DR MAHALINGAM

MCET

COLLEGE OF ENGINEERING AND TECHNOLOGY

Enlightening Technical Minds

Dr.Mahalingam

College of Engineering and Technology

Affiliated to Anna University ,Chennai. Approved by AICTE.
Accredited by NBA and NAAC with Grade A
Udumalai Road, Pollachi-642 003. Tel: 04259-236030/40/50

Department of Mechanical Engineering
Academic Year – 2015-16

STUDENT HANDOUT

2015-16

CONTENT:

VISION AND MISSION OF THE INSTITUTE

VISION:

We develop globally competitive workforce and entrepreneurs.

MISSION:

Dr. Mahalingam College of Engineering and Technology, Pollachi endeavors to impart high quality, competency based technical education in Engineering and Technology to the younger generation with the required skills and abilities to face the challenging needs of the industry around the globe. This institution is also striving hard to attain a unique status in the international level by means of infrastructure, state-of-the-art computer facilities and techniques.

VISION AND MISSION OF THE DEPARTMENT

VISION:

To transform students from rural background into professional leaders of tomorrow in the field of Mechanical Engineering with a strong sense of social commitment.

MISSION:

To impart quality – engineering education leading to specialization in the emerging areas of CAD/CAM/CAE, Energy Engineering and Materials Technology.

To provide continually updated and intellectually stimulating environment to pursue research and consultancy activities.

PROGRAM EDUCATIONAL OBJECTIVES

The graduates will:

PEO1. Technical Expertise: Actively apply technical and professional skills in engineering practices towards the progress of the organization in competitive and dynamic environment

PEO2. Lifelong Learning: Own their professional and personal development by continuous learning and apply the learning at work to create new knowledge

PEO3. Ethical Knowledge: Conduct themselves in a responsible, professional and ethical manner supporting sustainable economic development which enhances the quality of life.

PROGRAM OUTCOMES (2014 Regulation)

At the end of the mechanical engineering programme the Graduates will be able to:

PO 1. Apply scientific principles and concepts in design and development of products and manufacturing processes.

PO 2. Analyze the systems' behavior and optimize for the results using modeling, simulation and experiments.

PO 3. Design products and manufacturing facilities that deliver the requirements of the target customers and desired quality functions.

PO 4. Identify, formulate, and solve engineering problems using appropriate tools and techniques.

PO 5. Check and improve the DFX-assembly, manufacture, cost, quality, reliability, serviceability, recyclability etc.

PO 6. Face challenges with rigor and emotional stability

PO 7. Demonstrate understanding of the dynamic industrial and business environment in which the products are designed, manufactured and sold.

PO 8. Practice Ethical responsibility

PO9. Work effectively in teams and build/manage interpersonal relationships

PO10. Communicate effectively through oral, non-verbal and written means.

PO11. Plan and work to time

PO12. Learn continuously

Program Specific Outcomes PSO:

PSO 13. Develop and maintain positive health - physical, mental and social wellbeing

PSO14. Articulate and engage in pursuit of career and life goals

PSO 15. Develop adaptability to change

PROGRAM OUTCOMES (2011 Regulation)

At the end of the mechanical engineering programme the Graduates will be able to:

PO1. Engineering knowledge: Apply the fundamental knowledge of mathematics and engineering sciences to solve of mechanical engineering problems.

PO2. Problem analysis: Identify, survey literature, formulate and analyze complex mechanical engineering problems and reach substantiated conclusions.

PO3. Design/development of solutions: Design mechanical components, processes and systems that meet the requirements with due consideration for environment and public health / safety including cultural and societal considerations.

PO4. Conduct investigations of complex problems: Design experiments analyze/interpret data and synthesize information to provide valid conclusions in the field of mechanical engineering.

PO5. Modern tool usage: Apply appropriate techniques including usage of IT tools for prediction and modeling to create and evaluate mechanical engineering systems and their limitations.

PO6. The engineer and society: Practice as professional mechanical engineer to discharge responsibilities by taking informed decisions based on contextual knowledge to assess societal, health, safety, legal and cultural issues.

PO7. Environment and sustainability: Demonstrate the knowledge of, and need for sustainable development by understanding the impact of the professional engineering solutions in societal and environmental contexts.

PO8. Ethics: Comply with code of conduct/norms and professional ethics in engineering practices.

PO9. Individual and team work: Perform effectively as an individual and member / leader in multidisciplinary diverse teams.

PO10. Communication: Effectively communicate both orally / written on complex engineering activities.

PO11. Project management and finance: Manage projects in multidisciplinary environments cost effectively.

PO12. Life-long learning: Learn and acquire up to date knowledge in the field of mechanical engineering independently.

DEPARTMENT OF MECHANICAL ENGINEERING
2014 REGULATION

Curriculum for B.E Mechanical Engineering from Semester I to VIII

SEMESTER I

Course Code	Course Title	Hours/Week			Credits
		L	T	P	
THEORY					
140ME0101	Communication Skills - I	2	0	2	3
140ME0102	Engineering Mathematics – I	3	1	0	4
140ME0103	Applied Physics	2	1	0	3
140ME0104	Applied Chemistry	2	1	0	3
140ME0105	Introduction to Engineering	2	0	2	3
140ME0106	Engineering Graphics	1	3	0	4
PRACTICAL					
140ME0107	Engineering Practices Laboratory	0	0	3	2
140ME0108	Physics and Chemistry Laboratory	0	0	3	2
140ME0109	Promotion of Students' Wellness	0	0	3	2
TOTAL		**12**	**6**	**12**	**26**

SEMESTER II

Course Code	Course Title	Hours/Week			Credits
		L	T	P	
THEORY					
140ME0201	Communication Skills - II	2	0	2	3
140ME0202	Engineering Mathematics – II	3	1	0	4
140ME0203	Material Science	2	0	2	3
140ME0204	Engineering Mechanics	3	1	0	4
140ME0205	Engineering Metrology and Measurements	2	0	2	3
140ME0206	Manufacturing Process - I	3	1	0	4
PRACTICAL					
140ME0207	Manufacturing Process Laboratory- I	0	0	3	2
140ME0208	Computer Aided Drafting and Modeling Laboratory	0	0	3	2
140ME0209	Sports For Wellness	1	0	2	2
TOTAL		**16**	**3**	**14**	**27**

SEMESTER I

Course Code:140ME0101	**Course Title:** COMMUNICATION SKILLS – I
Core/Elective: Core	**L : T : P : C : M** – 2 : 0 : 2 : 3 : 100
Type: Lecture	**Total Contact Hours:**60

Course Outcomes

At the end of the course students will be able to:

CO 1 Recognize and use a wide range of vocabulary in speaking and writing
CO 2 Compose paragraphs, essays and write for academic and business purposes with coherence and accuracy
CO 3 Organize and articulate ideas logically, lucidly and persuasively within a given time frame
CO 4 Use various techniques to read, comprehend, appreciate and interpret content effectively

Course Content

UNIT I FUNCTIONAL GRAMMAR AND VOCABULARY 6+6

Importance of learning a Language Need for a right attitude Nominal word group adjectival word group verbal word group complementation concord pronoun noun agreement subject verb agreement appropriate verb (tense and voice) vocabulary roots affixation and compounding collocation hyponym mnemonics homophones and homographs idioms and phrases condensing one word substitution

UNIT II LISTENING 6+6

Listening to informal conversations and participating situation based dialogues conversations Understanding the structure of conversations tone intonation sounds Listening to a telephone conversation video conferencing model interviews lectures dialoguesfilm clippings with questions Listening for making inferences for main points and sub-points for note taking Listeningfor specific details and information themes and facts.

UNIT III SPEAKING 6+6

Elements of effective speech exchange of basic personal information, narration talk on general topics describing events and people Process description, Extempore GroupDiscussion debate marketing a product or service. Mock interview Just Minute talk pep talk small talk.

UNIT IV READING 6+6

Elements of effective reading skimming, scanning, intensive and extensive reading dictionary usage extractspecific information identify main and subordinate ideas summarize, préciswriting, paraphrase comprehension making inferences reading critically determining fact versus opinion spoken interaction understandthe description of events, feelings and wishes in personal letters understand familiar context specific names, words and sentences, for example on notices, posters and catalogues.

UNIT V WRITING **6+6**

Rules and conventions relating sentences, prewriting- paragraphs, essays cohesive devices and discourse markers thesis statement punctuation and proof reading Clarity and conciseness summarizing report writing, transcoding information business writing letters quotation seeking, order placing, complaint letter, cover letter, resume and email writing.

Text Books

1. M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill Education Pvt. Ltd., New Delhi 2005.

References

1. Halliday M.A.K., Introduction to Functional Grammar, Routledge, London 2014
2. Stuart Redman, English Vocabulary in Use - Pre-intermediate and Intermediate, Second Edition, Cambridge University Press, U.K. 2003
3. Suzanne W. Woodward, Fun With Grammar, Prentice Hall, New Jersey 1997
4. Essentials of Effective Public Speaking, Research and Education Association, New Jersey, 2004
5. Clare West, Reading Techniques, Cambridge University Press, Cambridge, 2010
6. Julie Robitaille and Robert Connelly, Writer's Resources, Second Edition, Thomson Wadsworth, USA 2007.

Web references

- www.cambridgeenglish.org/exams/business.../business-preliminary/
- http://www.pearsonlongman.com/intelligent_business/bec_tests/preliminary.html

CourseCode: 140ME0102	**Course Title:**ENGINEERING MATHEMATICS – I
Core/Elective: Core	**L : T : P : C : M** – 3: 1 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:**60

Course Outcomes

At the end of the course, the students will be able to:

CO1 Calculate Eigen values and Eigen vectors for a given real matrix

CO2 Apply the concepts of differentiation to curvatures

CO3 Identify the extreme values for two variable functions

CO4 Apply multiple integrals to find area and volume

CO5 Formulate simple problems of engineering dynamics as first order ordinary differential equations and state the underlying assumptions

Course Content

UNIT I MATRICES 9+3

Solution of system of equations-Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of eigenvalues and eigenvectors – Cayley-Hamilton Theorem – Diagonalization of matrices by orthogonal transformation–Reduction of a quadratic form to canonical form by orthogonal transformation.

UNIT II DIFFERENTIAL CALCULUS 9+3

Curvature – Cartesian and polar coordinates – Radius and Centre of curvature-Circle of curvature – Involutes andEvolutes – Envelopes.

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial derivatives – Homogeneous functions and Euler's theorem –Total derivative –Change of variables – Jacobians –Partial differentiation of implicit functions – Taylor's series for functions of two variables –Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT IV MULTIPLE INTEGRALS 9+3

Double integration-Cartesian and polar coordinates-Change of order of integration-Transformation from Cartesian to polar, spherical and cylindrical coordinates-Triple integration in Cartesian Coordinates-Applications: Evaluating area and volume using multiple integrals.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER 9+3

Formation of ordinary differential equation-Solution of differential equations of first order and first degree: homogeneous form, linear form and exact differential equations - Applications to engineering problems related to resisted motion.

Text Books

1. Ray Wylie C and Louis C Barret , “Advanced Engineering Mathematics”, 6th Edition McGraw-Hill, 2003
2. Erwin Kreyszig, “Advanced Engineering Mathematics”, 8th Edition, Wiley India, 2007.

References

1. Peter V. O'Neil, Advanced engineering mathematics, 6thEdition, Thomson Nelson, Toronto, 2007.
2. K.A. Stroud and Dexter J. Booth Advanced Engineering Mathematics, 5thEdition, Palgrave, Macmillan,2011.

Web Reference

- http://nptel.ac.in/video.php?subjectId=122107036

Course Code:140ME0103	**Course Title:**APPLIED PHYSICS
Core/Elective: Core	**L : T : P : C : M** – 2 : 1 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:**45

Course Outcomes

At the end of the course, the students will be able to:

- CO1Calculate the values of elastic and frictional properties of materials
- CO2Compute the amount of heat transfer by conduction and radiation in materials
- CO3 Apply the knowledge of ultrasonic's to Inspect the quality of materials through NDT
- CO4 Use the different types of pumps and gauges
- CO5 Apply lasers in various industrial applications

Course Content

UNIT I PROPERTIES OF MATTER 6+3

Elasticity**:** Hooke's law , Elastic modulii Poisson's ratio relation between them Factors affecting elasticity Expression for bending moment, I-shaped girders determination of Young's modulus by cantilever depression method Static Tension Expression for couple per unit twist Torsional oscillation. Friction**:** Static friction, laws of friction, sliding friction, angle of friction, cone of friction.

UNIT II TRANSMISSION OF HEAT 6+3

Conduction Co-efficient of the thermal conductivity Cylindrical flow of heat determination of thermal conductivity of bad conductor Lee's disc method. Experimental determination of Specific heat of liquid, variation of specific heat and atomic heat with temperature. Radiation Black body Wein's Law Rayleigh Jeans Law Stefan's law Experimental Determination of Stefan's constant Mathematical derivation of Stephan's law Solar constant Solar Spectrum.

UNIT III ULTRASONICS AND NDT 6+ 3

Properties of Ultrasonic waves, Production of ultrasonics by magnetostriciton and piezoelectric methods Detection of ultrasonics: Kundt's tube, Thermal method, acoustic grating Cavitation - Industrial applications: ultrasonic cleaning, welding and cutting. Non Destructive Testing: Principle of Ultrasonic testing ultrasonic transducer Couplant *Inspection techniques:* Liquid Penetrant Method, Radiographic testing, Ultrasonic flaw detector*:* Pulse echo system, transmission, A, B & C scan displays. Inspection standards.

UNIT IV VACUUM SCIENCE AND TECHNOLOGY **6+ 3**

Introduction concepts of vacuum throughput, pumping speed, effective pumping speed and conductance. Types of pumps working principle and construction of rotary pump, diffusion pump, turbo molecular pump. Operation of pressure gauges pressure range, measurement of vacuum using Pirani and Penning gauges, merits and limitations. Working of a vacuum system, applications and scope.

UNIT V LASER PHYSICS AND APPLICATIONS **6+ 3**

Laser principles: Stimulated and spontaneous emissions of radiations Population inversion and pumping methods Properties of lasers Nd: YAG laser and CO_2 molecular laser Applications of Lasers: welding, brazing, drilling, cutting and heat treatment of materials.

Text Books

1. D. S. Mathur, "Elements of Properties of Matter" S. Chand & Company Ltd., New Delhi, 2012
2. BrijLal and Dr. N. Subrahmanyam, "Heat and Thermodynamics", S. Chand & Company Ltd., New Delhi, 1997.

References

1. David Halliday, Robert Resnick, Jearl Walker, Fundamentals of Physics Extended, Ninth Edition, Wiley India.
2. R.K. Gaur, S.L. Gupta, Engineering Physics, DhanpatRai, 2013
3. Jayakumar S, "Engineering Physics", R K Publishers, Coimbatore, 2007.
4. Murugeshan, R., "Properties of Matter & Acoustics" S. Chand & Company Ltd., New Delhi, 2012
5. Rajendran, "Engineering Physics", Tata McGraw Hill Publishing Company limited. New Delhi, 2009.
6. Rao V V, Ghosh T. B. and Chopra K L, "Vacuum Science and Technology", Allied Publishers Limited, New Delhi, 1998
7. TarasovL,"Laser Physics and Applications", Mir Publications.

Web References

- http://nptel.ac.in/courses/115106061/
- www.apsu.edu
- www.physicsclassroom.com
- www.study.com
- www.physics.org

Course Code: 140ME0104	**Course Title:**APPLIED CHEMISTRY
Core/Elective: Core	**L : T : P : C : M** – 2 : 1 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:**60

Course Outcomes

At the end of the course, the students will be able to:

CO1 Explain the chemistry of water and specify the water treatment processes.

CO2 Select batteries based on the life cycle, working principle and their applications

CO3 Determine the rate of corrosion of a given metal in a given environment and identify appropriate control techniques to avoid corrosion.

CO4 Select a polymeric material for a specific engineering application and decide the handling, disposal methods and identify substitute bio-degradable polymeric materials for conventional polymeric materials

CO5 Describe the efficiency of fuels in different state based on its composition and calorific value

CO6 Identify appropriate lubricant for different engineering applications

CO7 Explain the significance of adsorption in catalytic phenomena and pollution abatement

Course Content

UNIT I WATER AND IT'S TREATMENT 6 + 3

Introduction, Hardness, Degree of hardness, Determination of hardness by Complexometric method (EDTA method), Municipal Water Supply, Requisites of drinking water, water quality standards-BIS, WHO, purification process. Water for steam making: Sludge and scale formation, caustic embrittlement and boiler corrosion. Methods of Boiler Water Treatment: Internal and external conditioning - Demineralization. Industrial wastewater and sewage treatment. Desalination -reverse osmosis.

UNIT II ELECTROCHEMISTRY AND BATTERIES 6 +3

Concept of Electro Chemistry, Electrochemical cells reversible and irreversible cells. EMF Single electrode potential Electrochemical series, Application of Nernst equation in electrochemical analysis - Galvanic Cells, Concentration Cells, Types of Electrodes- Reference Electrode (SCE), Ion Selective Electrodes (Glass Electrode), Electrochemical methods of analysis - Potentiometric titrations, conductometric titrations, pH metric titrations.

Batteries: Types Dry cell, Lead-Acid, Ni-Cd, Lithium ion construction, working and application. Fuel cells construction and working of hydrogen oxygen fuel cell, application.

UNIT III CORROSION AND CONTROL 6 + 3

Chemical Corrosion Pilling-Bed worth rule Electrochemical corrosion different types galvanic corrosion, differential aeration corrosion, Galvanic series, factors influencing corrosion. Mass loss method of corrosion testing, units to express corrosion rate.

Corrosion control sacrificial anode and impressed cathodic current methods corrosion inhibitors protective coating galvanizing and tinning electroplating and electroless Nickel-plating. Paint and its constituents, Special paints fluorescent paint, high temperature paints, fire retardant paints constituents and functions.

UNIT IV POLYMER CHEMISTRY AND SURFACE CHEMISTRY 6+3

Classification of polymers, Polymerization types Addition, condensation and copolymerization, Properties of polymers: Molecular weight, Tg, Tactility, polydispersity index. Compounding of plastics, Commodity plastics PVC, PE, and PET. Engineering plastics Preparation, properties and uses of PC, Teflon, Nylon. Recycling of plastics, biopolymers.

Surface Chemistry: Adsorption types, application of adsorption technology in industries activated carbon its applications in water purification and air purification, Catalysis types, application of catalytic convertors in IC engine emission control.

UNIT V FUELS AND LUBRICANTS 6 +3

Calorific value Coal proximate and ultimate analysis (method only), metallurgical coke manufacture by Otto Hoffmann method Fractional distillation of petroleum knocking octane number and cetane number. Gaseous fuels CNG and LPG composition, properties and uses.
Lubricants types, mechanism of lubrication, liquid lubricants properties and impact on lubrication viscosity, viscosity index, flash and fire points, cloud and pour points, oiliness, aniline point, solid lubricants graphite and molybdenum sulphide structure properties and uses. Greases types, composition and uses.

Text Books

1. P.C.Jain and Monica Jain, "Engineering Chemistry", 16th Ed., DhanpatRai Pub, Co., New Delhi (2004).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand &Co.Ltd., New Delhi (2006).

References

1. L. Brown and T. Holme, Chemistry for Engineering Students, 3rd edition, Cengage Learning (2010).
2. P.W. Atkins and de Paula Julio, "Physical Chemistry", Oxford University Press, 9th Ed. (Indian Student Edition) (2011).
3. S. Chawla, A Text Book of Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi (2013).
4. O.G. Palanna, Engineering Chemistry, Fourth Reprint. Tata McGraw Hill Education Pvt. Ltd. New Delhi (2009).
5. Wiley Engineering Chemistry, Second Edition, Wiley India Pvt. Ltd. New Delhi (2011).
6. V.R.Gowariker, N.V.Viswanathan and JayadevSreedhar, "Polymer Science", New Age International P (Ltd.,), Chennai (2006).

Web References

- http://nptel.ac.in/courses/122101001/downloads/lec-23.pdf
- http://nptel.ac.in/courses/122101001/downloads/lec-25.pdf
- http://nptel.ac.in/courses/104105039/

Course Code: 140ME0105	**Course Title:**INTRODUCTION TO ENGINEERING
Core/Elective: Core	**L : T : P : C : M** – 2 : 0 : 2 : 3 : 100
Type: Lecture	**Total Contact Hours:**60

Course Outcomes

At the end of the course, the students will be able to:

CO1 Explain the outcome based curriculum, structure of the courses, learning and assessment methodologies.

CO2 Explain the lab facilities and learning resources available in the institution and how they can utilize them effectively.

CO3 List the products that are used in day-to-day life of students and family .

CO4 Explain how these products work/function.

CO5 Explain the different engineering disciplines used in this product.

CO5 Observe every product with an engineering perspective.

Course Content

UNIT I ENGINEERING EDUCATION 6 +6

Expectations and Aspirations of engineering students, Graduate Engineering Attributes, Outcome based Engineering Curriculum, Engineering Skills – Technical and Professional. Courses, course map, Concepts and Theories of Learning – Higher Order Thinking Skills, Multiple Intelligences, learning styles inventory, teaching/learning process and methodologies (Lectures, tutorials, activities, lab/workshop exercises, factory visits, internships, projects, alignment to co-curricular activities and hobby projects) Rubrics, Assessment.

UNIT II LEARNING RESOURCE MANAGEMENT 6 +6

Awareness and effective use of resources for learning:- library resources, professional societies, centres of excellences, and value-added divisions. Code of conduct for resource utilization.

UNIT III SCIENCE AND ENGINEERING IN PRODUCTS 6 +6

Products used in day-to-day life, functions, science and engineering principles applied in the products disciplines, Working of the product, individual parts of the product, Scientific / Engineering principle. + Demonstration with Refrigerator, Wet Grinder, Laptop, Motorbike. Activity to explore working of products used in day to day life.

UNIT IV MULTI-DISCIPLINARY ENGINEERING 6 +6

Mechanical Engineering: Introduction to manufacturing methods, materials, relative motion between parts (Linear and Circular) Fastening methods

Electrical and Electronics Engineering: Electricity system used for domestic and industrial purpose (AC vs DC, AC signal, Single-phase, Three-phase, prime movers(motors) in products used in day to day life, DC, Electrical components: resistor, capacitor, and inductor, Electronic components: diode, and transistor. IC and PCB.
Computer science Engineering: Processor board, Computer peripherals, Operating system.

UNIT V PRODUCT APPRECIATION 6 +6

Essential needs in day-to-day life, Connections between the needs and the products, Product appreciation with engineering perspective.

References

1. C. David, "How it works: Printing and Processes", LadyBird books publication
2. S. Peter, "How it works: Rockets and Space craft", LadyBird books publication
3. Granada, " How things work", Granada, 1978.
4. J. L. Adams, "Flying Buttresses, Entropy, and O-Rings: The World of an Engineer".
5. J. E. Gordon, "The New Science of Strong Materials or Why You Don't Fall through the Floor".
6. R.P. Feynman," Six Easy Pieces: Essentials of Physics Explained by Its Most Brilliant Teacher", 2011

Web References

- https://en.wikibooks.org/wiki/General_Engineering_Introduction/Engineering_Science
- http://science.howstuffworks.com/engineering-channel.htm

CoursCode:140ME0106	**Course Title:**ENGINEERING GRAPHICS
Core/Elective: Core	**L : T : P : C : M** – 1: 3 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:**60

Course Outcomes

At the end of the course, the students will be able to:

CO1 Sketch different engineering curves and explain its application.

CO2 Prepare orthographic and isometric drawings of simple solids

CO3 Prepare development of lateral surfaces of simple objects**.**

CO4 Prepare perspective drawings of regular solids

UNITI CURVES USED IN ENGINEERING PRACTICES 3+9

Importance of graphics in engineering applications –BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning- Methods of Dimensioning. Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method –Construction of cycloid and involutes of square and circle – Drawing of tangents and normal to the above curves. Mathematical representation of these curves and their applications.

UNITII ORTHOGRAPHIC AND ISOMETRIC PROJECTION 3+9

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout of views – Developing visualization skills through free hand sketching of multiple views from pictorial views of objects. Orthographic projection of solids – Practices on three view projection of solids. Isometric Projection of solids – practices on simple solids.

UNITIII PROJECTION OF LINES AND PLANE SURFACES 3+9

Projection of straight lines located in the first quadrant and inclined to both the planes – Concept of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

UNITIV PROJECTION OF SOLIDS AND ITS SECTION 3+9

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane. Need for sectioning of solids – Sectioning of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by cutting planes inclined to one reference plane and perpendicular to the other – Orthographic views of sections of simple solids.

UNITV DEVELOPMENT OF SURFACES AND PERSPECTIVE PROJECTIONS 3+9

Development of lateral surfaces of simple and truncated solids – Prisms, pyramids, cylinders and cones. Concepts of Perspective projection of prisms, pyramids and cylinders by visual ray method.

Text Book

1. K. V. Natrajan, "A Text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2013).
2. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGrawHill Publishing Company Limited (2008).

References

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, (2008).
2. Cencil Jensen, Jay D. Helsel and Dennis R. Short Engineering Drawing and Design. Tata McGraw Hill Publishing Company Limited (2012).
3. John.K.C and Verghese.P.I "Machine Drawing", Jovast Publishers, Trissur,2007.

PUBLICATIONS OF BUREAU OF INDIAN STANDARDS

1. IS 10711 – 2001: Technical products Documentation – Size and lay out ofdrawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods. The mode of delivery is like practical.

Web References

- http://nptel.ac.in/courses/112103019/
- https://en.wikipedia.org/wiki/Engineering_drawing

Code:140ME0107	**Course Title:**ENGINEERING PRACTICES LABORATORY
Core/Elective: Core (G)	**L : T : P : C : M** - 0: 0 : 3 :2 : 100
Type: Practical	**Total Contact Hours:**45

List of Experiments

1. Make a wooden window frame to the required dimensions.
2. Make a steel table using fitting process to the required dimensions
3. Make a Castor Bracket using welding process to the required dimensions
4. Make a winnowing basket in sheet metal to the required dimensions
5. Assemble a pipe line from overhead tank to kitchen sink and dining wash basin
6. a) Make a Domestic wiring circuit to connect a lamp, a fan with regulator and a socket.

   b) Make the internal wiring of a tube light and check the connection
7. Make a Stair case wiring for controlling a lamp from two different locations
8. Do the continuity check in the given PCB and rectify the faults
9. Make an electronic circuit for bi-cycle horn
10. Install the given OS in the computer system
11. Do formatting and partitioning of Hard Disk Drive

Course Code:140ME0108	**Course Title:**PHYSICS AND CHEMISTRY LABORATORY
Core/Elective: Core (G)	**L : T : P : C : M** – 0 : 0 : 3 : 2 : 100
Type: Laboratory	**Total Contact Hours:**45

PHYSICS LABORATORY

List Of Experiments

1. Young's modulus of the material – Cantilever bending method
2. Rigidity modulus of the metallic wire – Torsional pendulum method
3. Thermal conductivity of insulator – Lee's disc method
4. Comparison Co-efficient of viscosity of the liquids
5. Wavelength of laser and determination of particle size using laser
6. Hysteresis loss of ferromagnetic material
7. Thickness of the sample using Air wedge
8. Efficiency of Solar cell

CHEMISTRY LABORATORY

List Of Experiments

I Water analysis

1. Determination of total hardness of water sample by EDTA method.
2. Determination of DO in water by Winkler's method.

II Viscometry

1. Determination of molecular weight of a polymer – Oswald viscometric method (demonstration only).

III Electrochemistry

1. To determine the strength of given acid – pH metrically
2. To determine the amount of Ferrous ions by potentiometry
3. To determine the strength of mixture of strong and weak acid by conductometric titrations.

IV Corrosion testing

1. Determination of corrosion rate and inhibitor efficiency– weight loss method.

References

1. Jeffery, G.H., Bassett, J., Mendham, J. and Denny, R.C., Vogel's Text book of quantitative Chemical Analysis, Oxford, ELBS, London,2002.
2. Shoemaker D.P. and C. W. Garland., Experiments in Physical Chemistry, Tata McGraw-Hill Pub. Co. Ltd., London, 2003.

Course Code:140ME0109	**Course Title:**PROMOTION OF STUDENTS WELLNESS
Core/Elective: Core(G)	**L : T : P : C : M** – 0 : 0 : 3 : 2: 100
Type: Lecture	**Total Contact Hours:**30

Course Outcomes

At the end of the course, the students will be able to:

CO1 Maintain physical wellbeing - grooming, BMI, flexibility, muscle strength, body compositions (vatha, pitha, kapa)

CO2 Maintain mental wellbeing - perceptions, attention/concentration, memory, gunas

CO3 Maintain social wellbeing - etiquettes, emotional and psychological aspects, stress management, morality and values

UNIT I PHYSICAL HEALTH

Physical structure and functions of human body – simplified physical exercises (hand exercises, Leg exercises, breathing exercises, eye exercises – kapalapathi – Maharasanas 1-2 – Massages – Acupuncture – relaxation – importance and benefits. Suryanamaskar.

