection, http://www.aws.org/files/205/2009011/AWSPHB~2.PDF
3. Certification Manual for Welding Inspectors by Hobart school of welding
4. Modern welding technology by Howard Cary
5. Metals Handbook vol 6 Welding, brazing, and soldering by ASM
6. Parmer R.S, "Welding Engineering and Technology", 2nd Edition, Khanna publishers, Delhi, 2010.

13MEBG PRODUCT DESIGN AND COSTING

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Express the process of product design
CO2: Analyze the economic issues in product design
CO3: Describe product modeling
CO4: Discuss the various cost involved in the product development
CO5: Discriminate the industrial design process and quality assessment methods

UNIT I PRODUCT DESIGN AND DEVELOPMENT 8

Principles of creativity in design- integrated product development and concurrent engineering – Product analysis – Criteria for product design – Market research – Design for customer and design for manufacture – Product life cycle.

UNIT II ECONOMICS OF DESIGN 9

Breaks even point - Selection of optimal materials and processes – Material layout planning – Value analysis – Re-engineering and its impact on product development.

UNIT III PRODUCT MODELING 9

Product modeling – Definition of concept - fundamental issues – Role and basic requirement of process chains and product models –Types of product models – model standardization efforts – types of process chains – industrial demands.

UNIT IV PRODUCT COSTING 10

Bill of materials – Outline Process charts – Concepts of operational standard time - Work measurement by analytical estimation and synthesis of time – Budgets times – Labor cost and material cost at every stage of manufacture – W.I.P. costing

UNIT V INDUSTRIAL DESIGN 9

Need for industrial design – Impact of industrial design – Industrial design process – Management of industrial design process – Assessing the quality of industrial design, design for manufacturing - cost considerations, Impact of DFM decisions on other factors.

L:45 TOTAL: 45 PERIODS

REFERENCES:

1. Samuel Eilon – "Elements of Production Planning and Control" – McMillan and Company, 1962
2. Jones S.W – "Product Dosing and Process Selection", Butterworth Publications, 1973
3. Karl T. Ulrich, Stephen D. Eppinger – "Product Design and Development", McGraw-Hill, 2008
4. Harry Nystrom – "Creativity and Innovation", John Wiley & Sons, 1979
5. George E. Dieter, "Engineering Design – Materials and process approach", Tata McGraw-Hill, 1991
6. Donald E. Carter – "Concurrent Engineering", Addison Wesley, 1992
7. Kevin Otto, Kristin Wood – "Product Design", Pearson Education, 2000

13MEBH CREATIVITY, INNOVATION AND PRODUCT DEVELOPMENT

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Demonstrate the concepts in creativity and innovation.
CO2: Evaluate the new project planning
CO3: Identify new products for commercialization
CO4: Discuss the importance of Intellectual Property Rights (IPR)

UNIT I CREATIVITY 9

Concept and history of creativity, need for creativity, creative environment, stages of creativity process, creativity and intelligence, creativity in various contexts, economic view of creativity, measuring creativity, fostering creativity, creative problem solving – brain storming and various techniques, lateral thinking. Role of creativity in entrepreneurship – Research and development (R & D). Case studies on creative solutions to contemporary issues.

UNIT II INNOVATION 9

Definition, creativity vis-à-vis innovation, conceptualizing innovation, types of innovation, sources of innovation, goals of innovation, process of technological innovation, diffusion of innovation, factors contributing to successful technological innovation, failure of innovations, innovation management, measures of innovation.

Case studies - Innovations in health sector, agriculture, education, entrepreneurship, and Corporate R & D.

UNIT III PROJECT PLANNING AND EVALUATION 9

Definition and purpose of project, collection of ideas, screening ideas, selection criteria for new projects, development of project plan, project evaluation – purpose, kinds of evaluation, stages of evaluation process, techniques of project evaluation, project analysis, benefits and risks of new projects.

UNIT IV PRODUCT DEVELOPMENT AND EVALUATION 9

Research and new product development – process and types of new products, creative design, design of prototype – purpose, process, and types, model preparation, testing and quality evaluation; marketing research – purpose and process, types and methods; introducing new products, cost evaluation. Product deployment and commercialization - Case Studies.

UNIT V PROTECTION OF INNOVATION 9

Intellectual property (IP), classes of IP – industrial property and copyrights; Intellectual Property Rights (IPR); Patents, patentability, patent acts, governing laws, history of patent laws and acts, patent administration; patenting process – patent application, patent search, prosecution, publication, examination, opposition, grant, renewal, patent rights; international code for patents, patents vis-à-vis economics.

L:45 TOTAL: 45PERIODS

REFERENCES:

1. Frederick Betz, Managing Technological innovation, John Wiley & Sons, Inc., Third Edition
2. Tom Kelly, The Art of Innovation, Doubleday, Random House Inc. USA, 2001.
3. Christensen, C. M. and Raynor, M. E. (2003), The Innovator's Solution: Creating and Sustaining Successful Growth, Boston, MA: Harvard Business School Press.

4. Paul Windrum and Per Koch, Innovation in Public Sector Services: Entrepreneurship, Creativity and Management, Edward Elgar Publishing Limited, 2008.
5. Harry Nystrom, Creativity and innovation, John wiley & sons, (1979).
6. I.P.R. Bulletins, TIFAC, New Delhi, 1997.

13MEBJ UNCONVENTIONAL MACHINING PROCESSES L T P C
3 0 0 3

COURSE OUTCOMES

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

CO1. classify the various non-traditional machining processes. (U)

CO2. explain the working of principle of Mechanical, Electrical, Chemical, Electro chemical and Thermal machining processes. (U)

CO3. interpret the process parameters associated with various non –traditional machining processes. (Ap)

CO4. compare the effect of process parameters on metal removal rate and surface finish for various machining processes. (An)

CO5. differentiate the applications and limitations of various non-traditional machining Processes. (An)

UNIT I INTRODUCTION 9

Unconventional machining Process – Need – classification – parameters involved – MRR.

UNIT II MECHANICAL ENERGY BASED PROCESSES 9

Abrasive Jet Machining (AJM) – Water Jet Machining (WJM) – Ultrasonic Machining (USM) - Working Principles – Process parameters – MRR – Applications.

