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 – 2016-17

STUDENTS HANDOUT

2016-17

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

2016 REGULATION

Curriculum for B.E Mechanical Engineering from Semester I & II

SEMESTER I

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
16ENT11	Communication Skills - I	2	0	2	3	100
16MAT11	Engineering Mathematics – I	3	2	0	4	100
16PHT11	Applied Physics	3	0	0	3	100
16CYT11	Applied Chemistry	3	0	0	3	100
16GET11	Introduction to Engineering	2	0	2	3	100
PRACTICAL						
16EGL11	Engineering Graphics	2	0	4	4	100
16PCL11	Physics and Chemistry Laboratory	0	0	4	2	100
16PSL11	Promotion of Students' Wellness	0	0	2	1	100
TOTAL		**15**	**2**	**14**	**23**	

SEMESTER II

Course Code	Course Title	Hours/Week			Credits	Marks
		L	T	P		
THEORY						
16ENT21	Communication Skills - II	2	0	2	3	100
16MAT21	Engineering Mathematics – II	3	2	0	4	100
16PHT21	Material Science	3	0	2	4	100
16GET21	Engineering Mechanics	4	0	0	4	100
16GET22	Engineering Metrology and Measurements	2	0	2	3	100
PRACTICAL						
16EPL21	Engineering Practices Laboratory	0	0	4	2	100
16CDL21	Computer Aided Drafting and Modeling Laboratory	1	0	4	3	100
16PSL21	Sports For Wellness	0	0	2	1	100
TOTAL		**15**	**2**	**16**	**24**	

SEMESTER I

Course Code: 16ENT11	**Course Title:** COMMUNICATION SKILLS I (Common to all B.E/B.Tech Programmes)
Core/Elective: Core	**L : T : P : C : M** - 2: 0 : 2 : 3 : 100
Type: Lecture & Practical	**Total Contact Hours:** 60

Prerequisites

- The student should have undergone English as his/her first or second language in school.

Course Outcomes

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

CO1 Listen to conversations, comprehend and answer questions equivalent to BEC preliminary listening exercises.

CO2 Answer questions about oneself and business-related themes on par with BEC preliminary speaking tests.

CO3 Read passages, infer and respond to the questions from BEC preliminary reading exercises.

CO4 Write appropriate business e mail, note, memo and letter on par with BEC preliminary writing tests.

CO5 Write simple and grammatically correct sentences.

Course Content

UNIT I LISTENING 12

Short conversations/monologues - numbers and spelling (dates, prices, percentages, figures, etc.) - and locate specific information - longer monologue and guided note taking - gap filling - Understanding the gist and extracting the main idea.

UNIT II SPEAKING 12

Answering questions about oneself, agreeing and disagreeing, expressing preferences - mini-presentation on a business theme (Oral) - Giving information and expressing opinions - discussion on business related topics – initiate a conversation and respond appropriately -business vocabulary - collocation.

UNIT III READING 12

Read short texts and understand the main message (signs, messages, postcards, notes, emails, labels) - Read and find specific information - Interpreting visual information - Comprehend detailed factual information - gather gist – cloze test

UNIT IV WRITING 12

Internal written communication - short messages to colleagues - note, message, memo, email- External communication - letter, email, notice - set phrases for letters and e-mails- Discourse markers, sign post words.

UNIT V GRAMMAR 12

Types of sentences – Declarative, interrogative, imperative and exclamatory – Usage of tenses (Simple and continuous forms) - Voices – Concord (Subject and verb) - Auxiliary - Infinitive and Gerunds – Article - Preposition - Comparative and superlative adjectives.

Text Book

1. Whitby Norman, "Business Benchmark Pre-intermediate to Intermediate Students" Book CUP Publications, 2nd Edition, 2014.
2. Wood Ian, Williams Anne, Cowper Anna, "Pass Cambridge BEC Preliminary", Cengage Learning, 2nd edition, 2015.

References

1. "BEC Preliminary Cambridge Handbook for Language Teacher", 2nd Edition, CUP 2000.
2. Hewings Martin "Advanced Grammar in use - Upper-intermediate Proficiency", CUP, Third Edition, 2013.

Web references

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

Course Code: 16MAT11	**Course Title:** ENGINEERING MATHEMATICS - I (Common to Automobile & Mechanical)
Core/Elective: Core	**L : T : P : C : M** – 3 : 2 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 75

Course Outcomes

At the end of the course 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 Solve the first order ordinary differential equations.

Course Content

UNIT I EIGENVALUES AND EIGENVECTORS 9+6

Eigenvalues 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+6

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

UNIT III FUNCTIONS OF SEVERAL VARIABLES 9+6

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+6

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+6

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. Srimanta Pal & Subodh C. Bhunia. "Engineering Mathematics", First edition, 2015, Oxford University Press.
2. Ervin Kreyszig. "Advanced Engineering Mathematics", 10th edition, 2015, Wiley India.

References

1. Peter V. O'Neil. "Advanced Engineering Mathematics", 7th Edition, 2012, Thomson Nelson, Toronto.
2. K.A. Stroud & Dexter J. Booth. "Advanced Engineering Mathematics", 5th Edition,2011, Palgrave Macmillan.
3. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.

Web Reference

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

Course Code: 16PHT11	**Course Title:** APPLIED PHYSICS
Core/Elective: Core	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:**45

Course Outcomes

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

CO1 Use the laws of mechanics to determine the equilibrium condition of particles and rigid bodies.
CO2 Compute the amount of heat transfer by conduction and radiation in materials
CO3 Apply the knowledge of Ultrasonics 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 BASICS OF MECHANICS 10

Review of fundamental laws of mechanics – scalars, vectors - 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-principle of transmissibility-equilibrium conditions-equilibrium of particles subjected to coplanar and non-coplanar force system - Triangle law, Parallelogram law and Lami's theorem.

UNIT II TRANSMISSION OF HEAT 8

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.

UNIT III ULTRASONICS AND NDT 10

Properties of Ultrasonic waves, Production of ultrasonics by magnetostriction and piezoelectric methods –Detection of ultrasonics: 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 9

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.

UNIT V LASER PHYSICS AND APPLICATIONS 8

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. R. C. Hibbeller, "Engineering Mechanics: Combined static and dynamics", Prentice Hall, 2009
2. Rajendran, "Engineering Physics", Tata McGraw Hill Publishing Company limited. New Delhi, 2009.

References

1. BrijLal and Dr. N. Subrahmanyam, "Heat and Thermodynamics", S. Chand & Company Ltd., New Delhi, 1997.
2. David Halliday, Robert Resnick, Jearl Walker, "Fundamentals of Physics Extended", Ninth Edition, Wiley India.
3. Jayakumar S, "Engineering Physics", R K Publishers, Coimbatore, 2007.

Web References

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

Course Code: 16CYT11	**Course Title:** APPLIED CHEMISTRY
Core/Elective: Core	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

Course Outcomes

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

CO1 Explain the chemistry of water and specify the water treatment processes.
CO2 Explain 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 Identify a polymeric material for a specific engineering application.
CO5 Describe the fuel characteristics based on composition and calorific value.
CO6 Identify appropriate lubricant for different engineering applications

Course Content

UNIT – I WATER TECHNOLOGY 9

Water Quality Parameters – Hardness – Types and expression - Determination of hardness by EDTA method. Boiler feed water. Boiler troubles – Sludge and Scale formation, Caustic embrittlement and Boiler corrosion. Methods of Boiler Water Treatment: Internal (Carbonate, Phosphate & Calgon) and External conditioning – Demineralization, Reverse Osmosis. Domestic Water Treatment.

UNIT – II ELECTROCHEMISTRY AND BATTERIES 9

Electrochemical Cells – Reversible and Irreversible cells, Galvanic Cells, Concentration Cells, Batteries: Characteristics, types - Dry Cell (Alkaline Battery), Lead-Acid, Lithium Ion (Li / TiS_2 and Li / S) – Construction, Working and Application. Batteries for automobiles. Fuel Cells - Construction and Working of Hydrogen - Oxygen fuel cell.

UNIT – III CORROSION AND CONTROL 9

Chemical Corrosion –Electrochemical corrosion – different types – galvanic corrosion, differential aeration corrosion, factors influencing corrosion. Corrosion control – sacrificial anode and impressed current cathodic methods – Corrosion inhibitors- Inorganic coating- Metallic coating – Galvanizing –Tinning- Organic coating. Electroplating of silver and electroless (Ni) - plating.

UNIT – IV POLYMER CHEMISTRY 9

Classification of Polymers – Thermoplastic and Thermosetting. Polymerisation: types – Addition, condensation and copolymerization, Properties of polymers: Tg, Tacticity, Molecular Weight (Weight average, Number average), polydispersity index. Compounding of plastics, Moulding techniques - blow and extrusion. Commodity plastics – Preparation, properties and uses of PE, and PET. Engineering plastics – Preparation, properties and uses of PC, Teflon, Foams - Preparation, properties and uses of PU and poly olefins.

UNIT – V FUELS AND LUBRICANTS 9

Calorific value (GCV and NCV) – metallurgical coke – manufacture by Otto-Hoffmann method – knocking – octane number and cetane number. Gaseous fuels- CNG and LPG - composition, properties and uses. Lubricants – types– properties of liquid lubricants and its significance. Greases – preparation, types and uses.

Text Books

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 16th Ed., Dhanpat Rai Pub, Co., New Delhi (2006).
2. "Engineering Chemistry", Second Edition, Wiley India Pvt. Ltd. New Delhi (2011).

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).

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: 16GET11	**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 students will be able to:

CO1 Explain the outcome based curriculum, structure of the courses, learning and assessment methodologies
CO2 Explain how the products that are used in day-to-day life of students and family work/function
CO3 Explain the different scientific principles used in this product
CO4 Explain the different engineering disciplines used in this product
CO5 Observe every product with an engineering perspective
CO6 Explain the lab facilities and learning resources available in the institution and how they can utilize them effectively

Course content

UNIT I ENGINEERING EDUCATION 12

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 SCIENCE AND ENGINEERING IN PRODUCTS 12

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, Pump, Windmill, Washing machine, Water purifier Motorbike, Microwave oven. Activity to explore working of products used in day to day life.

UNIT III MULTI-DISCIPLINARY ENGINEERING 12

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, transistor, SCR, DIAC and TRIAC. IC and PCB.
Computer science Engineering: Processor board, Computer peripherals, Operating system.

UNIT IV PRODUCT APPRECIATION 12

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

UNIT V LEARNING RESOURCE MANAGEMENT 12

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.

Note: CO6 will be assessed only in formative assessment mode.

Text Books

References

1. Louis A. Bloomfield, "How things work - Physics of everyday life", Wiley publication 2013
2. C. David, "How it works: Printing and Processes", Ladybird book's publication
3. S. Peter, "How it works: Rockets and Space craft", Ladybird book's publication
4. Granada, " How things work", Granada, 1978
5. J. L. Adams, "Flying Buttresses, Entropy, and O-Rings: The World of an Engineer".
6. J. E. Gordon, "The New Science of Strong Materials or Why You Don't Fall through the Floor".
7. 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

Course Code: 16EGL11	**Course Title:** ENGINEERING GRAPHICS
Core/Elective: General (G)	**L : T : P : C : M** - 2: 0 : 4 : 4: 100
Type: : Lecture & Practical	**Total Contact Hours:** 60

Course Outcomes

At the end of the course 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

Course Content

UNIT I CURVES USED IN ENGINEERING PRACTICES 12

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

UNIT II ORTHOGRAPHIC AND ISOMETRIC PROJECTION 12

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

UNIT III PROJECTION OF LINES AND PLANE SURFACES 12

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. Detailed factual information - gather gist – cloze test

UNIT IV PROJECTION OF SOLIDS AND ITS SECTION 12

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.

UNIT V DEVELOPMENT OF SURFACES AND PERSPECTIVE PROJECTIONS 12

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 McGraw Hill 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

Course Code: 16PCL11	**Course Title:** PHYSICS AND CHEMISTRY LABORATORY
Core/Elective: Core	**L : T : P : C : M** – 0 : 0 : 4 : 2 : 100
Type: Practical	**Total Contact Hours:**45

Course Outcomes

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

- Use standard laboratory equipment, modern instrumentation, and classical techniques to carry out experiments.

Course Content

Physics Laboratory

1. Young's Modulus of the material – Cantilever bending method
2. Rigidity modulus of the metallic wire – Torsional Pendulum method
3. Thermal Conductivity of the insulator – Lee's Disc method
4. Comparison of Co-efficient of viscosity of the liquids
5. Wavelength of laser and determination of particle size using laser
6. Testing the optical planeness of the given glass plate
7. Thickness of the sample using Air Wedge
8. Efficiency of the solar cell

Course Content

Chemistry Laboratory

I - Water Analysis
1. Determination of total hardness of water sample by EDTA method.

II - Viscometry
1. Determination of molecular weight of a polymer – Ostwald viscometric method.

III - Electrochemistry
1. To determine the strength of given acid – pH metrically
2. To determine the amount of ferrous ions by potentiometric titrations.

IV - Corrosion Testing
1. Determination of corrosion rate for mild steel specimen – weight loss method.
2. Determination of inhibitor efficiency of an organic inhibitor for mild steel specimen – weight loss method.

Reference

1. "Engineering Physics Laboratory Manual" R. Jayaraman, V. Umadevi, S. Maruthamuthu and B. Saravanakumar.
2. "Engineering Chemistry Laboratory Manual" Faculty, Chemistry Department, MCET.

Course Code: 16PSL11	**Course Title:** PROMOTION OF STUDENTS WELLNESS (Common to Auto, Mech, Civil, EEE & EIE)
Core/Elective: (G)	**L : T : P : C : M** – 0 : 0 : 2 : 1: 100
Type: Lecture	**Total Contact Hours:** 30

Course Outcomes

At the end of the course 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

Course Content

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

Orientation programme

Theory and practice demonstration

3 days - 7 hours /day for syllabus coverage

Follow-Up Practice

12 weeks x 2 hours/week: 24 hours

Evaluation:

Continuous evaluation:

Physical Exercises, Kaya kalpa practice, meditation	= 50 marks
Introspection (assessment of students workbook)	= 25 marks
Total	= 75 marks

Semester end examination:

Written test (MCQ and short answers)	= 30 marks
Physical exercises, meditation	= 50 marks
Viva-voce	= 20 marks
Total	= 100 marks

End semester mark out of 100 is reduced to 25 marks

The student should get a total of 50 marks put together for a pass.

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: 16ENT21	**Course Title:** COMMUNICATION SKILLS II
Core/Elective: Core	**L : T : P : C : M** - 2 : 0 : 2 : 3 : 100
Type: Lecture & Practical	**Total Contact Hours:** 60

Prerequisites

The student should have:

- Communication Skills I

Course Outcomes

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

CO1 Listen to monologues or dialogues, comprehend and answer questions equivalent to BEC vantage listening exam

CO2 Answer questions about oneself and business-related themes on par with BEC vantage speaking exam

CO3 Read business correspondence, infer and respond to the questions similar to BEC vantage reading exam

CO4 Write appropriate business e mail, memo, proposal, report and letter on par with BEC vantage writing exam

CO5 Write complex sentences using appropriate discourse markers

Course Content

UNIT I LISTENING 12

Listening to monologues or dialogues and noting specific information - Listening to identify topic, context, and function - Listening for details and main ideas - Gap filling and matching job descriptions and titles.

UNIT II SPEAKING 12

Giving personal information -Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - mini-presentation on a business theme - Giving information and expressing and justifying opinions - discussion on a business-related topic - Expressing and justifying opinions, speculating, comparing and contrasting, agreeing and disagreeing, etc. – negotiating and persuading.

UNIT III READING 12

Reading - skimming for gist and scanning for specific information (Newspaper and magazine articles, reports, advertisements, letters, messages, brochures, guides, manuals) - Reading and understanding text structure – Comprehension – Reading for vocabulary and structure - understanding sentence structure and finding errors.