UNIT II MENTAL HEALTH

Maintenance of youthfulness and life force – kayakalpa yoga – anti ageing process – benefits. Mind and its functions – mind wave frequency – meditation process – Agna, shanthi, thuriam – benefits

UNIT III PERSONALITY DEVELOPMENT – I

Purpose of life and analysis of thought – philosophy of life – introspection – practice. Moralization of desires and neutralization of anger - practices

UNIT IV PERSONALITY DEVELOPMENT – II

Eradication of worries and benefits of blessings – wave theory –practices. Genetic centre – purification – cause and effect theory

UNIT V SOCIAL HEALTH

Greatness of guru – cultural education – love and compassion – fivefold culture. Greatness of friendship and social welfare – individual, family and world peace.

Text Book

1. Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar ,"Value education for harmonious life (Manavalakalai Yoga)", Vethathiri Publications, Erode, I Ed. (2010)

References

1. Dr.R.Nagarathna, Dr.H.R.Nagendra, "Integrated approach of yoga therapy for positive health", Swami Vivekananda Yoga Prakashana, Bangalore, 2008 Ed.
2. Dr.R.Nagarathna, Dr.H.R.Nagendra , "New perspectives in stress management", Swami Vivekananda Yoga Prakashana, Bangalore, I Ed June 1986

OPERATIONAL MODALITIES

- 4-day programme of 6 hours /day for syllabus coverage
- Offered after the college orientation and bridge course to all 240 students at a stretch in a big hall.
- Two faculty members from Aliyar and 10 facilitators from local centre
- Programme Schedule

Forenoon		Afternoon	
9 am to 10.30 am	Session I	1.30 pm to 3.00 pm	Session III
10.30 am to 11.00 am	break	3.00 pm to 3.30 pm	Break
11.00 am to 12.30 pm	Session II	3.30 pm to 5.00 pm	Session IV
12.30 pm to 1.30 pm	Lunch	--	--

FOLLOW-UP PRACTICE

12 weeks x 2 hours/week: 24 hours

EVALUATION

During 4-day programme

Unit I : Practical

Unit II & Unit III : Written (Objective type test)

Unit IV & Unit V : Written (Objective type test)

Mid semester : Practical

End semester : Written and Practical

Assessment: Using measurement gadgets and questionnaires (as suggested by SVYASA and scoring sheets (from Aliyar)

DIMENSIONS AND TOOLS IN MEASUREMENT

Dimension	Sub dimension	Measurement tools
Physical	BMI	Electronic Weighing Machine, Height Measurement
	Flexibility	Sit & Reach
	Muscle Strength	Handgrip Dynamometer
	Prakruti	Dr Ramakrishna's Prakruti Questionnaire
Mental	Perception	Critical Flicker Fusion
	Attention	Digit Letter substitution Test
		Six Letter Cancellation Test
		Stroop Test
	Memory	Digit backward & Forward
Social	Interpersonal Effectiveness & Self Concept	FIRO B
	Psychological Well Being	Short wellbeing scale
		Short Happiness scale
		Barrat Impulsive Scale

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END OF SEMESTER- I

SEMESTER II

Course Code:140ME0201	**Course Title:**COMMUNICATION SKILLS – II
Core/Elective: Core (C)	**L : T : P : C : M** – 2 : 0 : 2 : 3 : 100
Type: Lecture & Practical	**Total Contact Hours:**60

Prerequisites

The student should have undergone the courses:

- Communication Skills – I

Course Outcomes

At the end of the course students will be able to:

CO1 Use various strategies to listen, infer the meaning and respond

CO2 Use formal, informal language and appropriate non-verbal skills in speaking

CO3 Use appropriate reading techniques, make notes and respond critically

CO4 Write effectively for a variety of professional and social settings

CO5 Use modern technologies to enhance communication

Course Content

UNIT I LISTENING 6+6

Types of Listening - discriminative, comprehensive, therapeutic, critical and appreciative listening - competitive, attentive and reflective listening models - Perception, Bias, Red flag words, Emotions and language barriers - Wh questions, Open-ended and close- ended questions, Predict vocabulary - Recognizing stress and intonation – Comprehension - Listening to business lecture & presentation - SQL2R, Surveying, questioning,listening, recall and review.Symbols and abbreviations - metacognition, literal and critical comprehension - Inferring meaning, emotions, opinionsand contexts

UNIT II SPEAKING 6+6

Informal conversation - day-to-day conversations - Small talk, conversation about other people, facts & opinions - conversing within oneself (intrapersonal) – **Informal language** - colloquial expressions, clichés, contraction, hesitation fillers, usage of personal pronouns, usage of verbs and adverbs, informal vocabularies, imperative sentences - **Non-verbal skills** – importance - types - kinesics - facial expressions, eye contact, gestures, postures, appearance, proxemics, time language, paralanguage, touch **Formal situations -** workplace conversations - downward, upward, horizontal, diagonal, inward, outward conversations - Oral Instructions, speeches, meeting, and negotiations **Formal language** modal auxiliaries, polite expressions, impersonal passive voice, avoiding second person pronouns.

UNIT III READING 6+6

Reading techniques - skimming, scanning, intensive reading - **Extensive reading** and its importance - **Fast Reading –** strategies, speed reading, eye fixation, regression, read in chunks or phrases and linear reading - Newspaper, user manuals, understanding reports, proposals,short stories and novels - R.K. Narayan's "Swami and his Friends "**Note-making** – mechanics, tropicalizing, schematizing, reduction devices, organization techniques and sequencing **Critical Reading** - SQ3R - survey, question, read, recall and review - Usage of dictionary - Book review Jumpha Lahiri's *Interpreter of Maladies (9 stories)*

UNIT IV WRITING 6+6

Importance of written business communication - Mind mapping- plotting ideas - accuracy of vocabulary, grammatical structures, appropriate register, connectives, signal words and format, notice, circular, agenda, minutes of the meeting, memo, E-mail, Proposal - difference between professional and social communication use of Imperative, modal auxiliary verbs- caption and slogan writing recommendations and instructions writing.

UNIT V MODERN TECHNOLOGY AND COMMUNICATION SKILLS 6+6

Technology advances in learning language - tone and style of language - Pros and cons of modern technologies in language learning process - Do's and Don'ts on online content - Structure of podcast, blogging and social media sites - greetings, grammar, punctuation – sms informal and formal language.

Textbooks

1. Herta A. Murphy, Herbert W. Hildebrandt, Jane P. Thomas, Effective Business Communication, Tata McGraw Hill, New Delhi, 2008.
2. M. Ashraf Rizvi, Effective Technical Communication, McGraw Hill Education Pvt. Ltd., New Delhi, 2005.

References

1. Meenakshi Raman, Business Communication, Oxford University Press, New Delhi 2006
2. Sehgal M.K., VandanaKhetarpal, Business Communication, Excel Books, New Delhi 2006
3. R C. Sharma, Krishna Mohan, Business Correspondence and Report Writing, Tata McGraw Hill Publishing Co., Ltd., New Delhi 2002

Web References

- www.cambridgeenglish.org/exams/business.../business-preliminary/
- http://www.examenglish.com/BEC/BEC_Vantage.html
- www.splendid-speaking.com/exams/bec_speaking.htmlhtml

Course Code:140ME0202	**Course Title:**ENGINEERING MATHEMATICS – II
Core/Elective: Core	**L : T : P : C : M** – 3 : 1 : 0 : 4 : 100
Type: Lecture &Tutorial	**Total Contact Hours:**60

Prerequisites:

The student should have undergone the courses:

- Engineering Mathematics-I

Course Outcomes

At the end of the course students will be able to:

CO1 Model simple physical phenomena into a set of differential equations.

CO2 Solve the second and higher order ordinary differential equations.

CO3 Apply the concepts of gradient, divergence and curl to solve engineering problems.

CO4 Construct an analytic function.

CO5 Apply the concept of complex integration to evaluate integrals.

CO6Apply the Laplace transform techniques to solve differential equations.

Course Content

UNIT I DIFFERENTIAL EQUATIONS OF SECOND AND HIGHER ORDER 9+3

Second and higher order linear differential equations with constant coefficients.Solution by variation of parameters, first order simultaneous differential equations.

UNIT II VECTOR CALCULUS 9+3

Gradient, divergence and curl, irrotational and solenoidal vector fields- Directional derivatives-Green's theorem in a plane (without proof)-Gauss divergence theorem (without proof) – Stoke's theorem (without proof)-evaluation of integrals using Green's, Gauss's and Stoke's theorem.

UNIT III ANALYTIC FUNCTIONS 9+3

Function of a complex variable-Analytic function –Singular points –Cauchy Riemann equations (without proof) – Properties-Construction of analytic functions.

UNIT IV COMPLEX INTEGRATION 9+3

Cauchy's fundamental theorem (without proof) – Cauchy's Integral formula- Taylor and Laurent expansions- Types of singularity – Residues-Cauchy Residue theorem.

UNIT V LAPLACE TRANSFORM 9+3

Laplace transform-Conditions for existence-Transform of elementary functions- Properties-Transform of derivatives– Transformation of periodic functions-Inverse Laplace transform-Convolution theorem- Solution of linear ODE of second order with constant coefficients using Laplace transform.

Text Books

1. Ray Wylie C and Louis C Barret , "Advanced Engineering Mathematics", McGraw-Hill, 2001
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th edition, Wiley India, 2007.

References

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.
2. Bali &Iyengar, "A Text Book of Engineering Mathematics", Laxmi Publications (P) Ltd., New Delhi, 6th Edition, 2006
3. Ramanna B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2008.

Web Reference

- http://nptel.ac.in/video.php?subjectId=122107036

Course Code:140ME0203	**Course Title:**MATERIAL SCIENCE
Core/Elective: Core	**L : T : P : C : M** – 2: 0 : 2 : 3 : 100
Type: Lecture & Practical	**Total Contact Hours:**60

Course Outcomes

At the end of the course students will be able to:

CO1 Calculate crystal parameters and analyze different crystal structures

CO2 Explain the mechanical, thermal and magnetic properties of bulk materials

CO3 Demonstrate the Mechanical and Thermal behaviors of bulk materials

CO4 Choose a suitable material for specific application

Course Content

UNIT I CRYSTAL STRUCTURE ON MATERIAL BEHAVIOR 6+6

Introduction: Crystalline and Non crystalline Materials: Single crystals, polycrystalline materials, Anisotropy **Crystal Parameters:** Atomic radius, Number of atoms per unit cell, Co-ordination number, Atomic Packing factor for SC, BCC, FCC and HCP – Influence of grain structure on material behavior. **Crystal Planes:** Miller indices, Bragg's law, Debye Scherrer method, Interplanar distance – Polymorphism and allotrophy. **Crystal imperfections:** Point, line surface and Volume.

UNIT II MECHANICAL PROPERTIES OF METALS 6+6

Elasticity and plasticity of bulk material, Ductility, malleabililty and brittleness, Stress and strain behavior, Hooke's law, Yield strength, Impact strength, Tensile strength, Resilience, Hardness, Rockwell hardness, Brinell hardness, Vicker's hardness, Micro indentation hardness. **Failure of Metals (Quantitative):** Fracture behavior, Ductile and Brittle fracture, Toughness, Fatigue, Endurance limit, SN curve, Creep, Stages of creep.

UNIT III THERMAL & MAGNETIC PROPERTIES OF MATERIALS 6+6

Thermal Properties of materials: Melting Point, Specific heat, Thermal Expansion, Thermal conductivity, Thermal diffusivity, Thermal shock resistance, Thermal stability and Heat resistance.

Magnetic Properties of materials: Basic concepts, Diamagnetism, Paramagnetism, Ferromagnetism, Domains and hysteresis, Soft and Hard magnetic materials, Antiferromagnetism, Ferrimagnetism, Influence of temperature on magnetic behavior.

UNIT IV POLYMERS AND CERAMIC MATERIALS 6+6

Polymers: Introduction: Hydrocarbon molecules, Polymer molecules, Molecular weight and molecular shape, Molecular structure. **Classification of polymers:** Thermoplastics, Thermosets & Elastomers – Common polymeric materials and Industrial application of polymers (Quantative) **Ceramics** – Constituents, properties and applications of Diamond, silicon carbide (SiC), zirconia (ZrO_2), Alumina (Al_2O_3), boron carbide (B_4C), and titanium diboride (TiB_2).

UNIT V COMPOSITES 6+6

Introduction, properties, functions of matrix and reinforcement in composites – Law of mixtures. **Classification of composites**: Particle-reinforced, Fiber-reinforced and Structural composites **Types of composite materials:** Polymer-matrix composites, Metal-matrix composites, Ceramic-matrix composites, Carbon-carbon composites and Hybrid composite – Applications

Textbooks

1. William D. Callister Jr, Materials Science and Engineering – an Introduction, John Wiley and Sons Inc., Sixth Edition, New York, 2007.
2. Khanna. O.P. A text book of Materials Science and Metallurgy, Khanna Publishers, 2003.

References

1. Vijaya. M.S. and G. Rangarajan, Material Science, Tata McGraw-Hill, 2007
2. P.K. Palanisamy, Material Science for Mechanical Engineers, Scitech Publication (India) Pvt Ltd, 2005.
3. Raghavan.V "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., 2007.

Web References

- www.nptel.ac.in
- www.ocw.mit.edu

MATERIAL SCIENCE LABORATORY

List of Experiments

1. Coercivity, Retentivity, Saturated magnetism, Permeability – Hysteresis loop
2. Conductivity, Resistivity – Four Probe method
3. Melting point of wax – Thermocouple
4. Hardness and Toughness measurement of FRP
5. Stress strain behavior of FRP – Using UTM

CourseCode:140ME0204	**Course Title:**ENGINEERING MECHANICS
Core/Elective: Core (C)	**L : T : P : C : M** – 3 : 1 : 0 : 4 : 100
Type: Lecture&Tutorial	**Total Contact Hours:**60

Prerequisites

The student should have undergone the course:

- Engineering Graphics

Course Outcomes

At the end of the course students will be able to:

CO1 Use the laws of mechanics to determine the equilibrium condition of particles and rigid bodies.

CO2 Construct free-body diagrams and calculate the unknown forces necessary to ensure static equilibrium.

CO3 Calculate geometric properties such as centroids and moment of inertia

CO4 Analyze the effect of dry friction in contact surfaces (ladder ,wedge, screw and belt)

CO5 Calculate and plot the motion of a particle

Course Content

UNIT I BASICS AND EQUILIBRIUM OF PARTICLES 9+3

Review of mathematical operations required for engineering mechanics -scalar and vector-vector operations-trigonometry. Review of Fundamental laws of mechanics-Newton's law of mechanics, Gravitational law.

Particles and rigid body, Concept of force and its effect on rigid body-system of forces-Free body diagram-Triangle law, parallelogram law and Lami's theorem-principle of transmissibility-equilibrium conditions-equilibrium of particles subjected to coplanar and non-coplanar force system.

UNIT II EQUILIBRIUM OF RIGID BODIES 9+3

Moment and couple. Free body diagram. Equilibrium conditions applicable to rigid bodies.Varignon’s theorem. Moment about point and axis. Problems in equilibrium of rigid body.

Beams-types of supports and their reactions-types of forces-method of finding reactions in statically determinate beams.

Machine members subjected to coplanar and non-coplanar force systems -unknown forces necessary to ensure static equilibrium of machine members subjected to coplanar force system.Introduction to Supports and connections for 3D machine members and their reactions. Problems related to reactions in machine members supported with ball and socket joints only.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 9+6

Properties of surface-centroid, Centroid of simple regular sections using integration (Rectangle, circle and triangle).Method of calculating centroid of composite sections. Problems involving centroid for composite planes such as **L, I, T.** Area Moment of Inertia -important of moment of inertia. Moment of inertia for simple sections using integration such as Rectangle, circle and triangle. Parallel and perpendicular axis theorem- concept of polar moment of inertia. problems involving moment of inertia for composite sections such as T,I,L. principal MI and principal axis for composite section such as T,I,L.

properties of solid geometry- centroid and centre of gravity. Centre of gravity of simple solids. Mass moment of inertia for simple solids.Pappus Guldinus theorem.Relation to area moment of inertia.Problems involving mass moment of inertia for composite solids consist of block, cylinder,cone, and sphere.

UNIT IV FRICTION 6+3

Characteristics of dry friction, law of dry friction, theory of friction- free body diagram for equilibrium and impending motion conditions. Equilibrium conditions involving dry friction, problems involving wedge, screw, ladder and flat belt drive. Problems in impending motion condition involving dry friction at some points.

UNIT V DYNAMICS OF PARTICLES 9+3

Kinematic parameters - displacement, velocity, acceleration and time. Types of motion- uniform, non-uniform motion, motion of particles in plane - Rectilinear and curvilinear motion of particles-normal and tangential component-motion of projectile- Relative motion- Dependent motion.Kinetics of particles-D'Alemberts principle-works energy and impulse momentum method.

Note: Use of Excel /MATLAB for solving the problems is encouraged (Not for external evaluation only for internal evaluation)

Textbooks

1. R.C. Hibbeller, Engineering Mechanics: Combined Statics & Dynamics, Prentice Hall, 2009
2. F.P. Beer, and Jr. E.R Johnston, Vector Mechanics for Engineers – Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2012

References

1. James L. Meriam and L.Glenn Kraige, “Engineering Mechanics (Statics and Dynamics)”, John Wiley & Sons, 2008
2. Shames.I.H, and Krishna Mohana Rao.G, “Engineering Mechanics (Statics and Dynamics)”, Dorling Kindersley (India) Pvt. Ltd. Pearson Education,2006.

3. S. Rajasekaran and G. Sankarasubramanian, Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., New Delhi, 2005.

Web References

- http://nptel.ac.in/courses/112103109/
- https://en.wikipedia.org/wiki/Mechanics

Course Code:140ME0205	**CourseTitle:** ENGINEERING METROLOGY AND MEASUREMENTS
Core/Elective: Core (C)	**L : T : P : C : M** – 2 : 0 : 2 : 3 : 100
Type: Lecture	**Total Contact Hours:** 60

Course Outcomes

At the end of the course, the students will be able to:

CO1Explain Metrology and Various Measuring Instruments and methods

CO2 Explain the Geometric Dimensioning and Tolerancing (GD&T) Principles and Symbol

CO3 Evaluate dimensional accuracy of components using linear and angular measuring

Instruments. CO4

Demonstrate form measurement methods.

CO5 Describe advanced methods and automation in measurements

Course Content

UNIT I INTRODUCTION TO ENGINEERING METROLOGY 6+2

General Concepts of metrology-Importance of metrology-Types of metrology-Dynamic, legal, deterministic-Measurement systems-units, standards, accuracy, precision-dimensional accuracy and precision-Methods of measurement-Sensitivity-Errors in measurements-Method of measurement-various measuring instruments.

UNIT II FORM AND SIZE TOLERANCE 6+6

Fundamental drawing rules-Tolerance grade and fundamental deviations- Fits, Limits and Tolerances and its needs on CAD/CAM –Datums- Application of datums- Datum feature identification - Cylindrical and Inclined- Form- Flatness, straightness, cylindricity and circularity-Orientation - Angularity, perpendicularity and parallelism –Position- Types of position - Clearance hole, Threaded hole and coaxiality-Concentricity and symmetry – Examples of concentricity and symmetry-Runout-Types of run out - circular, total-Profile-Profile tolerance-Profile of conical features-Profile inspection.

UNIT-III LINEAR AND ANGULAR MEASUREMENTS 8+6

Introduction to linear measurement-Linear measuring instruments-Scale, Vernier, micrometer-types-Gauges-slip gauges,plug gauge,ring gauge, snap gauge-comparators-mechanical, electrical, pneumatic-Introduction to Angular measurement-angular measuring instruments-Sine bar, bevel protractor, autocollimator, angle dekkor.

UNIT IV FORM MEASUREMENTS 8+6

Screw thread terminology - Errors in threads - Internal and external screw thread measurements - Screw thread measuring elements - Major diameter, Minor diameter, Pitch diameter & Thread form - Gear terminology - Types of gears - Gear errors - Gear measurement techniques -parkinson gear tester, Autocollimator ,Profile projector - Surface texture -Elements of surface texture - Surface finish

methods- Average roughness, Peak to vally, Form factor - Surface finish measuring instruments – Surface Measurement - Straightness and Flatness - Roundness Measurements

UNIT V LASER METROLOGY AND CMM 6+6

Laser metrology- Laser interferometer - Michelson, Dual frequency, Twyman green, Laser viewers - Types of CMM - Bridge, Cantilever, Horizontal boring mill type, Vertical mill type - Errors in CMM - Application, advantages & disadvantages of CMM - Coordinate Measuring Machine

NOTE: (Use of approved Data Book is permitted in the End semester examination)

Textbooks

1. K.R.Gopalakrishna, "Machine Drawing" Subhas Publication, 2002

2. Jain R.K., "Engineering Metrology", Khanna Publishers, 2005

References

1. Cencel .H.Jensen and J.D.Helsel, "Engineering drawing and design" McGrawHill science 7th Edition,2007.

2. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2005

3. Jayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications,2000

4. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 1997

Web References

- http://nptel.ac.in/courses/112106138/
- https://en.wikipedia.org/wiki/Metrology

List of Experiments

1. Measure the dimensions of the given component using vernier calliper.
2. Determine the diameter of a cylindrical component to accuracy of 0.01mm using micrometer and to check the result with digital micrometer.
3. Measure the height of the machined component using vernier height gauge.
4. Determine the thickness of the ground MS plate using slip gauges.
5. Measure the thickness of gear tooth by using gear tooth vernier and profile projector.

CourseCode:140ME0206	**Course Title:**MANUFACTURING PROCESS - I
Core/Elective: Core	**L : T : P : C : M** – 3 : 1 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

Course Outcomes

At the end of the course students will be able to:

- CO1Explain operational and procedural steps required in casting process
- CO2 Illustrate operational and procedural steps required in sheet metal process
- CO3 Choose appropriate welding process for the required weld joint
- CO4 Describe procedural steps in forging process
- CO5 Select appropriate processes and its sequence required for manufacture of a given design requirement which involves casting, welding, forging and sheet metal processes.

Course Content

UNIT I CASTING 9+3

Sand casting process, Types of patterns, pattern materials and allowances, Types of sand and sand properties, Mould preparation, Tools and equipments, Core making, types, moulding sand, sand properties and operational characteristics, Non- disposable casting processes, Centrifugal casting processes (True, Semi, Centrifuging), Continuous casting, Casting metals, properties, Importance of thickness of casting, Gating and metal flow system, Working principle of Cupola furnace, Crucible furnace, Electric arc furnace, Induction furnace

UNIT II SHEET METAL PROCESSES 9+3

Sheet metal characteristics, Shearing processes (Punching, Piercing, Perforation, Blanking process, Trimming, Notching, Nibbling, Shaving processes) Progressive, Compound and Combination dies, Types of shearing machines, Specifications of shearing presses, Working principle of shearing machines, Bending operations [Angle bending (Die bending, V-bending, Edge bending), Roll bending, Roll forming, Seaming], Spring back, Bending allowance, Force required for bending, Process parameters in bending, Drawing processes (Shallow drawing, Deep drawing, Reverse drawing and redrawing), Rigid die forming processes (Embossing, Coining and Stamping), Stretch forming, Defects in sheet metal operations.

UNIT III WELDING 9+3

Fusion welding processes: Arc welding processes, Manual metal arc welding, TIG & MIG welding, Submerged arc welding, Electro slag welding, Gas welding process (Oxy-acetylene), Types of flames, Working principle of Oxy-acetylene welding, Equipments involved in Oxy-acetylene welding (Nozzle, cylinders, hoses, regulator), Gas cutting, Non- fusion welding processes: Electrical resistance welding (ERW), Types of ERW (Spot, seam, percussion, projection, flash butt), Soldering (Soldering iron,

Fillers, Fluxes, Soft & Hard soldering), Brazing (Silver brazing, torch brazing, furnace brazing), Weld material preparation (Edge), Importance of Orientation, Direction , Weld speed, Types of electrodes, Significance of current characteristics, Weld symbol.

UNIT IV ADVANCED PROCESSES IN CASTING, SHEET METAL AND WELDING 9+3

Casting:
Lost wax process, Shell mould casting, Die casting (Cold chamber / Hot chamber), Process parameters in casting, Casting defects, Inspection and testing of cast components
Sheet Metal:
Flexible die forming processes (Rubber pad, Hydro forming), High energy rate forming (Explosive, electromagnetic), Metal spinning, Super plastic forming, Inspection and testing of Sheet metal components, Formability testing (Simulative drawing testing)
Welding:
Thermit welding, Electron beam welding, Laser beam welding. Process parameters in welding, types of weld defects. Testing methods of welds (Destructive, Non-destructive)

UNIT V MECHANICAL WORKING OF METALS 9+3

Hot working / Cold working of metals:
Rolling: Rolling mills, Load calculations, Roll passes and sequences, Rolling defects;
Forging: Types (Smith, Drop, Press & Machine), Forging operations (Drawing down / Swaging, Upsetting, Punching, Bending, Coining); Forging defects
Extrusion: Types (Direct, Indirect, Impact, Tube, etc.,), Extrusion operations (Tube extrusion, Wire drawing)

Text Book

1. Serope Kalpakjian, Steven R Schmid, "Manufacturing Process for Engineering Materials" – Pearson Education, 4th Edition, 2003.
2. Sharma. P.C., "A Text Book of Production Technology", S. Chand and Company, 2001.
3. Jain. R.K., "Production Technology", Khanna Publishers, New Delhi, 2001.

Reference

1. HMT Bangalore, "Production Technology", Tata McGraw Hill Publishing Company Limited, New Delhi, 2001.
2. Hajra Choudhary etal, "Elements of Production Technology –Vol.II", Asia Publishing House, 2000.
3. Rao, P.N. "Manufacturing Technology", TMH Ltd., 2003

Web References

- http://nptel.ac.in/courses/112107144/

Course Code:140ME0207	**Course Title:**MANUFACTURING PROCESS LABORATORY – I
Core/Elective: Core	**L : T : P : C : M** – 0: 0 : 3 : 2 : 100
Type: Practical	**Total Contact Hours:**45

List of Experiments

1. Casting of Aluminum wheel
    a. Review of melting properties of metal, Ex. Cast iron , steel, Aluminum
    b. Review of pattern allowances and pattern design
    c. Manufacture of pattern for the given cast product
    d. Preparation of mould cavity (with core, if needed)
    e. Casting of Aluminum wheel
2. Welding of support bracket
    a. Cutting of flats and preparation of weld edges
    b. Review of weld parameters
    c. Welding and finishing the component to the design requirement
3. Forging of wheel shaft
    a. Review of forging parameters for the given component
    b. Upsetting of pin head
    c. Punching hole for split pin
4. Fabricating sheet metal guard for the wheel
    a. Development of surface of the metal guard
    b. Forming the sheet to the required geometry
5. Assembly of castor wheel and validating for functional requirement

Course Code:140ME0208	**Course Title:**COMPUTER AIDED DRAFTING AND MODELING LABORATORY
Core/Elective: General (C)	**L : T : P : C : M** – 0 : 0 : 3 : 2 : 100
Type: Practical	**Total Contact Hours:** 45

Course Outcomes

At the end of the course the student will be able to

CO1 .Develop part and assembly models using CAD Software.

CO2 .Prepare production drawing for manufacturing process using CAD software.

UNIT I STANDARDS, SYMBOLS& CONVENTIONS `6

Conventional representation of machine components and materials, Designation of Standard parts - keys, pin joints, fasteners, hexagonal and square head bolts and nuts, conventional representation of threads. BIS codes for practice of Machine Drawing - Dimensioning, abbreviations and conventions, welding symbols, surface finish symbols, screws, bolts, nuts and rivets.

UNITII CAD SOFTWARE FEATURES 12

Capabilities of CAD software - Parametric modeling-Concepts, 3D software packages features-reference planes – 2D sketching tools - relationships and constraints -partmodelling tools – extrusion, revolve, sweep – modifying tools.

UNIT III DEVELOPMENT OF PARTAND ASSEMBLY MODELS 12

Drawing front view, top view and side view of objects from the given pictorial views. Preparation of 2-D drawings of standard machine elements.-Assembly tools features of modelling software. Creation of assembly models with functional features.