UNIT III ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) - working Principle-equipments-Process Parameters - Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing– Wire cut EDM – Applications.

UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining (CHM) and Electro-Chemical machining (ECM) – Etchants, maskant – Process Parameters – Surface finish and MRR – ECG and ECH- Applications.

UNIT V THERMAL ENERGY BASED PROCESSES 9

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM) - Principles – Equipments - Beam control techniques –Applications.

L: 45 TOTAL: 45 PERIODS

TEXT BOOK

1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007.

REFERENCES

1. Benedict. G.F. “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 1987.
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, NewDelhi, 2007.
3. McGeough, “Advanced Methods of Machining”, Chapman and Hall, London, 1998.
4. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, “Material and Processes in Manufacturing”, Prentice Hall of India Pvt. Ltd., New Delhi, 8th Edition, 2001.
5. Wellar, P.C., “Non-Traditional Machining Processes”, SME, Michigan, 1984.
6. www.nptel.ac.in/courses/112104028/1
7. www.nptel.ac.in/courses/112104028/2-34

13MEBK PROCESS PLANNING AND COST ESTIMATION

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: discuss method study, work measurement and various tools used to improve the process. (U)

CO2: discuss the steps involved in process planning. (U)

CO3: predict the parameters to evolve the cost of any product. (Ap)

CO4: estimate the cost of a product based on manufacturing methods. (Ap)

CO5: estimate the machining time to manufacture a given product.(Ap)

UNIT I WORK STUDY AND ERGONOMICS 9

Method study – Definition – Objectives - Motion economy - Principles – Tools and Techniques-Applications – Work measurements- purpose – use – procedure – tools and techniques- Standard time – Ergonomics – principles – applications.

UNIT II PROCESS PLANNING 9

Definition – Objective – Scope – approaches to process planning- Process planning activities – Finished part requirements- operating sequences- machine selection – material selection parameters- Set of documents for process planning- Developing manufacturing logic and knowledge- production time calculation – selection of cost optimal processes

UNIT III INTRODUCTION TO COST ESTIMATION 9

Objective of cost estimation- costing – cost accounting- classification of cost- Elements of cost. Types of estimates – methods of estimates – data requirements and sources- collection of cost- allowances in estimation

UNIT IV ESTIMATION OF COSTS IN DIFFERENT SHOP 9

Estimation in foundry shop – Pattern cost - Casting cost - Illustrative examples. Estimation in forging shop – Losses in forging – Forging cost - Illustrative examples. Estimation in welding shop – Gas cutting – Electric welding - Illustrative examples. Estimation in sheet metal shop – Shearing and forming - Illustrative examples.

UNIT V ESTIMATION OF MACHINING TIMES IN DIFFERENT SHOPS 9

Estimation of machining time for lathe operations - Estimation of machining time for drilling, boring, shaping, planning, milling and grinding operations - Illustrative examples.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Sinha.B.P, "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co., 1995.
2. Phillip.F Ostwalal and Jairo Munez, "Manufacturing Processes and systems", John Wiley, 9th Edition, 2008.
3. Chitale, A. K., and Gupta, R. C., “Product Design and manufacturing”, Prentice Hall of India, New Delhi, 6th Edition 2013.
4. Adithan, M. S., and Pabla, “Production Engineering Estimating and Costing”, Konark Publishers Pvt., Ltd. 1989.

REFERENCES

1. Banga T.R and Sharma.S.C, "Estimating and costing", Khanna Publishers, New Delhi, 16th Edition, 2011.
2. Nanua Singh, "System Approach to Computer Integrated Design and Manufacturing", John Wiley & Sons, New York, 2011.
3. S N Chary, "Production and Operations Management" Tata McGraw - Hill Education, 2009.

13MEBL	QUALITY CONTROL AND RELIABILITY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: design, use and interpret control charts for variables. (Ap)

CO2: design, use and interpret control charts for attributes. (Ap)

CO3: select appropriate sampling plan and construct OC curve. (Ap)

CO4: discuss the concepts of the reliability and calculate the system reliability for the given component connection. (Ap)

CO5: discuss various reliability improvement techniques. (Ap)

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 9

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

UNIT II PROCESS CONTROL FOR ATTRIBUTES 9

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

UNIT III ACCEPTANCE SAMPLING 9

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

UNIT IV LIFE TESTING - RELIABILITY 9

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems.

UNIT V QUALITY AND RELIABLITY 9

Reliability improvements – techniques- use of Pareto analysis – design for reliability – Redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product life cycles.

L: 45 TOTAL: 45 PERIODS

Note: (Use of approved statistical table is permitted in the End Semester Examination)

TEXT BOOKS

1. Douglas.C.Montgomery, "Introduction to Statistical quality control", John wiley, 7th Edition, 2013.
2. L.S.Srinath, "Reliability Engineering", East west press, 2005.

REFERENCES

1. John.S. Oakland. Statistical process control", Elsevier, 6th edition, 2008
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 2012

3. Monohar Mahajan, “Statistical Quality Control”, Dhanpat Rai & Sons, 2010.
4. R.C.Gupta, “Statistical Quality control and Quality management”, Khanna Publishers, 9th Edition, 2003.
5. Besterfield D.H., “Quality Control”, Prentice Hall, 2009.
6. Sharma S.C., “Inspection Quality Control and Reliability”, Khanna Publishers, 2008.
7. Danny Samson, “Manufacturing & Operations Strategy”, Prentice Hall, 1993

13MEBM PRODUCTION PLANNING AND CONTROL

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 functions and significances of production planning and control department (U).
CO2: apply suitable work study methods to control production process. (An)
CO3: determine the manufacturing operations and their sequences for a given product. (Ev)
CO4: analyse the feasible production Scheduling methods to improve the productivity.(An)
CO5: select an appropriate inventory Control Technique to economic order quantity (EOQ). (An)
CO6: appraise new and upcoming techniques for production planning. (Ev)

UNIT I INTRODUCTION 9

Objectives and benefits of production planning and control - Functions of production planning and control - Types of production- Organization of production planning and control department – Internal organization of department.