UNIT IV WRITING **12**

Internal written communication - Writing a message, memo or an email: giving instructions, explaining development, asking for comments, requesting information, agreeing to requests - External Communication (e.g. explaining, apologizing, reassuring, complaining), reports (e.g. describing, summarizing) or proposals (e.g. describing, summarizing, recommending, persuading and negotiating).

UNIT V GRAMMAR **12**

Conditional sentences – Modals and their usage- common errors - Linkers and discourse markers – concord (pronoun and antecedent)

Text Book

1. Whitby Norman, "Business Benchmark Upper Intermediate Students" Book CUP Publications, 2nd Edition, 2014.

References

1.Cambridge "BEC Vantage - Practice Tests", Self-study Edition, Cambridge University Press, 2002.

2. Hewings Martin, "Advanced Grammar in use - Upper-intermediate Proficiency", Cambridge University Press, Third Edition, 2013.

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: 16MAT21	**Course Title:** ENGINEERING MATHEMATICS-II (Common to Automobile & Mechanical)
Core/Elective: Core	**L : T : P : C : M** – 3 : 2 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 75

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics I

Course Outcomes

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

CO1 Solve the second and higher order ordinary differential equations.
CO2 Apply the concepts of gradient, divergence and curl to solve engineering problems.
CO3 Construct an analytic function.
CO4 Apply the concept of complex integration to evaluate integrals.
CO5 Apply the Laplace transform techniques to solve differential equations**.**

Course Content

UNIT I DIFFERENTIAL EQUATIONS OF SECOND AND HIGHER ORDER 9+6

Second and higher order linear differential equations with constant coefficients.Solution by variation of parameters, first order simultaneous differential equations. Applications to Simple Harmonic motion.

UNIT II VECTOR CALCULUS 9+6

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 COMPLEX DIFFERENTIATION 9+6

Function of a complex variable-Analytic function -Singular points –Cauchy Riemann equations (without proof) – Properties-Construction of analytic functions. Conformal mapping: w = z+ a, az, 1/z – Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION 9+6

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+6

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. Srimanta Pal & Subodh C. Bhunia. "Engineering Mathematics", First edition, 2015, Oxford University Press.
2. Ervin Kreyszig. "Advanced Engineering Mathematics", 10th edition, 2015, Wiley India.

References

1. Peter V. O'Neil. "Advanced Engineering Mathematics", 7th Edition, 2012, Thomson Nelson, Toronto.
2. K.A. Stroud & Dexter J. Booth. "Advanced Engineering Mathematics", 5th Edition, 2011, Palgrave Macmillan.
3. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition, 2007.

Web Reference

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

Course Code: 16PHT21	**Course Title:** MATERIALS SCIENCE (Common to Automobile & Mechanical)
Core/Elective: Core	**L : T : P : C : M** – 3 : 0 : 2 : 4 : 100
Type: Lecture & Practical	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course(s):

- Applied Physics

Course Outcomes

At the end of the course, the 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

UNIT I CRYSTAL STRUCTURE OF MATERIAL PROPERTIES 9

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 –Crystal Planes: Miller indices, Bragg's law, Debye Scherrer method, Interplanar distance –Polymorphism and allotrophy.Crystal imperfections: Point, line surface and volume, grain boundary and its role in mechanical properties.

UNIT II MECHANICAL PROPERTIES AND TESTING OF MATERIALS 9

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: Fracture behavior, Ductile and Brittle fracture, Toughness, Fatigue- Fatigue fracture-Fatigue test, Endurance limit, SN curve.Creep-Creep fracture- Stages of creep, Creep testing.

UNIT III THERMAL & MAGNETIC PROPERTIES OF MATERIALS 9

Thermal Properties of materials: Introduction to concept of Heat - Thermal Expansion, Thermal conductivity, Thermal diffusivity, Thermal stress, 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, applications: motors, generators, and transformers. Antiferromagnetism, Ferrimagnetism, Influence of temperature on magnetic behavior.

UNIT IV CERAMIC MATERIALS 9

Modern ceramic materials, Cermetsas Cutting tools, Glass ceramics and fibres - 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 9

Introduction, properties, functions of matrix and reinforcement in composites – Law of mixtures.Classification of composites: Particle-reinforced, Fiber-reinforced and Structural compositesTypes of composite materials: Polymer-matrix composites, Metal-matrix composites, Ceramic-matrix composites, Carbon-carbon composites and Hybrid composite – Aerospace, machinery and sports applications.

Text Books

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", KhannaPublishers, 2003.

References

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

Web References

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

Materials Science Lab

Any Four Experiments: 15 hrs

1. Determination of Coercivity, Retentivity, Saturated magnetism and Permeability from Hysteresis loop
2. Determination of Conductivity and Resistivity of samples using Four Probe method
3. Measurement of Melting point of wax with Thermocouple
4. Measurement of mechanical properties of materials using Hardness, Impact and I guard test
5. Determination of Stress strain behavior using Universal Testing Machine.
6. Determination of lattice constants – Debye Scherrer photograph.

Course Code: 16GET21	**Course Title:** ENGINEERING MECHANICS (Common to Automobile & Mechanical)
Core/Elective: Core (C)	**L : T : P : C : M** – 4 : 0 :0 :4 : 100
Type: Lecture	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course(s):

- Engineering Graphics
- Engineering Mathematics - I

Course Outcomes

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

CO1 Construct free-body diagrams and calculate the unknown forces necessary to ensure static equilibrium condition.
CO2 Calculate the magnitude of force acting in each member of frame and machine under static equilibrium condition.
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

UNIT I EQUILIBRIUM OF RIGID BODIES 12

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.
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 II ANALYSIS OF FRAMES AND MACHINES 9

Introduction - Frames - Machines, Structures containing multi-force members, Analysis of a frame, Analysis of machines.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 15

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.**
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 12

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 12

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.

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: 16GET22	**Course Title:** ENGINEERING METROLOGY AND MEASUREMENTS (Common to Automobile & Mechanical)
Core/Elective: General (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(s):

- Applied Physics

Course Outcomes

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

CO1 Explain 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

UNIT I INTRODUCTION TO ENGINEERING METROLOGY 6

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

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- Concept of Control Charts, Types of Control Charts, Control Charts for Attributes, p Chart, np Chart, c Chart, u Chart, Control Charts for Variables x Chart, R Chart.

UNIT III LINEAR AND ANGULAR MEASUREMENTS 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 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 - Roundness Measurements- Temperature: bimetallic strip, thermocouples, electrical resistance thermometer.

UNIT V LASER METROLOGY AND CMM 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

Textbooks

1 Gopalakrishna, K. R., "Machine Drawing", 20th Edition, Subhas publishing House, 2007.

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

References

1. Cencel .H.Jensen and J.D.Helsel, "Engineering Drawing and Design" McGraw Hill 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.

List of Experiments 30

1. Measure the dimensions of the given component using vernier caliper.
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.

Web References

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

Course Code: 16EPL21	**Course Title:** ENGINEERING PRACTICES LABORATORY
Core/Elective: General (G)	**L : T : P : C : M** - 0: 0 : 4 :2 : 100
Type: Practical	**Total Contact Hours:** 45

Course Outcomes

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

CO1 Demonstrate the basic carpentry, fitting and plumbing operations.

CO2 Demonstrate the operations of different power tools.

CO3 Exhibit the proper connection in electrical wiring.

CO4 Interpret various characteristics of basic electronic components.

CO5 Demonstrate the installation, formatting and partitioning of computer system.

List of Experiments

1. Make a wooden window frame to the required dimensions with 'T' joint and Dove Tail joint.
2. Make a steel table using fitting process to the required dimensions.
3. Assemble a pipe line from overhead tank to kitchen sink and dining wash basin.
4. Demonstrate the operations of different power tools.
5. 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.
6. Make a Stair case wiring for controlling a lamp from two different locations.
7. Do the continuity check in the given PCB and rectify the faults.
8. Make an electronic circuit for bi-cycle horn.
9. Install the given OS in the computer system.
10. Do formatting and partitioning of Hard Disk Drive

References

1. Jeyachandran.K, Natarajan.S & Balasubramanian.S, "A Primer on Engineering Practices Laboratory", Anuradha Publications, TamilNadu (India), 2007.
2. Rajendra Prasad.A & Sarma.P.M.M.S, "Work shop Practice", Sree Sai Publication, 2002.
3. Jeyapoovan.T, M.Saravanapandian & Pranitha.S, "Engineering Practices Lab Manual", Vikas Publishing House Pvt. Ltd., Uttar Pradesh (India), 2006.

Course Code: 16CDL21	**Course Title:** COMPUTER AIDED DRAFTING AND MODELING LABORATORY
Core/Elective: General (C)	**L : T : P : C : M** - 1: 0 : 4 : 3 : 100
Type: Lecture & Practical	**Total Contact Hours:** 45

Prerequisites

The student should have undergone the course(s):

- Engineering Graphics

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.

Course Content

UNIT I STANDARDS, SYMBOLS& CONVENTIONS 3

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.

UNIT II CAD SOFTWARE FEATURES 3

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

UNIT III DEVELOPMENT OF PART AND ASSEMBLY MODELS 3

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 3

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 3

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

List of Experiments **30**

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

References

1. Gopalakrishna, K. R., "Machine Drawing", 20th Edition Subhas publishing House,2007.
2. Cecil Jensen, Jay D. Helsel, Dennis R. Short , "Engineering Drawing & Design", 7th edition McGraw-Hill Higher Education. 2007

Course Code: 16PSL21	**Course Title:** SPORTS FOR WELLNESS (Common to Auto, Mech, Civil, EEE & EIE)
Core/Elective: General (G)	**L : T : P : C : M** – 0 : 0 : 2: 1 : 100
Type: Lecture	**Total Contact Hours:** 30

Prerequisites:

The student should have undergone the course(s):

- Promotion of Students Wellness

Course Outcomes

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

CO1 Explain the significance of physical fitness for healthy living
CO2 Maintain physical fitness through exercises
CO3 Exhibit mental agility

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", Thorsons Publications 2003.

2. Student reading material and workbook prepared by PS team of the college.

OPERATIONAL MODALITIES:

Orientation programme

Special lectures by invited resource persons at semester beginning
3 lectures x 4 hours = 12 hours

Follow-up practice

12 weeks x 2 hours/week = 24 hours

Evaluation

Continuous evaluation:

Physical Exercises	= 50 marks
Assessment of students workbook	= 25 marks
Total	= 75 marks

Semester end examination:

Written test (MCQ and short answers)	= 30 marks
Physical exercises	= 50 marks
Viva-voce	= 20 marks
Total	= 100 marks

End semester mark out of 100 is reduced to 25 marks

The student should get a total of 50 marks put together for a pass.

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			1

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
		L	T	P	
THEORY					
140ME0501	Heat and Mass Transfer	4	0	0	4
140ME0502	Design of Machine Elements	4	0	0	4
140ME0503	Design of Hydraulic and Pneumatic Systems	3	0	2	4
140ME0504	Engineering Economics and Cost Analysis	3	0	0	3
140ME0505	Microcontroller and Applications	3	0	2	4
XXX	Elective- I	3	0	0	3
PRACTICAL					
140ME0507	Heat Power Laboratory	0	0	4	2
140ME0508	Computer Aided Machine Drawing Laboratory	0	0	4	2
140ME0509	Teamness and Inter-Personal Skills(TIPS)	0	0	2	1
	One Credit Course	0	0	2	1
TOTAL		20	0	16	28

SEMESTER VI

Course Code	Course Title	Hours/Week			Credits
		L	T	P	
THEORY					
140ME0601	Finite Element Analysis	4	0	0	4
140ME0602	Design of Transmission Systems	4	0	0	4
140ME0603	Power Plant Engineering	3	0	0	3
140ME0604	Automobile Engineering	3	0	0	3
XXX	Elective II	3	0	0	3
PRACTICAL					
140ME0607	Simulation and Analysis Laboratory	0	0	4	2
140ME0608	Automobile Engineering Laboratory	0	0	4	2
140ME0609	Professional Skills - VI	0	0	2	1
140ME0610	Project Work -Phase I	0	0	4	2
	One Credit Course	0	0	2	1
TOTAL		17	0	16	25

SEMESTER V

Course Code: 140ME0501	**Course Title:** HEAT AND MASS TRANSFER
Core/Elective: Core (C)	**L : T : P : C : M** – 4 : 0 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics
- Fluid Mechanics & Machinery
- Engineering Thermodynamics

Course Outcomes

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

CO1 Solve one dimensional steady state conduction heat transfer in simple geometries, fins and internal heat generation

CO2 Solve forced and natural convection heat transfer for external and internal flows

CO3 Apply phase change heat transfer in heat exchanger design

CO4 Calculate radiation heat transfer between different sections

CO5 Solve diffusion mass transfer through plane membrane

CO6 Describe the different applications of Heat transfer

Course Content

UNIT I ONE DIMENSIONAL STEADY STATE CONDUCTION 12

Basic concepts-Modes of heat transfer – Conduction, Convection and Radiation-Cartesian coordinate- Simple geometries-Plane wall, Cylinder, Sphere, Composite wall , cylinder and Sphere – simple problems.
Fins – Short fin end insulated, Short fin end not insulated and long fin – Simple problems. Internal heat generation – Plane wall and cylinder – Simple problems. One dimensional Unsteady state heat conduction (Qualitative treatment only)

UNIT II CONVECTION 12

Basics – dimensionless numbers, boundary layer concepts- external flow – flow over plates, cylinders and spheres – bank of tubes – Simple problems, internal flow – flow through cylinders – simple problems.
Free convection – flow over horizontal plate, flow over vertical plate and flow through cylinders and spheres – simple problems.

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS 12

Phase change heat transfer – boiling- pool and flow boiling - condensation – simple problems.
Heat exchangers – Classifications - parallel flow, counter flow and cross flow- LMTD and NTU methods –simple problems.

UNIT IV RADIATION 12

Basic concepts – absorptivity, reflectivity and transmissivity – black body and grey body concepts – Laws of radiation – Stefan Boltzmann law, Kirchoff's law, Planck's law, Wien's law and Lambert's cosine law – shape factor algebra – between plates and discs – simple problems, Radiation shield – single and 'n' number of shields – simple problems.

UNIT V DIFFUSION MASS TRANSFER AND HEAT TRANSFER APPLICATIONS 12

Basic concepts – properties of mixtures – mass concentration and mass fraction – mole concentration and mole fraction – diffusion mass transfer – Fick's law of diffusion – diffusion through plane membrane- simple problems.
Applications of heat transfer – domestic applications – Refrigerator, Air conditioning, process industrial applications- Food industry, Sugar Industry and automotive applications – Engine, radiators.

NOTE: (Use of Steam table&Heat & Mass Transfer Datebook are permitted)

Text Book

1. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International, New Delhi, 2012.
2. Sachdeva R C, "Fundamentals of Engineering Heat and Mass Transfer" New Age International, 2010.

References

1. Yadav R "Heat and Mass Transfer" Central Publishing House, 1995.
2. Nag P.K, " Heat Transfer", Tata McGraw-Hill, New Delhi, 2011
3. Ozisik M.N, "Heat Transfer", McGraw-Hill Book Co., 1994.

Web References

- http://nptel.ac.in/courses/112101097/
- http://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Heat%20and%20Mass%20Transfer/New_index1.html

Course Code: 140ME0502	**Course Title:** DESIGN OF MACHINE ELEMENTS
Core/Elective: Core	**L : T : P : C : M** – 4 : 0 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course(s):

- Theory of Machines-II
- Strength of Materials

Course Outcomes

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

CO1 Design the machine elements subjected to simple and combined static loads.

CO2 Design the machine elements against fluctuating loads and impact loads

CO3 Calculate the design parameters for power transmitting element such as shaft, key, and coupling.

CO4 Determine the design parameters of helical and leaf spring for given application.

CO5 Design/Select a suitable bearing for the given application.

Course Content

UNIT I DESIGN FOR STATIC LOAD OR STEADY STRESSES 12

Design Processes and its types. Static stress- yield stress and ultimate stress, direct, bending bearing and shear stresses - factor of safety, selection. Selection of materials and its properties - eccentric loading-stress due to eccentric loading, problems. Theories of failure, simple problems.