UNIT IV PART DRAWING OF MACHINE COMPONENTS 9

Create part drawing using CAD software with manufacturing considerations. Exercise on bolt & nut (square and hexagon), studs and washers. Exercise on different types of keys, screws, spring etc.

UNIT- V PRODUCTION DRAWING 6

Preparation of Production drawing - Multiple views of part modelsand machine components –Bill of materials - Drawing Layout.

List of Experiments

1. Preparation of isometric view for the orthographic views of simple parts
2. Exercise on square, hexagonal bolt and nuts
3. Exercise on different types of keys
4. Exercise on screws , rivets and springs
5. Preparation of part drawing - aluminum wheel.
6. Preparation of part drawing - support bracket
7. Preparation of part drawing -sheet metal guard
8. Preparation of Assembly drawing - castor wheel
9. Preparation of production drawing -aluminum wheel assembly

Text Book

1. Gopalakrishna,K.R, "Machine Drawing", 16th Edition Subhas publishing House, Bangalore, 2002 .
2. Maitra Prasad, "Hand Book of Mechanical Design", Second edition, Tata McGraw Hill, Noida 1995.

References

1. Cencil Jensen, Jay D. Helsel and Dennis R. Short Engineering Drawing and Design. Tata McGraw Hill Publishing Company Limited (2012).
2. Sidheswar.N, Kannaiah.P, Sastri.V.V.S "Machine Drawing", Reprint, TMH, New Delhi 2006.
3. Faculty of Mechanical Engineering,"PSG Design Data Book", DPV Printers, Coimbatore 2006.

CourseCode:140ME0208	**Course Title:**SPORTS FOR WELLNESS
Core/Elective: Core	**L : T : P : C : M** – 1 : 0 :2 : 2: 100
Type: Lecture	**Total Contact Hours:** 36

Course Outcomes

At the end of the course students will be able to:

CO1. Describe the basics of digital system

CO2 .Illustrate the Microcontroller Architecture with programming concepts

CO3 .Explain the various Microcontroller Peripherals

CO4 .Design various Microcontroller Peripherals using Embedded 'C' Concept

CO5 .Design the Microcontroller concept in automation field

Course Content

UNIT I HEALTH

Meaning of health - Components of health - physical, mental, social, emotional, spiritual -importance of health - Personal hygiene - Heredity and environment –Adopting healthy habits

UNIT II FITNESS & WELLNESS

Fitness and wellness – what is physical fitness - categories - components of health related physical fitness- components of skill related physical fitness-values of physical fitness – Physical fitness development.

What is wellness - importance of wellness for engineers –factors promoting wellness – Physiology and health: cardio-respiratory, muscular and nervous systems – ageing

UNIT III FOOD & HEALTH

Energy balance and body composition – nutrients- problems of surplus and deficiency - balanced diet - good food habits for better health – hazards of junk food - food and the gunas.

UNIT IV FITNESS DEVELOPMENT I

Exercises related ailment and injuries - safety and precautions - first aid.

Muscular strength – exercises (calisthenics): pull-up, sit-up, push-up and weight training.

Explosive power – exercises: vertical jump, long jump,

Cardio respiratory endurance– exercises: walking, jogging, treadmill, stair climbing, bicycling, skipping.

Flexibility –exercises: stretching

UNIT V FITNESS DEVELOPMENT II

Speed, agility, balance and coordination – exercises: sprint, cone drill, ladder drill, hurdle drill, ball throw - mental agility tests.

Dexterity - 12 minutes cooper test – long run – adventure games

Team games.

References

1. Tony Buzan, Harper Collins, The Power of Physical Intelligence (English)
2. Padmakshan Padmanabhan, Handbook of Health & Fitness, Indus Source Books, First Edition, 2014.

OPERATIONAL MODALITIES WITH PROGRAM SCHEDULE

Special lectures by invited resource persons at semester beginning (for covering Units I, II, III)
3 lectures x 4 hours = 12 hours
Practical:
2 hours/week; (6^{th} and 7^{th} hour)
12 weeks x 2 hours/week = 24 hours
Evaluation:
Unit I, II, III = Theory
Unit IV and V = Practical
Mid semester: Written (objective type and short answers) and Exercises: (40% weightage)
End semester exam: Written and exercises: (60% weightage)
Criteria for passing: 50% put together.

MEASUREMENTS: At the Beginning + At Semester End

SCHEDULE OF EXERCISES FOR STUDENTS WITH DIFFERENT PHYSICAL CONDITIONS

Underweight	Normal	Obese
Flexibility exercises - stretching	Flexibility exercises - stretching	- Brisk walking
Minor games -forward running relay -backward running relay - over&under relay -circle games, etc.	-Walking - Walking-cum-jogging	- Minor games -
Strength Training - Calisthenics	Cardio/Functional Fitness - Skipping - Stair climbing - jogging - bicycling - long distance running	flexibility exercises - stretching - Cycling (static)
Cardio/Functional Fitness - Skipping - Stair climbing - jogging - bicycling	Agility - ladder drills - hurdle drill - cone drill	Cardio/Functional Fitness Skipping Jogging bicycling
Agility exercises - ladder drills - hurdle drill - cone drill	Strength Training -Calisthenics -gym workout for major muscles	Strength Training - Calisthenics - gym workouts
Diet Considerations	Diet considerations	Diet considerations
Measurements		
BMI Hand grip strength test 12 m Cooper run Sit&reach	BMI 12 m Cooper run Sit & reach test Illinois agility test	BMI Body fat percentage Waist-to-hip ratio Sit&reach

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END OF SEMESTER- II

2014 REGULATION

Curriculum for B.E Mechanical Engineering from Semester III & IV

SEMESTER III

Course Code	Course Title	Hours/Week			Credits
		L	T	P	
THEORY					
140ME0301	Engineering Mathematics – III	3	1	0	4
140ME0302	Engineering Thermodynamics	3	1	0	4
140ME0303	Manufacturing Processes – II	3	1	0	4
140ME0304	Fluid Mechanics and Machinery	3	1	0	4
140ME0305	Theory of Machines - I	2	1	2	4
140ME0306	Electrical Drives and Controls	2	0	2	3
PRACTICAL					
140ME0307	Fluid Mechanics and Machinery Laboratory	0	0	3	2
140ME0308	Manufacturing Processes Laboratory – II	0	0	3	2
140ME0309	Personal Effectiveness	0	0	3	1
	One Credit Course	0	0	2	1
TOTAL		**16**	**5**	**15**	**29**

SEMESTER IV

Course Code	Course Title	Hours/Week			Credits
		L	T	P	
THEORY					
140ME0401	Numerical Methods	2	2	0	4
140ME0402	Strength of Materials	3	1	0	4
140ME0403	Engineering Metallurgy	3	0	0	3
140ME0404	Theory of Machines - II	2	1	2	4
140ME0405	Thermal Engineering	3	1	0	4
140ME0406	C-Programming	3	0	2	4
PRACTICAL					
140ME0407	Strength of Materials and Metallurgy Laboratory	0	0	3	2
140ME0408	Thermal Engineering Laboratory	0	0	3	2
140ME0409	Ethical and Moral Responsibility	0	0	2	1
	One Credit Course	0	0	2	1
TOTAL		**16**	**5**	**14**	**29**

SEMESTER III

Course Code:140ME0301	**Course Title:**ENGINEERING MATHEMATICS- III
Core/Elective: Core (C)	**L : T : P : C : M** – 3 : 1 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the courses:

- Engineering Mathematics I
- Engineering Mathematics II

Course Outcomes

At the end of the course students will be able to:

CO1 Compute the Fourier series expansion for given periodic functions.
CO2Compute the Fourier transform for aperiodic functions.
CO3Determine the solution of first and second order PDE.
CO4Solve the one dimensional wave equation.
CO5 Solve one dimensional and two dimensional heat flow equations.

Course Content

UNIT I FOURIER SERIES 9+3

Periodic function - general Fourier series- Dirichlet's conditions- Euler's formulae - Fourier series expansion for a given periodic function - Fourier series expansion for a odd or even periodic function - half range Fourier cosine and sine series expansion for a given function - Parseval's identity.

UNIT II FOURIER TRANSFORM 9+3

Fourier transforms - Fourier cosine and sine transforms - Inverse transforms - Convolution theorem and Parseval's identity for Fourier transforms.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9+3

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

UNIT IV SOLUTION OF ONE DIMENSIONAL WAVE EQUATION 9+3

Method of separation of variables - Classification of second order linear partial differential equations - Variable separable solution of one dimensional wave equation.

UNIT V SOLUTION OF ONE AND TWO DIMENSIONAL HEAT FLOW EQUATION 9+3

One dimensional equation of heat conduction - Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) - Variable separable solutions of the heat equation

Text Book

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th edition, Wiley India, 2007.
2. Srimanta Pal &Subodh C. Bhunia. "Engineering Mathematics", First edition, 2015, Oxford University Press.

References

1. Grewal B.S. "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40thEdition,2007.
2. Bali &Iyengar, "A Text Book of Engineeing Mathematics", Laxmi Publications (P) Ltd, New Delhi, 7th Edition, 2007.
3. Ramana B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2008.

Web References

- http://nptel.ac.in/video.php/subjectId=122107036

Course 140ME0302	**Course Title:**ENGINEERING THERMODYNAMICS
Core/Elective: Core	**L : T : P : C : M** – 3 : 1 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the courses:

- Engineering Mathematics I
- Applied Physics

Course Outcomes

At the end of the course students will be able to:

CO1Explain the basic concepts of thermodynamics and gas properties.
CO2 Apply the first law of thermodynamics to closed and open systems viz.
Nozzle, diffuser, compressor, turbine, pump and heat exchanger.
CO3 Use second law of thermodynamics and the concept of entropy for evaluating the performance of heat engine, refrigerator and eat pump.
CO4 Evaluate the performance of vapor power cycles viz. rankine, reheat and regenerative cycles.
CO5 Estimate the heating and cooling loads for automotive, domestic and industrial air conditioning systems.

Course Content

UNIT I BASIC CONCEPTS 9+3

Concept of continuum, classical and statistical thermodynamics, thermodynamic systems, concept of equilibrium, zeroth law of thermodynamics, quasi static process, thermodynamic equilibrium, state, path, process and cycle, point function and path function, properties of system, first law of thermodynamics, types of work, problems on heat and work interactions. Properties of Ideal and real gases - Gas laws, Ideal and real gas properties, vander walls equation, generalized compressibility chart – properties of gas mixtures – problems.

UNIT II FIRST LAW OF THERMODYNAMICS 9+3

Steady and unsteady flow processes, steady flow energy equation, first law of thermodynamics to open system viz. nozzles, diffuser, compressor, turbine, pump and heat exchanger. Modes of expansions of gases, first law of thermodynamics to closed (fixed mass) system, PMM-I, limitations of first law of thermodynamics.

UNIT III SECOND LAW OF THERMODYNAMICS 9+3

Need for second law of thermodynamics, Kelvin - Plank and Clausius statements, PMM-II. Carnot cycle, Carnot theorem and irreversibility, Clausius inequality, concept of entropy, entropy analysis for open and closed systems, availability.Heat engine, refrigerator and heat pump - performance.

UNIT IVPROPERTIES OF PURE SUBSTANCE AND VAPOR POWER CYCLES 9+3

Phase rule, properties of pure substance (water) in three phases - P-V diagram, T-S diagram, H-S diagram, P-V-T surface. Third law of thermodynamics, thermodynamic properties of steam.Vapor power cycles- steam rate, heat rate, efficiency calculation of Rankine, Reheat and Regenerative cycles.

UNIT V PSYCHROMETRY 9+3

Psychrometry- properties, chart, properties of air vapour mixture, property calculations, psychrometric processes - sensible heating and sensible cooling processes, humidification and dehumidification. Heating and cooling loads for Automotive, Domestic and Industrial air conditioning systems.

(Use of Steam table, Mollier diagram and Psychometric chart are permitted in the End Semester examination)

Text Book

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill,New Delhi,2007.
2. Cengel, "Thermodynamics – An Engineering Approach" 3rdEdition ,Tata McGraw Hill, New Delhi, 2003.

References

1. Holman.J.P., "Thermodynamics", 3rd Edition McGraw-Hill, 1995.
2. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 1987
3. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.

Web References

- http://nptel.ac.in/courses/112105123/1
- https://en.wikipedia.org/wiki/Thermodynamics

Course Code: 140ME0303	**Course Title:** MANUFACTURING PROCESSES – II
Core/Elective: Core	**L : T : P : C** : M – 3 : 1 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course:

- Manufacturing Processes I

Course Outcomes

At the end of the course students will be able to:

CO1Select appropriate metal cutting processes which involve Lathe, Automat, Drilling and Milling machines to manufacture a machined part.

CO2 Select the metal finishing processes like grinding, honing, burnishing and lapping for the given design requirement

CO3 Develop process sequence for the given machined part

CO4 Use Lathe, Automat, Drilling and Milling machines to manufacture a machined part

CO5Describe modern manufacturing systems like CNC, RP & PM

Course Content

UNIT I THEORY OF METAL CUTTING 9+3

Metal removal processes, Orthogonal cutting, Oblique cutting, Cutting tools, Tool geometry of single point cutting tool, Types of chips, Continuous chips, Discontinuous chips, Chips with built up edge, Serrated chips, Characteristics of a cutting tool material, Materials for cutting tool, Mechanics of orthogonal cutting, Velocities in metal cutting, Cutting force, Machinability, Tool life using Taylors equation, Types of tool wear, Functions of cutting fluids, Types of cutting fluids, Introduction to Machine Tools (Rotary / Reciprocating metal cutting).

UNIT II MACHINING CYLIDRICAL FEATURES 9+3

LATHE

Constructional Features, Parts of a Centre lathe, Functions of parts, Operations performed on Centre lathe, Operations, Taper turning methods, Thread cutting methods, Attachments/Accessories, Process parameters in turning and related operations, Calculation of Machining time and power required in lathe, Capstan lathe and Turret lathe, Parts, Functions, Types of automatic lathes, Constructional features of automatic lathes, Turret indexing mechanism, Bar feeding mechanism, Operations performed in semi -automatic and automatic lathes, Tooling layout for machining a job.

DRILLING

Constructional features of drilling machine, upright drilling machine, radial drilling machine, Operations, Drilling, Boring, Reaming, Tapping, Process parameters, machining time, power required

UNIT III MACHINING PRISMATIC COMPONENTS WITH MILLING MACHINES 9+3

Types of milling machines (Column and knee, fixed bed type),Types of milling cutters (Plain, Side, End, Face, Slit, Angle), Nomenclature of milling cutter, Horizontal milling machine, Vertical milling machine, Up milling & Down milling, Slab milling, Face milling, End milling, Straddle milling, Gang milling, Gear Form cutting, Process parameters in Milling, Machining time, Estimation of power required for machining in milling machine

UNIT IV GRINDING, HONING, LAPPING 9+3

Grinding: Types of grinding machines (Portable, Bench, belt, cylindrical, centreless, surface, internal), Types of grinding wheels (Based on abrasive, bond, grade and structure: Based on shape: Straight, cup, cylinder, dish), Grinding wheel designation, Classification of grinding machines and grinding wheels, Constructional features of cylindrical grinding machines, Surface grinding machines, Significance of cutting speed, feed and depth of cut, Calculation of MRR and machining time. Honing, Types of honing, Lapping, Types of lapping (Equalising, form), Types of lapping machines, Burnishing, Polishing and Buffing.

UNIT V MODERN MANUFACTURING SYSTEMS 9+3

Fundamentals of NC/CNC Machines, Constructional features, Machining centre, Part programming, Principles of Rapid Manufacturing, Applications in Product Development, Reverse Engineering Introduction to Powder metallurgy, powder milling, compounding, compaction, sintering, heat treatment, applications

Text Book

1. Rao P C, "Manufacturing Technology, Vol 2, Metal Cutting and Machine Tools", 2nd Edition, Tata McGraw Hill, New Delhi, 13th reprint 2012
2. Kalpakjian, "Manufacturing Engineering and Technology", Addison Wesley Publishing Company, 3rdedition, 1995.

References

1. Rajput R K, "A Text Book of Manufacturing Technology", Laxmi Publications (P) Ltd., New Delhi, Reprint 2010
2. Sharma P C, "A Text book of Production Engineering", S Chand & Co Ltd., Reprint 2003
3. Jain R K, "Production Technology", Khanna Publishers, New Delhi, 4th edition, 1999.

Web References

- http://nptel.ac.in/courses/112107144/

Course Code: 140ME0304	**Course Title:**FLUID MECHANICS AND MACHINERY
Core/Elective: Core (C)	**L : T : P : C : M–** 3 : 1 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the courses:

- Engineering Mathematics I
- Applied Physics

Course Outcomes

At the end of the course students will be able to:

CO1 Calculate the properties of fluids.

CO2 Apply the principles of kinematics and dynamics of fluid.

CO3 Determine flow rates and head losses in viscous and turbulent flows.

CO4 Evaluate the performance of hydraulic machinery such as pumps and turbines

Course Content

UNIT I FLUID PROPERTIES AND STATICS 9+3

Fundamental Units and Dimensions, Properties-mass density, specific weight, specific gravity, specific volume, surface tension, capillarity and compressibility- Problems, Viscosity- Newton's law of viscosity and dynamic viscosity, kinematic viscosity - Problems, types of Fluids, concept of Continuum, Statics - Pressure, Pressure head, Pascal's law- Problems, Simple and differential manometers- Problems, Centre of pressure and total pressure- Problems, buoyancy- Problems.

UNIT II PRINCIPLES OF KINEMATICS AND DYNAMICS IN FLUID FLOW 9+3

Types of Fluid flow-Steady, unsteady, uniform, non-uniform, Laminar, turbulent, rotational, ir-rotational, compressible, incompressible, 1D, 2D and 3D flows, application of control volume to continuity equation, Kinematics-Lagrangian and Eularian approach – Stream lines, path lines and streak lines, Dynamics-Euler's equation (Bernoulli's equation)-applications-VenturimeterOrificemater and pitot tube - Problems, Velocity and Acceleration of fluid flow, Newton's second law of motion - momentum equation for a fluid- Problems, Moment of momentum equation, Boundary layer Theory.

UNIT III FLOW THROUGH PIPES AND DIMENSIONAL ANALYSIS 9+3

Hagen Poiseulle's formulae- Problems in Viscous flow through pipes, Major Head losses in pipes - Darcy Weisbach's equation, Chezy's equation- Problems, Minor losses in Pipe bent, entry, exit, sudden enlargement, sudden contraction – Problems, Flow through Pipes - series pipe, Equivalent pipe, Parallel pipe, Branch pipe, Hydraulic Gradient line and total energy line, Dimensional Homogeneity and Buckingham's π Theorem– Problems, Dimensionless numbers, Model analysis, Similarities

UNIT IV HYDRAULIC TURBINES 9+3

Impact of jets - Stationary vertical plates, Stationary curved plates, Moving vertical Plate, Moving curved plate – Problems, Turbines - working principles, classification, Draft tube, heads and efficiency, specific speed, unit quantities, Velocity triangle- impulse and reaction turbines, Work done and Power delivered by the turbine- Performance of turbines.

UNIT V HYDRAULIC PUMPS 9+3

Centrifugal pumps - working principle and types, specific speed, unit quantities, heads and efficiency, Priming, Cavitation, Performance curves, Net Positive Suction Head, Reciprocating pump and rotary pump – working, types, Performance of positive displacement pumps

Text Book

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Laxmi Publications (P) Ltd., New Delhi, 2005.
2. YunusCengel, John Cimbalal , "Fluid Mechanics- Fundamentals and Applications", Tata McGraw-Hill Education, 2013.

References

1. Rajput, R.K., "A Text Book of Fluid Mechanics", Chand S and Co. New Delhi - 2007
2. Som S. K, Biswas G " Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hill, 2008
3. Ramamritham. S, "Fluid Mechanics, Hydraulics and Fluid Machines", DhanpatRai& Sons, Delhi, 1988.

Web References

- http://nptel.ac.in/courses/112105171/1

Course 140ME0305	**Course Title:** THEORY OF MACHINES I
Core/Elective: Core	**L : T : P : C : M** – 2 : 1 : 2 : 4 : 100
Type: Lecture& Practical	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the courses:

- Engineering Mathematics I
- Engineering Mechanics

Course Outcomes

At the end of the course students will be able to:

CO1 Calculate the DOF of simple mechanisms.

CO2 Calculate the kinematic parameters of simple mechanisms.

CO3 Calculate the static and dynamic forces involved in mechanisms

CO4 Develop CAM profile for different follower motions

CO5 Calculate the kinematic parameters of gears and gear trains such as simple, compound and epicyclic gear trains

Course Content

UNIT I BASICS OF MECHANISMS 9+3

Mechanism, Machine, Structure.Kinematic link, Kinematic pair and their types.Working of four bar mechanism, slider crank mechanism and their respective inversions.Gruebler's criteria and Grashof'slaw.Degrees of Freedom (DoF), Transmission angle, Mechanical advantage.Working of Pantograph, Straight line generator (Peaucellier mechanism), Ackerman Steering, Geneva indexing mechanisms.
Introduction to serial and parallel kinematics.

UNIT II KINEMATIC ANALYSIS 9+3

Linear, angular, absolute and relative velocities.Rubbingvelocity.Tangential and radial components of acceleration. Instantaneous centre (IC) of rotation- properties of IC, Kennedy's theorem of three centres, procedure of locating ICs for four bar and slider crank mechanisms. Finding velocity and acceleration of four bar and slider crank mechanisms using: relative velocity method, instantaneous centre method - loop closure equation – analytical expressions for the position, velocity and acceleration of the four bar and slider crank mechanisms.

UNIT III STATIC AND DYNAMIC FORCE IN MECHANISMS 9+3

Applied and constrained forces, D'Alembert's principle, Static equilibrium conditions, Two and three force members, Problems in static force analysis, Inertia force and Inertia torque, Dynamic analysis in reciprocating engine- Gas forces, Bearing loads, Crank shaft torque, Dynamically Equivalent system, Turning moment diagrams, Flywheels, Coefficient of fluctuation of Energy and speed, mass of flywheel required.

UNIT IV KINEMATICS OF CAM 9+3

Types of cams - Types of followers - Radial cam -Terminology of radial cam - Types of follower motions- uniform motion, simple harmonic motion, constant acceleration/deceleration motion, cycloidal motion. cam profile for knife edge, roller, flat faced follower.

UNIT V KINEMATICS OF GEARS AND GEAR TRAINS 9+3

Types of gears, the spur gear terminologies, law of gearing, Conjugate action and conjugate curves, merits and demerits of involute and cycloidal profiles, The path of approach, Recess, length of path of contact - The arc of approach, Recess, length of arc of contact. - contact ratio, interference and undercutting - Derivation for the Minimum numbers of teeth on the pinion to avoid Interference - Classification of gear trains, calculation of velocities of Simple, Compound, Epicyclic& Reverted gear trains (tabulation method only).

Text Book

1. Ambekar A. G., "Mechanism and Machine Theory", Prentice Hall of India, New Delhi, 2007.
2. Rattan S S, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2007

References

1. UickerJ.J.Pennock G.R., Shigley J.E., "Theory of Machines and Mechanisms"(Indian Edition), Oxford University Press, 2003.
2. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
3. Sadhu Singh, "Theory of Machines", Pearson Publishers, 2012

List of Experiments

1. Cam Analysis
2. Study of mechanisms and their inversions
   a. Four bar mechanisms
   b. Double lever mechanism
   c. Crank lever mechanism
   d. Double crank mechanism
   e. Epicyclic gear train
   f. Differential gear train
3. Kinematics of gear trains
4. Computer simulation of simple mechanisms

Web References

- http://nptel.ac.in/courses/112104121/1

Course Code: 140ME0306	**Course Title:** ELECTRICAL DRIVES AND CONTROLS
Core/Elective: Core (C)	**L : T : P : C : M–** 2 : 0 : 2 : 3 : 100
Type: Lecture& Practical	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course:

- Engineering Mathematics I

Course Outcomes

At the end of the course students will be able to:

CO1 Explain the fundamental parts of an electrical drives and controls, operating principle of induction & DC machines

CO2 Explain the different types of speed control in DC & AC machines

CO3 Choose the special electrical drive such as stepper motor, BLDC and Servo motors for specific application

CO4 Select the drive for a particular application based on power rating and their role in home appliances, machine tools, automobiles, locomotives and specific industrial application

Course Content

UNIT I INTRODUCTION 6

Fundamentals of electric drives - characteristics of loads – different types of mechanical loads – four quadrant operation of electric drive- control circuit components: Fuses, circuit breakers, contactors, relays

UNIT II SPEED CONTROL OF DC MACHINES 6

Constructional features and working principle of a DC machine - Speed Torque characteristics of DC shunt & series motor – Methods of Speed control - Solid state DC drives: bridge rectifier fed DC drives, Chopper fed DC drives, Static Ward Leonard method.

UNIT III SPEED CONTROL OF AC MACHINES 6

Constructional details of induction motors – Types of rotors – Principle of operation – Slip - Speed torque Characteristics of Induction motors – speed control using: pole changing, stator frequency variation, stator voltage variation - basic inverter fed induction motor drive - variable voltage variable frequency drive.

UNIT IV SPECIAL ELECTRICAL DRIVES & CONTROLS 6

Stepper motor: Constructional and working – applications -BLDC motor : Constructional and working – applications – encoders - AC and DC Servo Motor : Constructional and working – applications.

UNIT V CONTROL AND SELECTION OF ELECTRIC DRIVES 6

Microcontroller, PLC & PC based control - Selection of an electric drive –IP classes - insulation testing and classes of electric motors - SF motors - continuous, intermittent and short time duty – Selection of drive for home appliances, machine tools, automobile applications, locomotives and steel rolling mills.

Text Book

1. N.K De and P.K Sen "Electric Drives" Prentice Hall of India Private Ltd.,2002.
2. VedamSubramaniam "Electric Drives" Tata McGraw Hill, New Delhi,2007.

References

1. Bhattacharya Brinjinder Singh S.K, "Control of Electrical Machines" New Age International Publishers, 2002.
2. Dubey.G.K., "Fundamental of Electrical Drives", Narosa publishing House, New Delhi 2013.
3. Krishnan R, "Electric motor drives Modeling, analysis and control", Pearson Education, New Delhi, 2003.

List of Experiments 30

1. Speed Torque Characteristics on DC Shunt and Series Motor
2. Speed Torque Characteristics on 3 Phase Induction Motor
3. Speed Control of DC Shunt Motor by Bridge Rectifier and Chopper
4. Speed Control of 3 Phase Induction Motor using VFD
5. Speed Control of BLDC Motor
6. Position Control using Stepper Motor
7. Insulation testing of motors using Megger

Web References

http://nptel.ac.in/courses/108108077/

Course Code: 140ME0307	**Course Title:** FLUID MECHANICS AND MACHINERY LABORATORY
Core/Elective: Core	**L : T : P : C : M–** 0 : 0 : 3 : 2 : 100
Type: Practical	**Total Contact Hours:** 45

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orificemeter.
2. Determination of the Coefficient of discharge of given Venturimeter
3. Determination of the velocity of flow using Pitot Tube
4. Calculation of the rate of flow using Rota meter.
5. Determination of friction factor of given set of pipes.
6. Draw the characteristic curves of Centrifugal pump
7. Draw the characteristic curves of Reciprocating pump.
8. Draw the characteristic curves of Gear pump.
9. Draw the characteristic curves of Pelton wheel.
10. Draw the characteristics curves of Francis turbine.
11. Draw the characteristic curves of Kaplan turbine.
12. Study of Impact of jets
13. Visualization of Reynolds Number

Course Code: 140ME0308	**Course Title:** MANUFACURING PROCESSES LABORATORY-II
Core/Elective: Core	**L : T : P : C : M–** 0 : 0 : 3 : 2 : 100
Type: Practical	**Total Contact Hours:** 45

LIST OF EXPERIMENTS

1. Exercise on Cylindrical Grinding.
2. Exercise on Key-way Milling.
3. Exercise on Spur Gear Cutting.
4. Exercise on Surface Grinding.
5. Exercise on Machining of bolt.
6. Exercise on Shaping- Male dove tail part.
7. Exercise on Shaping-Female dove tail part.
8. Exercise on Drilling, Reaming and Tapping.
9. Exercise on Key-way Machining in Slotting machine.
10. Exercise on Assembly of machined components (may include welding of gear housing)

Course Code: 140ME0309	**Course Title:** PERSONAL EFFECTIVENESS
Core/Elective: Core (C)	**L : T : P : C : M–** 0 : 0: 3 : 2 : 100
Type: Practical	**Total Contact Hours:** 30

Course Outcomes

At the end of the course the student will be able to:

CO1 Identify the strengths, weaknesses and opportunities
CO2 Set well-articulated goals for academics, career, and personal aspirations
CO3 Establish the road map to realize the goals
CO4 Apply time management techniques to complete planned tasks on time
CO5 Create time and pursue activities of self-interest that add value

Course Content

UNIT I THE IMPORTANCE OF ENVISIONING

Importance of positive self-perception – Principle of dual creation (Everything gets created twice – Envisioning) - Understanding vision and mission statements - Writing personal mission statements – 'Focus' as a way of life of most successful people – Importance of goal setting – Importance of planning and working to time

UNIT II FUNDAMENTAL PRINCIPLES OF GOAL SETTING AND WORKING TO TIME

Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume.