UNIT II WORK STUDY 9

Method study, basic procedure – Selection - Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III PRODUCT AND PROCESS PLANNING 9

Product planning - Extending the original product information - Value analysis - Problems in lack of product planning - Process planning and routing - Pre requisite information needed for process planning - 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 - Scheduling rules – Gantt charts - Perpetual loading - Basic scheduling problems - Line of balance – Flow production scheduling - Batch production scheduling - Product sequencing – Production Control systems - Periodic batch control - Manufacturing lead time - Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control – Purpose of holding stock - Effect of demand on inventories – Ordering Procedures - Two bin system - Ordering cycle system - ABC analysis - Recorder procedure. Introduction to computer integrated production planning systems - elements of just in time systems - Fundamentals of MRP II and ERP.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. S.K.Mukhpadyay, “Production Planning And Control” PHI Learning Pvt. Ltd., 2007
2. Martand Telsang, “Industrial Engineering and Production Management”, S. Chand and Company, 1st Edition, 2000.
3. James.B.Dilworth, “Operations management – Design, Planning and Control for manufacturing and services”, McGraw Hill International, 2nd Edition, 1992.

REFERENCES

1. Upendra Kachru, "Production and operations management – Text and cases", Excel books, 1st Edition, 2007.
2. Kanishka Bedi, "Production and Operations management", Oxford University press, 2nd Edition, 2007.
3. Norman Gaither, G. Frazier, "Operations management" ,Thomson learning, 9th Edition, IE, 2007.
4. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / Operations Management", John Wiley and Sons, 8th Edition, 2000.

13MEBN INDUSTRIAL SAFETY ENGINEERING

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: appraise concept of accidents and their prevention. (A_N)

CO2: use ergonomics to design the work system and change the human behaviour to avoid accidents. (A_P)

CO3: appraise various hazards present in an industry and control measures. (A_N)

CO4: Select the appropriate fire extinguishing systems for various classes of fire. (A_N)

CO5: use various safety management techniques to promote safety practice and avoid accidents. (A_P)

UNIT I ACCIDENT INVESTIGATION AND ANALYSIS 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- supervisory role –role of safety officer-role of safety committee- permanent total disabilities, Permanent partial disabilities, Temporary total disabilities-Calculation of frequency rate and severity rate of accidents. 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 places. 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 - Frustration and conflicts, reaction to frustration, 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. Engineering control methods- use of personal protective equipments.

UNIT IV FIRE PREVENTION AND PROTECTION 9

Fire triangle-principles of fire extinguishing- various classes of fires- 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 (IRT), disaster control, Job safety Analysis, Safety survey, safety inspection. Safety training programs, seminars, conferences, competitions- method of promoting safe practice- motivation- creating awareness, awards, celebrations, safety posters, safety displays, safety incentive scheme- 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.
3. E.J.McCormick and M.S. Sanders “Human Factors in Engineering and Design”, TMH, New Delhi, 1982.
4. Hand Book of “Occupational Safety and Health”, National Safety Council, Chicago, 1982.
5. Derek, James, “Fire Prevention Hand Book”, Butter Worths and Company, London, 1986.

REFERENCES

1. Krishnan.N.V. “Safety Management in Industry”, Jaico Publishing House, Bombay, 1997.
2. Lees, F. P. “Loss Prevention in Process Industries”, Butter Worth publications, London, 2nd Edition, 1990.
3. Dan Peterson, “Techniques of Safety Management”, McGraw Hill Company, Tokyo, 1981.
4. “Accident Prevention Manual for Industrial Operations”, N.S.C. Chicago, 1982.
5. Hunter, Gomos, “Engineering Design for Safety”, McGraw Hill Inc., 1992.
6. Encyclopedia of “Occupational Health and Safety” Vol I and II, Published by International Labour Office, Geneva, 1985.
7. Gupta. R.S., “Hand Book of Fire Technology”, Orient Black swan, 2010.
8. The Factories Act 1948, Madras Book Agency, Chennai, 2000.

13MECA **VIBRATION CONTROL**

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Describe the basic concepts of types of vibration and vibration control
CO2: Analyze the vibration generation mechanism
CO3: Explain the passive vibration control techniques
CO4: Discuss the active vibration control methods
CO5: Articulate the vibration measurement and analysis techniques

UNIT I BASIC CONCEPTS **9**

Review of free and forced vibrations with and without damping; Free and forced vibration of single, two and multi-degree 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.

UNIT III PASSIVE VIBRATION CONTROL **9**

Basics, design of absorber, absorber with ideal spring, shock absorber, isolators with stiffness and damping.

UNIT IV ACTIVE VIBRATION CONTROL **9**

Basics, Piezoelectric materials, electro rheological fluids, magneto rheological fluids, Magneto and Electrostrictive Materials in Vibration Control, shape memory alloys and electro-magnetic materials.

UNIT IV VIBRATION MEASUREMENT **9**

Basics, data acquisition, FFT analysis and filters

L:45 TOTAL: 45 PERIODS

REFERENCES:

1. Mechanical Vibrations, S. S. Rao, Pearson Education Inc. (4th Ed.), 2007.
2. Fundamentals of Signal Processing for Sound and Vibration Engineers, Kihong Shin and Joseph Hammond, John Wiley & Sons, Ltd.,2008
3. Mechanical Vibrations, S. Tamadonni & Graham S. Kelly, Schaum's out line Series, Mc-Graw Hill Inc, 1998.
4. Vibration Condition Monitoring of Machines, J. S. Rao, Tata Mc-Graw Hill, 2006

13MECB **PIPING DESIGN ENGINEERING**

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Apply the fundamental principles for designing pipes and creating engineering drawings.

CO2: Explain the working principle of piping components and Design pipes for various piping codes and standards

CO3: Analyze the stress induced in the pipes under static loading condition

CO4: Design pipes and piping support structures considering welding reinforcement and stress Intensifications

CO5: Predict mathematically the behavior of pipes under dynamic conditions

UNIT I FUNDAMENTALS 9

Engineering drawing fundamentals - Piping drawings - P& ID – Plot Plan - Layout – Mechanical Design fundamentals – Pressure, Temperature, Flow rates, stress, strain, theory of failure, young's modulus, moment of inertia, section modulus, radius of gyration. Dynamic loads – Harmonic, Modal, Spectrum, frequencies

UNIT II PIPING ELEMENTS AND MATERIALS 9

Introduction to piping –Piping Components – Pipe, Fittings, Flanges, Gaskets, Bolting – Valves – Isolation, Regulation, Non – return, Special purpose. Piping Materials – Piping Codes and Standards – Pipe Sizing, Diameter and Pressure drop calculations

UNIT III PIPING SUPPORTS AND STATIC STRESS ANALYSIS 9

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 9

Welding reinforcement calculations – Nozzle design - Stress intensification at elbows, tees and branch – Structure basics - Piping supporting structure modeling.