UNIT II DESIGN FOR FLUCTUATING AND IMPACT LOADS 12

Fatigue, types, Endurance limit, modifying factors, relation between endurance limit, ultimate tensile strength and yield strength, problems on different fatigue loading conditions. Stress concentration, stress concentration factor, causes of stress concentration, method of reducing stress concentration, stress concentration factor for different material configuration. Notch sensitivity, factors affecting of notch sensitivity.Impact loading, shock loading, simple problems.

UNIT III DESIGN OF SHAFTS, KEYS, AND COUPLINGS 12

Difference between shaft, axle and spindle, Shaft materials, criteria of shaft design, different transmitting elements on a shaft, shaft design against static loading for given application. Shaft design for fatigue loading. Keys, types of keys, stresses developed in the key. Spline, stresses in spline shaft, design of shunk key and spline. Couplings, types of coupling, design of coupling

based on given speed and load conditions, Design of flexible coupling based on given speed and loadconditions.

UNIT IV DESIGN OF SPRINGS 12

Springs, types of springs, applications, spring terminology. Stresses in helical springs, Design of helical and concentric spring for given loading. Leaf springs, NIP in leaf springs Design of leaf spring for given application.

UNIT V DESIGN OF BEARING 12

Bearings, bearing types, Parts of the bearing, rolling contact bearing, its applications. Load carrying capacity, equivalent load, Life of bearing, Load life relationship, Problems. Selection of ball bearings from manufacturing catalogue. Sliding contact bearings, types and Nomenclature. Hydrodynamic bearing, load carrying capacity, lubrication, selection of lubricant, equivalent load, minimum oil film thickness- length to diameter ratio- bearing pressure, radial clearance. Mckees equation, Somer field equations -Bearing characteristic number problems.

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

Text Book

1. V.B. Bhandari. "Design of Machine Elements" Tata McGraw Hills Education, 3rd edition2014.
2. P. C Sharma and A. K Agarwal. "Machine Design" (SI units). S.K. Kataria& Sons. Reprint 2013.

References

1.Shigley J.E and Mischke C.R., "Mechanical Engineering Design", Sixth Edition, Tata McGraw Hill, 2012.

2.Ugural A.C, "Mechanical Design – An Integral Approach", McGraw-Hill Book Co., 2010.

3.Spotts M.F., Shoup T.E "Design and Machine Elements" Pearson Education, 2012.

Web References

- http://nptel.ac.in/courses/112105124/
- http://www.nptel.ac.in/downloads/112105125/
- http://nptel.ac.in/courses/112106137/
- http://www.skf.com/in/index.html

Course Code: 140ME0503	**Course Title:** DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS
Core/Elective: Core	**L : T : P : C : M** – 3: 0 : 2 : 4 : 100
Type: Lecture & Practical	**Total Contact Hours:** 75

Prerequisites

The student should have undergone the course(s):

- Fluid Mechanics and Machinery
- Theory of Machines - II

Course Outcomes

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

CO1 Explain the fluid power systems with advantages and applications.

CO2 Explain construction and working of hydraulic system components.

CO3 Design hydraulic circuit to perform the desired function.

CO4 Explain construction and working of pneumatic system components

CO5 Design of pneumatic circuit to perform the desired function.

Course Content

UNIT I FLUID POWER SYSTEM AND FUNDAMENTALS 6

Introduction to Fluid power - Types of fluid power systems - Hydraulic system components - Pneumatic system components - Application of Pascal's Law in hydraulics-Advantages of fluid power system -Applications of Fluid power system -Properties of hydraulic fluids - Types of fluids.

UNITII HYDRAULIC SYSTEM AND COMPONENTS 12

Pumping theory - Pump classification - Construction and working of gear pumps, Vane pumps, Piston pumps - Construction and working of linear actuators - Special cylinder - Rotary actuator – Construction and operation of direction control valves (DCV), Pressure control valve, Flow control valve – Construction and operation of accumulators, Intensifiers.

UNIT III DESIGN OF HYDRAULIC CIRCUITS 9

Hydraulic symbols - Hydraulic circuits for linear actuators - Hydraulic circuits using different actuating devices - Speed control circuits - Sequencing circuit - Synchronizing circuit - Regenerative circuit - Accumulator circuit – Application of intensifier - Hydraulic circuit for Milling operation, Grinding Machine - Hydraulic braking in Automobile.

UNIT IV PNEUMATIC SYSTEM AND COMPONENTS 9

Properties of air – Compressor - Types of compressor - Construction and operation of air filter, air regulator, air lubricator - Pneumatic linear actuator - Rotary actuator - Constriction and working of pneumatic direction control valve – Flow control valve - Pneumatic symbols

UNIT V DESIGN OF PNEUMATIC CIRCUITS 9

Pneumatic circuits for single acting cylinder, Double acting cylinder - Pneumatic circuits using manual, mechanical, electrical actuating devices - Cascade method for sequencing: two and three Cylinders - Step counter method- Hydro-Pneumatic circuit - Material handling system circuit - Multiple operation Machining.

List of Experiments **30**

1. Design a hydraulic circuit for the actuation of hydraulic cylinder using Mechanical actuation.
   a) Using 4/2 DCV.
   b) Using 4/3 DCV.
2. Design a hydraulic circuit for the actuation of hydraulic cylinder using Electrical actuation.
   a) Using 4/2 DCV.
   b) Using 4/3 DCV.
3. Design a hydraulic circuit for Speed regulation of a double-acting cylinder (Meter in & Meter out).
4. Design a hydraulic circuit for Clamping and Drilling function (Pressure reducing valve).
5. Design a Pneumatic circuit for the actuation of single and double acting cylinder using Mechanical actuation.
6. Design a Pneumatic circuit for the actuation of single and double acting cylinder using Electrical actuation.
7. Develop a CASCADE circuit for given sequence operation (two and three cylinders).
8. Develop a Pneumatic circuit for Material handling application.

Text Book

1. Esposito Anthony, “Fluid Power with Applications”, Pearson Education Inc., New York, 2008.
2. Majumdar, S.R., “Oil Hydraulic Systems – Principles and Maintenance”, Tata McGraw-Hill, New Delhi, 2006.

References

1. Srinivasan.R, “Hydraulic and Pneumatic controls”, Vijay Nicole, 2006.
2. Andrew Parr, “Hydraulics and Pneumatics, A technician's and engineer's guide”, Third Edition, Butterworth-Heinemann, 2011.
3. Majumdar, S.R., “Pneumatic Systems – Principles and Maintenance”, Tata McGraw-Hill, New Delhi, 2006

Web References

- http://www.nptel.ac.in/courses/112106175/
- http://nptel.ac.in/courses/112105046/
- http://www.nitc.ac.in/dept/me/jagadeesha/mev303/Chapter2_Hydraulics_control_in_machine_tools.pdf
- http://maysaaiat.weebly.com/uploads/5/8/8/3/5883161/atm1122_hydraulics_module_1.pdf

Course Code: 140ME0504	**Course Title:**ENGINEERING ECONOMICS AND COST ANALYSIS
Core/Elective: Core (C)	**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):

- Engineering Mathematics-I
- Manufacturing Processes II

Course Outcomes

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

CO1 Categorize different cost and calculate the breakeven point for a given business situation

CO2 Apply different interest formulae and their application in decision making process.

CO3 Evaluate present value, future value and annual worth analysis on one or more economic alternatives.

CO4 Determine the economic value of an asset and develop a better replacement policy for a given equipment.

CO5 Evaluate the depreciation of equipment per period.

Course Content

UNIT I INTRODUCTION TO ECONOMICS 8

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - Elements of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis- V ratio, Elementary economic Analysis

UNIT II VALUE ENGINEERING 10

Make or buy decision, Value engineering – Function, aims, and 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, Examples in all the methods with problems.

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, Examples in all the methods.

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT V DEPRECIATION 9

Depreciation- 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. Case study

Text Book

1. PanneerselvamR, "Engineering Economics", Prentice Hall of India Ltd, NewDelhi, 2014
2. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2010.

References

1. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.
2. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2010.
3. Grant.E.L., Ireson.W.G., and Leavenworth, R.S, "Principles of Engineering Economy", Ronald Press, New York,1990.

Web References

- https://en.wikipedia.org/wiki/Engineering_economics
- https://en.wikipedia.org/wiki/Cost%E2%80%93benefit_analysis

Course Code: 140ME0505	Course Title: MICROCONTROLLER AND APPLICATIONS
Core/Elective: Core	L : T : P : C : M – 3 : 0 : 2 : 4 : 100
Type: Lecture& Practical	Total Contact Hours: 75

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 INTRODUCTION TO DIGITAL SYSTEM 6

Introduction to number system, Logic gates , Encoder , Decoder – Registers and Flip flops – Introduction to Microprocessor & Microcontroller .

UNIT II 8-BIT MICROCONTROLLER 10

Architecture of 8051 – Pin configuration – Memory Organization – SFRs – Interrupts – Addressing modes – Instruction set – Assembly Language Programming – Timer – Counter .

UNIT III MICROCONTROLLER INTERFACING 12

Interfacing concepts – Input /Output port configuration – Interfacing of LED, Switch, Matrix keyboard, Display Interfacing – 7 segment, LCD. DC Motor Interfacing – ADC /DAC interface, simple sensor interfacing.

UNIT IV MICROCONTROLLER WITH EMBEDDED ' C ' PROGRAMS 9

Introduction to Embedded 'C' –IDE – Simple Assembly Language Programming using IDE. Embedded C Programming using IDE: Interfacing of LED, Switch, 7 segment, LCD, DC Motor, ADC Sensor and Serial port.

UNIT V APPLICATIONS OF MICROCONTROLLER 8

Case study of Wind Screen Wiper Motion, a Pick and Place Robot, Car Engine Management, Controlling of AC & DC Appliances, Measurement of Frequency.

Text Book

1. M.A. Mazidi and J.G. Mazidi, "The 8051 Microcontroller and Embedded Systems", PHI/ Pearson Education, 2006.
2. M.MorrisMano,"Digital Design",3rdEdition,Pearson Education Pvt. Ltd., New Delhi, 2008.

Reference Book

1. Kenneth J. Ayala,"The 8051 Microcontroller, Architecture, Programming and Applications", Thomson Delmar Learning, Indian Edition, 2007.
2. Krishna Kant, "Microprocessor and Microcontroller", Prentice Hall of India, 2007.
3. William Botton, "Mechatronics – A Multidisciplinary Approach", Pearson Education Pvt. Ltd., New Delhi, 4th Edition, 2010.

List of Experiments **30**

1. Arithmetic operation using Microcontroller (ADD, SUB, MUL, DIV)
2. ALP based Compare instructions (GR, LR)
3. Study of Integration Development Environment
4. Simple Arithmetic operation using IDE
5. Write an Embedded C programming using IDE to interface the following
   I. LED
   II. Switch
   III. Display
   IV. DC Motor
   V. Temperature sensor using ADC
   VI. Serial port programming

Web References

- http://www.daenotes.com/electronics/digital-electronics/
- http://www.engineersgarage.com/microcontroller
- www.intorobotics.com

Course Code: 140ME0507	**Course Title:** HEAT POWER LABORATORY
Core/Elective: Core (C)	**L : T : P : C : M** –0: 0 : 4 : 2: 100
Type: Practical	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics
- Fluid Mechanics & Machinery
- Thermal Engineering

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. Heat transfer through composite wall
4. Thermal conductivity of insulating powder in a concentric sphere
5. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
6. Determination of heat transfer coefficient under forced convection inside tube.
7. Heat transfer from pin-fin (Natural and Forced convection mode)
8. Determination of Stefan Boltzman constant.
9. Determination of emissivity of grey surface.
10. Effectiveness of parallel/counter flow heat exchanger.
11. Performance test on Cooling tower.

REFRIGERATION & AIR-CONDITIONING

1. Study of Refrigeration & Air-conditioning systems
2. Determination of COP of Refrigeration system.
3. Determination of COP of Air-conditioning system.
4. Performance test on two stage reciprocating air compressor

Course Code: 140ME0508	**Course Title:**COMPUTER AIDED MACHINE DRAWING LABORATORY
Core/Elective: Core (C)	**L : T : P : C : M** –0: 0 : 4 : 2: 100
Type: Practical	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course(s):

- Engineering Graphics
- Metrology & Measurements
- Computer Aided Drafting and Modeling Laboratory

Course Outcomes

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

CO1 Develop part models of machine components

CO2 Prepare assembly drawings of machine components

Course Content

10. Exercise on Knuckle joint
11. Exercise on Flange coupling
12. Exercise on Plummer Block
13. Exercise on Screw Jack
14. Exercise on Piston and Connecting rod
15. Preparation of Knuckle joint assembly drawing
16. Preparation of Flange coupling assembly drawing
17. Preparation of Plummer block assembly drawing
18. Preparation of Screw Jack assembly drawing
19. Preparation of Piston and Connecting rod assembly drawing

References

3. Gopalakrishna, K. R., "Machine Drawing", SubhasPublishing House, 20th Edition, 2007.
4. Cecil Jensen, Jay D. Helsel, Dennis R. Short , "Engineering Drawing & Design", McGraw-Hill Higher Education, 7th edition, 2007.

Course Code: 140ME0509	**Course Title:** TEAMNESS AND INTER-PERSONAL SKILLS(TIPS)
Core/Elective: (G)	**L : T : P : C : M** – 0 : 0 : 2 : 1: 100
Type: Lecture	**Total Contact Hours:** 30

Course Outcomes

At the end of the course, students will

CO1 Be aware of attitudinal, behavioral and emotional aspects of self

CO2 Prefer to learn continuously about self and be in harmony with self

CO3 Understand others' preferences, values, roles & contexts and be in harmony with others

CO4 Identify barriers to harmonious relationships and derive ways to handle them

CO5 Work collaboratively as a team to deliver expected outcomes

Course Content

UNIT I HARMONY WITH SELF

Importance of learning about self continuously; Approaches to learn about self: introspection, being open to feedback, critical incidences as opportunities; Understanding life stages and challenges associated with them; Healthy ways of handling self in response to life's challenges;
Instruments/inventories to understand self and others: A) Know your temperament, B) Mayer Briggs Type Indicator, C) Interpersonal Needs Inventory (tentative).

UNIT II HARMONY WITH OTHERS

Importance of living in harmony with others; What it takes to live in harmony with others; Understanding preferences, values, roles and contexts of others; Approaches to navigating through differences between self and others;
Barriers to harmonious relationships - Perceptions, Judgments, and Emotional instability; Ways to handle each of the barriers; Importance of reaching-out to others

UNIT III GROUP DYNAMICS AND CONFLICTS RESOLUTION

Group dynamics: overt and covert processes at micro and macro levels; Understanding the basis of conflicts; Understanding one's own conflict handling style; Methods to handling conflicts effectively.

UNIT IV WORKING IN TEAMS

Effectiveness in communication; Forming – storming – norming and performing model; Competition vs collaboration – impact of both on team tasks; TEAM Questionnaire – components of a healthy team and approaches to improving them.

Mode of delivery:

1. A 2-day learning workshop

1. Activities (experiential learning)
2. Audio visuals (affective learning)
3. Case discussions (cognitive learning)
4. Instruments/questionnaires (reflective learning)

Guided by Learner's workbook.