UNIT III GOAL SETTING AND ACTION ORIENTATION

Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment – Importance of action orientation - Converting goals to actionable tasks – Establishing road map – Using Gantt chart for planning and progress

UNIT IV TIME MANAGEMENT - TOOLS AND TECHNIQUES

Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying 'NO' – Managing procrastination

UNIT V PUTTING INTO PRACTICE

Practicals: Using the weekly journal – Executing and achieving short term goals – Periodicreviews

Course handouts (compiled by PS team, MCET)

1. Learner's workbook
2. Personal efficiency Journal
3. Reading material for Personal Effectiveness

Further Reading

1. Stephen R Covey, "First things first", Simon & Schuster UK, Aug. 1997.
2. Sean Covey, "Seven habits of highly effective teenagers", Simon & Schuster UK, 2004.
3. College student's guide to time management (e-book)
4. Michael S Dobson, Susan B Wilson, "Goal setting" (e-book)

Operational modality

Enablement through learning workshops	Conducted by external experts and trained internal faculty	2 days 7 hours each	14 hours
Progress monitoring (face to face interaction with student and checking workbook/Journal	Internal faculty	1 hour per week for a minimum of 10 weeks	10 hours
Mid semester reinforcement- workshop	External expert	1 day	6 hours
Total			30 hours
No: of credits			2

Assessment

Assessment	Details	Weightage	Administration	By Whom	When
Knowledge Test*	Multiple choice questions (20)	20%	Pen and paper	Internal team	Immediately after the initial workshop
Final comprehensive Knowledge test*	Multiple choice questions (40)	30%		Internal team	End of semester
Scenario based knowledge test*	Multiple choice scenario responses (15)	30%	Pen and paper	Internal team	Immediately after mid-semester reinforcement
Review of student journal	Student held journal with enough pages for the whole semester	10%	Student journals to be reviewed	Trained Internal faculty	Once in a week.
Review of student journal by external expert		10%	Student journal comprehend sive review	External expert and Internal reviewer	End of semester

END OF SEMESTER- III

SEMESTER IV

Course Code:140ME0401	**Course Title:**NUMERICAL METHODS
Core/Elective: Core (C)	**L : T : P : C : M** – 2 : 2 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the courses:

- Engineering Mathematics I
- Engineering Mathematics II
- Engineering Mathematics III

Course Outcomes

At the end of the course, the students will be able to

CO1 Solve the system of linear equations and calculate the dominant Eigen value.

CO2 Solve the non-linear equations and apply the principle of least squares to fit a curve for the given data.

CO3 Predict the unknown values from the given set of data's; apply numerical techniques to find derivatives and to evaluate integrals.

CO4 Solve first order ordinary differential equation using numerical techniques.

CO5 Solve partial differential equation using numerical techniques.

Course Content

UNIT I SOLUTION OF SYSTEM OF LINEAR EQUATIONS 6+6

Solution of system of linear equations-Direct method: Gaussian elimination method, Choleski method, Iterative methods: Gauss-Seidel - sufficient conditions for convergence. Power method to find the dominant Eigen value and the corresponding Eigen vector.

UNIT II SOLUTION OF NON-LINEAR EQUATION & CURVE FITTING 6+6

Solution of non-linear equation: Method of false position - Newton- Raphson method -Order of convergence of these methods. Curve fitting - Method of least squares.

UNIT III INTERPOLATION, NUMERICAL DIFFERENTIATION & INTEGRATION 6+6

Newton's forward, backward interpolation – Lagrange's interpolation. Numerical Differentiation and Integration – Trapezoidal rule – Simpson's 1/3 rule – Gaussian two point and three point quadrature formula –Double integration using Trapezoidal rule.

UNIT IV SOLUTION OF FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 6+6

Numerical solution of first order ordinary differential equation-Single step method: Taylor's series- Euler's method - Runge-Kutta method of fourth order – Multi step method: Adams' method.

UNIT V SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS 6+6

Numerical solution of Laplace equation and Poisson equation by Liebmann's method - solution of one dimensional heat flow equation - Bender - Schmidt recurrence relation - Crank - Nicolson method.

Text Books

1. Srimanta Pal and Subodh C. Bhunia, "Engineering Mathematics", First Edition, Oxford University Press, New Delhi, 2015.
2. Grewal, B.S. and Grewal, J. S., "Numerical Methods in Engineering and Science", Sixth Edition, Khanna Publishers, New Delhi, 2004.

References

1. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2006.
2. Jain M. K., Iyengar, S. R. and Jain, R. K, "Numerical Methods for Scientific and Engineering Computation", Wiley Eastern Company.
3. Sastry.S.S "Introductory Methods of Numerical Analysis", 3rd Edition, PHI, 2003

Web References

- http://nptel.ac.in/courses/122102009/

CourseCode:140ME0402	**Course Title:** STRENGTH OF MATERIALS
Core/Elective: Core	**L : T : P : C : M** – 3 : 1 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course:

- Engineering Mechanics

Course Outcomes

At the end of the course students will be able to:

CO1 Calculate the stresses and strains on normal and inclined plane of a structural member subjected to external loading such as axial loads and thermal loads

CO2 Determine and illustrate shear force, bending moment and deflections of beam structures experiencing a combined loading

CO3 Analyze the torsion of shafts and springs

CO4 Analyze columns subjected to buckling loads

CO5 Calculate the stresses and strains associated with thin-wall cylindrical pressure vessels.

Course Content

UNIT I STRESS AND STRAIN OF SOLIDS 9+3

Rigid body and deformable body, Stiffness - types of stresses and strains-stresses in simple and compound bars under axial load- factor of safety- Poisson's ratio- elastic constants - Modulus of Elasticity- bulk Modulus- modulus of rigidity-Relationship between elastic constants- temperature stress and strain- Strain energy.

UNIT II ANALYSIS OF STRESSES IN TWO DIMENSION 9+3

Stresses on inclined planes-principal planes and stresses-Mohr's circle for biaxial stresses (Concepts only), Truss- Method of joints.

Thin wall pressure vessel and it types- The Longitudinal Stress - Hoop stress - application - Stresses and Strain in cylindrical thin shells

UNIT III BEAMS - LOADS AND STRESSES 9+3

Beam- Types of beams- transverse loads and its types- Shear force and bending moment - cantilever simply supported beams and overhanging beams (simple problems only).
Theory of simple bending - bending equation – bending stress -neutral axis – transverse shear stress - shear stress for I section and T section of beams.

UNIT IV DEFLECTION OF BEAM AND COLUMN 9+3

Deflection beams- Macaulay's method, Moment area method
Failure of a column-Euler's Column Theory - Limitation of Euler's formula- End conditions for long columns-Effective length-Slenderness Ratio- Rankine's formula.

UNIT V TORSION 9+3

Torsion- assumptions in the theory of pure torsion- torsional rigidity – torque transmitted by a solid and hollow bar of circular cross section- torque transmitted by a stepped shaft - torque transmitted by a compound shafts. Springs and its types- closed coil Helical springs subjected to compressive loads

NOTE: (Use of approved Design Data Book is permitted in the End semester examination)

Text Books

1. Hibbeller RC, "Mechanics of Materials", Prentice-Hall of India, New Delhi, 2013.
2. James M Gere, " Mechanics of Materials", Cengage Learning, India, 2012.

References

1. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1997
2. Beer F. P. and Johnston R," Mechanics of Materials", McGraw-Hill Book Co, Third Edition, 2002.
3. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995

Web References

- http://nptel.ac.in/courses/112107147/

Course Code 140ME0403	**Course Title:** ENGINEERING METALLURGY
Core/Elective: Core	**L : T : P : C : M** – 3: 0 : 0 : 3 : 100
Type: Lecture & Practical	**Total Contact Hours:** 45

Prerequisites

The student should have undergone the course:

- Material Science

Course Outcomes

At the end of the course students will be able to:

CO1 Analyze a phase diagram and explain iron-carbon equilibrium diagram.

CO2 Select an appropriate heat treatment process to impart a desired property for a given ferrous alloy and determine its harden ability.

CO3 Select an appropriate surface treatment process for ferrous and non-ferrous alloys.

CO4 Choose an appropriate alloying element to impart a desired property for a given ferrous alloy.

CO5 Choose an appropriate alloying element to impart a desired property for a given non ferrous alloy.

Course Content

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys- Solid solutions- Substitutional and Interstitial. Phase diagrams- Interpretation of Phase diagram, Lever rule, Gibbs phase rule. cooling curve for pure metal, binary solid solution and binary eutectic system. Iron – Iron Carbide equilibrium diagram. Micro constituents in Fe_3C diagram (Austenite, Ferrite, Cementite, Pearlite, Martensite, Bainite), Pearlite transformation.

UNIT III HEAT TREATMENT 9

Heat treatment process-purpose heat treatment. Types of heat treatment: Full Annealing, Process annealing, Stress relief annealing, Speroidising, Isothermal annealing, Normalizing , Hardening, Tempering of steel-Low tempering, medium tempering, high tempering. Austempering and Mar tempering.Quenching and quenching media.Isothermal transformation Diagram (TTT Diagram). Cooling curves superimposed on TTT diagram.CCR. Harden ability- Definition. Method to determine Harden ability- Jominy end quench test. Ideal Critical diameter.

UNIT III SURFACE TREATEMENT 9

Surface treatment process – Purpose of surface treatment . Case hardening- Carburizing- types – Pack carburizing Liquid carburizing, Gas carburizing, Nitriding, Cyaniding, Flame and Induction hardening-working principle, merits, demerits and applications.

UNIT IV FERROUS ALLOYS 9

Ferrous metals - Definition. Steel - Types (Low carbon, medium carbon and High carbon steels). Effect of alloying elements on properties of steel (Ms, Si, Cr, Mn, Va and W). Properties and applications of Stainless Steel and Tool steel. HSLA steels- Maraging steels. TRIP steels. Cast Iron-Types - White, Malleable, Grey and Spheroidal – Microstructure, properties and applications.

UNIT V NON-FERROUS ALLOYS 9

Non-ferrous metals – Types – Aluminium and its alloys -Designation system, Copper and its alloys, Nickel and its alloys Magnesium and its alloys, Titanium and its alloy – Composition, Properties, Applications,

Text Books

1. William D Callister "Material Science and Engineering", John Wiley and Sons, 2010.
2. AnupGoel, SSSabharwal, "Engineering Materials and Metallurgy", Technical Publication, 2014.

References

1. Raghavan.V "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., 2007.
2. Dieter G. E., "Mechanical Metallurgy", McGraw Hill Book Company, 2006.
3. Sydney H.Avner "Introduction to Physical Metallurgy" McGraw Hill Book Company, 2007.

Web References

- http://nptel.ac.in/courses/113106032/
- http://www.nptel.ac.in/courses/112108150/
- https://en.wikipedia.org/wiki/Materials_science

Course Code:140ME0404	**Course Title:** THEORY OF MACHINES - II
Core/Elective: Core (C)	**L : T : P : C : M** – 2: 1 : 2 : 4 : 100
Type: Lecture& Practical	**Total Contact Hours:** 75

Prerequisites

The student should have undergone the course:

- Theory of Machines I

Course Outcomes

At the end of the course students will be able to:

CO1 Classify the types of Governors and find their characteristics

CO2 Apply the principles of Gyroscopes for aero planes, ships and automobiles

CO3 Balance the rotating and reciprocating unbalances

CO4 Analyze the characteristics of free and forced longitudinal vibration

CO5 Analyze the characteristics of transverse and torsional vibration

Course Content

UNIT I GOVERNORSANDGYROSCOPES 9+3

Governors - types - centrifugal governors – watt governor, gravity controlled-Porter and Proell governor and spring controlled- Hartnell governor. Centrifugal governors characteristics – stability- sensitiveness-hunting, isochronisms-effect of friction -controlling force.
Gyroscopes - gyroscopic forces and torques - gyroscopic stabilization - gyroscopic effects in automobiles, ships and airplanes

UNIT II BALANCING 9+3

Static and dynamic balancing - balancing of rotating masses - balancing of single rotating mass by a single mass in the same plane. Balancing of single rotating mass by two masses in different plane and balancing of several rotating masses in the same plane, balancing of several masses in different planes - balancing of reciprocating masses-balancing of primary and secondary unbalanced forces of reciprocating masses. Partial balancing in locomotive engines – balancing of coupled locomotives.

UNIT III LONGITUDINAL VIBRATION 9+3

Undamped free vibration of single degree of freedom system- simple and compound pendulum.springs in series, springs in parallel and combinations. Natural frequency, Damped free vibration of single degree of freedom system, types of damping-viscous damping- critically damped- under damped system, Logarithmic decrement. Forced vibration of single degree of

freedom system, constant harmonic excitation, steady state vibration, magnification factor.Vibration isolation and transmissibility.

UNIT IV TRANSVERSE VIBRATION 9+3

Natural frequency of free transverse vibrations, Natural frequency of transverse vibration due to point load, uniformly distributed load over a cantilever beam-simply supported shaft-shaft fixed at both the ends, shaft subjected to number of point loads- Dunkerly's method, Critical speed – whirling of shafts.

UNIT V TORSIONAL VIBRATION 9+3

Torsional systems- natural frequency, natural frequency of single, two and three rotor systems, equivalent shafts, free torsional vibration of geared systems, Holzer's method, Signature Analysis.

Text Books

1. Rattan S.S, "Theory of Machines", Tata McGraw-Hill Publishing Ltd., New Delhi, 2007.
2. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc.,1995.

References

1. Rao J.S and Dukkipati R.V, "Mechanism and Machine Theory", New Age International, New Delhi, 2007.
2. R.S.Khurmi and J.K Gupta., "Theory of Machines",14th revised edition, S Chand Publications,2005.
3. Ballaney.P.L "Theory of Machines", Khanna Publishers, 1990.

List of Experiments 15

1. Governors - Determination of sensitivity, effort, etc. for Watt, Porter, Proell, Spring controlled Governors
2. Motorized Gyroscope-Verification of laws -Determination of gyroscopic couple.
3. Balancing of reciprocating masses and rotating masses.
4. Vibrating system – spring mass system –Determination of damping co-efficient of single degree of freedom system.
5. Determination of transmissibility ratio - vibrating table.
6. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
7. Determination of torsional frequencies for compound pendulum and flywheel system with lumped Moment of inertia.
8. Demonstration on Fast Fourier Transform (FFT) analyzer.

Web References

- http://nptel.ac.in/courses/112104114/
- https://en.wikipedia.org/wiki/Dynamics_(mechanics)

CourseCode:140ME0405	**Course Title:** THERMAL ENGINEERING
Core/Elective: Core	**L : T : P : C : M** – 3: 1 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course:

- Engineering Thermodynamics

Course Outcomes

At the end of the course students will be able to:

CO1 Evaluate the thermodynamic characteristics of IC engines using air-standard cycles.

CO2 Calculate the performance characteristics of steam boiler and condenser.

CO3 Analyze the performance characteristics of steam nozzles and steam turbines.

CO4 Evaluate the performance characteristics of air compressors.

CO5 Appraise the performance of refrigeration and air-conditioning systems.

Course Content

UNIT I GAS POWER CYCLESAND PERFORMANCE OF IC ENGINES 9+3

Air standard cycles- Otto, Diesel, Dual, Braytoncycles.Calculation of mean effective pressure and air standard efficiency. Engine tests - performance, heat balance, retardation and Morse test.

UNIT II STEAM BOILERS AND CONDENSERS 9+3

Steam boilers- Definition, Types – Fire tube and water tube, Mountings and Accessories, performance calculations, Indian Boilers Regulation (IBR) Act, Energy conservation opportunities in boiler. Steam condensers-Functions, elements of a condensing plant, types, estimation of cooling water requirement, condenser efficiency.

UNIT III STEAM NOZZLES AND TURBINES 9+3

Steam nozzles- flow through steam nozzles, effect of friction, critical pressure ratio and super saturated flow, nozzle design calculations. Steam turbines- impulse and reaction turbines, compounding, velocity diagram, governing of turbines.

UNIT IV AIR COMPRESSORS **9+3**

Introduction to air-compressors - Reciprocating air compressor, performance characteristics, effect of clearance volume, free air delivery and displacement, intercooler, after cooler - Rotary compressor - vane type, centrifugal and axial, flow performance characteristics, Application of various types of compressors.

UNIT V REFRIGERATION AND AIR CONDITIONING **9+3**

Fundamentals of refrigeration – COP - vapour compression refrigeration system - cycle, p-h chart, vapour absorption system- comparison, properties of refrigerants, performance calculations.

Fundamentals of air conditioning system, simple cooling and heat load estimation. Air-conditioners -window, split, summer and winter, centralized air-conditioning systems.

NOTE:(Use of Steam table, Mollier diagram, Psychometric chart and Refrigeration property table are permitted in the end semester examination)

Text Books

1. Kothandaraman C.P, Domkundwar and A.V. Domkundwar, "A Course in Thermal Engineering", DhanpatRai& Sons, Fifth Edition, 2002.
2. Rajput R.K. "Thermal Engineering", Laxmi Publications (P) Ltd., New Delhi, 6th edition, 2005.

References

1. Mahesh M Rathore, "Thermal Engineering", Tata McGraw-Hill,3rd edition,2013.
2. Arora C.P., "Refrigeration and Air conditioning", Tata McGraw-Hill, New Delhi, 2005.
3. Sarkar B.K., "Thermal Engineering", Tata McGraw-Hill, New Delhi New Delhi, 2001.

Web References

- http://www.nptel.ac.in/courses/112104039/
- http://www.ignou.ac.in/

Course Code: 140ME0406	**Course Title:**C -PROGRAMMING
Core/Elective: Core (C)	**L : T : P : C : M** – 3: 0 : 2 : 4: 100
Type: Lecture&Practical	**Total Contact Hours:** 60

Course Outcomes

At the end of the course students will be able to:

CO1 Write and draw a flowchart for given problems.

CO2 Recognize and build program using appropriate programming paradigms.

CO3 Implement modular programs using functions and files.

CO4 Apply pointers for effective memory usability.

CO5 Articulate the necessity of structures and unions.

Course Content

UNIT I INTRODUCTION 9

Basics of computers- Algorithm – Flow Chart-Introduction of C program-Identifier- Keywords - Data Types-Variables and Constants-Operators and Expressions – Managing Input and Output operations.

UNIT II CONTROL STATEMENTS AND ARRAYS 9

Decision Making and Branching-Looping statements-Nested looping- Arrays-Declaration-Initialization – One dimensional and two dimensional arrays-Advantages and Limitations of Arrays.

UNIT III STRINGS AND FUNCTIONS 9

String-Character Arrays-String operations--Arrays of Strings.Function –Built in function-User defined function-– Declaration of function – Definition of function-Pass by value – Pass by reference– Recursion.

UNIT IV POINTERS AND FILES 9

Pointers - Operations on Pointers– Arithmetic & Relational operations on pointers- Void Pointer- Null Pointer – Relationship between Pointers and Arrays - Array of Pointers-Applications of Pointers- Files-File Operations.

UNIT V STRUCTURES AND UNIONS **9**

Structure definition – Structure declaration – Operations on Structures–Pointer to Structures-Array of structures– Nested Structures-functions and structures-Union - Practical applications of Unions and structures.

Text Books

1. Anita Goel, Ajay Mittal, "Computer Fundamentals and programming in C" , First Edition, Pearson Education, 2013.
2. PradipDey, ManasGhosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009

References

1. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.
2. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

List of Experiments **15**

1. Program to evaluate an Expression using various types of operators
2. Program using Decision making and Branching statements
3. Program using Loops
4. Program using Arrays
5. Program using Strings
6. Program using Functions
7. Program using Pointers
8. Program using structures
9. Program using union
10. Program Using Files

Reference

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.

Course Code:140ME0407	**Course Title:** STRENGTH OF MATERIALS AND METALLURGY LABORATORY
Core/Elective: Core (C)	**L : T : P : C : M** – 0: 0 : 3 : 2: 100
Type: Practical	**Total Contact Hours:** 45

Course Outcomes

At the end of the course the student will be able to

CO1 Demonstrate the basic concepts of strength and mechanics of a given material under external loading

CO2 Demonstrate the micro structural characterization and the effect of heat treatment on a given material

LIST OF EXPERIMENTS

Strength of Materials Lab

1. Study of UTM and Test specimen- specification and standards
2. Conduct tension test on the given mild steel rod using universal testing machine for determining the yield stress, ultimate stress, breaking stress, percentage of reduction in area and percentage of elongation over a gauge length and Young's modulus.
3. Conduct shear test on Mild steel and Aluminium rods by Double shear.
4. Calculate the modulus of rigidity of mild steel rod by Torsion test
5. Determine the toughness of the given mild steel specimen using IZOD and CHARPY impact test.
6. Analyse the Hardness Number of metals by Brinell and Rockwell Hardness
7. Determine the flexural rigidity and verify the Maxwell Reciprocal Theorem of given rectangular beam by deflection test.
8. Estimate the stiffness and modulus of rigidity of the helical spring by Compression test.

Metallurgy Lab

9. Prepare a specimen using mounting press for metallographic examination.
10. Draw the microstructure of cast iron, copper and aluminum using Metallurgical microscope
11. Compare the hardness number and impact strength for unhardened, hardened and tempered mild steel specimens
12. Determine the harden ability of steel by Jominy End Quench

Course Code: 140ME0408	**Course Title**:THERMAL ENGINEERING LABORATORY
Core/Elective: Core (C)	**L : T : P : C : M** – 0: 0 : 3 : 2: 100
Type: Practical	**Total Contact Hours:** 45

Course Outcomes

At the end of the course, the students will be able to

CO1 Draw the valve and port timing diagrams of IC engines.

CO2 Evaluate the performance of IC engines

CO3 Determine the fuel properties

CO4 Evaluate the performance of steam boilers and turbines

List of Experiments

I.C Engine Lab and Fuels Lab **30**

1. Valve timing and port timing diagrams.
2. Performance test on single cylinder, 4-stroke high speed diesel engine.
3. Performance test on single cylinder, 4-stroke computerized VCR petrol/diesel engine.
4. Heat balance test on twin cylinder, 4-stroke diesel engine.
5. Morse test on multi-cylinder petrol engine.
6. Retardation test to find frictional power of single cylinder, slow speed diesel engine.
7. a). Determination of viscosity using Redwood viscometer.
   b). Determination of flash point and fire point using Pensky-Martens closed cup apparatus

Steam Lab **15**

1. Study of steam generators and turbines.
2. Performance and energy balance test on a steam generator.
3. Performance and energy balance test on steam turbine.

Course Code:140ME0409	**Course Title:** ETHICAL AND MORAL RESPONSIBILITY
Core/Elective: Core (C)	**L : T : P : C : M** – 0: 0 : 2 : 1: 100
Type: Practical	**Total Contact Hours:**30

Course Outcomes

At the end of the course the student will be able to:

CO1 Articulate the importance of ethical and moral responsibilities

CO2 Explain the fundamental aspects of ethical practices

CO3 Validate one's appropriate and inappropriate behaviors in various roles

CO4 Elaborate code of conduct of professional bodies

CO5 Explain the importance of professional practices as a future employee/entrepreneur

UNIT I ETHICAL PRACTICES - IMPORTANCE 8*

Why ethical practices; The current day scenario of ethical practices – parents, society, politics & business; Awareness of skewedness of information – news, advertisements and other media; The need for ethical and moral responsibility on a personal level; Handling oneself amidst peer pressure and societal pressure;

UNIT II ETHICAL PRACTICES - FUNDAMENTALS 6*

Morality & Ethics; Moral issues, inquiry, moral dilemmas; Moral autonomy – Kohlberg's theory and Gilligan's refinement; Theories on "right action" – virtue ethics, utilitarianism, duty ethics, rights ethics – resolving moral dilemmas; justifying moral obligations;

UNIT III CODES OF CONDUCT 8*

Importance of code of conduct and its role;Evolving draft Code of conduct for different roles – son/daughter, student, future employee & citizen; Reflectionon real time incidences at the college

Engineers as responsible experimenters; Faith of the Engineer (ABET); Pledge and Code of ethics as per National Society of Professional Engineers (NSPE); Code of Ethics of Institution of Engineers (India); Case studies and discussions in professional context

UNIT IV PROFESSIONAL PRACTICES AT WORK 8*

Transition from a student to a professional; Importance of professional practices at work; Integrity as the topmost virtue of a professional; Self-awareness: Where competence ends and professionalism takes over; Professional qualities;

Need to align oneself to culture & values of organizations; Need to embrace diversity in organizations.

*- Includes review sessions

Assessments

Assessment	Details	Wt:	Administration	When
Class room participation	Group assignments presentation; Case discussions participation	70%	Continuous assessment in class	During class
Knowledge test	Multiple choice questions	10%	Pen and Paper	End of course
Scenario based assessments	Multiple choice questions	20%	Pen and Paper	End of course

No. of hours& credits:

Enablement through class room lecture, case discussions and group presentations	Conducted by trained internal faculty	30 hours – 1 credit
At least two guest lectures	Delivered by senior people from Industries/Government organizations	

Course handouts (compiled by Professional Skills team, MCET)

1. Instructor's Manual (for the faculty)
2. Learner's workbook (for the student)

References

1. Mike W Martin & Roland Schinzenger, "Ethics in Engineering", Latest Edition, Tata McGraw-Hill
2. Code of conduct document, MCET student handbook
3. Gail D Baura, "Engineering Ethics - an industrial perspective", Academic Press, Elsevier,
4. SubratoBagchi, "The professional - Defining the new standard of Excellence at work", Penguin Books India.

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END OF SEMESTER- IV

SEMESTER-V

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
11ME501	Operations Research	3	1	0	4	100
11ME502	Heat and Mass Transfer	3	1	0	4	100
11ME503	Automobile Engineering	3	0	0	3	100
11ME504	Design of Machine Elements	3	1	0	4	100
11ME505	Computer Integrated Manufacturing	3	0	0	3	100
11ME506	Electrical Drives and Control	3	0	0	3	100
PRACTICAL						
11ME507	Thermal Engineering Laboratory	0	0	3	2	100
11ME508	Electrical Engineering Laboratory	0	0	3	2	100
11ME509	Kinematics and Dynamics Laboratory	0	0	3	2	100
	TOTAL	**18**	**3**	**9**	**27**	**900**

SEMESTER-VI

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
11AU601	Finite Element Analysis	3	1	0	4	100
11ME601	Design of Transmission Systems	3	1	0	4	100
11ME602	Total Quality Management	3	0	0	3	100
11ME603	Microprocessor and Microcontroller	3	0	0	3	100
XXX	Elective - I	3	0	0	3	100
XXX	Elective – II	3	0	0	3	100
PRACTICAL						
11ME607	CAM Laboratory	0	0	3	2	100
11ME608	Heat Power Laboratory	0	0	3	2	100
11ME609	Microprocessor and Microcontroller laboratory	0	0	3	2	100
11ME610	Mini project	0	0	3	2	100
	TOTAL	**18**	**2**	**12**	**28**	**900**

SEMESTER V

Course Code:11ME501	**Course Title: OPERATIONS RESEARCH**
Core/Elective: Core	**Credits (L:T:P:C:M) – 3 : 1 : 0 : 4 : 100**
Type: Lecture/Tutorial	**Total Contact Hours:60**

PREREQUISITES:

The student should have undergone the course(s):

- 11CO102 ENGINEERING MATHEMATICS I

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1:Understand the principles of linear programming and apply them in solving the linear programming problems

CO2: Apply the techniques of simplex method in solving the transportation problems

CO3: Apply the techniques of Hungarian method in solving the assignment problems

CO4: Evaluate the inventory problems using the appropriate inventory models

CO5: Evaluate the scheduling problems using the network models

CO6: Apply the queuing theory in solving the queuing problems

CO7:Make the possible replacement of items using the replacement models

COURSE CONTENT:

UNIT I LINEAR PROGRAMMING 9+3

Introduction - Formulation of linear programming models – Assumptions-Graphical solution procedure – solving LPP using simplex algorithm – Degeneracy, Revised Simplex Method Duality theory - Interpretation of dual variables- Primal Dual Relationships – Role of duality in sensitivity analysis - Dual simplex method

UNIT II TRANSPORTATION & ASSIGNMENT MODELS 9+3

Transportation problems, transportation simplex method– Assignment problems, Hungarian method- LP formulation of transportation and Assignment networks- Traveling sales man problem

UNIT III INVENTORY MODELS 9+3

Purchase model with no shortages – manufacturing model with no shortage – Purchase model with shortage – Manufacturing model with shortages –model with price breaks

UNIT IV NETWORK MODELS 9+3

Maximal flow problem – Shortest route problem – Minimal spanning tree problem - Project networks, CPM, PERT, Crashing of networks, L P model for crashing – project costing and control.