UNIT V DYNAMIC ANALYSIS 9

Wind and Seismic analysis –Damping – Lumped Mass – Steady state vibration and harmonic analysis – Time history Analysis

L:45 TOTAL: 45 PERIODS

TEXT BOOKS

1. MohinderL.Nayyar, "Piping Handbook", McGraw Hill Handbook, Seventh Edition, 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 & B31.3, 2012
2. KellogM W, "Design of Piping Systems", John Wiley & Sons, Second Revised Second Edition, 1991
3. Liang-Chuan Peng and Tsen-Loong Peng, "Pipe Stress Engineering", ASME Press, New York, 2009

13MECC **ADVANCED MODELING TECHNIQUES** **L T P C**
2 0 2 3

COURSE OUTCOMES

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

CO1: Describe the principles and concepts of Geometric modeling, solid modeling, and assembly. (U)

CO2: Apply advanced modeling and computational tools for complex mechanical parts. (Ap)

CO3: Produce detailed exploded assembly views with Bills of Materials. (Ap)

CO4: Execute element and sheet metal CAD drawings for mechanical engineering applications in the current industrial practice. (Ap)

CO5: Create and export computer-generated animations showing the assembly and operation of mechanical problems. (C)

UNIT I MODELING CORE CONCEPTS 9

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 and Assembly.

UNIT II ADVANCED PARTS AND ASSEMBLY 9

Sketch – 3D Sketch, Parabola, Conics, Splines, Derived sketches. **Part** – Flex, Bending, Twisting, Tapering and 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 9

Model view, Projection view, Section view, Detail view, Broken view, Exploded view, Dimensions – ordinate, driving, baseline, annotations, ballons, Bill of materials, tables, Tolerances. Geometric Dimensioning and Tolerance.

.

UNIT IV WELDMENT AND SHEET METAL 9

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 ANIMATIONS AND ADVANCED CONCEPTS 9

Animations – walkthrough videos, Tool Analyst, Photoview, Rendering, Mold, Plastics, Introduction to CAM.

L:45 TOTAL: 45 PERIODS

REFERENCES

1. Ibrahim Zeid, “Mastering CAD/CAM”- Tata McGraw Hill Publishing Ltd. 2004
2. Donald Hearn, “Computer Graphics”- Pearson Education Ltd.
3. Matt Lombard, Solidworks 2010 Bible.

13MECD **NEW PRODUCT DESIGN AND DEVELOPMENT**

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: Recognize the basic concepts of product design and development with focus on the Product Initiation, development techniques, Quality Concepts and Product legality. (U)

UNIT I PRODUCT INITIATION 12

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 11

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 QUALITY CONCEPTS 11

Design for quality, Quality Function Deployment, Design Of Experiments, Failure Modes & Effect Analysis, TQM, design for six sigma, brain storming techniques, Design for manufacturing,

UNIT IV PRODUCT LEGALITY 11

Product standards, Drawing standards, product certifications, system certifications, Patent, copy right, trademarks, geographical indication

L: 45 TOTAL: 45 PERIODS

REFERENCES

1. Anita Goyal, Karl T Ulrich, Steven D Eppinger, “Product Design and Development “, 4th Edition, 2009, Tata McGraw Hill Education, ISBN-10-007-14679-9
2. Bridger R S, “Introduction to Ergonomics”, Taylor and Francis, London, 2003.
3. Concurrent Engg./Integrated Product Development. Kemnneth Crow, DRM Associates, 6/3,ViaOlivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book
4. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN OTTO & KRISTIN WOOD, Pearson Education (LPE), 2001.
5. G.B.Reddy, “Intellectual Property Rights and the Law”, Gogia Law Agency, 7th Edition - Reprint, 2009.

13MECE INDUSTRIAL TRIBOLOGY

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 basic concepts of tribology and differentiate sliding contact bearings and rolling contact bearings. (A_P)

CO2: discuss about fundamental concepts and different mechanism involved in the friction and wear. (a_p)

CO3: discuss different lubrication theory in bearings. (U)

CO4: analyze the load carrying capacity, flow measurement and energy losses in bearings. (A_N)

CO5: select suitable surface modification methods based on the bearing materials. (Ap)

UNIT I INTRODUCTION 9

Defining Tribology - Tribology in Design - Mechanical design of oil seals and gasket - Defining Lubrication - Basic Modes of Lubrication - Properties of Lubricants - Lubricant Additives - Defining Bearing Terminology - Sliding contact bearings - Rolling contact bearings - Comparison between Sliding and Rolling Contact Bearings

UNIT II FRICTION AND WEAR 9

Friction - Laws of friction - Friction classification - Causes of friction - Theories of Dry Friction - Friction Measurement - Wear - Wear classification – Wear between solid and liquid - Factors affecting wear – Measurement of wear. Theories of Wear - Approaches to Friction Control and Wear Prevention.

UNIT III LUBRICATION OF BEARINGS 9

Mechanics of Fluid Flow - Theory of hydrodynamic lubrication - Mechanism of pressure development in oil film. Two Dimensional Reynolds's Equation and its Limitations. Designing Journal Bearing - Parameters of bearing design - Unit pressure - Temperature rise - Length to diameter ratio - Radial clearance - Minimum oil-film thickness.

UNIT IV FINITE BEARINGS 9

Finite Bearing- Basic concept - Advantages and limitations - Viscous flow through rectangular slot – Load carrying capacity and flow requirement - Energy losses - Optimum design.