2. Continuous learning guided by learning journal, and reviews by faculty

3. Half-day reinforcement session towards the end of the semester

Assessments and Evaluation:

Assessment	**Details**	**Weightage**	**Administration**	**By Whom**	**When**
Continuous Assessment					
Initial Knowledge Test	Multiple choice questions (20)	10%	Pen and paper	Internal team	Immediately after the initial workshop.
Review of student journal	Student held journal book.	50%	Student journals to be reviewed	Trained Internal faculty	Once in a week.
Semester End Examination:					
Final comprehensive Knowledge test	Multiple choice questions (40)	10%	Pen and paper	Internal team	End of semester after the reinforcement program.
Viva-Voce	Scenario based questions	30%		Internal team	

Continuous Assessment = 60%
Semester end examination = 40%
An overall mark of 50 is to be scored for a pass in the course

END OF SEMESTER V

SEMESTER VI

Course Code: 140ME0601	**Course Title:**FINITE ELEMENT ANALYSIS
Core/Elective: Core (C)	**L : T : P : C : M** – 4 : 0 : 0 : 4 : 100
Type: Lecture	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course(s):

- Engineering Mathematics - I
- Numerical Methods
- Strength of Materials
- Heat and Mass Transfer

Course Outcomes

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

CO1 Convert physical problems into mathematical model using finite element procedure

CO2 Solve the one dimensional structural problems

CO3 Solve the vector variable problems using 2D CST element

CO4 Solve the scalar variable problems using 1D and 2D elements

CO5 Solve the vector variable problems using 2D Quadrilateral element

Course Content

UNIT I FINITE ELEMENT FORMULATION 12

Finite element methods - general applicability of the methods, general finite element procedure, discretization of the domain, degree of freedom, basic element shapes and nodes, numbering of element and nodes, displacement models, local, global coordinates, Spring element - derivation of element stiffness matrices, global stiffness matrix and force vector using minimum potential energy principle, incorporation of boundary conditions, solution of numerical problems.

UNIT II ONE DIMENSIONAL VECTOR VARIABLE PROBLEMS 12

Finite element modeling – Natural Coordinates and shape functions - linear bar element, - total potential energy approach - element stiffness matrix and force vector – global stiffness matrix and force vector - boundary condition – problems- quadratic element, Plane Trusses - development of shape function - element equations , element stiffness matrix and force vector – global stiffness matrix and force vector – boundary condition- problems, beam element –finite element formulation – Load vector –boundary condition- problems.

UNIT III TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS USING CONSTANT STRAIN TRIANGLES 12

Finite element modeling – constant strain triangular element – Iso-parametric representation – Potential Energy approach - Element stiffness matrix and force vector – global stiffness matrix and force vector –Boundary condition – Problems, Axisymmetric solids subjected to Axisymmetric loading - axis symmetric formulation - Element stiffness matrix and force vector – global stiffness matrix and force vector –Boundary condition – Problems.

UNIT IV HEAT TRANSFER / SCALAR VARIABLE PROBLEM 1 D & 2D 12

Scalar variable problems- steady state heat transfer- 1D,2Dconduction& convection – Global stiffness matrix and global thermal load vector - Boundary condition – Problems.

UNIT V TWO DIMENSIONAL VECTOR VARIABLE PROBLEM USING QUADRILATERAL ELEMENTS 12

Iso parametric elements – the four node quadrilateral- derivation of shape function, element stiffness matrix, element force vector- global stiffness matrix and force vector- Boundary condition-problems.

Text Book

1. Chandrupatla&Belagundu, "Introduction to Finite Elements in Engineering", Prentice-Hall of India, 3rd Edition, Eastern Economy Editions, 2011.
2. Logan D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002

References

1. David V.Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw-Hill Edition, 2005.
2. J.N.Reddy, "An Introduction to the Finite Element Method", McGraw-Hill International Editions(Engineering Mechanics Series), 2005.
3. Seshu, P, "Text Book of Finite Element Analysis", Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

Web References

- http://nptel.ac.in/courses/112104115/4
- http://textofvideo.nptel.iitm.ac.in/105106051/lec1.pdf
- http://nptel.ac.in/courses/112104116/

Course Code: 140ME0602	Course Title: DESIGN OF TRANSMISSION SYSTEMS
Core/Elective: Core	L : T : P : C : M – 4 : 0 : 0 : 4 : 100
Type: Lecture	Total Contact Hours: 60

Prerequisites

The student should have undergone the course(s):

- Theory of Machines – I & II
- Design of Machine Elements

Course Outcomes

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

CO1 Select a suitable flexible element drives for industrial applications.

CO2 Design a spur gear and helical gear drives for given situations.

CO3 Design a bevel and worm gear drives for given conditions.

CO4 Design a sliding mesh gear box for automobile applications.

CO5 Design clutches and brakes for automobile applications.

Course Content

UNIT I SELECTION OF FLEXIBLE ELEMENT DRIVES 12

Mechanical drives-types of drives -power and motion transmission drives-stepped and steeples transmission-speed ratio-under direct and over drives and its applications-reversible and irreversible drives and its applications-belt drives and its applications-Select suitable flat belt and V-belt drives and pulleys for industrial applications-chain drives-hoisting and hauling chains - Conveyor Chains -Power transmitting chains-block chain- roller chain-silent chain-select suitable roller chains and sprockets for industrial applications

UNIT II DESIGN OF SPUR GEAR AND HELICAL GEAR DRIVES 12

Toothed gearing and its applications- gear tooth terminology- failures in gears- gear materials-law of gearing- tooth forces and stresses- Design of spur gear for given situations, helical gear - Tooth terminology - equivalent number of teeth – Design of Helical Gear drives for given situations, Cross helical: Terminology (Qualitative Treatment only)

UNIT III DESIGN OF BEVEL AND WORM GEAR DRIVES 12

Types of bevel gear - Tooth terminology - equivalent number of teeth gear, Design the bevel gear, Materials- Worm Gear terminology , Types of worm gears - equivalent number of teeth,

gear Materials, Thermal capacity, Efficiency - Tooth forces and stresses of worm gears, Design of worm gear drives.

UNIT IV DESIGN OF SLIDING MESH GEAR BOX 12

Preferred numbers- Geometric progression- standard step ratio- kinematic layout- ray diagram- Design 3, 6, 9 and 12 sliding mesh speed gear box.

UNIT V DESIGN OF CLUTCHES AND BRAKES 12

Needs and role of clutch- types of clutch-positive clutch- square jaw clutch- spiral jaw clutch- friction clutch- types of friction clutch-plate clutches- cone clutch- centrifugal clutch- Design of plate clutches- needs and role of brakes- types of brakes -single block or shoe brake- pivoted block or shoe brake- double block or shoe brake- simple band brake- differential band brake- band and block brake- internal expanding brake- Design of shoe brake, band and block brake, internal expanding brake, Disc Brake.

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

Text Book

1. Shigley J.E and Mischke C.R, **"**Mechanical Engineering Design" 9th Edition, Tata McGraw-Hill,2011.
2. Bhandari V.B, **"**Design of Machine Elements" 3rdEdition,Tata McGraw-Hill, 2010.

References

1. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
2. GitinMaitra, L. Prasad "Hand book of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2001.
3. Sundararajamoorthy T.V, Shanmugam N, "Machine Design", Anuradha Publications, Chennai, 2003.

Web References

- http://nptel.ac.in/courses/112106137/
- http://nptel.ac.in/courses/112102014/38
- http://dunloptransmissions.com/
- http://www.renold.in/Products/TransmissionChainSprockets/TransmissionChainIndexPage.asp
- http://khkgears.net/gear-knowledge/

Course Code: 140ME0603	**Course Title:** POWER PLANT ENGINEERING
Core/Elective: Core (C)	**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):

- Thermal Engineering
- Engineering Economics and Cost Analysis

Course Outcomes

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

CO1 Describe the construction and working principle of steam power plant

CO2 Explain the working principle of hydroelectric and nuclear power plants

CO3 Explain the operation and maintenance of diesel and gas turbine power plants

CO4 Explain the working principle of non conventional power plants

CO5 Calculate the cost of power generation for various power plants

Course Content

UNIT I STEAM POWER PLANT 12

Layout of Steam power plant- Fuel and Ash handling systems - Combustion equipment for burning coal- Mechanical Stokers – Pulveriser – Gas cleaning systems- Electrostatic Precipitator and Mechanical dust collector. Draught – Different types- Surface Condenser and Cooling Towers. Steam Boilers– High Pressure, Super Critical Boilers and Ultra supercritical boilers– Fluidised Bed Boilers, Pollution Control methods.

UNIT II HYDROELECTRIC AND NUCLEAR POWER PLANT 9

Layout of Hydroelectric Power Plant – Essential Elements –Types – Standalone and Pumped storage- Site selection - Indian Scenario.

Nuclear Energy – Fission, Fusion Reaction- Layout of Nuclear power plant-Types of Reactors- Pressurized water , Boiling water , Gas cooled , Fast breeder Reactor- Waste Disposal and safety - site selection- Indian scenario – Recent Developments.

UNIT III DIESEL AND GAS TURBINE POWER PLANT 9

Layout of Diesel Power Plant -Types and Components - Engine Selection based on Application- Recent developments.

Gas Turbine Power Plant – Layout – Fuels - Gas Turbine Material - Types of Combustion Chambers – Performance Improvement Methods - Reheating, Regeneration, Inter cooling, Combined Cycle Power Plant- Recent developments.

UNIT IV NON-CONVENTIONAL POWER PLANTS 8

Solar Power Plants-Low, Medium and High Temperature Systems -Wind Energy Conversion System-Horizontal and Vertical Wind Turbines –Geo-Thermal Power Plant – Bio Gas Power Plant – MHD - OTEC Systems - Tidal Power Plants.

UNIT V POWER PLANT ECONOMICS, RENOVATION AND MODERNIZATION7

Load duration curves - Cost of Electric Energy, Types of Tariffs- Economics of Load Sharing - Comparison of Economics of Various Power Plants. Energy Conservation and Energy Audit in steam power plant - Renovation and Modernization of aged power plants.

Text Book

1. S. C. Arora and S. Domkundwar, "A course in Power Plant Engineering", DhanpatRai& Sons, New Delhi, 2008.
2. P. K. Nag, "Power Plant Engineering", Tata McGraw Hill Company Pvt Ltd., New Delhi,2007.

References

1. M. M. EI-Wakil, "Power Plant Technology", Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,1985.
2. G. R. Nagpal, "Power Plant Engineering", Khanna Publishers, New Delhi, 2002.
3. G.D. Rai, "Introduction to Power Plant Technology", Khanna Publishers, New Delhi, 1995.

Web References

- http://nptel.ac.in/courses/108105058/8
- http://www.ignou.ac.in/

Course Code: 140ME0604	**Course Title:** AUTOMOBILE ENGINEERING
Core/Elective: Core (C)	**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):

- Electrical Drives and Controls
- Design of Machine Elements
- Thermal Engineering

Course Outcomes

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

CO1 Explain the vehicle structure and components

CO2 Explain petrol, diesel and lubricating systems

CO3 Explain the construction and working principle of Transmission system

CO4 Explain the construction and working principle of steering, braking and suspension system of automobile

CO5 Explain electrical system, accessories and emission norms

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, Introduction to IC Engines-types, working principles, components of engines-their forms functions and materials.

UNIT II FUELS AND LUBRICATION SYSTEM 9

Petrol fuel feed system: Feed pump – mechanical, electrical type – Carburetors – fixed venturi type (carter), variable venturi type (SU), multiple barrel type (Solex, Mikuni), carburetors 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.

UNIT III 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 NORMS9

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 Book

1. Kirpal Singh, "Automobile Engineering Vol. 1 & 2", Standard Publishers, 7th Edition 2012.
2. Sethi H.M, "Automobile Technology", Tata McGraw-Hill, 2003.

References

1. Jain, K.K., and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.
2. Srinivasan.S, "Automotive Mechanics" 2nd edition, Tata McGraw-Hill, 2003.
3. Joseph Heitner, "Automotive Mechanics", 2nd edition, East-West Press, 1999.

Web References

- https://en.wikipedia.org/wiki/Automotive_engineering
- http://auto.howstuffworks.com/

Course Code: 140ME0607	**Course Title:** SIMULATION AND ANALYSIS LABORATORY
Core/Elective: Core (C)	**L : T : P : C : M** – 0 : 0 : 4 : 2 : 100
Type: Practical	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the course(s):

- Numerical Methods
- Thermal Engineering
- Strength of Materials
- Theory of Machines-I&II
- Design of Hydraulics & Pneumatics System

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

Course Code:140ME0608	**Course Title:** AUTOMOBILE ENGINEERING LABORATORY
Core/Elective: Core (C)	**L : T : P : C : M** –0: 0 : 4 : 2: 100
Type: Practical	**Total Contact Hours:** 60

Prerequisites

The student should have undergone the courses

- Design of Machine Elements
- Design of Hydraulic and Pneumatic Systems
- Electrical Drives and Control
- Thermal Engineering Laboratory

LIST OF EXPERIMENTS

1. Study of various tools used in Automobile workshop.
2. Dismantling and assembling of following types of engine – Single cylinder petrol and diesel engine.
3. Dismantling and assembling the components of Single plate clutch and Multi-plate clutch.
4. Dismantling and assembling the components of Sliding mesh gearbox and Constant mesh gearbox.
5. Study and prepare report on the constructional details, working principles and operation of the Manual Steering Systems [Rack & Pinion steering] and Power steering Systems.
6. Study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.
   (a) Hydraulic & Pneumatic Brake systems.
   (b) Drum Brake System.
   (c) Disk Brake System
7. Check wiring diagram of battery coil ignition system.
8. Check wiring diagram of electronic ignition system.
9. Check the circuit diagram of an electric horn and to carry out its adjustments.
10. Dismount, dismantle and reassemble a wiper motor.

END OF SEMESTER VI

ELECTIVES

Course Code:140ME9111	**Course Title:** AUTOMOTIVE AERODYNAMICS
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):

- Fluid Mechanics and Machinery

Course Outcomes

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

CO1 Describe the Potential of vehicle aerodynamics
CO2 Calculate the drag coefficient of cars
CO3 Explain the shape optimization of cars
CO4 Calculate forces and moments due to side winds
CO5 Demonstrate the use of wind tunnel for automotive aerodynamics

Course Content

UNIT I INTRODUCTION 9

Scope – historical development trends – Fundamentals of fluid mechanics – Flow phenomenon related to vehicles – External & Internal flow problems – Resistance to vehicle motion – Performance – Fuel consumption and performance – Potential of vehicle aerodynamics.

UNIT II AERODYNAMIC DRAG OF CABS 9

Car as a bluff body – Flow field around car – drag force – types of drag force – analysis of aerodynamic drag – drag coefficient of cars – strategies for aerodynamic development – low drag profiles.

UNIT III SHAPE OPTIMIZATION OF CABS 9

Front and modification – front and rear wind shield angle – Boat tailing – Hatch back, fast back and square back – Dust flow patterns at the rear – Effect of gap configuration – effect of fasteners.

UNIT IV VEHICLE HANDLING 9

The origin of force and moments on vehicle – side wind problems – methods to calculate forces and moments – vehicle dynamics under side winds – the effects of forces and moments – Characteristics of forces and moments – Dirt accumulation on the vehicle – wind noise – drag reduction in commercial vehicles.

UNIT V WIND TUNNELS FOR AUTOMOTIVE AERODYNAMICS 9

Introduction – Principles of wind tunnel technology – Limitation of simulation – Stress with scale models – full scale wind tunnels – measurement techniques – Equipment and transducers – road testing methods – Numerical methods.

Textbook

1. Hucho, W.H., "Aerodynamics of Road Vehicles", Butterworths Co. Ltd., 1998.
2. Pope, A, "Wind Tunnel Testing, John Wiley & Sons", 2nd Edn., New York, 1999.

References

1. "Automotive Aerodynamics" Update SP-706, SAE, 1987.
2. "Vehicle Aerodynamics", SP-1145, SAE, 1996.
3. T.YomiObidi "Theory and Applications of Aerodynamics for Ground Vehicles"SAE International, ISBN 978-0-7680-2111-0, 2014.