UNIT V QUEUING AND REPLACEMENT MODELS 9+3

Queuing theory terminology – Single server, multi server, Limited queue capacity – applications – Markov chains. Replacement models – Money value, present worth factor and discount rate

TEXT BOOKS:

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2000
2. R.Panneerselvam, Operations Research,PHI,2006

REFERENCES:

1. Philips, Ravindran and Solberg, Operations Research, John Wiley,2002
2. Hamdy A Taha, Operations Research – An Introduction, Prentice Hall India,2003
3. Ronald L Rardin, Optimization in Operations Research, Pearson, 2003
4. David R. Anderson, et al , An Introduction to Management Science – Quantitative to Decision Making, Thomson,2003

WEB REFERENCES:

1. http://www.nptel.ac.in/syllabus/111107064/
2. http://www.mit.edu/~orc/
3. http://www.pitt.edu/~jrclass/or/or-intro.html#history
4. http://www.britannica.com/topic/operations-research#ref22348

Course Code:11ME502	Course Title: HEAT AND MASS TRANSFER
Core/Elective: Core	Credits (L:T:P:C:M) – 3 : 1 : 0 : 4 : 100
Type: Lecture/Tutorial	Total Contact Hours:60

PREREQUISITES:

The student should have undergone the course(s):

- 11AU302 ENGINEERING MATHEMATICS III
- 11AU302 ENGINEERING THERMODYNAMICS
- 11AU303 FLUID MECHANICS & MACHINERY

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Demonstrate the different modes of heat transfer through different sections.
CO2. Solve the problems in different types of conduction, convection and radiation.
CO3. Acquired the knowledge of phase change and various methods of heat exchanging processes
CO4. Solve problems on radiation between different sections
CO5. Demonstrate the transfer of mass between different mediums.

COURSE CONTENT:

UNIT I CONDUCTION 9+3

Basic Concepts – Mechanism of Heat Transfer – Conduction, Convection and Radiation– Fourier Law of Conduction - General Differential equation of Heat Conduction –Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction – Conduction through Plane Wall, Cylinders and Spherical systems –Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces –Unsteady Heat Conduction – Lumped Analysis – Use of Heislers Chart.

UNIT II CONVECTION 9+3

Basic Concepts –Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – Dimensional Analysis – External Flow – Flow over Plates, Cylinders and Spheres – Internal Flow – Laminar and Turbulent Flow – Flow over Bank of tubes – Free Convection – Dimensional Analysis – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 9+3

Nusselts theory of condensation-pool boiling, flow boiling, correlations in boiling and condensation. Types of Heat Exchangers – Heat Exchanger Analysis – LMTD Method and NTU - Effectiveness – Overall Heat Transfer Coefficient – Fouling Factors.

UNITIV RADIATION **9+3**

Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoffs Law –Black Body Radiation –Grey body radiation -Shape Factor Algebra – Electrical Analogy – Radiation Shields –Introduction to Gas Radiation

UNIT V MASS TRANSFER **9+3**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlation

TEXT BOOKS:

1. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 1995.
2. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and Sons, 1998.

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.

WEB REFERENCES:

1. http://www.nptel.ac.in/syllabus/111107064/
2. http://www.mit.edu/~orc/
3. http://www.pitt.edu/~jrclass/or/or-intro.html#history
4. http://www.britannica.com/topic/operations-research#ref22348

Course Code:11ME503	Course Title: AUTOMOBILE ENGINEERING
Core/Elective: Core	Credits (L:T:P:C:M) – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

PREREQUISITES:

The student should have undergone the course(s):

- 11CO103 ENGINEERING PHYSICS
- 11AU303 FLUID MECHANICS & MACHINERY
- 11ME301 - KINEMATICS OF MACHINERY
- 11ME402 -DYNAMICS OF MACHINERY

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Understand and distinguish the various parts of an automobile and its function.

CO2. Explain the transmission, suspension, steering and braking systems of automobiles

CO3. Understand and explain the cooling system, lubrication system and electrical system of an automobile.

CO4. Recognize the emission control and its standards.

COURSE CONTENT:

UNIT I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles , vehicle construction and different layouts chassis, frame and body, resistances to vehicle motion and need for a gearbox, components of engine-their forms functions and materials.

UNIT II FUEL AND LUBRICATION SYSTEM 9

Petrol fuel feed system: Feed pump – mechanical, electrical type – Carburettors – fixed venturi type (carter), variable venturi type (SU), multiple barrel type (solex mikuni), carburettor for two wheelers -Petrol injection – Multi Point Fuel Injection (MPFI), VVT (petrol engines),Turbo chargers, Diesel fuel system: Jerk type fuel injection pump–Methods of fuel injection–common rail, distributor types-Nozzles–Cold starting aids,Cooling system: Direct and indirect cooling,Lubricating system: Mist, wet and dry sump

UNITIII TRANSMISSION SYSTEMS 9

Clutch-types and construction , gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel –torque converter, propeller shaft, slip joints, universal joints ,Differential, and rear axle, Hotchkiss Drive and Torque Tube Drive

UNIT IV STEERING,BRAKES AND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems , Pneumatic and Hydraulic Braking Systems, Antilock Braking System and Traction Control

UNIT V ELECTRICAL SYSTEMS ,ACCESSORIES AND EMISSION NORMS: 9

Ignition system- coil ignition and magneto ignition system – Spark plug, Battery - Construction and maintenance, Starter motor – types, alternator, distributor, generator, cut out relay, panel board instruments and: Power operated windows-Vehicle Air conditioning- Air bags- Air pollution control- Catalytic converter working principle-Emission norms- Bharat and Euro emission Standards

TEXT BOOKS:

1. Kirpal Singh, " Automobile Engineering Vols 1 & 2 ", Standard Publishers, 7th Edition 1997, New Delhi
2. Jack Erjavec, "Systems approach to Automotive Technology", Prentice Hall, 2008

REFERENCES:

1. Jain,K.K.,and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002
2. Crouse and Anglin, "Automotive Mechanics", 10th Edition, Tata-McGraw Hill Publishers, 2004
3. Joseph Heitner, "Automotive Mechanics,", Second Edition ,East-West Press ,1999
4. Martin W. Stockel and Martin T Stockle , " Automotive Mechanics Fundamentals", The Goodheart –Will Cox Company Inc, USA ,1978
5. Heinz Heisler , 'Advanced Engine Technology," SAE International Publications USA,1998
6. Ganesan V." Internal Combustion Engines" ,Third Edition, Tata Mcgraw-Hill 2007

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Automotive_engineering
2. http://www.emae.eu
3. http://www.sae.org

Course Code:11ME504	Course Title: DESIGN OF MACHINE ELEMENTS
Core/Elective: Core	Credits (L:T:P:C:M) – 3 : 1 : 0 : 4 : 100
Type: Lecture/Tutorial	Total Contact Hours:60

PREREQUISITES:

The student should have undergone the course(s):

- 11AU205 – ENGINEERING MECHANICS
- 11ME301 - KINEMATICS OF MACHINERY
- 11AU404 - STRENGTH OF MATERIALS
- 11AU403 - METALLURGICAL ENGINEERING

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Calculate the stresses induced in members and understand the failure theories

CO2. Discuss the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.

CO3. Apply standards and Use design data book for designing machine elements

COURSE CONTENT:

UNIT I STEADY AND VARIABLE STRESSES IN MACHINE MEMBERS 9+3

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties, Preferred numbers – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principal stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and 'C'frame - Factor of safety - theories of failure – stress concentration – design for variable Loading– Soderberg, Goodman and Gerber relations.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9+3

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of Keys and key ways - Design of rigid and flexible couplings.

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9+3

Threaded fasteners - Design of bolted joints including eccentric loading – design of knuckle joints-Design of welded joints, riveted joints for structures - theory of bonded joints.

UNITIV DESIGN OF SPRINGS AND LEVERS 9+3

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

UNIT V DESIGN OF BEARINGS AND FLYWHEELS 9+3

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

TEXT BOOKS:

1. Bhandari V.B, “Design of Machine Elements”, Second Edition, Tata McGraw-Hill Book Co,2007
2. Shigley J.E and Mischke C.R., “Mechanical Engineering Design”, Sixth Edition, Tata McGraw-Hill, 2003.

REFERENCES:

1. Norton R.L, “Design of Machinery”, Tata McGraw-Hill Book Co, 2004.
2. Ugural A.C, “Mechanical Design – An Integral Approach, McGraw-Hill Book Co, 2004.
3. Spotts M.F., Shoup T.E “Design and Machine Elements” Pearson Education, 2004.
4. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", M/s.DPV Printers, Coimbatore, 2000.

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

WEB REFERENCES:

1. http://nptel.ac.in/courses/112105124/
2. http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv077-Page1.htm
3. http://ocw.mit.edu/courses/mechanical-engineering/2-72-elements-of-mechanical-design-spring-2009

Course Code:11ME505	Course Title: COMPUTER INTEGRATED MANUFACTURING
Core/Elective: Core	Credits (L:T:P:C:M) – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME302 PRODUCTION TECHNOLOGY I
- 11ME403 PRODUCTION TECHNOLOGY II

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. To understand automation strategies and transfer lines and to know about NC,CNC and DNC systems

CO2. To elucidate the knowledge in CAD, CAPP,CAE and CIM evolution.

CO3. To understand the usage of material handling and storage systems

CO4. To learn the fundamentals of robotics, languages and robot cell design.

CO5. To know the concepts of AI,FMS and inspection methods

COURSE CONTENT:

UNIT I INDUSTRIAL AUTOMATION STRATEGIES 9

Review on Concepts of industrial automation strategies - Semi-automats, automats and transfer lines, Fundamentals & classification of NC systems - NC machine tools - MCU functions - Control loops of NC system - CNC concepts, reference pulse and sampled data techniques – and CNC adaptive control – ACO and ACC systems, Direct Numerical Control

UNIT II INTEGRATED DESIGN & MANUFACTURING 9

Application of CAD computer-aided process planning - post processing - NC code generation – principles of computer aided engineering and concurrent engineering, Computer aided manufacturing, programming and interface hardware – computer aided process monitoring - adaptive control, CIM - Evaluation, hardware and software of CIM - Concurrent engineering

UNIT III AUTOMATION IN MATERIAL HANDLING SYSTEMS 9

Review on Materials handling and Storage Systems - Automated storage and retrieval systems, carousel storage systems - Interfacing Handling and Storage with Manufacturing, AGVs

UNIT IV ROBOTICS IN CIM ENVIRONMENT 9

Review on Fundamentals of robotics – end effectors, actuators, sensors, robot control units, motion controls, Robot Programming - different languages, Robot applications in manufacturing - material transfer & machine loading/unloading -processing operations – inspection - automation robot cell design & control

UNIT V INTELLIGENT MANUFACTURING SYSTEMS 9

Automated inspection and testing - machine vision, Coordinate measuring machines; Cellular manufacturing - Group Technology - Flexible manufacturing systems: configurations-workstations, planning, applications and benefits – control Systems, The role of Artificial Intelligence in the factory of the future, Basic concepts of Artificial intelligence, Intelligent systems and expert systems.

TEXT BOOKS:

1. Groover, M. P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall, 2007
2. Radhakrishnan, P.,Subramanyan, S., Raju,V., "CAD/CAM/CIM", New Age International Publishers(P),Ltd., 2006
3. Deb, S.R., "Robotic Technology and Flexible Automation", Tata Mc Graw Hill, 1994

REFERENCES:

1. Paul Ranky., "The design and operation of FMS", IFS publication, 1983
2. David J.Parrish, "Flexible Manufacturing" Butterworth-Heinemann, 1990
3. Richard D Klafter, Thomas A Chmielewski & Michael Negin, "Robotic Engineering – An Integrated Approach", Prentice Hall, 1994
4. Fu & Gonzales,, "Industrial Robotics", Tata Mc Graw Hill, 1988
5. Andrew Kussiak,, "Intelligent Manufacturing Systems", Prentice Hall , 1990

WEB REFERENCES:

1. http://nptel.ac.in/courses/112103174/module1/lec2/3.html
2. http://www.nptel.ac.in/courses/112102011/
3. http://elearning.vtu.ac.in/06ME72.html
4. https://en.wikipedia.org/wiki/Computer-integrated_manufacturing

Course Code:11ME506	Course Title: ELECTRICAL DRIVES AND CONTROL
Core/Elective: Core	Credits (L:T:P:C:M) – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

PREREQUISITES:

The student should have undergone the course(s):

11ME302 - ELECTRICAL MACHINES

COURSE OUTCOMES

At the end of the course the student will be able to:

CO 1. Discuss about various operation and performance of drives
CO 2. Describe the speed control methods of dc drives
CO 3. Describe the speed control methods of ac drives
CO 4. Apply the knowledge starters and controllers
CO 5. Discuss about the power rating of drives

COURSE CONTENT:

UNIT I INTRODUCTION 9

Fundamentals of electric drives – advances of electric drive-characteristics of loads – different types of mechanical loads – choice of an electric drive – control circuit components: Fuses, switches, circuit breakers, contactors. Relay – control transformers.

UNIT II SPEED CONTROL OF DC MACHINES 9

DC shunt motors – Speed Torque characteristics - Ward Leonard method, DC series motor – series parallel control – solid state DC drives – Thyristor bridge rectifier circuits- chopper circuits.

UNIT III SPEED CONTROL OF AC MACHINES 9

Induction motor – Speed torque Characteristics – pole changing, stator frequency variation - slip-ring induction motor – stator voltage variation - Rotor resistance variation, slip power recovery – basic inverter circuits- variable voltage frequency control.

UNIT IV MOTOR STARTERS AND CONTROLLERS 9

DC motor starters : using voltage sensing relays, current sensing relays and time delay relays - wound rotor induction motor starters – starters using frequency sensing relays - DOI –starter and auto transformers starter.

UNIT V HEATING AND POWER RATING OF DRIVE MOTORS 9

Load diagram, over load capacity, insulating materials, heating and cooling of motors, service condition of electric drive – continuous, intermittent and short time – industrial application.

TEXT BOOKS:

1. N.K De and P.K Sen ‘Electric Drives’ Prentice Hall of India Private Ltd,2002.
2. Vedam Subramaniam ‘Electric Drives’ Tata McGraw Hill ,New Delhi,2007
3. V.K Mehta and Rohit Mehta ‘ Principle of Electrical Engineering’ S Chand & Company,2008

REFERENCES:

1. S.K Bhattacharya Brinjinder Singh ‘Control of Electrical Machines’ New Age International Publishers,2002.
2. John Bird ‘Electrical Circuit theory and technology’ Elsevier, First Indian Edition, 2006.

WEB REFERENCES:

1. http://nptel.ac.in/courses/108108077/
2. http://www.industry.usa.siemens.com/drives/us/en/pages/drive-technologies.aspx

Course Code: 11ME507	Course Title: THERMAL ENGINEERING LABORATORY
Core/Elective: Core	**L : T : P : C : M** – 0 : 0 : 3 : 2: 100
Type: Practical	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11CO103-ENGINEERING PHYSICS
- 11AU303-FLUID MECHANICS AND MACHINERY
- 11ME401-THERMAL ENGINEERING

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Explain the importance of valve and port timing diagrams for IC engines
CO2. Evaluate the performance of IC engines
CO3. Determine the fuel properties
CO4. Evaluate the performance of steam boilers and turbines and their performance analysis
CO5. Analyze the aerodynamic characteristics of various models using wind tunnel

COURSE CONTENT

LIST OF EXPERIMENTS

I.C ENGINE LAB AND FUELS LAB **30**

1. Valve Timing and Port Timing Diagrams.
2. Performance Test on 4-stroke Diesel Engine.
3. Heat Balance Test on 4-stroke Diesel Engine.
4. Morse Test on Multi-cylinder Petrol Engine.
5. Retardation Test to find Frictional Power of a Diesel Engine.
6. a)Determination of Viscosity – Red Wood Viscometer.
7. b)Determination of Flash Point and Fire Point.

STEAM LAB **15**

1. Study of Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.
4. Performance test on centrifugal air blower.
5. Determination of lift and drag characteristics using wind tunnel

Course Code: 11ME508	Course Title: ELECTRICAL ENGINEERING LABORATORY
Core/Elective: Core	**L : T : P : C : M** – 0 : 0 : 3 : 2: 100
Type: Practical	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME302 - ELECTRICAL MACHINES

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Demonstrate the circuit connections of various types DC& AC motors

CO2. Apply the testing techniques to AC & DC machines to find the efficiency and performance characteristics

CO3. Illustrate speed control concepts for various DC &AC motors and its characteristics

CO4. Demonstrate the construction and working principle of DC& AC motor starters

COURSE CONTENT

LIST OF EXPERIMENTS

1. Speed Control of DC Shunt Motor
2. Load Test on DC Shunt Motor
3. Study of DC Motor starter
4. Swinburne's Test
5. Load Test on DC Series Motor
6. Load Test on 1 phase induction Motor
7. Load Test on 3 Phase Induction Motor
8. Squirrel cage
9. Slip-ring
10. Study of AC Motor Starters
11. No load and Blocked Rotor Test on 3 Phase Induction Motor
12. Speed control of Induction Motor

Course Code: 11ME509	Course Title: KINEMATICS AND DYNAMICS LABORATORY
Core/Elective: Core	**L : T : P : C : M** – 0 : 0 : 3 : 2: 100
Type: Practical	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME301 - KINEMATICS OF MACHINERY
- 11ME402 -DYNAMICS OF MACHINERY

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Apply the concepts of displacement, velocity, and acceleration to analyze mechanisms
CO2. Construct characteristic curve for governor and profile of cam
CO3. Manipulate the gyroscopic couple and moment of inertia for a given application.
CO4. Perform static and dynamic balancing of rotating and reciprocating masses.
CO5. Measure natural frequency of forced and free vibrations.

COURSE CONTENT

LIST OF EXPERIMENTS

1. Kinematics of 4 bar mechanisms – Slider crank and Crank Rocker Mechanism - Determination of velocity and acceleration.
2. Kinematics of Universal Joints – Determination of velocity and acceleration
3. Kinematics of Gear Trains –Determination of velocity ratio and Torque
4. Governors - Determination of sensitivity, effort, etc. for Watt, Porter, Proell, Spring controlled Governors
5. Cam - Study of jump phenomenon and drawing profile of the cam.
6. Motorized Gyroscope-Verification of laws -Determination of gyroscopic couple.
7. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
8. Balancing of reciprocating masses and rotating masses
9. Determination of moment of inertia by oscillation method for connecting rod and flywheel.
10. Determination of transmissibility ratio - vibrating table.
11. Vibrating system – spring mass system –Determination of damping co-efficient of single degree of freedom system.
12. Determination of torsional frequencies for compound pendulum and flywheel system with lumped Moment of inertia.
13. Demonstration on Fast Fourier Transform (FFT) analyzer

SEMESTER VI

Course Code: 11AU601	Course Title : FINITE ELEMENT ANALYSIS
Core/Elective: Core	Credits (L:T:P:C:M) – 3 : 1 : 0 : 4 : 100
Type: Lecture/Tutorial	Total Contact Hours:60

PREREQUISITES:
The student should have undergone the course(s):

- 11ME403 STRENGTH OF MATERIALS
- 11AU401 NUMERICAL METHODS

COURSE OUTCOMES
At the end of the course the student will be able to:

CO1. Understand the principles involved in discretization and finite element approach.
CO2. Solve problems in finite element method adopted for cylinders and other axisymmetric objects.
CO3. Apply finite element concepts for solving thermal and solid mechanics problems

COURSE CONTENT:

UNIT I INTRODUCTION 12

Historical background – Relevance of FEA to design problems, Application to the continuum – Discretization – Matrix approach, Matrix algebra – Gaussian elimination – Governing equations for continuum – Classical Techniques in FEM – Weighted residual method – Galerkin method -Ritz method.

UNIT II ONE DIMENSIONAL PROBLEMS 13

Finite element modeling – Coordinates and shape functions – Potential energy approach– Element matrices and vectors – Assembly for global equations – Boundary conditions – Higher order elements - Shapes functions – Applications to axial loadings of rods – Extension to plane trusses – Bending of beams –heat transfer- Finite element formulation of stiffness matrix and load vectors – Assembly to Global equations –boundary conditions – Solutions and Post processing - Example Problems.

UNIT III TWO DIMENSIONAL PROBLEMS – SCALAR VARIABLE PROBLEMS 12

Finite element modeling – CST element – Element equations, Load vectors and boundary conditions – Assembly – Application to heat transfer and torsion of noncircular shaft - Examples

UNIT IV TWO DIMENSIONAL PROBLEMS – VECTOR VARIABLE PROBLEMS 12

Vector Variable problems – Elasticity equations – Plane Stress, Plane Strain and Axisymmetric problems – Formulation – element matrices – Assembly – boundary conditions and solutions Examples.

UNITV ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL PROBLEMS 12

Natural coordinates, Iso parametric elements, Four node quadrilateral element– Shape functions – Element stiffness matrix and force vector – Numerical integration - Displacement and Stress calculations – Examples

TEXT BOOKS:

1. Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education 2002, 3rd Edition.
2. Logan D.L., "A First course in the Finite Element Method", Third Edition, Thomson Learning, 2007

REFERENCES:

1. Seshu P "Finite Element Analysis" PHI edition, 2009. Rao S.S., "The Finite Element Method in Engineering", Butterworth-Heinemann, 2005.
2. David V Hutton "Fundamentals of Finite Element Analysis"2005. McGraw-Hill Int. Ed.
3. Robert D.Cook., David.S, Malkucs Michael E Plesha, "Concepts and Applications of Finite Element Analysis" 4 Ed. Wiley, 2003.
4. Reddy J.N., "An Introduction to Finite Element Method", McGraw-Hill International Student Edition, 2005

WEB REFERENCES:

1. www.accessengineeringlibrary.com
2. http://nptel.ac.in/courses/112104116/
3. https://en.wikipedia.org/wiki/Finite_element_method

Course Code:11ME601	Course Title: DESIGN OF TRANSMISSION SYSTEMS
Core/Elective: Core	Credits (L:T:P:C:M) – 3 : 1 : 0 : 4 : 100
Type: Lecture/Tutorial	Total Contact Hours:60

PREREQUISITES:

The student should have undergone the course(s):

- 11AU205 - ENGINEERING MECHANICS
- 11ME504 - DESIGN OF MACHINE ELEMENTS

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Understand the performance requirements in the selection of commercially available transmission drives.

CO2.Explain the applications of the various systems, materials used to make transmission elements and methods used for Spur gear and helical gear drive.

CO3. Design the transmission elements such as bevel and worm gear drive.

CO4. Design the gear box, speed reducers, speed diagrams and stepped pulley.

CO5. Understand and identify the quantify failure modes for Transmission Elements.

COURSE CONTENT:

UNIT I TRANSMISSION SYSTEMS FOR FLEXIBLE ELEMENTS 12

Selection of v-belts and pulleys-selection of Flat belt and pulleys-Selection of transmission chains and sprockets. timer pulley and belt

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEAR 12

Terminology-Speed ratios and number of teeth-Face analysis-Tooth stresses dynamic effects-Fatigue strength-Factor of safety-Gear materials-Module and face width-Power rating calculations based on strength and wear considerations-Parallel axis Helical Gears-Pressure angle in the normal and transverse plane-Equivalent number of teeth-force and stresses.

UNIT III BEVEL, WORM AND CROSS HELICAL GEARS 12

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits-terminology. Thermal capacity. Materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology

UNIT IV DESIGN OF GEAR BOXES 12

Geometric progression-Standard step ratio- kinematics layout - Ray diagram, design of sliding mesh gear box

UNIT V DESIGN OF CLUTCHES AND BRAKES 12

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

TEXT BOOKS:

1. Juvinall R. C., 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 Publishing Company Ltd.1994

REFERENCES:

1. Maitra G.M., Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGraw-Hill,1985
2. Shigley J.E and Mischke C.R., "Mechanical Engineering Design", McGraw-Hill International Editions, 1989
3. Norton R.L, "Design of Machinery", McGraw-Hill Book co, 2004.
4. Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", . McGraw-Hill Book Co., 1999

WEB REFERENCES:

1. http://www.explainthatstuff.com/gears.html
2. http://www.nptel.ac.in/courses/112105125/pdf/mod13les1.pdf

Course Code:11ME602	Course Title: TOTAL QUALITY MANAGEMENT
Core/Elective: Core	Credits (L:T:P:C:M) – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME302 PRODUCTION TECHNOLOGY I
- 11ME403 PRODUCTION TECHNOLOGY II

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Describe total quality management concepts and principles
CO2. Make use of statistical tools for quality control
CO3. Apply concepts of TQM tools
CO4. Apply the Quality Systems ISO 9000, TS 16949 and ISO 14000 in industry

COURSE CONTENT:

UNIT I INTRODUCTION 9

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Historical Review, Principles of TQM, Leadership – Concepts, Role of Senior Management, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation

UNIT II 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, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure

UNITIII STATISTICAL PROCESS CONTROL (SPC) 9

The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools

UNIT IV TQM TOOLS **9**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, overview of FMEA – Stages of FMEA

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2004 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, TS 16949, ISO 14000 – Concept, Requirements and Benefits

TEXT BOOKS:

1. Dale H. Besterfiled, et al., "Total Quality Management", Pearson Education, Inc. 2003. (Indian reprint 2004).
2. Subbaraj ramasamy, " Total Quality Management" McGraw-Hill,2008.

REFERENCES:

1. James R.Evans & William M. Lidsay, "The Management and Control of Quality", (5th Edition), South-Western (Thomson Learning), 2002
2. Feigenbaum.A.V. "Total Quality Management", McGraw-Hill, 1991.
3. Oakland.J.S. "Total Quality Management", Butterworth Hcinemann Ltd., Oxford, 1989.
4. Narayana V. and Sreenivasan, N.S. "Quality Management – Concepts and Tasks", New Age International 1996.
5. Zeiri. "Total Quality Management for Engineers", Wood Head Publishers, 1991

WEB REFERENCES:

1. http://nptel.ac.in/faq/110101010/
2. http://nptel.ac.in/courses/110105039/10
3. https://en.wikipedia.org/wiki/Total_quality_management

Course Code:11ME603	Course Title: MICROPROCESSOR AND MICROCONTROLLER
Core/Elective: Core	Credits (L:T:P:C:M) – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

PREREQUISITES:

The student should have undergone the course(s):

- 11AU106 – BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1.Develop an in-depth understanding of the operation of the 8085 microprocessor.

CO2.Understanding of the operation of Timing Diagram with 8085 microprocessor with programming.

CO3.Design and interface the peripherals with microprocessor-based systems in both hardware and Software.

CO4.Develop the knowledge of the architecture of the 8051 microcontroller and to write Assembly language Programs.

CO5.Understand the Applications of 8085 Microprocessor and the 8051 Microcontroller

COURSE CONTENT:

UNIT I 8085 MICROPROCESSOR 10

Introduction-Architecture of 8085-Pin Configuration-Addressing Modes-Instruction set.

UNIT II TIMING DIAGRAM AND PROGRAMMING 8

Instruction cycle-machine cycle-T states and Timing diagram of 8085- Calculation of instruction Cycle timings- Assembly Language Programming using 8085 instructions.

UNIT III PERIPHERALS AND INTERFACING 12

keyboards- interfacing output display-interfacing memory-A/D and D/A Converters Interfacing.

UNIT IV 8051 MICROCONTROLLER 9

Introduction- Architecture of 8051- Pin configuration- Ports- External Memory- counters and Timers- Serial and Parallel Data I/O- Interrupts – Assembly language programming

UNIT V APPLICATIONS using Intel 8085 and 8051 6

Temperature Control - Stepper Motor Control- Traffic Light Controller. Measurement and speed control of DC motor.