UNIT V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS 9

Surface modifications - Transformation Hardening, surface fusion – Surface coatings - Plating and anodizing - Fusion Processes -Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Bharat Bhushan (Editor), "Introduction to Tribology", John wiley & Sons Ltd, Publication, USA, 2nd Edition, 2013.
2. Michael M. Khonsari and E. Richard Booser "Applied **Tribology: Bearing Design** and Lubrication", John wiley & Sons Ltd, Publication, USA, 2nd Edition, 2008.

REFERENCES

1. Gwidon Stachowiak and Andrew W Batchelor, "Engineering **Tribology"**, Elsevier International Publishing, Australia, 4th Edition, 2013.
2. Giovanni Straffelini, "Friction and Wear: Methodologies for Design and Control (Springer Tracts in Mechanical Engineering)", Springer International Publishing, Switherland, 2015.
3. M. K Ghosh, B. C. Majumdar, Mihir Sarangi "Fundamentals of Fluid Film Lubrication", McGraw Hill Education(India) Pvt.Ltd, New delhi, 1st Edition, 2013.
4. http://nptel.ac.in/courses/IIT-MADRAS/Machine_Design_II/pdf/5_4.pdf.
5. http://www.astbearings.com/assets/files/Bearing-Materials-Technical-Information-Sheet_ENB-04-0553.pdf.

13MECF DESIGN OF JIGS, FIXTURES AND PRESS TOOLS

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: select locating and clamping devices for a given machining operation.(Ap)
CO2: design jig and fixture for a simple component to perform simple operation.(Ap)
CO3: estimate press capacity and prepare strip layout.(An)
CO4: design and development of bending and drawing dies.(Ap)
CO5: design a blanking and piercing dies.(Ap)

UNIT I LOCATING AND CLAMPING PRINCIPLES 9

Tool design objectives - Advantages of Jigs and fixtures - Important Considerations while designing Jigs and Fixtures-Principles of location – Locating methods and devices – Redundant Location –Principles of clamping – Clamping elements with mechanical, pneumatic and hydraulic actuation. Standard parts – Drill bushes– Tolerances and error analysis.

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 PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING 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 FORMING AND DRAWING DIES 9

Difference between bending and drawing – 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 approved design data book is permitted in the End Semester Examination)

TEXTBOOKS

1. Joshi P.H, “Jigs and Fixtures”, Third Edition, Tata McGraw Hill, New Delhi, 2010.
2. Donaldson, Lecain and Goold. “Tool Design”, Tata McGraw Hill, 4TH edition, 2012.
3. Hoffman, “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore, 2004.

REFERENCES

1. K. Venkataraman, “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2015.
2. Kempster, “Jigs and Fixture Design”, Hoddes and Stoughton, Third Edition 1974.
3. Joshi, P.H. “Press Tools – Design and Construction”, Wheels publishing, 1999.
4. ASTME Fundamentals of Tool Design, Prentice Hall of India, 1984
5. Design Data Hand Book, PSG College of Technology, Coimbatore, 2011.

13MECG FUNDAMENTALS OF NANOTECHNOLOGY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1. describe the basic concept of nanotechnology.(U)
CO2. discuss about bulk synthesis of nano materials.(U)
CO3. choose appropriate chemical methods for synthesis of nano materials.(Ap)
CO4. illustrate the concept of nano materials synthesis by physical approaches.(Ap)
CO5. demonstrate the various imaging technique to characterize nano materials.(Ap)

UNIT I INTRODUCTION TO NANO MATERIALS 9

Background to Nanoscale Science and Technology-Basic principles of nano scale materials-Effect of nano dimension on materials properties. Classification of nano materials - properties and applications. Nano sized metals and alloys, semiconductors, ceramics.

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, Banerjee A. N, "Introduction to Nanoscience and nanotechnology", PHI Learning Private Ltd, 2009.
2. Ying Wang Guozhong Cao Wang Cao, "**Nanostructures and Nanomaterials: Synthesis, Properties and Applications",** World Scientific Publishing Ltd, 2nd Revised Edition, 2010.
3. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1997.

REFERENCES

1. C. Suryanarayana, "Mechanical alloying and milling", Marcel Dekker, Inc., New York, 2005.
2. G. Cao, "Nanostructures & Nano materials: Synthesis, properties & applications", Imperial college press, 2004.
3. N John Dinardo, "Nanoscale characterization of surfaces & Interfaces",
4. Weinheim Cambridge, Wiley-VCH, 2nd Edition, 2000.
5. J.George, "Preparation of thin films", Marcel Dekker, Inc., New York, 2005.

13MECH INDUSTRIAL ROBOTICS

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

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

CO1. describe the various configurations of robots (U).
CO2. select suitable drive system and end effectors for the various fields of robot applications (Ap).
CO3. suggest the suitable sensors for robot applications (Ap)
CO4. demonstrate machine vision system and write simple robot programming (Ap)
CO5. describe the use of robot in manufacturing industries (Ap)

UNIT I FUNDAMENTALS OF ROBOT 9

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and Functions – Need for Robots

UNIT II ROBOT DRIVE SYSTEMS AND ROBOT KINEMATICS 9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor and A.C. Servo Motors – Salient Features, Applications and Comparison of Drives-End Effectors – Grippers -Selection and Design Considerations.

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom in 2 Dimension.

UNIT III SENSORS FOR ROBOT 9

Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors Piezo-electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors, Range Sensors Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters, Proximity Sensors Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors, Touch Sensors, Binary Sensors, Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors.

UNIT IV MACHINE VISION ROBOT PROGRAMMING 9

Camera, Frame Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage and Lighting Techniques. Image Processing and Analysis –Data Reduction: Edge detection, Feature Extraction and Object Recognition.

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, Processing operations like Welding & painting, Assembly operations- Inspection automation, Robot cell layouts-Multiple robots & Machine interference, safety considerations Economics and social aspects of robotics.

L: 45 TOTAL: 45 PERIODS

TEXT BOOK

1. M.P.Groover, “Industrial Robotics – Technology, Programming and Applications”, McGraw-Hill, 2001.

REFERENCES

1. K.S. Fu, R.C Gonzalz, and C.S.G Lee., “Robotics Control, Sensing, Vision and Intelligence”, McGraw-Hill Book Co., 1987.
2. P.A Janakiraman., “Robotics and Image Processing”, Tata McGraw-Hill, 1995.
3. H. Asada, and J. J. Slotine., “Robot Analysis and Control”, New York, NY: Wiley, 1986.
4. C. Ray Asfahl, “Robots and Manufacturing Automation” Wiley India Pvt Ltd, 2nd Edition, 2012.