Web References

- http://web-aerodynamics.webs.com/backgroundresearch
- https://en.wikipedia.org/wiki/Automotive_aerodynamics

Course Code:140ME9112	Course Title: NOISE, VIBRATION AND HARSHNESS
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):

- Theory of Machines-II

Course Outcomes

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

CO 1 Describe the sources of noise and vibration
CO 2 Explain the effects of NVH on people
CO 3 Explain the effects of noise and vibration on external environment
CO 4 Explain the effects of noise and vibration on internal environment
CO5 Explain the measurement methods of noise and vibration

Course Content

UNIT I FUNDAMENTALS OF ACOUSTICS AND NOISE, VIBRATION 8

Theory of Sound—Predictions and Measurement, Sound Sources, Sound Propagation in the Atmosphere, Sound Radiation from Structures and Their Response to Sound, General Introduction to Vibration, Vibration of Simple Discrete and Continuous Systems, Random Vibration, Response of Systems to Shock, Passive Damping

UNIT II EFFECTS OF NOISE, BLAST, VIBRATION, AND SHOCK ON PEOPLE 7

General Introduction to Noise and Vibration Effects on People and Hearing Conservation, Sleep Disturbance due to Transportation Noise Exposure, Noise-Induced Annoyance, Effects of Infrasound, Low-Frequency Noise, and Ultrasound on People, Auditory Hazards of Impulse and Impact Noise, Effects of Intense Noise on People and Hearing Loss, Effects of Vibration on People, Effects of Mechanical Shock on People, Rating Measures, Descriptors, Criteria, and Procedures for Determining Human Response to Noise.

UNIT III TRANSPORTATION NOISE AND VIBRATION 10

Introduction to Transportation Noise and Vibration Sources, Internal Combustion Engine Noise Prediction and Control—Diesel, Exhaust and Intake Noise and Acoustical Design of Mufflers, Tire/Road Noise—Generation, Measurement, and Abatement, Aerodynamic Sound Sources in Vehicles—Prediction and Control, Transmission and Gearbox Noise and Vibration Prediction and Control, Brake Noise Prediction and Control.

UNIT IV INTERIOR TRANSPORTATION NOISE AND VIBRATION 10

Introduction to Interior Transportation Noise and Vibration Sources, Automobile, Bus, and Truck Interior Noise and Vibration Prediction and Control, Noise and Vibration in Off-Road Vehicle Interiors- Prediction and Control

UNIT V NOISE AND VIBRATION TRANSDUCERS 10

General Introduction to Noise and Vibration Transducers, Measuring Equipment, Measurements, Signal Acquisition, and Processing, Acoustical Transducer Principles and Types of Microphones, Vibration Transducer Principles and Types of Vibration Transducers, Sound Level Meters, Noise Dosimeters, Analyzers and Signal Generators, Equipment for Data Acquisition, Noise and Vibration Measurements, Determination of Sound Power Level and Emission Sound Pressure Level, Sound Intensity Measurements, Noise and Vibration Data Analysis, Calibration of Measurement Microphones, Calibration of Shock and Vibration Transducers, Metrology and Traceability of Vibration and Shock Measurements.

Text Books

1. Clarence W. de Silva, "Vibration Monitoring, Testing and Instrumentation",CRC Press, 2007.
2. David A.Bies and Colin H.Hansen "Engineering Noise Control: Theory and Practice Spon Press", London, 2009.

References

1. Munjal M.L., "Acoustic Ducts and Mufflers", John Wiley, 2014.
2. Norton M P, "Fundamental of Noise and Vibration", Cambridge University Press,1998.
3. Allan G. Piersol ,Thomas L. Paez Harris "Shock and Vibration Handbook" , McGraw-Hill, New Delhi, 2010.

Web References

- https://en.wikipedia.org/wiki/Noise,_vibration,_and_harshness
- https://Griffin. Handbook of Human Vibration.

Course Code:140ME9113	**Course Title:**GAS DYNAMICS AND JET PROPULSION
Core/Elective: Elective (E)	**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):

- Engineering Thermodynamics
- Fluid Mechanics & Machinery
- Heat and Mass Transfer

Course Outcomes

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

CO1 Explain the basics and energy equations for compressible flow
CO2 Calculate the isentropic fluid flow properties with variable duct area
CO3 Evaluate fluid flow properties with normal shock wave in one dimensional flow
CO4 Identify fluid flow in constant area duct with heat transfer and friction
CO5 Describe the various types of Aircraft and Rocket Propulsion engines

Course Content

UNIT I BASICS OF COMPRESSIBLE FLOW 9

Basics-compressible flow, flow process and non-flow process, Mach number, Energy Equations-Energy Equation for Flow and Non- Flow process, adiabatic energy equation, stagnation states, various region of flow, Mach waves and Mach cone, reference velocities, Bernoulli equation.

UNIT II ISENTROPIC FLOWS 9

Isentropic and adiabatic processes-Mach number variation in Nozzle and diffuser-stagnation and critical states-area ratio as function of Mach number-impulse function-mass flow rate in terms of pressure ratio, area ratio, Mach number-flow through nozzles and diffusers.

UNIT III NORMAL SHOCK 9

Development of shock wave-Prandtl Mayer relation-variation of flow parameters across the normal shock-impossibility of shock wave in subsonic flow-Mach number of supersonic flow-supersonic wind tunnels- Introduction to oblique shock.

UNIT IV FLOW THROUGH DUCTS 9

Rayleigh flow-Rayleigh curve, Rayleigh flow equations, variable flow properties, maximum heat transfer

Fanno flow -Fanno curve, Fanno flow equations, variable flow properties, variation of Mach number with duct length.

UNIT V AIR CRAFT AND SPACE PROPULSIONS 9

Aircraft Propulsion- types-construction and working-ramjet engine, turbojet engine, turbofan engine, turbo propeller engine, Rocket Propulsion –types-construction and working-liquid propellant engine, solid propellant engine, hybrid propellant engine, nuclear propellant engine.

Text Book

1. S.M. Yahya, "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 2010.
2. V. Babu, "Fundamentals of a Propulsion", Ane's Books Pvt. Ltd., 2009

References

1. H. Cohen, G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory", Pearson India, 2001.
2. Anderson, J.D., "Modern Compressible flow", McGraw Hill, 3rd Edition, 2012.
3. Robert D. Zucker, Oscar Biblarz, "Fundamentals of Gas Dynamics", John Wiley and Sons, 2002.

Web References

- http://nptel.ac.in/courses/112106166/

Course Code:140ME9114	**Course Title:** COMPUTATIONAL FLUID DYNAMICS
Core/Elective: Elective(E)	**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):

- Fluid Mechanics & Machinery
- Heat and Mass Transfer

Course Outcomes

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

CO1 Explain the governing equations, classification of partial differential equation, initial and boundary conditions.
CO2 Discretize governing equations using finite difference method.
CO3 Discretize governing equations using finite volume method.
CO4 Solve incompressible viscous flow problems using MAC and SIMPLE algorithms.
CO5 Discuss basics of turbulence, its modeling and boundary conditions in real life problems.

Course Content

UNIT I GOVERNING EQUATIONS 9

Introduction to fluid mechanics – Reynolds Transport Theorem- Continuity Equation – Momentum Equation - Energy Equation – Classification of PDE's – Initial and Boundary conditions.

UNIT II FINITE DIFFERENCE METHOD 9

Taylors Series – Forward, Backward and Central differencing schemes – FDM Formulation – Explicit scheme – FTCS and Dufort-Frankel method – Implicit scheme- Laasonen and Crank Nicolson method –1D Heat conduction –Problems - Errors (Qualitative).

UNIT III FINITE VOLUME METHOD 9

Introduction – 1D Steady state diffusion – 2D Steady state diffusion - 1D Steady state convection-diffusion - Central differencing schemes –UPWIND Scheme – Problems

UNIT IV VISCOUS FLOW 9

Incompressible flow using MAC and Simple algorithm - Stream function and Vorticity formulation for viscous incompressible flow. Two dimensional incompressible viscous flow.

UNIT V TURBULENCE AND ITS MODELLING 9

Introduction to turbulence- Turbulence models- One equation model - Mixing length model – Two equation model – K-Ɛ Model – Implementation of boundary condition in practical applications.

Text Book

1. Anderson D.A., Tannehil J.C, Pletcher R.H, "Computational Fluid Mechanics & Heat Transfer", Hemisphere Publishing Corporation, New York, 2004.
2. Versteeg H.K, Malalasekara W, "An Introduction to Computational Fluid Dynamics: The Finite Volume Method", Second Edition, Pearson Publishers, 2007.

References

1. Klaus A. Hofmann, Steve T. Chiang, "Computational Fluid Dynamics", Fourth Edition, Engineering Education System, 2000.
2. John D. Anderson, "Computational Fluid Dynamics: The Basics with Applications", First Edition, McGraw-Hill Education, 2012
3. Murlidhar.K.,Sunderrajan.T, "Computational Fluid Mechanics and Heat Transfer", Narosa Publishing House, 2008.

Web References

- http://nptel.ac.in/courses/112105045/
- http://www.cfd-online.com/

Course Code: 140ME9115	**Course Title:** DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENT
Core/Elective: Elective (E)	**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):

- Manufacturing Processes I
- Manufacturing Processes II
- Design of Machine Elements

Course Outcomes

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

CO1 Understand the process to plan and develop products.
CO2 List the process of collecting information and develop product specifications.
CO3 Discuss the concept generation, selection and testing processes.
CO4 Explain the concepts of industrial design and design for manufacture.
CO5 Describe the basics of prototyping, economic analysis and project planning.

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"., Marcel Dekker, New York 2005

References

1. Harry Peck , "Designing for Manufacture", Pitman Publishing, 1973
2. Dickson, John. R, and Corroda Poly, "Engineering Design and Design for Manufacture and Structural Approach", Field Stone Publisher, USA, 1999
3. Fixel, J. "Design for the Environment" McGraw hill., 2011

Web References

- http://www.nptel.ac.in/courses/112101005/

Course Code: 140ME9116	**Course Title:** PRODUCT DESIGN AND DEVELOPMENT
Core/Elective: Elective (E)	**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):

- Manufacturing Processes I
- Manufacturing Processes II
- Design of Machine Elements

Course Outcomes

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

CO 1 Understand the process to plan and develop products.

CO 2 List the process of collecting information and develop product specifications.

CO 3 Discuss the concept generation, selection and testing processes.

CO 4 Explain the concepts of industrial design and design for manufacture.

CO 5 Describe the basics of prototyping, economic analysis and project planning

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 customer

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 COMPONENT 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 PROTOTYPING & 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, 2011.
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 2012.

Web References

- http://users.encs.concordia.ca/~andrea/inse6411/Lecture2.pdf.
- http://www.me.umn.edu/courses/me4054/lecnotes/archive.html

Course Code: 140ME9117	Course Title:FAILURE ANALYSIS AND DESIGN
Core/Elective: Elective (E)	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):

- Strength of Materials
- Design of Machine Elements

Course Outcomes

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

CO1 Explain reliability concepts used in failure analysis
CO2 Describe different types of fracture failure
CO3 Explain the importance of fatigue fracture in design
CO4 Explain the corrosion and wear mechanism in failure analysis
CO5 Describe different types of creep failure

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.,2012.
2. George E Dieter, "Mechanical Metallurgy", McGraw Hill Book Company, 2013.

References

1. JaapSchijve, "Fatigue of Structures and Materials", Kluwer Academic Publishers, 2013.
2. ASM Metals Handbook, "Failure Analysis and Prevention", ASM Metals Park, USA, Vol. 10, 10th Edition, 1995.
3. Rajput R.K, "Engineering Materials& Metallurgy", S.Chand Publication, 2006.

Web Reference

- https://en.wikipedia.org/wiki/Failure_mode_and_effects_analysis
- https://en.wikipedia.org/wiki/Failure Modes_effects _and _criticality Analysis

Course Code:140ME9118	**Course Title:** MECHANICAL SYSTEM 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):

- Engineering Mathematics -I
- Numerical Methods

Course Outcomes

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

CO1 Understand the engineering process and system approach to formulate a problem.
CO2 Understand the system theories and system modeling concepts.
CO3 Apply the mathematical formulation in system design and optimization concepts.
CO4 Apply the decision analysis principles and system simulation concepts.
CO5 Apply the financial analysis to evaluate the system performance.

Course Content

UNIT I SYSTEM APPROACH AND PROBLEM FORMULATION 9

Engineering processes- Role of an Engineer in Mechanical system Design, Engineering Problem solving. System approach-Application of system concepts, Characteristics of systems, elements of systems, Types of systems. Problem formulation-Problems and forming models, nature of engineering problems, problem characteristics, problem environment, problem statement and techniques involved in defining a problem, a case study.

UNIT II SYSTEM THEORIES AND SYSTEM MODELING 9

System Theories-Black box approach, state theory approach, component integrated approach, decision theory approach. System Modeling-Need of modeling, modeling process, principles, modeling types-static physical model, dynamic physical model, static mathematical model, dynamic mathematical model, a case study on system modeling.

UNIT III MATHEMATICAL FORMULATION IN MECHANICAL DESIGN 9

Mathematical Formulation in System Design-Linear Programming Problem- Graphical method, Simplex method, Network Flow analysis- critical path method, and probability of completion time. Optimization Concepts-optimization in engineering applications, ingredients and classifications, statement of optimization, design vector, constraints, objective function, Optimization concept in single variable optimization and multi variable optimization problem.

UNIT IV DECISION ANALYSIS AND SYSTEM SIMULATION 9

Decision analysis-Elements of decision problem, decision making under certainty, decision making under uncertainty, decision models- quantitative methods, decision tree. System Simulation concepts- types of simulation models, simulation programs and languages, Monte Carlo simulation , waiting line simulation.

UNIT V SYSTEM EVALUATION 9

System evaluation-Request for proposals, Evaluation factors, stage of evaluation, Needs and benefits, Feasibility assessment, planning horizon. Financial analysis of system performance-Average rate of return method, Payback period, Balance sheet- profit and loss statement, a case study.

Text Book

1. R.C Mishra and Simant, "Mechanical System Design-PHI" learning New Delhi, 2009.
2. K.U. Siddiqui and Manojkumarsingh, "Mechanical system Design"-New Age international Publishers, 2010.

References

1. S.S.Rao "Engineering Optimization-Theory and Practice" New Age international Publishers, 1996.
2. S.Kalavathy "Operations Research" Vikas Publishing House,2012
3. Ramachandran Aryasry&VV.Ramana Murthy, "Engg Economics & Financial Accounting", Tata McGraw-Hill Company, NewDelhi, 2004.

Web References

- http://content.asce.org/files/pdf/team2010-2Mechanical_systems_designpresentation.pdf
- http://www.engr.mun.ca/~yuri/Courses/MechanicalSystems/Design.pdf
- http://www.coursera.org

Course Code: 140ME9119	Course Title: 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):

- Materials Science
- Strength of Materials
- Metallurgical Engineering.

Course Outcomes

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

CO1 Classify different types of Matrix and Reinforcements
CO2 Explain different types Fibres and Matrices
CO3 Explain different types of methods to fabricate composites
CO4 Explain the mechanics of Fibre reinforced composites
CO5 Explain the load bearing behavior of Composite structures.

Course Content

UNIT I INTRODUCTION 9

Definition – Classification of Composite materials based on structure – based on matrix.Advantages of composites – application of composites – functional requirements of reinforcement and matrix. Reinforcement types – Fibres – continuous, particulate and whisker reinforcements – Properties -Applications – Comparison of fibre strengths –. Matrix materials – Properties. Wettability fibre with matrix – Effect of surface roughness – Interfacial bonding

UNIT II REINFORCEMENTS AND MATRICES 9

Different types of fibers - Manufacturing , properties and applications of glass fibers, carbon fibers,
Kevlar fibers. Thermoset and thermoplastic matrices - properties of polyester, epoxy and nylon matrices , polypropylene and PEEK matrices

UNIT III MANUFACTURING OF COMPOSITES 9

Polymer matrix composites: Preparation of Moulding compounds and pre-pregs – hand lay up method – Autoclave method – Filament winding method – Compression moulding – Reaction injectionmoulding.

UNIT IV 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, Inter laminar stresses.

UNIT V COMPOSITE STRUCTURES 9

Fatigue – S-N curves – Fatigue behaviors of CMCs – Fatigue of particle and whisker reinforced composites. Introduction to structures - selection of material, manufacturing and laminate configuration -design of joints - bonded joints - bolted joints - bonded and bolted

Text Book

1. Krishnan K.Chawla, "Composite Materials Science and Engineering", Springer 2006.
2. Mallick, P.K., "Fiber Reinforced Composites: Materials, Manufacturing and Design",Manee Dekker Inc, 2007.