TEXT BOOKS:

1. Krishna Kant, Microprocessors & Microcontrollers", Prentice Hall of India, 2007.
2. Ramesh Gaonkar, "Microprocessor Architecture, Programming and Applications with 8085", Wiley Eastern, 1998

REFERENCES:

1. M.A. Mazidi and J.C. Mazidi, "The 8051 Microcontroller and Embedded systems", PHI / Pearson Education, 2006.
2. P.K.Ghosh and P.R.Sridhar, "Introduction to Microprocessors for Engineers and Scientists", Prentice Hall of India, 2001
3. Kenneth J.Ayala, "The 8051 Microcontroller, Architecture, Programming and applications",Thomson Delmar Learning, Indian Edition, 2007.
4. L.A. Levental, Introduction to microprocessors Software and HardwareProgramming", Prentice Hall Inc, 1978.
5. Aditya, P.Mathur, "Introduction to Microprocessors Software", Tata McGraw Hill,1983

WEB REFERENCES:

1. http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors%20and%20Microcontrollers/New_index1.html
2. http://www.semico.com/
3. http://www.infineon.com/cms/en/product/channel.html?channel
4. =ff80808112ab681d0112ab6b2dfc0756
5. http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR/microcontrollers/micro/ui/Course_home1_1.htm

Course Code: 11ME607	Course Title: COMPUTER AIDED MANUFACTURING LABORATORY
Core/Elective: Core	**L : T : P : C : M** – 0 : 0 : 3 : 2: 100
Type: Practical	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11AU210 - COMPUTER AIDED DRAFTING AND MODELING LABORATORY
- 11AU310 - COMPUTER AIDED MACHINE DRAWING LABORATORY

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Develop the CNC part programmes for the given components in simulating the turning, milling and threading operations

CO2. Select the appropriate machining tools and conditions for machining

CO3. Generate the CNC codes for the given machining conditions

COURSE CONTENT

LIST OF EXPERIMENTS

1. Manual part programming (Using G and M Codes) in CNC lathe **15**
   a. Simple Turning, Facing, Chamfering,
   b. Taper Turning, Profile Turning, Grooving,
   c. Thread Cutting, End drilling, Linear Interpolation, Circular Interpolation
   d. Canned Cycles

2. Manual part programming (using G and M codes) in CNC milling **15**
   a. End / Face milling, Pocket milling,
   b. Linear Interpolation, Circular Interpolation Contour motions,
   c. Canned Cycles, Drilling,

3. Peck drilling, Boring, Mirror command **15**
   a. Component Modeling and CL data generation using CAD/CAM Software like Unigraphics, Pro/E, Edge CAM etc.,
   b. Modeling of turned components using Edge Cam
   c. Modeling of Milled components using Edge Cam
   d. NC code generation of turned and Milled components

4. Post processing for standard CNC control like FANUC, SINUMERIC etc.,

Course Code: 11ME608	Course Title: HEAT POWER LABORATORY
Core/Elective: Core	**L : T : P : C : M** – 0 : 0 : 3 : 2: 100
Type: Practical	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11CO103- ENGINEERING PHYSICS
- 11AU303- FLUID MECHANICS AND MACHINERY
- 11ME401- THERMAL ENGINEERING
- 11ME507- THERMAL ENGINEERING LAB

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Explain the mechanism of heat conduction and evaluating the thermal conductivity of insulating materials in thermal systems.

CO2. Evaluate the heat transfer coefficients and heat transfer rates in natural and forced convection systems.

CO3. Estimate the radiation properties in thermal systems.

CO4. Determining the coefficient of performance of refrigeration and air-conditioning systems.

CO5. Evaluate the performance of two stage reciprocating air compressor

COURSE CONTENT

LIST OF EXPERIMENTS

HEAT TRANSFER

1. Thermal conductivity measurement using guarded plate method.
2. Thermal conductivity measurement of pipe insulation using lagged pipe approach.
3. Determination of heat transfer coefficient under natural convection from a vertical
4. cylinder.
5. Determination of heat transfer coefficient under forced convection inside tube.
6. Heat transfer from pin-fin (Natural and Forced convection mode)
7. Determination of Stefan boltzman constant.
8. Determination of emissivity of grey surface.
9. Effectiveness of parallel/counter flow heat exchanger.

REFRIGERATION & AIR-CONDITIONING

10. Study of Refrigeration & Air-conditioning systems
11. Determination of COP of Refrigeration system.
12. Determination of COP of Air-conditioning system.
13. Performance test on two stage reciprocating air compressor
14. Demonstration on Fast Fourier Transform (FFT) analyzer

Course Code: 11ME609	Course Title: MICROPROCESSOR AND MICROCONTROLLER LABORATORY
Core/Elective: Core	**L : T : P : C : M** – 0 : 0 : 3 : 2: 100
Type: Practical	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11AU106 – BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Solve basic binary math operations using the microprocessor.

CO2. Apply the programming techniques in assembly language programs for solving simple problems using instruction sets of microprocessor and microcontroller.

CO3. Illustrate programming concepts of microprocessor and microcontroller.

CO4. Demonstrate programming proficiency using the various addressing modes and data transfer instructions of the target microprocessor and microcontroller.

CO5. Design electrical/Electronic circuitry to the Microprocessor I/O ports to interface the processor to external devices

COURSE CONTENT

LIST OF EXPERIMENTS

1.Assembly language programs using 8085 and 8051

i) Arithmetic operation

ii) Ascending/descending order and

iii) Finding largest/ smallest number in an array.

2.Assembly Language Programs for code conversion using 8085 and 8051

i) BCD to binary

ii) Binary to BC

3.8051 Assembly Language Program for timer operations.

4.Interfacing of 8 bit A/D and D/A converters using 8085

5.Interfacing of 8 bit A/D and D/A converters using 8051

6.Stepper motor interface using 8085

7.Stepper motor interface using 8085

8.Stepper motor interface using 8051

9.Display unit interface with 8085

10.Display unit interface with 8051

Regulation 2011

Curriculum for B.E. Mechanical Engineering

SEMESTER-VII

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
11AU701	Engineering Economics & Cost Analysis	3	0	0	3	100
11ME701	Design of Jigs, Fixture & Press Tools	3	0	0	3	100
11ME702	Mechatronics	3	0	0	3	100
XXX	Elective – III	3	0	0	3	100
XXX	Elective – IV	3	0	0	3	100
PRACTICAL						
11ME707	Mechatronics Laboratory	0	0	3	2	100
11ME708	Simulation and Analysis Laboratory	0	0	3	2	100
11ME710	Project Work Phase – I	0	0	3	0	100
TOTAL		**18**	**0**	**12**	**19**	**900**

SEMESTER-VIII

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
11CS801	Principles of Management	3	0	0	3	100
XXX	Elective – V	3	0	0	3	100
XXX	Elective – VI	3	0	0	3	100
PRACTICAL						
11ME810	Project Work Phase –II	0	0	12	8	300
TOTAL		**12**	**0**	**12**	**17**	**700**

SEMESTER – VII

Course Code:11AU701	**Course Title: ENGINEERING ECONOMICS AND COST ANALYSIS**
Core/Elective: Core	**Credits (L:T:P:C:M) – 3 : 0 : 0 : 3 : 100**
Type: Lecture	**Total Contact Hours:45**

PREREQUISITES:
The student should have undergone the course(s): NIL

COURSE OUTCOMES
At the end of the course the student will be able to:

CO1. Calculate the Breakeven point in terms of units of output and sales for a given business situation.
CO2. Categorize different costs.
CO3. Decide upon whether to make or buy a product
CO4. Develop a better replacement policy for given equipment.
CO5. Determine the economic life of an asset

COURSE CONTENT:

UNIT – I INTRODUCTION TO ECONOMICS 8

Introduction to economics– Law of supply and demand – Concept of engineering economics – Engineering efficiency – Economic efficiency – Scope of engineering economics – Element of costs – Marginal cost – Marginal revenue – Sunk cost – Opportunity cost – Break-even analysis – P/V ratio – Elementary economic analysis – Material selection for product design selection for a product – Process planning.

UNIT – II VALUE ENGINEERING 10

Make or buy decision – Value engineering – Function – Aims – Value engineering 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 payment 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) – Rate of return method .

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.

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.

TEXT BOOKS:

4. Panneer Selvam R, "Engineering Economics", Second Edition, PHI learning private limited, 2013.
5. Park C S, "Contemporary Engineering Economics", Fifth Edition, Prentice Hall of India, 2011.

REFERENCES:

1. Newman, D.G., Lavelle, J.P., "Engineering Economics and analysis", Oxford University Press, 2004.
2. Sullivan W.G, Elin M Wicks and C Patrick Koelling, "Engineering Economy", Pearson education, 2009.
3. John A. White, Kenneth E. Case, David B. Pratt, "Principles of Engineering Economic Analysis", Wiley Global Education, 2012.

WEB REFERENCES:

1. http://www.edushareonline.in/Management/eco%20new.pdf
2. http://www.swlearning.com/economics/hirschey/managerial_econ/chap01.pdf
3. http://global.oup.com/us/companion.websites/9780199339273/student

[

Course Code:11ME701	Course Title: DESIGN OF JIGS, FIXTURES AND PRESS TOOLS
Core/Elective: Core	Credits (L:T:P:C:M) – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME302 PRODUCTION TECHNOLOGY I
- 11ME403 PRODUCTION TECHNOLOGY II
- 11ME504 - DESIGN OF MACHINE ELEMENTS

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Apply the basic principles in designing general jigs and fixtures, as well as moulds and dies

CO2. Assess the performance of a given tool design for meeting the specific design criteria

CO3. Evaluate the effects of a given tool design on work quality

CO4. Analyze a product design and develop a plan for manufacture

CO5. Identify the characteristics of their designs that have safety, societal, or Environmental impact.

COURSE CONTENT:

UNIT I LOCATING AND CLAMPING PRINCIPLES 9

objectives of Tool design – Function and advantages of Jigs and fixtures - Materials used in Jigs and Fixtures – principles of location – Locating methods and devices - Principles of clamping- Mechanical actuation-pneumatic and hydraulic actuation-Analysis of clamping force-Tolerance and error analysis.

UNIT II JIGS 9

Different types of jigs-plate latch, channel, box, post, angle plate, angular post, turnover, pot jigs-Indexing jigs ,Drill bushes, Automatic drill jigs-Rack and pinion operated, Air operated Jigs components. Design and development of Jigs for given components.

UNIT II FIXTURES 9

General principles of boring, lathe, milling and broaching fixtures- Grinding, planing and shaping fixtures, assembly, Inspection and welding fixtures- Modular fixtures-Quick change fixtures. Design and development of fixtures for given component.

UNIT IV PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES **9**

Press working terminology-Operations-Types of Presses and press accessories-Computation of capacities and tonnage requirements. Elements of progressive and compound dies: Die block, die shoe. Bolster plate-punch plate - punch holder-guide pins and bushes – strippers – knockouts-stops – pilots-Selection of standard die sets, Design and development of progressive and compound dies for Blanking and piercing operations ,strip lay out-strip lay out calculations

UNIT V BENDING ,FORMING AND DRAWING DIES **9**

Bending ,forming and drawing operations –Blank development for above operations- Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect - pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing and combination dies – Blank development for axi-symmetric, rectangular and elliptic parts – Single and double action dies. Design considerations in forging, extrusion, casting and plastic dies

TEXT BOOKS:

1. Edward G Hoffman, “Jigs & Fixture Design”, Thomson – Delmar Learning, 2004
2. Donaldson.C,“ToolDesign”,TataMcGraw-Hill,1986

REFERENCES:

1. Kempster, “Jigs & Fixtures Design”, The English Language Book Society, 1978
2. Joshi, P.H., “Jigs & Fixtures”, Second Edition, Tata McGraw-Hill Publishing Company Limited, 2004
3. Hiram E Grant, “Jigs and Fixture”, Tata McGraw-Hill, 2003
4. Fundamentals of Tool Design”, CEEE Edition, ASTME, 1983
5. Faculty of Mechanical Engineering, PSG College of Technology, "Design Data Book", M/s.DPV Printers, Coimbatore, 2000.

WEB REFERENCES:

1. http://nptel.ac.in/courses/112105126/35
2. https://en.wikipedia.org/wiki/Fixture_(tool)
3. http://engineeringhut.blogspot.in/2010/11/design-principles-common-to-jig-and.html
4. http://www.brighthubengineering.com/machine-design/47195-the-3-2-1-principle-of-jig-fixture-design/

Course Code:11ME702	Course Title: MECHATRONICS
Core/Elective: Core	Credits (L:T:P:C:M) – 3 : 0 : 0 : 3 : 100
Type: Lecture	Total Contact Hours:45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME506 - ELECTRICAL DRIVES AND CONTROL
- 11ME918 - DESIGN OF HYDRAULICS AND PNEUMATICS SYSTEM
- 11ME603 - MICRO PROCESSOR AND MICROCONTROLLER

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Recognize the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical and Electronic Systems

CO2. Define the fundamentals of Microprocessor based system design and the operations of logic controllers

CO3. Demonstrate the skill of programming for PLC

COURSE CONTENT:

UNIT I INTRODUCTION 6

Introduction to Mechatronics- Systems- Concepts of Mechatronics approach-Need for Mechatronics- Emerging area of Mechatronics- Classification of Mechatronics.

UNIT II SENSORS AND TRANSDUCERS 9

Introduction – Performance Terminology- Potentiometers-LVDT-Capacitance sensors-Strain gauges- Eddy current sensor-Hall effect sensor- Temperature sensors- Light sensors-Selection of sensors- Signal processing

UNIT III MOTION CONTROL AND MEASUREMENT SYSTEM 10

Control system- Open Loop and Feedback Control-Measurement System-Drives and actuators- Control devices- Servo systems- Motion converters.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS 10

Introduction- Basic structure- Input and output processing- Programming Mnemonics-Timers, Counters and internal relays- Data handling-Selection of PLC

UNIT V DESIGN OF MECHATRONICS SYSTEMS 10

Design process-stages of design process-Traditional and Mechatronics design concepts- Case studies of Mechatronics systems- Pick and place Robot- Autonomous mobile robot-Wireless surviellance balloon- Engine Management system- Automatic car park barrier.

TEXT BOOKS:

1. Bolton,W, “Mechatronics” , Pearson education, second edition, fifth Indian Reprint, 2003
2. Smaili.A and Mrad.F , "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008

REFERENCES:

1. Godfrey C. Onwubolu, "Mechatronics Principles and Applications", Elsevier, 2006
2. Devadas Shetty and Richard A.Kolk, “Mechatronics systems design”, PWS Publishing company 2007.
3. Nitaigour Premchand Mahalik, “Mechatronics Principles, Concepts and Applicatlions” Tata McGraw-Hill Publishing company Limited, 2003.
4. Michael B.Histand and Davis G.Alciatore,” Introduction to Mechatronics and Measurement systems”. McGraw Hill International edition,1999.
5. Bradley D.A, Dawson.D, Buru N.C and Loader A.J, “Mechatronics” Chapman an Hall, 1993.
6. Lawrence J.Kamm, “Understanding Electro-Mechanical Engineering – An Introduction to Mechatronics”, Prentice Hall of India Pvt Ltd, 2000.
7. Dan Necsulescu, “Mechatronics”, Pearson education,2002.
8. Newton C.Braga, “Mechatronics Sourcebook”, Thomson Delmar Learning, Eswar Press,2003.

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Mechatronics
2. http://www.cedrat.com/en/publications/categories/device systems/systems/mechatronics.html
3. http://nptel.ac.in/courses/112103174/

Course Code: 11ME707	Course Title: MECHATRONICS LABORATORY
Core/Elective: Core	**L : T : P : C : M** – 0 : 0 : 3 : 2: 100
Type: Practical	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME603 – MICROPROCESSOR AND MICROCONTROLLER
- 11ME609 – MICROPROCESSOR AND MICROCONTROLLER LAB

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Simulate the basic and electro- Hydraulics and Pneumatics circuits
CO2. Interfacing the PLC systems with Pneumatics systems.
CO3. Data logging for temperature, pressure, level and flow systems

COURSE CONTENT

LIST OF EXPERIMENTS

1. Simulation of basic hydraulic, pneumatic and electrical circuits.
2. Study of Electro pneumatic circuits.
3. Simulation of electro- pneumatic circuits using PLC.
4. Modeling and Simulation of basic hydraulic, pneumatic and electrical circuits using 'FLUID SIM' Software.
5. Data logging and control of various types of transducers-Pressure, level, Temperature.
6. Open and closed loop control of AC and DC drives (servo motors)
7. Study of PLC and its applications.

Course Code: 11ME708	Course Title: SIMULATION AND ANALYSIS LABORATORY
Core/Elective: Core	**L : T : P : C : M** – 0 : 0 : 3 : 2: 100
Type: Practical	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11AU210 - COMPUTER AIDED DRAFTING AND MODELING LABORATORY
- 11AU310 - COMPUTER AIDED MACHINE DRAWING LABORATORY

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Demonstrate stress analysis of various mechanical components using analysis software.
CO2. Perform modal analysis for 2D component.
CO3. Analyze thermal stresses in a component.
CO4. Simulate mechanical & thermal systems using mat lab and software

COURSE CONTENT

LIST OF EXPERIMENTS

SIMULATION LAB

1. Simulation of Air conditioning system with condenser temperature and evaporator temperatures as input to get COP using C /MAT Lab.
2. Simulation of free vibration characteristics of spring, mass and damper system
3. Simulation of Hydraulic / Pneumatic cylinder using C / MAT Lab.
4. Simulation of cam and follower mechanism using C / MAT Lab.

ANALYSIS (SIMPLE TREATMENT ONLY)

1. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
2. Stress analysis of a plate with a circular hole.
3. Stress analysis of rectangular L bracket
4. Stress analysis of an Axi-symmetric component
5. Mode frequency analysis of a 2 D component
6. Mode frequency analysis of beams(Cantilever, Simply supported, Fixed ends)
7. Harmonic analysis of a 2D component
8. Thermal stress analysis of a 2D component
9. Conductive heat transfer analysis of a 2D component
10. Convective heat transfer analysis of a 2D component

SEMESTER – VIII

Course Code:11CS801	**Course Title: PRINCIPLES OF MANAGEMENT**
Core/Elective: Core	**Credits (L:T:P:C:M) – 3 : 0 : 0 : 3 : 100**
Type: Lecture	**Total Contact Hours:45**

PREREQUISITES:

The student should have undergone the course(s):

- 11CO201 - COMMUNICATION SKILLS II

COURSE OUTCOMES

At the end of the course the student will be able to:

CO1. Define the concept of management and discuss why organizations are needed, why managers are necessary, and why management is a challenge.

CO2. Explain why planning is needed in organizations and why long-term objectives are necessary for successful planning and Identify the essential characteristics of decision making.

CO3. Differentiate between the various types of organizational structures and patterns. Explain the importance of delegation in organizations and describe the relationship between authority, responsibility and accountability.

CO4. Analyze the leadership function, recognizing leadership as the relationship between a supervisor and subordinates in an organizational environment.

CO5. Recognize the link between planning and controlling, and the various means by which managers measure and compare performance to objectives. Explain why financial controls are used by organizations as the predominant means of control.

COURSE CONTENT:

UNIT – I INTRODUCTION TO ECONOMICS 9

Historical developments –approaches to management– Management and Administration – Development of Management Thought – Contribution of Taylor and Fayol – Functions of Management – Types of Business Organization.

UNIT – II MANAGERS & ENVIRONMENT 9

Social responsibility–Planning – Objectives – Setting Objectives – Process of Managing through Objectives – Strategies- Policies & Planning Premises- Forecasting Techniques – Decision-making

UNIT – III FUNCTIONAL AREA OF ORGANISATION 9

Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process – Techniques

UNIT – IV MOTIVATION & DIRECTIONS 9

Objectives– Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication-Types

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

TEXT BOOKS:

1. Harold Koontz & Heinz Weihrich "Essentials of Management"- Tata McGraw- Hill- 7th Edition-2007.
2. Tripathy PC and Reddy PN, "Principles of Management"- Tata McGraw-Hill 2008

REFERENCES:

1. Maheswari S N," Principles of management accounting" Sultan chand & sons, 2012
2. Vilas Bagad," Principles of Management", technical publishers,2009

WEB REFERENCES:

1. http://aom.org/Placement/AOM-Placement-Presentations.aspx
2. http://www.managementstudyguide.com/management_principles.htm
3. http://study.com/academy/course/principles-of-management-course.html
4. http://catalog.flatworldknowledge.com/bookhub/reader/5?cid=41991&e=carpenter-ch01
5. http://www.nios.ac.in/media/documents/VocInsServices/m1-4f.pdf
6. http://discovery.bitspilani.ac.in/dlpd/courses/coursecontent/courseMaterial/mgtszc211/principles_of_management_notes.pdf
7. http://faculty.mercer.edu/jackson_r/Ownership/chap02.pdf

ELECTIVES

Course Code: 11ME901	Course Title: DESIGN FOR MANUFACTURE AND ASSEMBLY
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES: The student should have undergone the course(s):

- 11CO109 ENGINEERING GRAPHICS
- 11CO108 ENGINEERING PRACTICES LABORATORY
- 11CO203 MATERIALS SCIENCE
- 11ME302 PRODUCTION TECHNOLOGY II
- 11ME403 PRODUCTION TECHNOLOGY II
- 11ME503 DESIGN OF MACHINE ELEMENTS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Analyse important considerations to be made in designing a product.

CO2. Apply design principles considering in component design which involves machining and casting.

CO3. Assess environmental impact of a product considering environmental regulations and standards.

COURSE CONTENT:

UNIT I INTRODUCTION 9

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances - Geometric tolerances - Assembly limits -Datum features - Tolerance stacks, GD & T

UNIT II FACTORS INFLUENCING FORM DESIGN 9

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice - Influence of materials on form design - form design of welded members, forgings and castings.

UNIT III COMPONENT DESIGN - MACHINING CONSIDERATION 9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability - Design for accessibility - Design for assembly.

UNIT IV COMPONENT DESIGN – CASTING CONSIDERATION 9

Redesign of castings based on parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

UNIT V DESIGN FOR THE ENVIRONMENT AND DFMA TOOLS 9

Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application Design for energy efficiency – Design to regulations and standards. AT&T life cycle assessment methods

TEXT BOOK:

1. Geoffrey Boothroyd, Peter Dewhurst, Winston A. Knight Product Design for Manufacture and Assembly, Third Edition, CRC Press, 2010
2. Boothroyd, G, Design for Assembly Automation and Product Design.York, Marcel Dekker. 2005Hall, 1997

REFERENCES:

1. Kevien Otto and Kristin Wood, Product Design. Pearson Publication, 2004
2. Bralla, Design for Manufacture handbook, McGraw hill, 1998
3. Harry Peck , "Designing for Manufacture", Pitman Publishing, 1973
4. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995
5. Fixel, J. Design for the Environment McGraw hill., 1996
6. Graedel T. Allen By. B, Design for the Environment Angle Wood Cliff, Prentice Hall. Reason Pub., 1996
7. Poke -Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 1992

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/DFMA
2. http://me.gatech.edu/files/capstone/L071ME4182DFA
3. https://www.dfma.com/

Course Code: 11ME902	Course Title: PRODUCT DESIGN AND DEVELOPMENT
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

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PREREQUISITES:

The student should have undergone the course(s):

- 11ME302 PRODUCTION TECHNOLOGY-I
- 11ME403 PRODUCTION TECHNOLOGY-II
- 11ME503 DESIGN OF MACHINE ELEMENTS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Understand the product development concepts from the voice of the customer.

CO2. Establish the product specifications through the internal and external search

CO3. Understand the concept selection and product architecture in system level design issues.

CO4. Understand the need for industrial design in assessing its quality, DFM on cost considerations and other decision issues.

CO5. Understand the principles of prototyping and cost analysis in the quantitative factors.

COURSE CONTENT:

UNIT I INTRODUCTION 9

Product Development process – Product development organizations, Gather raw data – Interpret raw data- organize the needs into a hierarchy – Relative importance of the needs, voice of cutomer.

UNIT II PRODUCT SPECIFICATIONS 9

Establishing the product specifications,– Target specifications – Refining specification Concept generation-Clarify the problem – Search internally – Search externally – Explore systematically.

UNIT III CONCEPT SELECTION 9

Concept selection- Screening – scoring, Product architecture – Implication of architecture – Establishing the architecture – Related system level design issues.

UNIT IV 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.

UNIT V PROTO TYPING AND COST ANALYSIS 9

Principles of prototyping – Planning for prototypes, economics of product development projects, Elements of economic analysis – Base – Case financial model – Sensitivity analysis – Influence of the quantitative factors.

TEXT BOOK:

1. Karal, T.UlrichstevenD.Eppinger, Product Design and Development, McGraw Hill,International Editions, 2003.
2. Kevien Otto and Kristin Wood, Product Design. Pearson Publication, 2004

REFERENCES:

1. S.Rosenthal, Effective Product Design and Development, Irwin, 1992.
2. Charles Gevirtz Developing New products with TQM, McGraw Hill International Editions, 1994.
3. Dieter.G.E., "Engineering Design," McGraw Hill Company International Edition
4. Ullman D.G., "The Mechanical Design Process", McGraw Hill Company International Edition

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Product_design
2. http://www.rqriley.com/pro-dev.htm
3. http://www.pddnet.com/

Course Code: 11ME903	Course Title: FAILURE ANALYSIS AND DESIGN
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11AU404 STRENGTH OF MATERIALS
- 11ME503 DESIGN OF MACHINE ELEMENTS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Understand the concept of reliability in design process.

CO2. Calculate the stresses and apply the fracture mechanics concept in design

CO3. Design the components like bolts, welds and adhesive joints against fatigue loading

CO4. Analyze the wear, corrosion and creep failures

COURSE CONTENT:

UNIT I RELIABILITY 9

Reliability concept and hazard function, life prediction, condition monitoring, application of Poisson, exponential and Weibull distribution for reliability - bath tub curve - parallel and series system - mean time between failures and life testing. Introduction to FMEA.

UNIT II INTRODUCTION TO SOLID MECHANICS AND FRACTURE FAILURE 9

STRESSES IN A BODY: Two dimensional and three dimensional state of stress, Mohr's circle in two and three dimensions, hydrostatic stress, Von-mises, maximum shear stress (Tresca), octahedral shear stress, torsional stresses for large plastic strain.

FRACTURE: Types of fracture, Griffith crack theory, stress analysis of cracks, metallographic aspects of fracture. Brittle, ductile fractures, notch effects, fracture curve, R curve, fracture under combined stresses, probabilistic aspects of fracture mechanics, toughness of materials.

UNIT III INTRODUCTION TO SOLID MECHANICS AND FRACTURE FAILURE 9

FATIGUE: Statistical nature of fatigue, S-N curve, LCF, HCF, strain life equations, structural feature of fatigue, fatigue crack propagation, effect of stress concentration, size, surface properties, metallurgical variables on fatigue, case studies, designing against fatigue, detail design, improvements after failure and service, fatigue of bolts, welded and adhesive joints.

FATIGUE TESTS: Purpose, specimen, fatigue test procedures, evaluation of fatigue test results, crack growth measurement.

UNIT IV WEAR AND CORROSION FAILURE 9

WEAR FAILURES: Type of wear, role of friction in wear, lubricated and non-lubricated wear, analysing wear failures, wear tests SOAP, ferrography.

CORROSION FAILURES: Factors influencing corrosion failures, analysis of corrosion failures, overview of various types of corrosion, stress corrosion cracking - sources, characteristics of stress corrosion cracking, procedure of analysing stress corrosion cracking, various types of hydrogen damage failures, corrective and preventive action.

UNIT V CREEP FAILURE 9

ELEVATED TEMPERATURE FAILURES: Creep, stress rupture, elevated temperature fatigue, metallurgical instabilities, environmental induced failure, elevated temperature effects on certain gas turbine components and petroleum refinery components, tests for analysis of failure at elevated temperatures.

TEXT BOOK:

1. Richard W Hertzberg, "Deformation and Fracture Mechanism of Engineering Materials", John Wiley & Sons,Inc.,1995.

REFERENCES:

1. 1JaapSchijve, "Fatigue of Structures and Materials", Kluwer Academic Publishers, 2001.
2. ASM Metals Handbook, "Failure Analysis and Prevention", ASM Metals Park, USA, Vol. 10, 10th Edition, 1995.
3. George E Dieter, "Mechanical Metallurgy", McGraw Hill Book Company, 1988.
4. John M. Barsom, Stanley Theodore Rolfe "Fracture and Fatigue Control in Structures: Applications of Fracture Mechanics " ASTM International, 1999
5. Prasantasahoo" Engineering Tribology" PHI Learning pvt. Ltd, 2005

WEB REFERENCES:

1. http://nptel.ac.in/courses/112101005/28
2. http://www.journals.elsevier.com/engineering-failure-analysis/
3. http://www.tms.org/Students/Winners/Davidson/Davidson.html
4. http://www.journals.elsevier.com/case-studies-in-engineering-failure-analysis/recent-articles/
5. http://www.tech.plymouth.ac.uk/sme/interactive_resources/tutorials/FailureAnalysis/index.html

Course Code: 11ME904	Course Title: OPTIMIZATION TECHNIQUES
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME404 STRENGTH OF MATERIALS
- 11ME501 OPERATIONS RESEARCH
- 11ME503 DESIGN OF MACHINE ELEMENTS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Apply the principles of optimization in solving the constraint and unconstraint problems.