13MECJ **AIRCRAFT ENGINEERING** **L T P C**
3 0 0 3

COURSE OUTCOMES

Upon successful completion of this course, the students will be able to
CO1: demonstrate the component of Flight and its operation (Ap)
CO2: choose the suitable materials for Aircraft structure (Ap)
CO3: demonstrate the operation of airplane control system and Engine system. (Ap)
CO4: recognize avionics and auto pilot system (U)
CO5: appraise the recent air craft technologies (E)

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 and brake system – components, landing gear systems-classification – shock absorbers-retraction 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

Fuel systems - piston and jet engines – components - multi-engine fuel systems-lubricating systems in piston and jet engines - starting and ignition systems in piston and jet engines

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, technologies-Auto pilot – Basic principles, longitudinal and lateral auto pilot

UNIT V RECENT AIRCRAFT TECHNOLOGIES 9

Latest technology in air crafts in Defense, cargo and passenger flight. Supersonic air craft-wing in ground aircraft-uninhabited aerial vehicle (UAV)-Invincible aircraft-Air ship-jet pack.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Anderson, J.D, “Introduction to Flight”, 5TH edition, McGraw-Hill, 2005.
2. Stephen. A. Brandt, "Introduction to Aeronautics: A design perspective", American Institute of Aeronautics & Astronautics, 3rd edition, 2015.
3. Mekinley , J.L. and R.D. Bent, "Aircraft Power Plants", McGraw Hill, 2nd edition, 1993.
4. Pallet, E.H.J, "Aircraft Instruments & Principles", Pitman & Co. 1993
5. Albert Helfrick.D., "Principles of Avionics", Avionics Communications Inc., 2004
6. Collinson.R.P.G. "Introduction to Avionics", Chapman and Hall, 2nd edition, 2003.

13MECK	MECHATRONICS	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 sensors for given systems. (Ap)

CO2: suggest suitable actuation systems and drives for the given applications.(Ap)

CO3: derive the simple mathematical models for mechatronic systems. (An)

CO4: describe the functions of programmable logic controllers (PLC). (U)

CO5: design a mechatronic systems for given applications. (An)

UNIT I SENSORS FOR MECHATRONIC SYSTEMS 9

Introduction to Mechatronic Systems–Control Systems- Microprocessor based Controllers. Sensors and Transducers–Performance Terminology– Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors-Applications.

UNIT II ACTUATION SYSTEMS AND DRIVES 9

Pneumatic and Hydraulic Systems–Direction Control Valves–Rotary Actuators. Mechanical Actuation Systems–Cams–Gear Trains–Ratchet and pawl– Belt and Chain Drives–Bearings. Electrical Actuation Systems–Mechanical Switches–Solid State Switches–Solenoids–Construction and working principle of DC and AC Motors – speed control of AC and DC drives, Stepper Motors-switching circuitries for stepper motor – AC & DC Servo motors

UNIT III SYSTEM MODELS AND CONTROLLERS 9

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational Transnational Systems, Electromechanical Systems–Hydraulic–Mechanical Systems. Continuous and discrete process Controllers–Control Mode–Two–Step mode–Proportional Mode–Derivative Mode–Integral Mode–PID Controllers–Introduction.

UNIT IV INTRODUCTION TO PLC 9

Programmable Logic Controllers (PLC)–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.

UNIT V DESIGN OF MECHATRONICS SYSTEM 9

Stages in designing of Mechatronics Systems–Traditional and Mechatronic Design-Possible Design Solutions. Case studies of Mechatronics systems- Pick and place Robot-Autonomous mobile robot-Wireless surveillance balloon-Engine Management system-Automatic car park barrier.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Bolton.W, “Mechatronics” , Pearson education, 2nd edition, fifth Indian Reprint, 2003.
2. Smaili.A and Mrad.F , “Mechatronics integrated technologies for intelligent machines”, Oxford university press, 2008

REFERENCES

1. Rajput. R.K, “A textbook of Mechatronics”, S. Chand & Co, 2007.
2. Michael B. Histand and David G. Alciatore,“Introduction to Mechatronics and Measurement Systems”, McGraw-Hill International Editions, 2000.
3. Bradley D. A., Dawson D., Buru N.C. and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
4. Dan Necsulesu, “Mechatronics”, Pearson Education (Asia), 2002 (Indian Reprint).

5. Lawrence J. Kamm, “Understanding Electro – Mechanical Engineering: An Introduction to Mechatronics”, Prentice – Hall of India Pvt., Ltd., 1st Edition, 2000.
6. Nitaigour Premch and Mahadik, “Mechatronics”, Tata McGraw-Hill publishing Company Ltd, 2003.

13MECL APPLIED HYDRAULICS AND PNEUMATICS

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 basics concept of fluid power and recognize the fluid power symbols. (U)

CO2: describe the various components of hydraulic and pneumatic systems. (U)

CO3: read, construct, analyze and design the fluid power circuit for any application. (An)

CO4: discuss the concepts of fluidic devices, PLC Circuit and trouble shooting of hydraulic & Pneumatic circuits. (U)

UNIT I FUNDAMENTALS OF FLUID POWER SYSTEMS 9

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems-desirable properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics - Laminar and Turbulent flow – Reynold‘s number – Losses in pipe, valves and fittings.

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 and Rotary actuators – Fluid motors, Gear, Vane and Piston motors.

UNIT III HYDRAULIC VALVES, PNEUMATIC SYSTEMS AND COMPONENTS 9

Construction of Control Components: Direction control valve – 3/2 way valve – 4/2 way valve 4/3 way valve– Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves Pneumatic Components: Properties of air – Compressors – Filter-Regulator, Lubricator Unit – Air control valves, Quick exhaust valves, pneumatic actuators.

UNIT IV DESIGN OF HYDRAULIC AND PNEUMATIC CIRCUITS 9

Fluid Power Circuit Design Speed control circuits, Synchronizing circuit, Automatic cylinder reciprocating circuit, Regenerative circuit, Fail-Safe circuits, Pneumo hydraulic circuit and Sequential circuit design for simple applications using cascade method. Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit.