References

1. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites",John Wiley and Sons, New York, 2012.
2. Gibson, R.F., "Principles of Composite Material Mechanics", McGraw-Hill, 2011.
3. Srinivasan K , "Composite Material" NarosaPublication , 2009.

Web References

- http://nptel.ac.in/courses/101104010/
- http://nptel.ac.in/courses/Webcourse-contents/IISc BANG/Composite%20Materials/New_index1.html

Course Code:140ME9120	Course Title: COMPUTER INTEGRATED MANUFACTURING
Core/Elective:Elective	L : T : P : C : M – 3 : 0 : 0 : 100
Type: Lecture	Total Contact Hours: 45

Prerequisites

The student should have undergone the course(s):

- Manufacturing Processes I
- Manufacturing Processes II

Course Outcomes

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

CO1 Explain NC, DNC and CNC used in CIM.

CO2 Apply the features of CAD System in design and modeling.

CO3 Explain the role of AGVs, AS/RS and Robots in material handling and Storage System.

CO4 Describe Group Technology and Classification of Coding system.

CO5 Explain Artificial Intelligent system, Expert system and FMS.

Course Content

UNIT I INTRODUCTION TO CIM 9

Automated Manufacturing system – Needs, Types. CIM - CIM wheel - Components, Evolution, needs, Benefits. NC system - Components, NC motion control system, application, advantages and disadvantages. Computer Numerical control System – Components, functions, advantages. Direct Numerical Control System – Components, functions, advantages.

UNIT II COMPUTER AIDED DESIGN 9

Concept of CAD as drafting and designing facility, desirable features of CAD package, drawing features in CAD – Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate. - typical CAD command structure - Types CAD modeling - wire frame modeling, surface modeling and solid modeling.

UNIT III MATERIAL HANDLING AND STORAGE SYSTEMS 9

Materials handling and Storage Systems - Automated storage and retrieval systems, carousel storage systems - Interfacing of Handling and Storage with Manufacturing system. AGVs - types, advantages and application. Robot – Basic concepts, applications.

UNIT IV GROUP TECHNOLOGY 9

GroupTechnology - RoleofG.TinCAD/CAM Integration, partfamilies, part Classificationandcoding–DCLASSandMICLASSandOPITZcodingsystems - facility designusingG.T, benefitsofG.T - Cellular Manufacturing.

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UNIT V ARTIFICIAL INTELLIGENT SYSTEM, EXPERT SYSTEM AND FMS 9

Artificial Intelligence System, Basic concepts of Artificial intelligence, Intelligent systems and expert systems. Flexible manufacturing systems – Configurations, workstations, planning, applications and benefits – Automated inspection and testing - Machine vision.

Text Book

1. Mikell. P. Groover "Automation, Production Systems and Computer Integrated Manufacturing", Pearson Education 2015.
2. Mikell. P. Groover and Emory ZimmersJr.,"CAD/CAM", Prentice hall of India Pvt. Ltd., 2013.

References

1. James A. Regh and Henry W. Kreabber, "Computer Integrated Manufacturing", Pearson Education second edition, 2005.
2. Chris McMahon and Jimmie Browne, "CAD CAM Principles, Practice and Manufacturing Management", Pearson Education second edition, 2005.
3. Ranky, Paul G., "Computer Integrated Manufacturing", Prentice hall of India Pvt. Ltd., 2005.

Web References

- https://en.wikipedia.org/wiki/Computer-integrated_manufacturing
- https://en.wikipedia.org/wiki/Computer-aided_manufacturing
- https://en.wikipedia.org/wiki/Integrated_Computer-Aided_Manufacturing
- http://www.simflow.net/publications/books/cimie-part1.pdf
- https://prezi.com/tnl5tme5rwr6/computer-integrated-manufacturing-cim

Course Code: 140ME9121	Course Title:NON-DESTRUCTIVE TESTING METHODS
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):

- Engineering Metrology and Measurements.

Course Outcomes

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

CO1 Explain Visual Inspection and Eddy Current Testing Method.
CO2 Apply the Magnetic Particle Testing Method to identify the defects in ferrous metals.
CO3 Use Liquid Penetrant Testing Method to identify the defects in different components.
CO4 Apply the Ultrasonic Testing Method to identify the defects in different components.
CO5 Describe Radiographic Testing Method

Course Content

UNIT I VISUAL INSPECTION AND EDDY CURRENT TESTING METHOD 9

Scope and advantages of NDT-Compare NDT with DT-Principle of Visual Inspection theory-Optical aids used for Visual Inspection-Microscope, Boroscope, Endoscope, Flexiscope, Telescope and Hollography- Principles of Eddy Current Theory-surface mounted coils-Encircling coils-types of Probes-Eddy current sensing Probes-Flux leakage sensing Probes-Eddy Current Techniques, Advanced Eddy Current Techniques-applications, Limitations and standards.

UNIT II MAGNETIC PARTICLE TESTING METHOD 9

Basic Principle of magnetic particle testing(MPT)-induced magnetic fields-circular and longitudinal fields-Hysteresis curve-magnetic flux strips and coils-residual fields and demagnetization-MPT techniques-magnetization using a permanent magnet, magnetization using a Electro magnet, contact current flow method, wet and dry particle inspection methods, remote magnetic particle inspection, probe power inspection, light weight UV lamps inspection, semi automatic inspection, applications and limitations of MPT.

UNIT III LIQUID PENETRANT TESTING METHOD 9

Physical properties of liquid penetrant-penetrant testing materials-penetrants,cleaners,emlusifiers developers, lint free cloth-Basic Principle, applications and limitations of liquid penetrant testing(LPT)-different LPT methods-Post-Emulsification Fluorescent penetrant process, Reverse Fluorescent Dye penetrant process, Visible Dye penetrant process, Water-Emulsification visible Dye penetrant process, solvent clean visible Dye penetrant process.

UNIT IV ULTRASONIC TESTING METHOD 9

Basic properties of sound beam-sound waves-velocity of ultrasonic waves, Acoustic Impedencebehaviour of ultrasonic waves-ultrasonic transducers-characteristics of ultrasonic beam, Flaw sensitivity, Beam divergence, Attenuation-Principle of ultrasonic testing methods, applications and limitations-Ultrasonic testing method-normal incident pulse echo inspection method, normal incident through transmission testing method, angle beam pulse echo inspection method.

UNIT V RADIOGRAPHIC TESTING METHOD 9

Basic Principle of Radiography-Electromagnetic radiation sources-X ray source, Gamma ray source-properties of X and Gamma rays-Radiographic Imaging-Geometrical factors-radiographic film-film density-Radiographic sensitivity- Penetrameter-Radiographic Inspection Techniques-single wall single image technique, wall penetration technique, Latitude technique-Applications and Limitations of Radiographic Inspection Techniques.

Text Book

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu,"Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. J Prasad, C G K Nair, "Non-Destructive Testing and Evaluation of Materials", Tata McGraw-Hill
   Education Private Limited, 2003.

References

1. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International
   Publishers, 2010.
2. American Metals Society, "Non-Destructive Examination and Quality Control", Metals Hand Book, Vol.17, 9th Edition, Metals Park, 1989.
3. Paul Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition,New Jersey,2005.

Web References

- https://www.nde-ed.org/index_flash.htm
- http:// http://117.55.241.6/library/E-Books/NDT%20Notes.pdf
- http:// www.slideshare.net/ndtindia123/introduction-uses-of-non-destructive-testing-24377016
- http:// www.eis.hu.edu.jo/ACUploads/10526/Ultrasonic%20Testing.pdf
- http://www.hse.gov.uk/comah/sragtech/ndt2.pdf

Course Code:140ME9122	Course Title: LEAN 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):

- Manufacturing Processes I
- Manufacturing Processes II

Course Outcomes

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

CO1 Explain the need for Lean Manufacturing.
CO2 Describe the tools and methodologies of Lean Manufacturing.
CO3 Describe the value stream management in Lean Manufacturing.
CO4 Explain the implementation of Lean Manufacturing in manufacturing and service industries.
CO5 Calculate the various lean metrics.

Course Content

UNIT I INTRODUCTION TO LEAN MANUFACTURING 7

Manufacturing systems-Types-Ford Production System, Lean Manufacturing Paradigm-History of Lean Manufacturing-Traditional Vs Lean Manufacturing, TQM vs. Lean, Toyota Production System. Lean Principles-Value Added Activities-Non-Value Added Activities-Necessary Non-Value added Activities- 3Ms-Muda, Mura and Muri-Types of wastes, Lean objectives-Need for lean manufacturing.

UNIT II LEAN TOOLS AND METHODOLOGIES 9

Problem solving tools-Cause and Effect Diagram, Pareto analysis, FMEA, Work cell and equipment management tools- Process Mapping, Spaghetti diagram, U shaped Layout, Poke Yoke, Kanban , Andon, SMED, One Piece Flow , GenchiGenbutsu, Milk run , Visual workplace, Quality at the source Methodologies-Pillars of Lean Manufacturing-Just in Time, Jidoka, 5S, TPM, Six sigma, DFMA, Kaizen.

UNIT III VALUE STREAM MANAGEMENT 10

Value stream Mapping-Value stream icons-Road map-Current State, Future State-Demand stage-Market Dynamics, Customer Demand; PQ Analysis; PR Analysis; Takt Time; Pitch; Finished Goods Stock, Cycle Stock Buffer Stock; Safety Stock-Flow Stage-Continuous flow, work cells,

Line balancing, Standardized work, Quick change over, Autonomous maintenance, In process Super markets, Kanban systems, FIFO Lanes, Production Scheduling, Leveling Stage-Paced Withdrawal, Heijunka(Load Leveling), Heijunka Box, The Runner-a Case Study.

UNIT IV LEAN IMPLEMENTATION 10

Training Stage-Management Commitment, Identify the value stream manager/Champion and core Implementation team Members, Training of team members, Planning stage-Customer Focus, Go to the floor, Hosin Planning, Brain storming, Prepare Tree Diagram, Select the cross functional team, Prepare project plan, Improvement stage-Production and Productivity-Operator, Process, Machinery and Equipment, Work place Organization, Inventory management, Planning and Procurement of Materials, A case study on Lean implementation in manufacturing and service industries.

UNIT V LEAN METRICS 9

Lean Metrics-the fundamentals, steps in identifying Lean Metrics, WIP inventory, Total Product cycle time, Total value stream lead time, On time delivery, Defective PPM, Uptime, OEE, Throughput rate, Through put yield, Utilization rate, Lean Manufacturing assessment-Radar Chart-a case study.

Text Book

1. Don Tapping, Tom Luyster, and Tom Shuker, "Value stream Management Eight steps to planning", Mapping and sustaining Lean Improvements, Productivity Press,New York, ,2002.
2. N.Gopalakrishnan, "Simplified Lean Manufacture Elements, Rules", Tools and Implementation, PHI Learning, New Delhi, 2010.

REFERENCES

1. James P. Womack, Daniel T Jones, Daniel Ross "The Machine That Change the world", Free Press trade paperback edition, U.S.A, 2007.
2. Ronald G. Askin& Jeffrey B.Goldberg, "Design and Analysis of Lean Production Systems",2003, John Wiley & Sons,2003.
3. Rother M. and Shook J, "Learning to See: Value Stream Mapping to Add Value and Eliminate Muda" , Lean Enterprise Institute, Brookline, MA,1999.

Web References

- https:// www.learning –to-see.co.uk.
- https://www.lean.org.
- https://www.leanproduction.com.

Course Code:140ME9123	Course Title: UNCONVENTIONAL MACHINING PROCESSES
Core/Elective: Elective (E)	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):

- Manufacturing Processes I
- Manufacturing Processes II

Course Outcomes

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

CO1 Classify Unconventional Machining Processes.

CO2 Compare various Mechanical energy based unconventional machining processes

CO3 Compare various Electrical energy based unconventional machining processes

CO4 Compare various Chemical & Electro chemical energy based unconventional machining processes

CO5 Compare various Thermal energy based unconventional machining processes processor

Course Content

UNIT I INTRODUCTION 9

Need for unconventional machining process-Advantages of UCM - Disadvantages of UCM - Comparison of conventional and unconventional machining processes - Process parameters - Processes based on type of energy required to shape the material- Processes based on mechanism of material removal- Processes based on transfer media- Processes based on source of energy

UNIT II MECHANICAL ENERGY BASED UCM PROCESSES 9

Principle of Mechanical energy based UCM Processes - Mechanical energy based unconventional machining processes: Ultrasonic machining process, Abrasive Jet machining process, Water Jet Machining process - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Mechanical energy based unconventional machining processes

UNIT III ELECTRICAL ENERGY BASED UCM PROCESSES 9

Principle of Electrical energy based UCM Processes - Electrical energy based unconventional machining processes: Electric Discharge machining - Principle, Layout of EDM process, Functions and types of dielectric fluid, Properties of different tool materials, Working of R-C (Relaxation) circuit, R-C-L circuit, rotary pulse generator circuit, controlled pulse generator

circuit, Process parameters in EDM Process, Mechanism of metal removal, Applications, Advantages and Disadvantages. Wire cut EDM (WCEDM) process: Layout, Construction and working of various elements, Applications, Advantages and Disadvantages. Drilling and Die sinking by EDM process. Comparison of Electrical energy based unconventional machining processes

UNIT IV CHEMICAL & ELECTRO CHEMICAL ENERGY BASED UCM PROCESSES 9

Principle of Chemical & Electro chemical energy based UCM Processes - Chemical & Electro chemical energy based unconventional machining processes: Chemical machining, Electro chemical machining, Electro chemical grinding, Electro chemical honing processes - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Chemical & Electro chemical energy based unconventional machining processes

UNIT V THERMAL ENERGY BASED UCM PROCESSES 9

Principle of Thermal energy based UCM Processes - Thermal energy based unconventional machining processes: Electron Beam machining (EBM), Laser Beam machining (LBM), Plasma Arc machining (PAM) processes - Principle, Working of various elements, Mechanism of metal removal, Applications, Advantages and Disadvantages. Comparison of Thermal energy based unconventional machining processes

Text Book

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi ,2007.

References

1. Benedict.G.F."Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York ,1987.
2. 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.
3. Ghosh and Malik, "Manufacturing Science", 1st ed., EWP Private Ltd., 2008.

Web References

- https://en.wikipedia.org/wiki/Machining
- https://en.wikipedia.org/wiki/Laser_beam_machining
- https://en.wikipedia.org/wiki/Electrical_discharge_machining
- http://mechteacher.com/manufacturing-technology/
- http://www.engineershandbook.com/MfgMethods/nontraditionalmachining

Course Code: 140ME9124	**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):

- Manufacturing Processes I
- Kinematics of Machinery
- Electrical Drives & Controls
- Manufacturing Processes II

Course Outcomes

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

CO1 Explain the fundamentals of robot.
CO2 Describe the working of various robot drive systems and end effectors
CO3 Discuss the working principle of various sensors.
CO4 Explain the concepts of robot kinematics and robot programming.
CO5 Understand the implementation of robotics in industries.

Course Content

UNIT I FUNDAMENTALS OF ROBOT 7

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 10

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 10

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 10

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 8

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, 2012.
2. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 1987

References

1. YoramKoren, "Robotics for Engineers", McGraw-Hill Book Co., 1992
2. Janakiraman.P.A., "Robotics and Image Processing", Tata McGraw-Hill, 1995
3. S.R.Deb and ShankaDeb "Robotics Technology and Flexible Automation", Tata McGraw Hill,2009.

Web References

- http://www.cdeep.iitb.ac.in/nptel/Mechanical/Robotics%20Course/TOC.htm
- http://nptel.ac.in/video.php?subjectId=112101099

Course Code: 140ME9125	Course Title: RAPID PROTOTYPING AND TOOLING
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):

- Manufacturing Processes I &II

Course Outcomes

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

CO1 Understand the importance of Rapid Prototyping Technology over the existing traditional methods in present competitive scenario in terms of product development cycle and cost.

CO2 Explain various liquid based and solid based rapid prototyping systems.

CO3 Explain data preparation for rapid prototyping technologies.

CO4 ExplainThree Dimensional Printing process.