CO2. Apply the dynamic programming concepts in solving the multi objective and multi stage problems.

CO3. Solve the optimization problems using unconventional optimization techniques.

CO4. Solve the design of Machine elements problems using optimization techniques.

COURSE CONTENT:

UNIT I UNCONSTRAINED OPTIMIZATION TECHNIQUES 9

Introduction to optimum design - General principles of optimization – Problem formulation & their classifications - Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods**. (Condense)**

UNIT II CONSTRAINED OPTIMIZATION TECHNIQUES 9

Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions, Lagrange multipliers - Geometric programming, Introduction to Design of experiments and analysis of variance.

UNIT III DYNAMIC PROGRAMMING 9

Multi stage optimization – dynamic programming; stochastic programming; Multi objective Optimization.

UNIT IV UNCONVENTIONAL OPTIMIZATION TECHNIQUES 9

Genetic algorithms, Simulated Annealing and Ant Colony techniques; Neural network & Fuzzy logic principles in optimization

UNIT V DESIGN APPLICATIONS 9

Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, weight – Design of shafts and torsionally loaded members – Design of springs.

TEXT BOOK:

1. Kalyanamoy Deb, "Optimization for Engineering design algorithms and Examples", Prentice Hall of India Pvt. Ltd. 2006
2. Saravanan.R, "Manufacturing optimization through intelligent techniques",Taylor and Francis Publications,CRC Press,2006.
3. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", McGraw Hill Professional, 1996
4. K. Krishnaiah, P. Shahabudeen "Applied Design Of Experiments And Taguchi Methods" PHI Learning Pvt. Ltd, 2012
5. R. Pannerselvam "Design and Analysis of Experiments **"**PHI Learning Pvt, 2012

REFERENCES:

1. SingaresuS.Rao, "Engineering Optimization – Theory & Practice", New Age International (P) Limited, New Delhi, 2000.
2. Johnson Ray, C., "Optimum design of mechanical elements", Wiley, John & Sons, 1990.
3. Goldberg, D.E., "Genetic algorithms in search, optimization and machine", Barnen, Addison-Wesley, New York, 1989

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Mathematical_optimization
2. https://mech.iitm.ac.in/nspch52.pdf

Course Code: 11ME905	Course Title: MICRO-ELECTRO MECHANICAL SYSTEMS (MEMS)
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11CO203 MATERIAL SCIENCE
- 11AU404 STRENGTH OF MATERIALS
- 11ME402 DYNAMICS OF MACHINERY

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Understand micro fabrication techniques

CO2. Know the major classes components and applications of MEMS Devices/ Systems

CO3. Recognize the principles of design and Manufacture of MEMS device or micro system

COURSE CONTENT:

UNIT I INTRODUCTION 9

Overview-Microsystems and microelectronics - Working principle of Microsystems – Micro actuation techniques-microsensors-types-microactuators-types-micropump-micromotorsmicro-valves-microgrippers-scaling laws-scaling in geometry-scaling in rigid body dynamics- scaling in electrostatic forces- scaling in electricity- scaling in fluid mechanics scaling in heat transfer

UNIT II MATERIALS AND FABRICATION PROCESS 9

Substrates and wafer-single crystal silicon wafer formation-ideal substrates-mechanical properties-Silicon compounds – Silicon Dioxide, Silicon Carbide, Silicon Nitride and polycrystalline silicon – Silicon piezoresistors - Gallium arsenide, Quartz-piezoelectric crystals-polymers for MEMS -conductive polymers – Photolithography -- Ion implantation - Diffusion – Oxidation –CVD – Sputtering- Deposition by epitaxy - etching process.

UNIT III MICROMECHANICS 9

Introduction-static bending of thin plates-circular plates with edge fixed - rectangular plate with all edges fixed and square plate with all edges fixed – Mechanical vibration-resonant vibration- micro accelerometers-design theory and damping coefficients- thermo mechanics thermal stresses-fracture mechanics-stress intensity factors, fracture toughness and interfacial fracture mechanics.

UNIT IV MICRO SYSTEM MANUFACTURING 9

Clean room technology-Bulk Micro manufacturing- surface micro machining –LIGA-SLIGA Microsystems packaging-materials-die level-device level-system level-packaging techniques die preparation-surface bonding-wire bonding-sealing.

UNIT V MICRO SYSTEM DESIGN 9

Design considerations-process design-mask layout design- mechanical design-applications of micro system in -automotive industry-bio medical –aero space-telecommunications.

TEXT BOOK:

1. Tai-Ran Hsu,MEMS& Microsystems Design and Manufacture,Tata McGraw-Hill,2006.
2. Rai-Choudhury P. MEMS and MOEMS Technology and Applications, PHI Learning Private Limited, 2009.

REFERENCES:

1. Mohamed Gad-el-Hak, The MEMS Hand book, CRC press, 2002.
2. Julian W.Gardner,VijayK.Varadan,OsamaO.AwadelKarim,Microsensors MEMS and Smart Devices, John Wiby& sons Ltd.,2001.
3. S.Fatikow, U.Rembold, Microsystem Technology and Microrobotics,Springer-Verlag Berlin Heidelberg ,1997.
4. Francis E.H Tay and W.O Choong, Microfludics and BioMEMS Applications, Springer, 2002.

WEB REFERENCES:

1. https://www.mems-exchange.org/MEMS/what-is.html
2. https://en.wikipedia.org/wiki/Microelectromechanical_systems
3. http://www.memsindustrygroup.org/?page=WhatIsMEMS

Course Code: 11ME906	Course Title: ADVANCED STRENGTH OF MATERIALS
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11AU404 STRENGTH OF MATERIALS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Determine the important mechanical properties of materials
CO2. Demonstrate the different theories of failure for brittle and ductile materials
CO3. Apply the different methods of unsymmetrical bending analysis
CO4. Demonstrate the significance and concept of shear centre
CO5. Apply the principles of structural dynamics

COURSE CONTENT:

UNIT I ELASTICITY 9

Stress – Strain relation and General equation of elasticity in cartesian, polar and spherical coordinates- differential equation of equilibrium – compatibility equations – boundary conditions, representations of three dimensional stress tensor – generalized Hooke's law – St.Vennant's principle – Plane strain, plane stress – introduction to Airy's stress function.

UNIT II UNSYMMETRICAL BENDING 9

Stresses and deflection in beams subjected to unsymmetrical loading – Kern of a section. Curved flexural members - circumferential and radial stresses – deflection and radial curved beam with re-strained ends – closed ring subjected to concentrated load and uniform load.

UNIT III THICK CYLINDERS AND ROTATING DISKS 9

Thick walled cylinder subjected to internal and external pressures – Shrink fit joints – Stresses due to rotation – Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness – allowable speed. – Rotating shafts and cylinders.

UNIT IV TORSION OF NON CIRCULAR SECTIONS 9

Torsion of rectangular cross section – St.Vennant Theory – elastic membrane analogy – Prandtl's stress function – Torsional stresses in hollow thin walled tubes.

UNIT V STRESSES IN FLAT PLATES 9

Stresses in circular and rectangular plates due to various types of loading and end conditions – Buckling of plates. Theory of contact stresses – methods of computing contact stresses – deflection of bodies in point and line contact – applications.

TEXT BOOK:

1. Arthur P.Boresi and Richard J.Schmidt, "Advanced Mechanics of Materials",John, Willey &Sons, Inc., 2003.
2. Srinath.L.S., Advanced Mechanics of Solids, Tata McGraw Hill PublishingCompany Limited,2003.

REFERENCES:

1. Arthur P.Boresi and Omar M.Siseborttom, "Advanced Mechanics of Materials", John, Willey International Education, 1985.
2. Robert,D.Cook, Wareen.C.Yound, "Advanced Mechanics of Materials", Macmillon Publishers Company, 1985.
3. KrishnaRaju.N.,Gururaja.D.R, Advanced Mechanics of Solids and Structures,Narosa Publishing House, 1997.
4. Jindal. U.C., "Advanced Topics of Strength of materials", Galgotia Publications, First edition, 1997
5. Kazimi, S.M.A., Solid Mechanics, Tata McGraw Hill, 1976.
6. Punmia, B.C., Strength of Materials Part II, Standard Publishers and Distributors, 1991.
7. Shames I.H., Engineering Mechanics, Prentice Hall of India,1996

WEB REFERENCES:

1. www.accessengineeringlibrary.com
2. www. nptel.ac.in
3. www.engineeringtoolbox.com

Course Code: 11ME907	Course Title: VIBRATION AND NOISE ENGINEERING
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME402 - DYNAMICS OF MACHINERY

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Calculate the natural frequency of the system.

CO2. Apply approximate methods like Rayleigh's energy method, Rayleigh-Ritz method, Dunkerleys method to solve the continuous system.

CO3. Apply the vibration control techniques

CO4. Analyze the industrial noise and apply the control technique

COURSE CONTENT:

UNIT I BASICS OF VIBRATION 9

Introduction, classification of vibration: free and forced vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT II VIBRATION OF CONTINUOUS SYSTEMS 9

Vibration of continuous systems: exact methods, boundary value problem, eigen value problem, axial vibration of rods, transverse vibration of beams, response of system by modal analysis, General elastic waves, approximate methods to analyse system, different methods like Rayleigh's energy method, Rayleigh-Ritz method, Dunkerleys method.

UNIT III VIBRATION ANALYSIS AND CONTROL TECHNIQUES 9

Vibration isolation, tuned absorbers, untuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, Experimental Methods in Vibration Analysis.-Vibration Measuring Instruments - Selection of Sensors- Accelerometer Mountings. –Vibration Exciters-Mechanical, Hydraulic, Electromagnetic And Electrodynamics –Frequency Measuring Instruments.

UNIT IV BASICS OF NOISE 9

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise level, legislation, measurement and analysis of noise, measurement environment and equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT V INDUSTRIAL NOISE AND CONTROL 9

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise. Introduction to -Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles.

TEXT BOOK:

1. Ambekar A.G. "Mechanical Vibrations and Noise Engineering" Prentice Hall of India Pvt. Ltd, 2008
2. SingiresuS.Rao - "Mechanical Vibrations" - Pearson Education, ISBM –81-297-0179-0 -2004

REFERENCES:

1. Rao V. Dukkipati&Srinivas J. "Mechanical Vibrations" - Prentice Hall of India Pvt. Ltd, 2008
2. KewalPujara "Vibrations and Noise for Engineers, DhanpatRai& Sons, 1992.
3. W. T. Thomson, Theory of Vibrations with applications –CBS Publishers
4. Rao, J.S., & Gupta, K. – "Ind. Course on Theory and Practice Mechanical Vibration", New Age International (P) Ltd., 1984.
5. Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000.

WEB REFERENCES:

1. http://nptel.ac.in/courses/112107088/
2. http://nptel.ac.in/courses/112104040/
3. http://www.journals.elsevier.com/journal-of-sound-and-vibration/most-downloaded-articles/
4. http://www.kineticsnoise.com/industrial/
5. http://www.nerc.ac.uk/about/policy/safety/procedures/procedure-vibration/
6. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/290397/sp4-079-tr-1-e-e.pdf
7. http://www.bretech.com/reference/Practical%20Methods%20for%20Vibration%20Control%20of%20Industrial%20Equipment.pdf

Course Code: 11ME908	Course Title: MECHANICS OF COMPOSITE MATERIALS
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME404 STRENGTH OF MATERIALS
- 11CO203 MATERIALS SCIENCE
- 11AU403 METALLURGICAL ENGINEERING

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Understand the specifics of mechanical behavior of layered composites compared to isotropic Materials

CO2. Apply constitutive equations of composite materials and understand mechanical behavior at micro,macro and meso level.

CO3. Determine stresses and strains in composites.

CO4. Apply failure criteria and critically evaluate the results.

CO5. Understand mechanical behavior of composites due to variation in temperature and moisture

COURSE CONTENT:

UNIT I INTRODUCTION 9

Definition – Classification of Composite materials based on structure – based on matrix-Matrices – Polymer, Graphite, Ceramic and Metal Matrices - Advantages of composites – application of composites – functional requirements of reinforcement and matrix. Reinforcement types – Fibres – Glass, Carbon, Ceramic and Aramid fibers - continuous, particulate and whisker reinforcements – Properties - Applications – Comparison of fiber strengths – Matrix materials – Properties.

UNIT II MECHANICS OF COMPOSITES 9

Rule of mixture -volume and mass fractions – density - void content, Evaluation of four elastic moduli based on strength of materials approach and Semi - Empirical model - Longitudinal Young's modulus-transverse Young's modulus – major Poisson's ratio-In-plane shear modulus, Ultimate strengths of a unidirectional lamina. Characteristics of Fiber-reinforced lamina – laminates – lamination theory, Interlaminar stresses.

UNIT III MANUFACTURING OF COMPOSITES 9

Polymer fiber matrix composites: Preparation of Moulding compounds and pre-pregs – hand layup method – Autoclave method – Filament winding method –Types – Processing – Thermal matrix composites – Hand lay-up and spray technique, filament winding, Pultrution, resin transfer moulding, autoclave moulding – Thermoplastic matrix composites – Compression moulding –Reaction injection moulding.

UNIT IV PERFORMANCE 9

Static mechanical properties-fatigue- S-N curves – Fatigue behaviors of CMCs – Fatigue of particle and whisker reinforced composites and impact properties-environmental effects-long term properties, fracture behavior and damage tolerance

UNIT V DESIGN 9

Introduction to structures - selection of material, manufacturing and laminate configuration – design of joints - bonded joints - bolted joints - bonded and bolted-design of beam and torsional member. Application of FEM for design of composites.

TEXT BOOK:

1. Krishnan K.Chawla, "composite Materials Science and Engineering", Springer.
2. Mallick, P.K., Fiber –"Reinforced Composites: Materials, Manufacturing and Design",Maneel Dekker Inc, 1993.

REFERENCES:

1. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of FiberComposites",John Wiley and Sons, New York, 1990.
2. Gibson, R.F., Principles of Composite Material Mechanics, McGraw-Hill, 1994,Second Edition

WEB REFERENCES:

1. www.accessengineeringlibrary.com
2. www. nptel.ac.in
3. www.engineeringtoolbox.com

Course Code: 11ME909	Course Title: UNCONVENTIONAL MACHINING PROCESSES
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME302 PRODUCTION TECHNOLOGY-I
- 11ME403 PRODUCTION TECHNOLOGY-II

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Describe various unconventional machining processes.

CO2. Explain the machining of complex shapes in the high strength materials using advanced machining techniques.

CO3. Compare various energy based processes and determine suitable process for an application.

COURSE CONTENT:

UNIT I INTRODUCTION 9

Need for unconventional machining process-Classification of unconventional machining process, Principles of Unconventional machining process-Advantages and Disadvantages of Unconventional Machining process-Applications of Unconventional Machining Process.

UNIT II MECHANICAL ENERGY BASEDPROCESSES 9

Abrasive Jet Machining – Water Jet Machining – Ultrasonic Machining. (AJM, WJM and USM). Working Principles – equipment used – Process parameters – MRR-Variation in techniques used –Applications

UNIT III ELECTRICAL ENERGY BASEDPROCESSES 9

Electric Discharge Machining (EDM) - workingPrinciples-equipments-ProcessParameters-MRR-electrode/Tool–PowerCircuits-ToolWear–Dielectric–Flushing–Wire cut EDM – Applications.

UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES` 9

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants-maskant-techniques of applying maskants-Process Parameters –MRR-Applications. Principles of ECM-equipments- MRR-Electrical circuit -Process Parameters- ECG and ECH Applications

UNIT V THERMAL ENERGY BASEDPROCESSES 9

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

TEXT BOOK:

1. Vijay.K.Jain"AdvancedMachiningProcesses"AlliedPublishersPvt.Ltd., NewDelhi(2002).
2. Benedict G.F., "Non Traditional Manufacturing Processes", 1st ed., Marcel Dekker Publication.

REFERENCES:

1. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, NewDelhi(1980).
2. McGeough, "Advanced Methods of Machining" Chapman and Hall, London(1998).
3. 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)
4. Hassan, E.L.-HOFY, "Advanced Machining Process - Nontraditional &Hybrid Machining Process", 1sted., Tata McGraw Hill,2005.
5. Ghosh and Malik, "Manufacturing Science", 1st ed., EWP Private Ltd., 2008

WEB REFERENCES:

1. www.mnre.gov.in
2. https://en.wikipedia.org/wiki/Solar_power
3. https://en.wikipedia.org/wiki/Wind_power
4. http://nptel.ac.in/downloads/108108078/

Course Code: 11ME910	Course Title: INDUSTRIAL ROBOTICS AND AUTOMATION
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME301 - KINEMATICS OF MACHINERY
- 11ME302- PRODUCTION TECHNOLOGY-I
- 11ME403 - PRODUCTION TECHNOLOGY-II
- 11ME505 - COMPUTER INTEGRATED MANUFACTURING
- 11ME506 - ELECTRICAL DRIVES & CONTROL

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Understand the working principle and parts of a robot.
CO2. Explain various drive system used in a robot.
CO3. Understand the functions of sensors used in robot.
CO4. Understand the kinematics and programming methods of a robot.
CO5. Evaluate safety and economic analysis of robot.

COURSE CONTENT:

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 – Different Applications

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of Drives End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations

UNIT III SENSORS AND MACHINE VISION 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. Camera, Frame

Grabber, Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processing and Analysis – Data Reduction: Edge detection, Feature Extraction and Object Recognition - Algorithms. Applications – Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) – Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands, End effecter commands, and Simple programs

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 9

Industrial applications like pick & place, welding, painting, inspection, etc. ; RGV, AGV; Implementation of Robots in Industries, Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method

TEXT BOOK:

1. M.P.Groover, "Industrial Robotics – Technology, Programming and Applications", McGraw-Hill, 2001

REFERENCES:

1. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 1987
2. Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 1992
3. Janakiraman.P.A., "Robotics and Image Processing", Tata McGraw-Hill, 1995

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Industrial_robot
2. http://www.roboticautomationsystems.com/
3. http://www.kuka-robotics.com/india/en/

Course Code: 11ME911	RAPID PROTOTYPING AND TOOLING Course Title:
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME302 PRODUCTION TECHNOLOGY-I
- 11ME403 PRODUCTION TECHNOLOGY-II
- 11ME505 COMPUTER INTEGRATED MANUFACTURING

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Understand micro fabrication techniques.

CO2. Know the major classes components and applications of MEMS Devices/ Systems.

CO3. Know the major classes components and applications of MEMS Devices/ Systems.

COURSE CONTENT:

UNIT I INTRODUCTION 9

Introduction: Need for time compression in product development, Product development – conceptual design – development – detail design – prototype – tooling

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 9

Classification of RP systems, Fusion Deposition Modeling – Principle – process parameters – Applications. Laminated Object Manufacturing – Principle – process parameters – Applications, Stereo lithography systems – Principle – process parameters –process details –, Applications.-Selective laser sintering (SLS) -Direct Metal Laser Sintering (DMLS) system – Direct Metal Deposition- Principle –process parameters –Applications-Solid ground curing .

UNIT III DATA PREPARATION FOR RAPID PROTOTYPING TECHNOLOGIES 9

Basic concept- Digitization techniques – Model Reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data Requirements – geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation

UNIT IV THREE DIMENSIONAL PRINTING 9

Three dimensional Printing (3DP):Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition

Manufacturing (SDM): Introduction, basic process, shape decomposition, mold, SDM and applications. Selective Laser Melting, Electron Beam Melting – Rapid manufacturing

UNIT V RAPID TOOLING 9

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication processes, Applications. Case studies - automotive, aerospace and electronic industries

TEXT BOOK:

1. Rapid prototyping: Principles and applications, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2010
2. Pham,D.T. &Dimov.S.S., "Rapid manufacturing", Springer-Verlag, 2001. Terry wohlers, "Wohlers Report 2000", Wohlers Associates, 2000

REFERENCES:

1. Rapid prototyping, Andreas Gebhardt, Hanser Gardener Publications, 2003
2. Rapid Prototyping and Engineering applications: A tool box for prototype development, LiouW.Liou, Frank W.Liou, CRC Press, 2007.
3. Paul F Jacobs, "Rapid Prototyping and manufacturing – Fundamentals ofStreolithography", Society of Manufacturing Engineering Dearborn, 1992.
4. Rapid Prototyping and Tooling, Industrial Design Centre, IIT, 1983 Rapid Prototyping: Theory and practice, Ali K. Kamrani, EmadAbouel Nasr, Springer, 2006.
5. Rapid Tooling: Technologies and Industrial Applications, Peter D.Hilton, Hilton/Jacobs, Paul F.Jacobs, CRC press, 2000.
6. User Guide to Rapid Prototyping,Todd Grimm ,Todd Grimm and Associates Inc,2004.

WEB REFERENCES:

1. http://www.protosystech.com/press-march1998.htm
2. http://www.cmeri.res.in/rnd/rpnrt.html
3. http://orca.cf.ac.uk/8337/1/Rapid_prototyping_and_rapid_tooling.pdf

Course Code: 11ME912	Course Title: PLANT LAYOUT AND MATERIAL HANDLING
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME302 PRODUCTION TECHNOLOGY-I
- 11ME403 PRODUCTION TECHNOLOGY-II

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Identify load & categorize material handling based on application through general Analysis procedure

CO2. Apply the design procedures of material handling equipment& components

CO3.Model load lifting & load movement attachments with proper design consideration &plan for appropriate material storage.

CO4. Demonstrate the automation of material handling

COURSE CONTENT:

UNIT I PLANT LOCATION AND PHYSICAL FACILITIES 9

Factors to be considered - Influence of location on plant layout, selection of plant site, consideration in facilities planning and layout - Equipment required for plant operation, Capacity, Serviceability and flexibility and analysis in selection of equipment's, space and man power requirements

UNIT II PLANT LAYOUT 9

Need for layout, types of layout, factors influencing product, process, fixed and combination layout, tool and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models - machine data. Layout planning procedure - visualization of layout, revision and improving existing layout, balancing of fabrication and assembly line

UNIT III INDUSTRIAL BUILDINGS AND UTILITIES 9

Centralized electrical, pneumatic, water line systems. Types of buildings, lighting, heating, air-conditioning and ventilation utilities - planning and maintenance, waste handling, statutory requirements, packing and storage of materials: Importance of packaging, layout for packaging - packaging machinery - wrapping and packing of materials, cushion materials **.**

UNIT IV MATERIAL HANDLING 9

Importance and Scopes - Principles of material handling - engineering and economic factors - planning, relationship to plant layout - types and selection of material handling systems, factors influencing their choice - concept of containerization and palletisation.

UNIT V ANALYSIS OF MATERIAL HANDLING 9

Factors involved - motion analysis, flow analysis, graphical analysis, safety analysis, equipment cost analysis, palletisation analysis, analysis of operation, material handling surveys - Designing of material handling systems - V System equation - Planning chart, Unit load design -principle - efficiency of containers, pallet sizes

TEXT BOOK:

1. Anderson, J.D., Modern Compressible flow, McGraw Hill, 3rd Edition, 2003.
2. H. Cohen, G.E.C. Rogers and Saravanamutto, Gas Turbine Theory, Longman Group Ltd., 1980.
3. S.M. Yahya, fundamentals of Compressible Flow, New Age International (P) Limited, New Delhi, 1996.

REFERENCES:

1. G.K Agrawal, "Plant Layout and Material Handling", Jain Publishing, 2012.
2. Khanna, O. P., "Industrial Engineering and Management", Dhanpatrai and Sons, 2003.

WEB REFERENCES:

1. https://smartech.gatech.edu/bitstream/handle
2. http://www.diva-portal.org/smash/get/diva2:205109/fulltext01

Course Code: 11ME913	Course Title: MAINTENANCE ENGINEERING
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

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PREREQUISITES:

The student should have undergone the course(s):

- 11CO109 ENGINEERING GRAPHICS
- 11CO108 ENGINEERING PRACTICES LABORATORY
- 11CO203 MATERIALS SCIENCE
- 11ME302 PRODUCTION TECHNOLOGY I
- 11ME403 PRODUCTION TECHNOLOGY II
- 11ME503 DESIGN OF MACHINE ELEMENTS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Plan the maintenance needs of fundamental machinery and equipments in the mechanical engineering field

CO2. Formulate and practice maintenance policies, strategies and schedules

CO3. Understand repair methods and keep machine records including computer based records.

COURSE CONTENT:

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- Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT IV SAFETY AND OTHER ASPECTS OF MAINTENANCE 9

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

UNIT V 9

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

TEXT BOOK:

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", I Documentation, Gower Press, 1979.
2. Mishra R.C. and Pathak K. "Maintenance Engineering and Management" Prentice Hall of India Pvt. Ltd. 2007. 3 Garg M.R., "Industrial Maintenance", S. Chand & Co., 1986.
3. Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1988.
4. Armstrong, "Condition Monitoring", BSIRSA, 1988. 6 Davies, "Handbook of Condition Monitoring", Chapman &Hall, 1996

WEB REFERENCES:

1. www.mnre.gov.in
2. https://en.wikipedia.org/wiki/Solar_power
3. https://en.wikipedia.org/wiki/Wind_power
4. http://nptel.ac.in/downloads/108108078/

Course Code: 11ME914	Course Title: INDUSTRIAL SAFETY ENGINEERING
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES: The student should have undergone the course(s):

- 11CO204 ENVIRONMENTAL SCIENCES
- 11ME302 PRODUCTION TECHNOLOGY-I
- 11ME403 PRODUCTION TECHNOLOGY-II

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. To apply the concept of probability and probability distributions in their field. To acquire the concept of estimation theory
CO2. To do testing of hypothesis which will be useful in solving engineering problems.
CO3. To design and analyze the statistical experiments.

COURSE CONTENT:

UNIT I BASICS OF SAFETY ENGINEERING & ACTS 9

Evolution of modern safety concept – safety audit – Concept of an accident investigation and reporting – safety performance monitoring. Acts – factories act – 1948 – Statutory authorities – inspecting staff – Tamilnadu Factories Rules 1950 under Safety and health – environment act – 1986 – Air act 1981, water act 1974 – other acts. Safety in industries – General safety concepts, machine guarding, hazards in metal removing process, welding process, cold and hot working process.

UNIT II OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE (Basic concepts, related hazards and exposure limits) 9

Physical Hazards – Noise, heat, recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases. Biological and Ergonomical Hazards-Basic concepts. Occupational Health Concept and spectrum of health – functional units and activities of occupational health services, pre employment and post-employment medical examinations –Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, Preliminary Hazard Analysis (PHA), human error analysis, hazard operability studies (HAZOP), safety warning systems.

UNIT III FIRE ENGINEERING AND EXPLOSIVE CONTROL 9

Concepts and systems, biomass production, energy plantation, short rotation species, forestry system, biomass resource agro forestry wastes, municipal solid wastes and agro processing industrial residues - Thermo chemical conversion: direct combustion, gasification, pyrolysis and liquefaction - biochemical conversion: anaerobic digestion, alcohol production from

biomass - chemical conversion process: hydrolysis and hydrogenation. Biogas - generation - types of biogas Plants- applications.

UNIT IV ERGONOMICS 9

Introduction to ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, Anatomy, Posture and Body Mechanics: anatomy of the spine and pelvis related to posture, posture stability and posture adaptation, back pain, Anthropometry, principles of applied anthropometry in ergonomics. Applications of human factors engineering, man as a sensor, information processor, controller – Man vs Machine – concepts of bio mechanics.

UNIT V SAFETY EDUCATION AND TRAINING 9

Importance of training – identification of training needs – training methods – programmes, seminars, conferences, competitions – method of promoting safe practice – motivation – communication – role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training, CPR and ERT.