UNIT V LOGIC CONTROL SYSTEMS 9

Advanced Controls for Fluid Power Systems and Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves. Fluidics – Introduction to fluidic devices, simple circuits, Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits; failure and troubleshooting.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Bolton.W, "Mechatronics" , Pearson education, 2nd edition, fifth Indian Reprint, 2003.
2. Smaili.A and Mrad.F , "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008

REFERENCES

1. Rajput. R.K, "A textbook of Mechatronics", S.Chand & Co, 2007.
2. Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2000.
3. Bradley D. A., Dawson D., Buru N.C. and Loader A.J, "Mechatronics", Chapman and Hall, 1993.
4. Dan Necsulesu, "Mechatronics", Pearson Education (Asia), 2002 (Indian Reprint).
5. Lawrence J. Kamm, "Understanding Electro – Mechanical Engineering: An Introduction to Mechatronics", Prentice – Hall of India Private Limited, 1st Edition, 2000.
6. Nitaigour Premchand Mahadik, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, 2003

13MECM DESIGN FOR MANUFACTURING AND ASSEMBLY

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1: describe the various factors influencing the manufacturability of components and the use of tolerances in manufacturing. (U)

CO2: apply the concept of Design for Manufacture DFM to various forging, casting, welding and machining processes. (Ap)

CO3: illustrate the various assembly methods and processes and design for assembly Guidelines. (Ap)

UNIT I INTRODUCTION 9

Qualities of a designer - Systematic working plan - Factors influencing choice of materials - Manufacturing methods. Process capability. Tolerances - Relevant to manufacturing, assembly. Tolerance stack - effects on assembly - Methods of eliminating tolerance stack.

UNIT II FORM DESIGN - CASTING AND WELDING 9

Influence of loading, materials, production methods on form design. Casting considerations - Requirements and rules. Welding considerations - Requirements and rules. Redesign of components for castings. Redesign of components for welding. Case studies.

UNIT III FORM DESIGN - FORGING AND MACHINING 9

Forging considerations - Requirements and rules. Choice between casting, forging and welding. Machining considerations - Requirements and rules. Redesign of components for forging. Redesign of components for machining. Case studies.

UNIT IV DESIGN FOR ASSEMBLY (DFA) 9

Distinction between assembly methods and processes. Factors determining assembly methods and processes. Design factors independent of methods and processes. Design factors dependent on methods. Design factors dependent on processes.

UNIT V DESIGN FOR ASSEMBLY (DFA) METHODS 9

Approaches to design for assembly - Approaches based on design principles and rules - Qualitative evaluation procedures, knowledge based approach, and computer aided DFA methods. Assemblability measures. Boothroyd - Dewhurst DFA method - Redesign of a simple product. Case studies.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Harry Peck, “Design for Manufacture”, Pittman Publication, 1983.
2. Alan Redford and Chal, “Design for Assembly - Principles and Procedures”, McGraw Hill International Europe, London, 1994.

REFERENCES

1. Robert Matousek, “Engineering Design - A Systematic Approach”, Blackie & Sons Ltd., Digitized 2007.
2. James G. Bralla, “Hand Book of Product Design for Manufacturing”, McGraw Hill Co., 1986.
3. Swift.K.G, “Knowledge Based Design for Manufacture”, Kogan Page Ltd., 1987

13MEDA **TOTAL QUALITY MANAGEMENT** **L T P C**
3 0 0 3

COURSE OUTCOMES

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

CO1: Recognize the need for total quality management and areas of application of this management concept. (R)
CO2: Predict the need for customer expectations and employee involvement. (U)
CO3: Estimate six-sigma and perform benchmarking. (U)
CO4: Devise methods to use Quality Function Deployment (QFD), failure Mode Effect Analysis (FMEA) and Taguchi's loss functions. (Ap)
CO5: Describe ISO 9000 and Environmental Management System (EMS) standards. (U)

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM –- Contributions of Deming, Juran and Crosby – Cost of Quality, Analysis Techniques for Quality Costs -Barriers to TQM.

UNITII TQM PRINCIPLES 9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kanban, Kaizen, POKA-YOKE, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, - Business Excellence Model-Rajiv Gandhi National Quality Award.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Deviation and Standard Deviation; Phases and Defective Units of Six Sigma; Its Importance; Overview of Master Black and Green Belt– Bench marking– Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9000-2000 Quality System –Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 - ISO/TS 16949 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Dale H.Besterfiled, et at., "Total Quality Management", Pearson Education Asia, 3 Edition, Indian Reprint (2010).
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6 Edition, South-Western (Thomson Learning), 2005.

REFERENCES

1. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Limited, Oxford, 3 Edition, 2003.
2. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Private Limited, 2006.
3. Janakiraman B and Gopal R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Private Limited, 2006.
4. Ramachandran, S. “Total Quality Management”, Air Walk Publications, 2 Edition 2008.

FEW HYPERLINKS FOR REFERENCES

- http://nptel.ac.in/courses/110101010/16
- http://www.iso.org/iso/qmp_2012.pdf
- http://en.wikipedia.org/wiki/ISO_9000

13MEDB ENTREPRENEURSHIP DEVELOPMENT

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

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

CO1: describe the concept of entrepreneurship and need for becoming an entrepreneur. (R)

CO2: discuss about competencies and motivation acquired for an entrepreneur. (U)

CO3: demonstrate their plan to start a small enterprise.(Ap)

CO4: analyze the financial and accounting details needed for starting and running a small enterprise. (An)

CO5: summarize the various supports available to start a small enterprise. (U)

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.

UNITV 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.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. S.S.Khanka "Entrepreneurial Development" S.Chand and Co. Ltd., New Delhi, 2014.
2. Hisrich R D 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 Publishers Entrepreneurship Development Institute of India, Ahmadabad, 1986.

13MEDC MARKETING MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OUTCOMES

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

CO1. describe the basic concepts of marketing. (U)
CO2. apply product planning, development and pricing strategy.(Ap)
CO3. examine the best channel of distribution and sales promotion strategy. (An)
CO4. apply the appropriate marketing research process for introducing a new product. (E)
CO5. create a new ideas and solutions for the issues and developments in marketing. (C)

UNIT I INTRODUCTION 9

Scope and importance of marketing; Marketing concept and its evolution; 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; Consumer decision making process.