CO5 Explain the classification of Rapid tooling and case studies on applications in industries

Course Content

UNIT I INTRODUCTION 6

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 10

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 10

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 10

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. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Second edition, World Scientific Publishers, 2010
2. Pham,D.T. &Dimov.S.S., "Rapid manufacturing", Springer-Verlag, 2001.

References

1. Andreas Gebhardt, Hanser "Rapid prototyping", Gardener Publications, 2003.
2. LiouW.Liou, Frank W.Liou, "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007.
3. Paul F Jacobs, "Rapid Prototyping and manufacturing – Fundamentals of Streolithography", Society of Manufacturing Engineering Dearborn, 1992.

Web References

- https://www.nde-ed.org/index_flash.htm

Course Code: 140ME9126	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):

- Manufacturing Processes I
- Manufacturing Processes II

Course Outcomes

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

CO1 Understand the concept of plant layout and required equipments for plant operations

CO2 Explain the techniques for developing various types of layouts and layout planning procedure

CO3 Identify the suitable environment for industrial buildings and utilities

CO4 Understand the benefit of an efficient material handling system

CO5 Understand difficulties in material handling system on process layout

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 equipments, 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 lines

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 palletization.

UNIT V ANALYSIS OF MATERIAL HANDLING 9

Factors involved – motion analysis, flow analysis, graphical analysis, safety analysis, equipment cost analysis, palletization analysis, analysis of operation, material handling surveys – Designing of material handling systems – System equation - Planning chart, Unit load design – principle - efficiency of containers, pallet sizes

Text Book

1. G.K Agrawal, "Plant Layout and Material Handling", Jain Publishing, 2012
2. Khanna, O. P., "Industrial Engineering and Management", Dhanpatrai and Sons, 2003.

References

1. James A. Tompkins , John A. White, Yavuz A. Bozer and J. M. A. Tanchoco "Facilities Planning", 3rd edition , John Wiley & Sons, 2003.
2. Fred E Meyers, "Plant Layout and Material Handling", 2nd edition, Prentice Hall, 1999.
3. James MacGregor Apple, "Plant Layout and Material Handling", Wiley Publishing, 1977.

Web References

- https://en.wikipedia.org/wiki/Plant_layout_study
- https://en.wikipedia.org/wiki/Material_handling
- http://nptel.ac.in/courses/Webcourse-contents/IIT-Delhi/project%20and%20production%20management/mod7/mod73.htm

Course Code: 140ME9127	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):

- Manufacturing Processes I
- Manufacturing Processes II
- Engineering Material Science

Course Outcomes

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

CO1 To understand the properties, design and behaviour of various micro materials.
CO2 To analyze the microscopic and macroscopic properties of micro materials.
CO3 To understand the concept of various micro fabrication process.
CO4 To impart the principles of different micro machining process.
CO5 To understand the principles and applications of Micro Electro Mechanical Fabrication Systems.

Course Content

UNIT I INTRODUCTION 9

Introduction to Micro System design, Material properties, micro fabrication Technologies. Structural behavior, sensing methods, micro scale transport – feed back 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 8

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 10

Theory of micromachining-Chip formation-size effect in micromachining-micro-turning, micro-milling, 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. Sámi Franssila, "Introduction to Micro Fabrication", John Wiley and sons Ltd., UK, 2004,
2. Jain V.K, "Micro manufacturing Processes", CRC Press, 2012.

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.

Web References

- https://en.wikipedia.org/wiki/Microfabrication
- http://www.micromanufacturing.net/didactico/Desarollo/microforming/1-introduction

Course Code: 140ME9128	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):

- Manufacturing Processes I
- Manufacturing Processes II

Course Outcomes

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

CO1 Understand the basic concepts of process planning.

CO2 Evaluate the various approaches of manual and computer aided process planning and costing.

CO3 Understand the different components involved in direct and indirect costs .

CO4 Analyze the cost calculation methods of different manufacturing process.

CO5 Understand the concept of Break Even Analysis & Cost Management.

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 8

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 10

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, 2010.

References

1. Russell R.S and Tailor B.W, "Operations Management", PHI, 4th Edition, 2003.
2. Chitale A.V and Gupta R.C, "Product Design and Manufacturing", PHI, 2nd Edition, 2002.
3. Kesavan R "Process Planning and Cost Estimation", New Age International Pvt. Ltd., Chennai, 2005.

Web References

- https://en.wikipedia.org/wiki/Planning
- http://nptel.ac.in/courses/Webcourse-contents/IIT Delhi/Computer%20Aided%20Design%20&%20ManufacturingII/Module%20G/Module%20G(5)/p3.htm
- https://en.wikipedia.org/wiki/Cost_estimate

Course Code: 140ME9129	**Course Title:** PRODUCTION PLANNING AND CONTROL
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):

- Manufacturing Processes - I
- Manufacturing Processes - II
- Engineering economics and cost analysis.

Course Outcomes

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

CO1 Outline the fundamentals of production planning control.

CO2 Apply work measurement techniques and method-study for productivity improvement.

CO3 Infer steps in product planning using product information.

CO4 Solve Problems related to production scheduling.

CO5 Discuss the effect of demand on inventories and recent trends in production process control

Course Content

UNIT I INTRODUCTION 9

Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect - Functional aspects- Operational aspect-Durability and dependability aspect-aesthetic aspect. Profit consideration- Standardization, Simplification & specialization-Break even analysis-Economics of a new design.

UNIT II WORK STUDY 9

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

UNIT III PRODUCT PLANNING AND PROCESS PLANNING 9

Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing - Pre requisite information needed for process planning - Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi-product system.

UNIT IV PRODUCTION SCHEDULING 9

Production Control Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problems - Line of balance - Flow production scheduling- Batch production scheduling-Product sequencing - Production Control systems-Periodic batch control- Material requirement planning kanban – Dispatching-Progress reporting and expediting-Manufacturing lead time-Techniques for aligning completion times and due dates.

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system -Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis-Recorder procedure-Introduction to computer integrated production planning systems- elements of Just in time systems Fundamentals of MRP II and ERP.

Text Book

1. MartandTelsang, "Industrial Engineering and Production Management", First Edition,S. Chand and Company, 2006.
2. James.B.Dilworth,"Operations Management – Design, Planning and Control for manufacturing and services" McGraw Hill International Edition 1992.

References

1. Andrew Sloss, Dominic Symes& Chris Wright, "ARM system Developer's guide", Elsevier,2005.
2. Samson Eilon, "Elements of Production Planning and Control", Universal Book Corpn.1984
3. Elwood S.Buffa, and RakeshK.Sarin, "Modern Production / Operations Management", 8th Ed. John Wiley and Sons, 2000.

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Web References

- http://www.managementstudyguide.com/production-planning-and-control.htm
- http://www.tandfonline.com/toc/tppc20/current
- http://infocenter.arm.com/help/index.jsp
- http://www.yourarticlelibrary.com/production-management/elements-of-production-planning-and-control-in-an-organization/26170/

Course Code:140ME9130	**Course Title:** TRANSPORT MANAGEMENT
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

Course Outcomes

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

CO1 Explain the legislative laws governing the use of motor vehicle
CO2 Explain the types of vehicle insurance and the importance of road safety
CO3 Explain the operation of passenger transport system
CO4 Explain the operation of goods transport system
CO5 Describe taxation and traffic management

Course Content

UNITI MOTORVEHICLEACT 9

Motor Vehicle Act: Short titles & definitions, Laws governing to use of motor vehicle & vehicle transport, Licensing of drivers & conductors, Registration of vehicle, State & interstate permits, Traffic rules, Signals & controls, Offences, penalties & procedures, Different types of forms. Government administration structure, Personnel, Authorities &duties,Rules regarding construction of motorvehicles

UNITII INSURANCE ANDROAD SAFETY 9

Insurance types & significance, Comprehensive, Third party insurance, Furnishing of particulars of vehicles involved in accident, MACT (Motor Accident Claims Tribunal), Solatium Fund, Hit & Run case, Duty of driver in case of accident, Surveyor & Surveyor's report

UNIT III PASSENGERTRANSPORTOPERATION 9

Structure of passenger transport organizations, typical depot layouts, requirements, Fleet maintenance -Scheduling operation &control.Propaganda, passenger amenities, Parcel traffic. Theory of fares, Basic principles of fare charging , Needs, straight and tapered scales,Differential rates for different types of services, Depreciation & debt charges, operation cost, Economics & records.

UNIT IV GOODSTRANSPORTOPERATION 9

Structure of goods transport organizations, Typical depot layouts, requirements ,scheduling of goods transport, materials Handling equipments in the goods transport operation, , storage & transportation of petroleum products

UNIT V TAXATION AND TRAFFIC MANAGEMENT 9

Objectives, Structure & methods of laving taxation, One-time tax, Tax Exemption & tax renewal, Global positioning system- Traffic navigation, advanced traffic control devices.

Text Books

1. "Motor Vehicle" Act - Govt. of India Publications.
2. Santosh Sharma, "Productivity in Road Transport", 2nd Edition, Association of State Roadtransport Undertakings, New Delhi.

Reference Books

1. P.G.Patankar, "Road Passenger Transport in India", CIRT,Pune.
2. S.K.Srivastava, "Transport Development in India", S. Chand & Co. Pvt. Ltd., New Delhi.
3. Edmund J. Gubbins "Managing Transport Operations", Kogan Page Publishers, 2003.

Web References

- https://en.wikipedia.org/wiki/Transportation_management_system

Course Code:140ME9131	Course Title: INSTRUMENTATION AND CONTROL
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):

- Engineering Metrology and measurements
- Electrical drives and controls

Course Outcomes

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

CO1 Explain the working of various measuring instruments used in automobiles.
CO2 Describe the working of engine system analyzer
CO3 Explain wheel alignment, wheel balancing and wind tunnel testing
CO4 Explain NVH measurement and chassis dynamometers
CO5 Explain the basics of control systems in automotive applications

UNIT I INTRODUCTION 10

Transducers, types, thermistor, LVDT, inductive pickup, capacitance, strain gauges, semiconductors, photocells, piezoelectric accelerometer, proximity sensors, micro switches, encoders, piezo-electric pressure sensors, instruments, ammeter, voltmeter, odometer, speedometer, fuel level indicator, pressure gauge, vacuum gauge, analog and digital, calibration, cathode ray oscilloscope, study of microprocessors 8085, micro controller, PLC.

UNITII ENGINESYSTEMANALYZER 10
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Introduction, exhaust gas analyzer, emission norm standards, flasher instrumentations, accelerometer, real time DAQ , fuel injection calibration, calibration rig ignition timer calibration, stroboscope, smoke meter, macro inspection of interior parts using fiber optics.

UNIT III CHASSISINSTRUMENTATION 8

Introduction Wheel alignment gauges, laser alignment, measurement different wheel parameters system wheel balancing, calibrations, wind tunnel testing and drag estimation and profile optimization

UNIT IV NVH, DYNAMOMETERSANDGAUGES 8

Sound level meters, acoustic measurement, FFT analyzer**,** anechoic chamber, varechoic chamber, sound level measurements, NVH standards. Torque measuring instruments, Study of different dynamometers, chassis dynamometer for two and four wheelers

UNITV CONTROLSYSTEMSFUNDAMENTALS 9

Basics of controls systems –different types , PID controller, sliding mode control- design and analysis, automotive applications of control systems

Text Books

1. Beckwith T G and Buck N L "Mechanical Measurements" Wesley publishing company limited, USA,2006.
2. UWE Kiencke , Lars Nielsen "Automotive control systems" Springer, 2005.

References

1. Peter Elgan "Sensors for Measurements and control", 2nd edition, Pearson Education Limited, England,2001.
2. Longman "TecQuipmentmanual" Patent No. 20070261482, In-cylinder pressure detection device and method for internal combustion engine.
3. Holman "Experimental methods for engineers", McGraw hill publishing company,1994.

Web References

- https://www.prospects.ac.uk/job-profiles/control-and-instrumentation-engineer
- http://www.iicta.org/

Course Code: 140ME9132	Course Title: ALTERNATIVE FUELS AND ENERGY SYSTEMS
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):

- Power plant Engineering
- Thermal Engineering

Course Outcomes

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

CO1 Describe the different types of alternate energy sources and fuels
CO2 Explain the performance and emission characteristics of IC engines with alcoholic Fuels
CO3 Explain the Performance and emission characteristics of LPG, LPG in SI and CI Engines
CO4 Explain the Performance and emission characteristics of vegetable oils in IC engines
CO5 Explain the layout and working of electric, hybrid, fuel cell and solar cars

UNIT I INTRODUCTION 9

Alternate energy sources

Introduction to alternate energy sources, Man and energy, energy forms, Need for alternate sources of energy, availability, Merits and demerits. Scope of alternate energy sources in India, Energy management, Global Energy Issues, National & State Level Energy Issues

Alternate fuels

Need for alternate fuel, Availability and properties of alternate fuels, General use of alcohols LPG, hydrogen, ammonia, CNG and LNG, vegetable oils, biogas, EV, hybrid vehicles, Fuel cells and solar cells ,Merits and demerits of alternate fuels,

UNIT II ALCOHOLS 9

Properties as engine fuels, alcohols and gasoline blends, Performance in SI engine using methanol blends, Performance in SI engine using gasoline blends, Combustion characteristics in CI engine, Emission characteristics, DME, DEE properties, Performance analysis of DME, DEE, Performance in SI engine, Performance in CI engine

UNIT III NATURAL GAS, LPG, HYDROGENANDBIOGAS 9

Availability of CNG, properties, Modification required to be done in engines for CNG Performance and emission characteristics of CNG, Performance and emission characteristics of LPG, LPG in SI and CI engines, Hydrogen storage and handling, Performance and safety aspects. Biogas, Properties, production methods, Performance and emission characteristics

UNIT IV VEGETABLEOILS 9

Various vegetable oils for engines, Etherification process in vegetable oils, Performance of engines using vegetable oils, Performance and emission characteristics of a engine using vegetable oils, Bio-diesel and its characteristics

UNIT V ELECTRIC, HYBRID, FUEL CELL AND SOLARCARS 9

Layout of electric vehicles, Advantages and limitations of electric vehicles, Specifications and system components, Electronic control system, High energy and power density batteries, Hybrid vehicles, Fuel cell vehicles, Solar powered vehicles

Text Book

1. Richard.L.Bechtold, "Alternative Fuels Guide Book", SAE, 1997.
2. G.D. Rai, "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 1999.

References

1. Nagpal, "Power Plant Engineering", Khanna Publishers, 1991.
2. MaheswarDayal, "Energy today & tomorrow", I & B Horishr India, 1982.
3. "Alcohols as motor fuels progress in technology", Series No.19, SAE Publication,1980

Web References

- https://en.wikipedia.org/wiki/Alternative_fuel

Course Code: 140ME9133	**Course Title:** REFRIGERATION AND AIR-CONDITIONING
Core/Elective: Elective(E)	**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):

- Engineering Thermodynamics
- Thermal Engineering

Course Outcomes

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

CO1 Evaluate the performance of refrigeration cycles and selection of refrigerants for specific applications
CO2 Explain the various components of Vapour compression refrigeration systems
CO3 Calculate the heating and cooling loads in an air conditioning system
CO4 Discuss the various applications of refrigeration and air conditioning systems
CO5 Describe the basic installation and servicing methods used in refrigeration and air conditioning systems

Course Content

UNIT I REFRIGERATION 9

Thermodynamic principles of refrigeration – Types of Refrigeration Systems – Vapour compression refrigeration cycle, use of Ts and P-H diagrams, Performance calculation – Refrigerants: Primary& secondary refrigerants, Nomenclature of Refrigerants, properties and selection – Environment friendly alternatives.

UNIT II COMPONENTS OF REFRIGERATION SYSTEM 9

Refrigerant Compressors- Different Types, Performance, Capacity Control – Evaporators, Evaporators Circuitry, Different Types and application – Condensers- Types-air cooled- water cooled - evaporative condensers- Optimum Cooling Water Rate and Velocity – Expansion Devices.