TEXT BOOK:

1. William Handlin, "Industrial Hand Book", McGraw-Hill, 2000
2. Krishnan N.V., "Safety Management in Industry", Jaico Publishing House, Bombay, 1997.
3. Hand book of "Occupational Safety and Health", National Safety Council, Chicago, 1982

REFERENCES:

1. The factories Act 1948, Madras Book Agency, Chennai, 2000 Water (Prevention and control of pollution) act 1974, Commercial Law publishers (India) Pvt. Ltd., New Delhi.
2. Air (Prevention and control of pollution) act 1981, Commercial Law Publishers (India) Pvt. Ltd., New Delhi
3. Guidelines for Hazard Evaluation Procedures, Centre for Chemical Process Safety, AICHE 1992

WEB REFERENCES:

1. http://www.spplimited.co.in/industrial-safety-certificate-course-training-in-chennai/
2. http://kiot.ac.in/courses/pg/industrial-safety-engineering/

Course Code: 11ME915	Course Title: MICRO MANUFACTURING
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11CO203 MATERIAL SCIENCE
- 11ME302 PRODUCTION TECHNOLOGY-I
- 11ME403 PRODUCTION TECHNOLOGY-II.

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Learners have knowledge about the fundamentals of micro system design and micro fabrication Technologies.

CO2. Students have knowledge of Microstructure of materials, and its effect on macroscopic properties and phase transformations in crystalline solids, smart materials.

CO3. Students learn the various micro fabrication techniques and mechanical micro machining techniques.

CO4. Students learn fabrication of MEMS.

COURSE CONTENT:

UNIT I INTRODUCTION 9

Introduction to Micro System design, Material properties, micro fabrication Technologies. Structural behavior, sensing methods, micro scale transport – feedback systems

UNIT II MICROMECHANICS 9

Microstructure of materials, its connection to molecular structure and its consequences on macroscopic properties – Phase transformations in crystalline solids including marten site, ferroelectric, and diffusional phase transformations, twinning and domain patterns, smart materials

UNIT III MICRO-FABRICATION 9

Bulk processes – surface processes – sacrificial processes and Bonding processes – special machining: Laser beam micro machining-Electrical Discharge Machining – Ultrasonic Machining- Electro chemical machining. Electron beam machining. Clean room-yield model – Wafer IC manufacturing – PSM – IC industry-New Materials-Bonding and layer transfer devices.

UNIT IV MECHANICAL MICROMACHINING 9

Theory of micromachining-Chip formation-size effect in micromachining-micro-turning, micromilling, micro-drilling- Micromachining tool design-Precision Grinding-Partial ductile mode grinding-Ultra precision grinding- Binder less wheel – Free form optics

UNIT V MICRO ELECTRO MECHANICAL SYSTEM FABRICATION 9

Introduction – advance in Micro electronics – characteristics and Principles of MEMS – Design and application of MEMS: Automobile, defence, healthcare, Aerospace, industrial properties etc., - Materials for MEMS – MEMS fabrication- Bulk Micro Machining-LIGA – Microsystems packaging- Future of MEMS

TEXT BOOK:

1. Sami Franssila, "Introduction to Micro Fabrication", John Wiley and sons Ltd., UK, 2004, ISBN: 978-0- 470-85106-7.

REFERENCES:

1. Madore J, "fundamental of Micro fabrication", CRC Press, 2002.
2. Mark J. Jackson, "Micro fabrication and Nanomanufacturing", CRC Press, 2006.
3. Peter Van Zant, "Microchip fabrication", McGraw Hill, 2004.
4. Mohamed Gad-el-Hak, "The MEMS Handbook", CRC Press, 2006.

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Microfabrication
2. https://en.wikipedia.org/wiki/Micro_process_engineering
3. https://en.wikipedia.org/wiki/Microelectromechanical_systems

Course Code: 11ME916	Course Title: PROCESS PLANNING AND COST ESTIMATION
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME302 PRODUCTION TECHNOLOGY-I
- 11ME403 PRODUCTION TECHNOLOGY-II

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Explain about traditional process planning by choosing suitable processes, cutting parameters, Machine tools and jigs and fixtures

CO2. Explain about Computer aided process planning and different costing methods.

CO3. Calculate the direct and indirect cost components.

CO4. Determine elements of costing of various manufacturing methods

CO5. Carryout cost analysis & break-even analysis

COURSE CONTENT:

UNIT I PROCESS PLANNING, DESIGN AND CONCEPTS OF PROCESS PLAN 9

Introduction- Place of process planning-economics- Process & Production Planning, Process Planning & Concurrent Engineering-Types of production- standardization- Production design & selection. Selection of processes, tools, cutting parameters & machine tools- Jigs and Fixtures - Grouping of processes- Sequencing of operations- Selecting primary manufacturing processes for rough & refined needs- Process capability, Process Charts

UNIT II MANUAL AND COMPUTER AIDED PROCESS PLANNING ESTIMATING AND COSTING 9

Retrieval type/variant approach, group technology – generative approach, logics decision tress and tables, axiomatic approach – AI expert systems – feature recognition – applications Concepts, differences, different costing methods – classification of costs – cost grid-problems

UNIT III DIRECT AND INDIRECT COST COMPONENTS 9

Labour cost–direct, indirect–estimation–labour norms–time study rating – labour cost variances; material cost–direct, indirect–estimation–material issue valuation – material cost variances–problems. Overhead cost - Elements – factory, administrative, sales and distribution expenses–methods of absorbing overheads – Direct Labour, Direct Material, Machine Hour Rate methods – depreciation – methods –accounting for service department expenses – problems

UNIT IV COST CALCULATIONS 9

Machined components–welded components, forged components, powder metallurgy parts, calculation of sales cost, case studies, use of computers in cost estimation, cost of rejection. OPTIMUM MACHINING CONDITIONS: Taylor's equation, deriving the equation for optimum economic cutting velocity– selection of cutting speed for optimum cost, problems process capability analysis

UNIT V BREAK EVEN ANALYSIS & COST MANAGEMENT 9

Concept, make or buy decision, assumptions, merits and demerits of break even analysis. Applications. Linear, multi product break-even analysis Learning curves, product life cycle cost analysis -Tools and techniques–activity based costing - concepts, cost drivers; introduction to target costing - need and applications

TEXT BOOK:

1. Kannappan D, "Mechanical Estimating and Costing", Tata McGraw Hill, New Delhi, 2003.
2. Banga T R and Sharma S C, "Mechanical Estimating and Costing", Khanna Publishers, New Delhi, 2002. 3. Kesavan R "Process Planning and Cost Estimation", New Age International Pvt. Ltd., Chennai,

REFERENCES:

1. Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, 2012-13 Edition, Cost Estimators, on the Internet at http://www.bls.gov/ooh/business-and-financial/cost-estimators.htm (visited October 21, 2012).
2. Cost Estimating and Assessment Guide, Best Practices for Developing and Managing Capital Program Costs, GAO-09-3SP, United States Government Accountabity Office, March 2009
3. A Guide to the Project Management Body of Knowledge (PMBOK Guide) Third Edition, An American National Standard, ANSI/PMI 99-001-2004, Project Management Institute, Inc, 2004,

WEB REFERENCES:

1. http://www.nptel.ac.in/courses/112102103/17
2. http://www.nptel.ac.in/courses/Webcourse-contents/IIT Delhi/project%20and%20production %20 management/mod6/mod62/p1.htm

Course Code: 11ME918	Course Title: DESIGN OF HYDRAULICS AND PNEUMATICS SYSTEM
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11AU303 FLUID MECHANICS AND MACHINERY
- 11ME301 KINEMATICS OF MACHINERY

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Design hydraulic and pneumatic circuits.

CO2. Understand the advantages and applications of fluid power engineering and power transmission system.

CO3. Explain the applications of fluid power system in automation of machine tools and other equipments.

COURSE CONTENT:

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 9

Introduction to fluid power, Advantages of fluid power, Application fluid power system. Typesof fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols-.Basics of Hydraulics-Applications of Pascals Law- Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses in pipe, valves and fittings.

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, Rodless, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary actuators – Fluid motors, Gear, Vane and Piston Motors

UNIT III DESIGN OF HYDRAULIC CIRCUITS 9

Construction of Control Components : Director control valve – 3/2 way valve – 4/2 way valve –Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays ,ladder diagram. Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit-Introduction to Electro Hydraulic systems.

UNIT IV PNEUMATIC SYSTEMS AND COMPONENTS 9

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, Lubricator Unit –Air control valves, Quick exhaust valves, pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method

UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

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

TEXT BOOK:

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

REFERENCES:

1. Majumdar, S.R., "Oil Hydraulic Systems – Principles and Maintenance", Tata McGraw-Hill, New Delhi, 2006
2. Sullivan James A., "Fluid Power - Theory and Applications", Fourth edition, Prentice Hall International, New Jersey, 1998.

WEB REFERENCES:

1. http://hydraulicspneumatics.com/fluid-power-basics/system-design
2. http://engineering.nyu.edu/mechatronics/Control_
3. http://www.nptel.ac.in/courses/112106175/Module%201/Lecture%201.pdf
4. http://hydraulicspneumatics.com/fluid-power-basics/pneumatics

Course Code: 11ME917	Course Title: REFRIGERATION AND AIR-CONDITIONING
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11AU302 ENGINEERING THERMODYNAMICS
- 11ME401 THERMAL ENGINEERING
- 11ME502 HEAT AND MASS TRANSFER

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Introduce students to HVAC technology, engineering, research, systems, system designs energy impacts, and overall goals.

CO2. Develop understanding of the principles and practice of thermal comfort.

CO3. Develop understanding of the principles and practice and requirements of ventilation.

CO4. Develop generalized psychrometrics of moist air and apply to HVAC processes.

CO5. Review heat transfer and solar energy engineering and develop techniques for the analysis of building envelope loads

COURSE CONTENT:

UNIT I REFRIGERATIONCYCLES - ANALYSIS 9

Development of Vapor Compression Refrigeration Cycle from Reverse Carnot Cycle- conditions for high COP-deviations from ideal vapor compression cycle –Analysis

UNIT II MAIN SYSTEM COMPONENTS 9

Compressor- Types , performance , Characteristics of Reciprocating Compressors , Capacity Control , Types of Evaporators & Condensers and their functional aspects , Expansion Devices

UNIT III REFRIGERANTS 9

Classification of Refrigerants, Refrigerant properties, Oil Compatibility, Environmental Impact-Montreal / Kyoto protocols-Eco Friendly Refrigerants. Different Types of Refrigeration Tools , Evacuation and Charging Unit , Recovery and Recycling Unit , Vacuum Pumps

UNIT IV SUMMER AND WINTER AIR CONDITIONING 9

Classification of Refrigerants, Refrigerant properties, Oil Compatibility, Environmental Impact-Montreal / Kyoto protocols-Eco Friendly Refrigerants. Different Types of Refrigeration Tools , Evacuation and Charging Unit , Recovery and Recycling Unit , Vacuum Pumps

UNIT V AIR DISTRIBUTION 9

Flow through Ducts, Static & Dynamic Losses, Air outlets, Duct Design–Equal Friction Method, Duct Balancing, Indoor Air Quality, Thermal Insulation, Fans & Duct System Characteristics, Fan Arrangement Variable Air Volume systems, Air Handling Units and Fan Coil units.

TEXT BOOK:

1. Dossat R.J., Principles of refrigeration, John Wiley, S.I. Version (2001).
2. Stoecker W.F., Refrigeration and Air conditioning, McGraw-Hill Book Company, 1989.
3. Arora C.P., Refrigeration and Air Conditioning, Tata McGraw Hill Pub. Company , New Delhi – 2000

REFERENCES:

1. Trott A.R, Welch.T.C , Refrigeration and Air conditioning, Butterworth-Heinemann,2000
2. Jordan and Priester, Refrigeration and Air conditioning, Prentice Hall, 1985.
3. Goshnay W.B., Principles and Refrigeration, Cambridge, University Press, 1985.
4. ASHRAE, Fundamentals and equipment, 4 volumes- ASHRAE Inc. 2005.

WEB REFERENCES:

1. www.mnre.gov.in
2. https://en.wikipedia.org/wiki/Solar_power
3. https://en.wikipedia.org/wiki/Wind_power
4. http://nptel.ac.in/downloads/108108078/

Course Code: 11ME919	Course Title: POWER PLANT ENGINEERING
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11AU302 ENGINEERING THERMODYNAMICS
- 11ME401 THERMAL ENGINEERING
- 11ME502 HEAT AND MASS TRANSFER

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Describe the operation and maintenance of power plants.
CO2. Understand the design, operation and maintenance of hydro-electric power plant from mechanical engineering perspective.
CO3. Explain the role of mechanical engineers in the design, operation and maintenance of steam and nuclear power plants.
CO4. Analyze the power plant economics, renovation and modernization of old power plants.

COURSE CONTENT:

UNIT I HYDRO-ELECTRIC POWER PLANT, STEAM BOILERS AND MHD POWER PLANTS 9

Layout of hydel power plants – Types – stand alone – pumped storage.

Steam Boilers and cycles – High pressure and Super critical boilers – Ultra Supercritical boilers – Fluidized bed boilers – Types, Applications – Comparison - Selection.

UNIT II STEAM POWER PLANT 9

Layout of steam power plant – Fuel and Ash handling systems – Combustion equipment for burning coal – Mechanical Stokers – Pulverizers – Electrostatic precipitator – Draught – different types. Surface Condenser – types, Cooling Towers, Pollution Control.

UNIT III NUCLEAR POWER PLANT 9

Nuclear energy – Fission, Fusion reactions. Layout of nuclear power plant – Types of reactors, Pressurized water reactor, Boiling water reactor, Gas cooled reactor, Fast breeder reactor – Environmental aspects, Waste disposal and safety – Indian scenario – Development trends.

UNIT IV DIESEL AND GAS TURBINE POWER PLANTS 9

Layout of diesel power plant, types and components, selection of engine type, applications.

Gas turbine power plant – Layout, fuels, Gas turbine material, types of combustion chambers, reheating, regeneration, inter-cooling, Combined cycle power plant.

UNIT V POWER PLANT ECONOMICS, RENOVATION AND MODERNIZATION 9

Load duration curves, cost of electric energy, types and tariff - Economics of load sharing, comparison of economics of various power plants.

Renovation and modernization of aged power plants

TEXT BOOK:

1. P.K.Nag, 'Power Plant Engineering', Tata McGraw Hill Publishing Company, 2002.
2. C.P.Arora and Domkundwar, 'A Course in Power Plant Engineering', 4th edition, DhanpatRai& Co., New Delhi.
3. G.R.Nagpal, 'Power Plant Engineering', Khanna Publishers, 1980.
4. G.D.Rai, 'Introduction to Power Plant Technology', 3rd edition, Khanna Publishers, 1996

REFERENCES:

1. Frank D Graham, 'Power Plant Engineers Guide', D.B.Taraporevala Sons & Co., New Delhi,1993.
2. Frederick T. Morse, 'Power Plant Engineering', Prentice Hall of India, 1998.
3. Standard Handbook of Power Plant Engineering, Thomas C. Elliot, Kas Chen and Robert.

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Power_engineering
2. https://en.wikipedia.org/wiki/Power_station
3. https://en.wikipedia.org/wiki/Electrical_engineering

Course Code: 11ME920	Course Title: GAS DYNAMICS AND JET PROPULSION
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11AU302 ENGINEERING THERMODYNAMICS
- 11AU303 FLUID MECHANICS AND MACHINERY
- 11ME401 THERMAL ENGINEERING

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Understand the basic concepts and solve the problems on isentropic flow through variable duct area.

CO2. Explain and solve the problems on flow through constant duct with heat transfer andwith friction.

CO3. Acquired the knowledge of Variation of flow parameters across the normal and oblique shocks

CO4.Understand the concepts behind several types of jet engines: determine propulsion efficiency

CO5.Understand the concepts behind several types of rocket engines: determine propulsion efficiency

COURSE CONTENT:

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 9

Energy and momentum equations of compressible fluid flows - Stagnation states, Mach waves and Mach cone –Effect of Mach number on compressibility - Isentropic flow through variable area ducts - Nozzle and Diffusers –Use of Gas tables

UNIT II FLOW THROUGH DUCTS 9

Flow through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) - Variation of flow properties - Use of tables and charts - Generalised gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS 9

Governing equations - Variation of flow parameters across the normal and oblique shocks - Prandtl – Meyer relations - Use of table and charts - Applications.

UNIT IV JET PROPULSION 9

Theory of jet propulsion - Thrust equation - Thrust power and propulsive efficiency - Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines – Aircraft combustors

UNIT V SPACE PROPULSION 9

Types of rocket engines - Propellants - Ignition and combustion - Theory of rocket propulsion – Performance study - Staging - Terminal and characteristic velocity - Applications - Space flights.

TEXT BOOK:

1. Anderson, J.D., Modern Compressible flow, McGraw Hill, 3rd Edition, 2003.
2. H. Cohen, G.E.C. Rogers and Saravanamutto, Gas Turbine Theory, Longman Group Ltd., 1980.
3. S.M. Yahya, fundamentals of Compressible Flow, New Age International (P) Limited, New Delhi, 1996.

REFERENCES:

1. Robert D. Zucker, Oscar Biblarz, Fundamentals of Gas Dynamics, John Wiley and Sons, 2002.
2. V. Babu, Fundamentals of a Gas Dynamics, Ane's Books Pvt. Ltd., 2008.
3. V. Babu, Fundamentals of a Propulsion, Ane's Books Pvt. Ltd., 2008

WEB REFERENCES:

1. https://en.wikipedia.org/wiki/Compressible_flow,
2. https://en.wikipedia.org/wiki/Aerodynamics

Course Code: 11ME921	Course Title: COMPUTATIONAL FLUID DYNAMICS
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11AU303 FLUID MECHANICS AND MACHINERY
- 11ME401 THERMAL ENGINEERING
- 11ME502 HEAT AND MASS TRANSFER

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Explain the basic concept about the numerical flow problems and various flow analysis

CO2. Examine the steady and unsteady state conduction problems

CO3. Explain the importance of finite element and finite volume methods used for thermal analysis

COURSE CONTENT:

UNIT I INTRODUCTION AND BASIC CONCEPTS 9

Introduction of CFD - Types of fluids and basic equations of flow - conservation of mass, Newton's second law of motion - Governing equations of fluid flow - NavierStokes equations - boundary layer equations, expanded form of N-S equations - conservation of energy principle, classification of second order partial differential equations - initial and boundary conditions - governing equations in generalized coordinates.

UNIT II DIFFERENTIAL EQUATIONS AND DISCRETIZATION 9

Elementary finite difference equations - Basic aspects of Finite Difference Equations - Errors and stability analysis – discretization - application to heat conduction and convection - problems on 1-D and 2-D steady state and unsteady state conduction - problem on advection phenomenon - incorporation of advection scheme.

UNIT III INTRODUCTION TO FINITE ELEMENT METHOD 9

Basics of finite element method - stiffness matrix, isoperimetric elements - formulation of finite elements for flow and heat transfer problems - strong and weak formulations of a boundary value problem.

UNIT IV INTRODUCTION TO FINITE VOLUME METHOD 9

Finite Volume Techniques - Cell Centered Formulation - Lax - Vendoroff Time Stepping - Range - Kutta Time Stepping – Multi stage Time Stepping - Accuracy - Cell Vertex Formulation - Multistage Time Stepping - FDM -like Finite Volume Techniques – Central

and Up-wind Type Discretizations - Treatment of Derivatives. Flux – splitting schemes. Pressure correction solvers – SIMPLE, PESO - Vorticity transport formulation- Implicit/semi-implicit schemes.

UNIT V VISCOUS FLOW 9

Incompressible flow using MAC and simple algorithm - Solutions of viscous incompressible flows by stream function, vorticity formulation - Two dimensional incompressible viscous flow - estimation of discretization error - applications to curvilinear geometries - derivation of surface pressure & drag.

TEXT BOOK:

1. Patankar, "Numerical heat transfer & Fluid Flow", Mc.GrawHill.,2002.
2. Murlidhar.K, Sunderrajan.T, "Computational Fluid Mechanics and Heat Transfer", Narosa Publishing House. 2008.

REFERENCES:

1. Anderson D.A, Tannehil J.C, Pletcher R.H." Computational fluid mechanics & heat transfer Hemisphere publishing corporation,.Newyork, U.S.A20042.
2. Carnahan B, "Applied numerical method" John Wiley & Sons-2001.3. Date A. W., "Introduction to Computational Fluid Dynamics",
3. Cambridge Uni. Press, 2005.4. Ferziger J. H., Peric M., "Computational Methods for Fluid Dynamics", Springer, 2002.

WEB REFERENCES:

1. www.mnre.gov.in
2. https://en.wikipedia.org/wiki/Solar_power
3. https://en.wikipedia.org/wiki/Wind_power
4. http://nptel.ac.in/downloads/108108078/

Course Code: 11ME922	Course Title: ADVANCED IC ENGINES
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES: The student should have undergone the course(s):

- 11AU302 ENGINEERING THERMODYNAMICS
- 11ME401 THERMAL ENGINEERING

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Explain the various components and working of SI Engines.
CO2. Acquired the knowledge of pollutant formation, their effects and control measures in IC Engines
CO3. Identify the alternate fuel for IC engines
CO4. Understand the recent trends in IC engines

COURSE CONTENT:

UNIT I SPARK IGNITION ENGINES 9

Spark ignition engine mixture requirements – Fuel injection systems – Mono point, Multi point and Direct injection – Stages of combustion – Normal and abnormal combustion – Factors affecting knock – Combustion chambers – design and types

UNIT II COMPRESSION IGNITION ENGINES 9

Stages of combustion – Knocking – Factors affecting knock – Direct and indirect injection systems – Common Rail Direct Injection (CRDI) System – Combustion Chambers – design, types – Fuel spray behaviour – spray structure, spray penetration and evaporation – Air motion – Introduction to Turbo-charging and Super-charging.

UNIT III POLLUTANT FORMATION AND CONTROL 9

Pollutant Sources – Formation of CO, unburned hydro carbons, Nitrogen oxides, Smoke and Particulate Matter – Methods of controlling emissions – Catalytic converters and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.

UNIT IV ALTERNATIVE FUELS 9

Methanol, Ethanol, Hydrogen, Natural Gas, Biogas LPG and Bio-diesel – Properties, Suitability, Merits and demerits as fuels –Engine Modifications.

UNIT V RECENT TRENDS 9

Hydrogen, generation, storage, transport and utilization- Applications: power generation, transport – Fuel cells – technologies, types – applications - economics and the power generation. -Piezo Electric power generation.

TEXT BOOK:

1. V.Ganesan, Internal Combustion Engines', 4th edition, Tata-McGraw Hill Publication Company Ltd., 2012.
2. Gupta H.N., 'Internal Combustion Engines' PHF Learning Private Ltd., 2009. 3. R.P.Mathur and M.L.Sharma, 'Internal Combustion Engines', Dhanpat Rai & Sons, 2005.

REFERENCES:

1. John B.Heywood, 'Internal Combustion Engine Fundamentals', Mc-Graw Hill, 1988.
2. James E.Duffy and Howard Bud Smith, 'Auto Fuel Systems', The Good Heart Willox Company, Inn.1987.
3. John M. Lumley, ' Engines – An Introduction', Cambridge Universtiy Press, 1999.
4. Willard W.Pulkrabek, 'Engineering Fundamentals of IC Engines', PHI Learning Pvt. Ltd., 2008.
5. Rowland S.Benson and N.D. White house, 'Internal Combustion Engines', Vol I and II, Pargamon Press, 1983.

WEB REFERENCES:

1. https://www.google.co.in/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=SI+Engines+ppt
2. https://www.google.co.in/webhp?sourceid=chrome-intant&ion=1&espv=2&ie=UTF-8#q=CI+Engine+components+ppt
3. http://web.iitd.ac.in/~pmvs/courses/mel345/mel345-42.ppt

Course Code: 11ME923	Course Title: ALTERNATE ENERGY SOURCES
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME401 THERMAL ENGINEERING
- 11ME918 POWER PLANT ENGINEERING

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Learners have knowledge about various alternative energy sources.

CO2. Students know how to choose the appropriate renewable energy as an alternate for conventional power in any application.

CO3. Students are able to analyze the cost effectiveness of alternative energy sources.

COURSE CONTENT:

UNIT I SOLAR ENERGY 9

Solar Radiation – Measurements of solar radiation and sunshine – Solar Thermal Collectors – Flat plate and Concentrating Collectors – Solar Applications – Fundamentals of photo voltaic conversion - Solar Cells – PV systems – design and applications.

UNIT II WIND ENERGY 9

Wind Data and Energy Estimation – Wind Energy Conversion System – Wind Energy Generators and its performance – Wind Energy Storage – Applications – Hybrid Systems

UNIT III BIO-ENERGY 9

Tidal energy – Wave energy – Data, Technology options – Open and closed OTEC cycles – Small hydro, turbines – Geothermal energy sources, power plant and environmental issue

UNIT IV OTEC, TIDAL, GEOTHERMAL AND HYDEL ENERGY 9

Ocean energy resources - principles of ocean thermal energy conversion systems - ocean thermal power plants Tidal energy – Wave energy – Data, Technology options –Geothermal energy sources, power plant and environmental issues - Small hydro turbines –site selection – construction.

UNIT V NEW ENERGY SOURCES 9

Hydrogen – generation, storage, transport and utilization – Applications – power generation, transport – Fuel cells – technologies, types – economics and power generation.

TEXT BOOK:

1. G.D. Rai, "Non-Conventional Energy Sources", 4th Edition, Khanna Publishers,2012.
2. B.H.Khan,"Non conventionalEkergy Resources", Tata McGraw Hill, 1st Edition 2006.
3. Hart, A.B., and Womack, G. J., "Fuel Cells: Theory & Applications", Prentice Hall, 1997

REFERENCES:

1. Kreith, F and Kreider, J. F., "Principles of Solar Engineering", McGraw-Hill, 1978.
2. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K, 1996.
3. Sukhatme, S.P., "Solar Energy", Tata McGraw Hill, 1984

WEB REFERENCES:

1. www.mnre.gov.in
2. https://en.wikipedia.org/wiki/Solar_power
3. https://en.wikipedia.org/wiki/Wind_power
4. http://nptel.ac.in/downloads/108108078/

Course Code: 11ME924	Course Title: PROFESSIONAL ETHICS AND HUMAN VALUES
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- 11ME801 PRINCIPAL OF MANAGEMENT

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Characterize the fundamental principles and theories in Engineering Ethics`

CO2. Define the code of ethics that shape the ethical behavior of the engineer

CO3. Identify the various methods for assessment of Risk Benefit Policies

CO4. Illustrate the significance of societal responsibilities, Loyalty and Professional Rights

CO5. Exhibit professional ethics in society and devise ethical norms for societal and technological development

COURSE CONTENT:

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 – Cooperation – Commitment – Empathy – Self-Confidence – Character – Spirituality

UNIT II ENGINEERING ETHICS 9

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

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Concepts and systems, biomass production, energy plantation, short rotation species, forestry system, biomass resource agro forestry wastes, municipal solid wastes and agro processing industrial residues - Thermo chemical conversion: direct combustion, gasification, pyrolysis and liquefaction - biochemical conversion: anaerobic digestion, alcohol production from biomass - chemical conversion process: hydrolysis and hydrogenation. Biogas - generation - types of biogas Plants- applications

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

TEXT BOOK:

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, 2009.

REFERENCES:

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004 Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000
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

WEB REFERENCES:

1. https://www.scu.edu/ethics/,
2. http://www.geoethics.org/,
3. http://www.ucl.ac.uk/philosophy/LPSG/

Course Code: 11ME925	Course Title: ENTREPRENEURSHIP DEVELOPMENT
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

PREREQUISITES:

The student should have undergone the course(s):

- BASICS OF MANAGEMENT SKILLS

COURSE OUTCOMES:

At the end of the course the student will be able to:

CO1. Translate the imagination of the idea into useful products / service

CO2. Understand the business opportunities available, project financing and accounting preparation

CO3. Know the supports given by the Government agencies

COURSE CONTENT:

UNIT I INTRODUCTION 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth

UNIT II MOTIVATION 9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Entrepreneurial skills - Self Rating, Business Game, Thematic Appreciation Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives

UNIT III BUSINESS 9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING 9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT / CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TEXT BOOK:

1. S.S.Khanka "Entrepreneurial Development" S.Chand& Co. Ltd. Ram Nagar New Delhi, 4th edition, 2010.
2. Kurahko&Hodgetts, " Enterprenuership – Theory, process and practices", Thomson learning 8th edition,2009

REFERENCES:

1. Hisrich R D and Peters M P, "Entrepreneurship" Tata McGraw-Hill,6th Edition, 2007.
2. Mathew J Manimala," Enterprenuership theory at cross roads: paradigms and praxis" Dream tech 2nd edition, 2006.
3. EDII "Faculty and External Experts – A Hand Book for New Entrepreneurs" Publishers: Entrepreneurship Development" Institute of India, Ahmedabad, 1986

WEB REFERENCES:

1. www.mnre.gov.in
2. https://en.wikipedia.org/wiki/Solar_power
3. https://en.wikipedia.org/wiki/Wind_power
4. http://nptel.ac.in/downloads/108108078/