UNIT II PRODUCT DECISIONS 9

Concept of a product; 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 9

Distribution Channels and Physical Distribution Decisions, Nature, functions, and types-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 and scope of marketing research; marketing research process-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. Dr.Rajan Nair, “Marketing”, Sulan Chand & Sons, New Delhi, 2004.
2. Dr.Varma & Agarwal, “Marketing Management”, Forward Publishing Company New Delhi, 2014.

REFERENCES

1. Philip. Kotlar and Kevin Lane Keller, “Marketing Management”, Prentice Hall, New Delhi. 15th edition, 2015
2. Stanton, Etzel, Walker, “Fundamentals of Marketing”, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 10th Edition, 2012.
3. R.S.N. Pillai & Bagavathi,“Modern Marketing Principles and Practices”, S.Chand & Co pvt. Ltd, New Delhi, 2004.

13MEDD	ENGINEERING ECONOMICS AND COST ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OUTCOMES

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

CO1: describe basic concepts and terminologies used in engineering economics. (U)
CO2: describe the concept of value engineering and find the time value of money.(Ap)
CO3: compare and select alternative methods based on time value of money. (Ap)
CO4: perform replacement and maintenance analysis for different alternatives. (An)
CO5: estimate the depreciations and economic life of asset. (Ap)

UNIT I INTRODUCTION TO ECONOMICS 9

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - 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 (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram) and rate of return method, Examples in all the methods.

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9

Replacement and Maintenance analysis – Types of maintenance, types of 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- Introduction, Straight line method of depreciation, declining balance method of depreciation-Sum of the years digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- introduction, Examples, 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 approved design data book is permitted in the End Semester Examination)

TEXT BOOKS

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi, 5th Edition, 2006.
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, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2002
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 1984
4. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, "Principles of Engineering Economy", Ronald Press, New York,1976.
5. Smith, G.W., "Engineering Economy", Lowa State Press, Iowa, 1973.
6. Truett & Truett, "Managerial economics - Analysis, problems & cases "Wiley India 8th edition 2004.
7. Luke M Froeb / Brian T Mccann, "Managerial Economics – A problem solving approach" Thomson learning, 2007.

13MEDE PROJECT MANAGEMENT L T P C
3 0 0 3

COURSE OUTCOMES

Upon successful completion of this course, the students will be able to
CO1: describe the discipline of project management as it applies to using Microsoft project (U)
CO2: create a Work Breakdown Structure (Ap)
CO3: set up a Project with a Calendar, Start date, and scheduling method (An)
CO4: create a Resource Leveled Schedule (An)
CO5: capture actual performance data (Ap)
CO6: set project baselines and use them to measure progress (An)

UNIT I INTRODUCTION TO PROJECT MANAGEMENT 9

Understanding Projects, Managing Projects & Project Management Software, Taking a first look at Project – Starting Project, Entering Information, Changing Views, What's new in Project Management and software tools.

UNIT II CREATING A NEW PROJECT 9

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

UNIT III BUILDING TASKS 9

Establishing Timing for Tasks, Assigning Task Timing, Using Recurring Tasks, Establishing Constraints and Deadline Dates, Manipulating Gantt Chart to View Timing, Entering Task Notes, Establishing Dependencies Among Tasks, Viewing Dependencies

UNIT IV CREATING RESOURCES AND ASSIGNING COSTS 9

Understanding Resources, Creating Resource List, Modifying Resource Information, Using Resources and Tasks, Handling Unusual Cost Situations.
Understanding Basics of Views: Definition, Examining Indicators, Admiring Views – Calendars, Detail Gantt, Gantt Chart, Leveling Gantt, Tracking Gantt, Multiple baselines Gantt. Resource Allocation , Resource Form, Resource Graph, Resource Name Form, Resource Sheet, Resource Usage, Roll up Views, Task Details Form, Task Entry, Task Form, Task Name Form,Task Sheet, Task Usage, Printing Project.

UNIT V TRACKING PROJECT PROGRESS 9

Tracking Project Progress I:Understanding the Principles of Tracking, Using Baseline, Changing the Baseline, Viewing Progress with the Tracking Gantt Chart View – Interpretation, Task Variance Table, Task Cost Table, Task Work Table, Understanding Tracking Strategies.
Tracking Project Progress II: Recording Actuals – Organizing the Updating Process, Understanding Calculation Options, Updating Tasks to Reflect Actual Information, Using Actuals and Costs, Techniques and Tips for Updating, Reviewing Progress.

L: 45 TOTAL: 45 PERIODS

TEXT BOOKS

1. Project Engineering, The Essential Toolbox for Young Engineers by Frederick B. Plummer, Elsevier Science & Technology Books, 2007
2. Microsoft Office Project 2007 Bible by Elaine Marmel, Wiley Publishing Inc, 2007
3. Microsoft Office Project Dummies by Nancy C.Muir, Wiley Publishing Inc, 2007.

13TD01E INDIAN BUSINESS LAWS L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

13TD02E LEADERSHIP AND PERSONALITY DEVELOPMENT L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

13TD03E INTERNATIONAL BUSINESS MANAGEMENT L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

13TD04E BASICS OF MARKETING L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

13TD05E RETAILING AND DISTRIBUTION MANAGEMENT L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

13TD06E **INTERNATIONAL ECONOMICS** **L T P C**
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

13TD07E INDIAN ECONOMY L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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).

13TD08E RURAL ECONOMICS L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

13TD09E INTERNATIONAL TRADE L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

13TD10E GLOBAL CHALLENGES AND ISSUES L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

13TD11E INDIAN CULTURE AND HERITAGE L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

13TD12E INDIAN HISTORY L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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

13TD13E SUSTAINABLE DEVELOPMENT AND PRACTICES L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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”, Earthscan 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.

13TD14E WOMEN IN INDIAN SOCIETY L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

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13TD15E INDIAN CONSTITUTION L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.

13TD16E BIO MECHANICS IN SPORTS L T P C
0 0 0 3

COURSE OUTCOMES

Upon Successful 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.