UNIT III AIR CONDITIONING SYSTEM AND ITS COMPONENTS 9

Characteristics of Human comfort condition – Different types of Air Conditioner , Construction Details of Room Air Conditioner , Window Type, Package Type, Split Type Central Units – Automotive Heater –Air conditioning Equipments , air filters , humidifiers & dehumidifiers, fans & blowers , control system – Thermal insulation and Ventilation in air conditioning system – Types of load - Cooling Load Calculations, Air Distribution Patterns.

UNIT IV APPLICATION OF REFRIGERATION AND AIR CONDITIONING SYSTEMS 9

General layout, Working Principle, Advantages & Disadvantages - Food Preservation, Food Storage & Distribution - Beverage Coolers, LNG – Ice Manufacturing – Solar Air Conditioning, Solar dehumidifier – Automobile air conditioning, Refrigerated trucks, Aircraft air conditioning, Railway Refrigerator Cars, Marine Air conditioning

UNIT V INSTALLATION AND SERVICING 9

Duct installation - Charging of refrigerant - Servicing of central, packaged, split air-conditioning, – Safety procedures, Leak detection procedures- safety controls, trouble shooting. – Basic Elements of Control systems - temperature control, Bimetal thermostat, Electric resistance thermostat, Electronic thermostat- Humidity control elements- Automatic Dew point recorder - Energy conservation methods.

Text Book

1. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International, 2004
2. Arora. C.P., "Refrigeration and Air conditioning", 2nd edition. Tata McGraw-Hill, 2000.

References

1. Dossat, R.J. "Principles of Refrigeration", Prentice-Hall, 1997.
2. Stoecker N.F and Jones, "Refrigeration and Air Conditioning", McGraw Hill Education (Asia) 2nd Edition 2001
3. ASHRAE 2012 Hand book (Fundamentals &Equipments)

Web References

- http://nptel.ac.in/courses/112105128/
- https://www.ashrae.org/

Course Code:140ME9134	**Course Title:** TOTAL PRODUCTIVE MAINTENANCE
Core/Elective: Core	**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):

- Manufacturing Processes I
- Manufacturing Processes II

Course Outcomes

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

CO1 Describe modern maintenance concepts and practices
CO2 Apply analytical tools in maintenance management
CO3 Apply Reliability Centered Maintenance for industrial systems
CO4 Illustrate TPM and global trends in maintenance management
CO5Demonstrate use of simple instruments used for condition monitoring in maintenance

Course Content

UNIT I MODERN MAINTENANCE CONCEPTS AND PRACTICES 9

Maintenance definition –Maintenance management – Maintenance Concepts: Objectives, Organization and Functions of Maintenance, Maintenance strategies, Types of Maintenance – Maintenance systems – (Planned, Unplanned / Breakdown, Corrective, Opportunistic, Routine, Preventive, Predictive, Condition based maintenance systems),Maintenance planning and scheduling, Maintenance Logistics, Human factors in Maintenance and Staffing methods, Maintenance manuals, Maintenance costs

UNIT II ANALYTICAL TOOLS IN MAINTENANCE MANAGEMENT 9

Failure Data Analysis, MTBF,MTTF, Useful life-Survival curves, Repair time, Breakdown time distributions- Poisson's, Normal, Exponential,Availability, Reliability, Maintainability, Maintainability prediction – System effectiveness- Overhaul / Repair / Replace maintenance policy, Queuing applications, simulation, spare parts management, Replacement Decisions: Optimal interval between preventive replacements, Overall Equipment Effectiveness

UNIT III RELIABILITY CENTERED MAINTENANCE 9

Reliability Centered Maintenance (RCM), Objectives and function, Steps in RCM implementation, steps in RCM analysis, System selection, Tero technology – RCM effectiveness indicators, RCM tasks Proactive Maintenance, Reliability models - System reliability- Series, Parallel and mixed configuration, System reliability determination; Reliability improvement, Scheduled restoration and scheduled discard, The P-F interval and P-F curves, linear as non linear PF curves , Default actions, RCM Decision diagrams.

UNIT IV TPM AND GLOBAL TRENDS 9

Concept of TPM, Characteristics of TPM, Zero breakdown concepts, Zero Defects and TPM, FMECA – Maintainability prediction– Design for maintainability, Maximizing equipment effectiveness, Autonomous maintenance program, Five pillars of TPM, TPM Small group activities. Implementing TPM. Philosophy / Indications of TPM. TPM Development - Preparation phase, Master Plan, Initiatives, Promotion, Planning, Organization, Awareness, Training, Establishment of basic policies and goals, TPM organization, Implementation phase; Consolidation phase. Measuring TPM effectiveness: Measuring TPM effectiveness Indicators, Plant effectiveness and Measuring; TPM Benefits and Global trend

UNIT V CONDITION MONITORING IN MAINTENANCE 9

Condition Based Maintenance: Machine signatures, Signature Analysis-MMIS Expert systems, Temperature noise, vibration and wear particle analysis, on line and off line techniques. Online Monitoring Condition Monitoring Techniques, Vibration Monitoring and Signature Analysis. Wear Debris Monitoring, Maintenance Management Information System, Expert systems, Corrosion Monitoring and Control, Case Studies in Maintenance, Measurement and benchmarking of performance, MIS for maintenance

Text Book

1.Seiichi Nakajima, "Introduction to TPM|", Productivity Press, Chennai, 1998.

2.Gopalakrishnan, P. and Banerji, A.K., "Maintenance and Spare Parts Management", Prentice – Hall of India Pvt. Ltd., 2013.

References

1. Goto, F., "Equipment planning for TPM Maintenance Prevention Design", Productivity Press, 1992.
2. Shirose, K., "Total Productive Maintenance for Workshop Leaders", Productivity Press, 1992.
3. David J. Sumanth, "Total Productivity Management : A Systematic and Quantitative Approach to Compete in Quality, Price and Time", Productivity Press, 1997

Web References

- http://www.plant-maintenance.com/articles/tpm_intro.pdf
- http:// www.ame.org/sites/default/files/TPM-introduction-AME.pdf
- http://www.ijettjournal.org/volume-4/issue-5/IJETT-V4I5P85.pdf
- http:// www.rsareliability.com/TPM%20Materials.pdf
- http://www.smrp.org/files/public/smrpchapter-ginder.pdf

Course Code:140ME9135	Course Title: RELIABILITY AND MAINTENANCE 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):

- Manufacturing Processes I
- Manufacturing Processes II

Course Outcomes

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

CO1 Distinguish between reliability and quality, availability and maintainability
CO2 Apply Redundancy Techniques To Improve Higher Reliability Of System.
CO3 Evaluate system reliability from reliability of sub systems.
CO4 Explain the principles, functions and practices adopted in industry for the successful management of maintenance activities.
CO5 Conduct hazard and safety analysis for material handling equipments

Course Content

UNIT I BASIC CONCEPTS OF RELIABILITY MAINTENANCE AND AVAILABILITY 9

Reliabilty –Definition, Reliability vs quality, Failure and failure modes,Bath tub curve,causes of failures and unreliability. Maintainability, Availability- Concepts, Definition. System down time, uptime – MTBF,MTTR,MTBM. Types of availability- Inherent availability, Achieved availability and Operation availability. Reliability and Maintanability trade off.

UNIT II DESIGN FOR RELIABILITY 9

Reliability analysis, Mathematical models and numerical evaluation. Designing for higher reliability. Redundancy Techniques, Application. Various forms of redundancy.

UNIT III SYSTEM RELIABILITY 9

Determination of system reliability from subsystems. Series configuration, Parallel configuration, Mixed configuration, R out of N structure. Component redundancy vs Unit redundancy, Stand by redundancy, Mixed redundancy- Simple problems to calculate system reliability. Reliability cost trade off.

UNIT IV 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 V SAFETY AND OTHER ASPECTS OF MAINTENANCE 9

Repair methods for material handling equipment – Equipment records – Job order systems – use of computer in maintenance.

Text Book

1. Srivastava S.K., "Industrial Maintenance Management", - S. Chand and Co., 2002.
2. Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 2001.

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. 2012.
3. Garg M.R., "Industrial Maintenance", S. Chand & Co., 1987.

Web References

- http://catalog.flatworldknowledge.com/bookhub/reader/5?cid=41991&e=carpenter-ch01
- http://www.nios.ac.in/media/documents/VocInsServices/m1-4f.pdf
- http://discovery.bits-pilani.ac.in/dlpd/courses/coursecontent/courseMaterial/mgtszc211.pdf
- http://faculty.mercer.edu/jackson_r/Ownership/chap02.pdf

Course Code: 140ME9136	**Course Title:** ENTREPRENEURSHIP DEVELOPMENT
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

Course Outcomes

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

CO1 Describe the requirements for entrepreneurship
CO2 Explain different motivational theories and policies for entrepreneur development
CO3 Explain the types of enterprises and ownership structure
CO4 Explain the various processes in managing an enterprise
CO5 Explain the government norms and policies that govern small scale enterprises

UNIT I ENTREPRENEURSHIP 9

Definition, requirements to be an entrepreneur, entrepreneur and manager, growth of entrepreneurship in India, women entrepreneurship, rural and urban entrepreneurship.

UNIT II ENTREPRENEURIAL MOTIVATION 9

Motivating factors, motivation theories-Maslow's Need Hierarchy Theory, McClelland's Acquired Need Theory, government's policy actions towards entrepreneurial motivation, entrepreneurship development programmes.

UNIT III TYPES OF ENTERPRISES AND OWNERSHIP STRUCTURE 9

Small scale, medium scale and large scale enterprises, role of small enterprises in economic development; proprietorship, partnership, Ltd. companies and co-operatives: their formation, capital structure and source of finance.

UNIT IV MANAGEMENT OF ENTERPRISES 9

objectives and functions of management, scientific management, general and strategic management; introduction to human resource management: planning, job analysis, training, recruitment and selection, etc.; marketing and organizational dimension of enterprises; enterprise financing : raising and managing capital, shares, debentures and bonds, cost of capital; break-even analysis, balance sheet its analysis..

UNIT V INSTITUTIONAL SUPPORT AND POLICIES 9

Institutional support towards the development of entrepreneurship in India, Technical consultancy organizations, government policies for small scale enterprises.

Text Books

1. Ram Chandran, "Entrepreneurial Development", Tata McGraw Hill, New Delhi, 2008.
2. Khanka, S S. "Entrepreneurial Development", S Chand & Company Ltd. New Delhi, 2007.

Reference Books

1. Saini, J. S., "Entrepreneurial Development Programmes and Practices", Deep & Deep Publications (P), Ltd, 2001.
2. Badhai, B "Entrepreneurship for Engineers", DhanpatRai& co. (p) Ltd,2013.
3. Desai, Vasant, "Project Management and Entrepreneurship", Himalayan Publishing House, Mumbai, 2013.

Web References

- http://www.ediindia.org/

Course Code: 140ME9137	**Course Title:** PRINCIPLES OF MANAGEMENT
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

Course Outcomes

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

CO1 Describe the overview of management
CO2 Explain the planning process, policy and decision making
CO3 Explain the human resource structure and policy
CO4 Explain the motivational theories for management
CO5 Explain the control techniques for operations

Course content

UNIT I OVERVIEWOFMANAGEMENT 9

Organization – Management – Role of managers – Evolution of Management thought – Organization and the environmental factors – Managing globally – Strategies for International Business.

UNIT II PLANNING 9

Nature and Purpose planning – Planning process – Types of plans – Objectives – Managing by objective (MBO) Strategies – Types of strategies – Policies – Decision Making – Types of decision –Decision Making Process - Rational Decision Making Process – Decision Making under different conditions.

UNIT III ORGANISING 9

Nature and purpose of organizing – Organization structure – Formal and informal groups / organization – Line and Staff authority – Departmentation – Span of Control – Centralization and Decentralization – Delegation of authority – Staffing – Selection and Recruitment – Orientation Career Development – Career stages – Training – Performance Appraisal.

UNIT IV DIRECTING 9

Creativity and Innovation – Motivation and Satisfaction – Motivation Theories Leadership – Leadership theories – Communication – Hurdles to effective communication – Organization Culture – Elements and types of culture – Managing cultural diversity

UNIT V CONTROLLING 9

Process of controlling – Types of control – Budgetary and non-budgetary control techniques – Managing Productivity – Cost Control – Purchase Control – Maintenance Control – Quality Control – Planning operations.

Text Books

1. Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall of India, 8th edition, 2009.
2. Charles W.L Hill, Steven L McShane, "Principles of Management", Mcgraw Hill Education, 2007.

References

1. Hellriegel, Slocum & Jackson, "Management – A Competency Based Approach", Thomson South Western, 10th edition, 2007.
2. Harold Koontz, Heinz Weihrich and mark V Cannice, "Management – A global & Entrepreneurial Perspective", Tata McGraw Hill, 12th edition, 2007.
3. Andrew J. Dubrin, "Essentials of Management", Thomson Southwestern, 7th edition, 2007.

Web References

- http://www.managementstudyguide.com/all-subjects.htm

Course Code:140ME9138	**Course Title:** ENVIRONMENTAL SCIENCE AND ENGINEERING
Core/Elective: Elective	**L : T : P : C : M** – 3 : 0 : 0 : 3 : 100
Type: Lecture	**Total Contact Hours:** 45

Course Outcomes

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

CO1 Describe environment, ecosystem and Biodiversity

CO2 Explain the causes, effects and remedies for environmental pollution

CO3 Describe various natural resources and the effect of depleting them

CO4 Explain the environmental legislation and social issues

CO5 Explain the effect of human population on environment

Course Content

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 10

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere – formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO2, NOX, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals – Water treatment processes. (c) Soil pollution – soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine

pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act –The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). Enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

Text Books

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

References

1. Trivedi.R.K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media, 3rd edition, BPB publications, 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2007.

Web References

- http://coe.berkeley.edu/students/EngAnn08.pdf
- http://web.mit.edu/catalogue/degre.engin.civil.shtml

Course Code:140ME9139	**Course Title:** TOTAL QUALITY MANAGEMENT
Core/Elective: Elective (E)	**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):

- Manufacturing Processes I
- Manufacturing Processes II

Course Outcomes

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

CO1 Understand the philosophy and core values of Total Quality Management

CO2 Explain the principles and concepts inherent in a Total Quality Management (TQM) approach to managing a manufacturing or service organization

CO3 Learn the fundamentals of quality tools and techniques in both manufacturing and service industry

CO4 Explain the various quality tools for identifying appropriate process improvements

CO5 Explain the quality management with respect to the ISO 9000 & ISO 14000 quality management standard

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

UNIT III 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 Book

1. Dale H. Besterfiled, et al., "Total Quality Management", Pearson Education, Inc. 2011.

(Indian reprint 2004).

2. Subbarajramasamy, " Total Quality Management" McGraw-Hill, 2008.

References

1. James R.Evans& William M. Lidsay, "The Management and Control of Quality", 5th Ed., 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, 2014.

Web References

- https://en.wikipedia.org/wiki/Total_quality_management

Course Code:140ME9140	**Course Title:** OPERATIONS RESEARCH
Core/Elective: Elective (E)	**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):

- Engineering Mathematics I
- Engineering Mathematics II

Course Outcomes

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

CO1 Apply linear programming model to domain specific situations.

CO2 Analyze the various methods under transportation model and assignment model and apply the model for testing the closeness of their results to optimal results.

CO3 Analyze the various inventory models and apply them in domain specific situations.

CO4 Apply the concepts of PERT and CPM for decision making and optimally managing projects.

CO5 Analyze the various queuing theories and replacement models and apply them in domain specific situations.

Course Content

UNIT I LINEAR PROGRAMMING 9

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

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

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

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

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

Text Book

1. Hillier and Lieberman "Introduction to Operations Research", TMH, 2011.
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

Web References

- http://nptel.ac.in/courses/112106134/1
- http://www.mit.edu/~orc/

Course Code: 140ME9141	Course Title: INDUSTRIAL SAFETY MANAGEMENT
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):

- Engineering Physics
- Engineering Chemistry

Course Outcomes

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

CO1 Explain the importance of safety management.

CO2 Explain the techniques used for Measurement and Monitoring of safety performance.

CO3 Explain the roles and responsibilities of Safety department of an Organisation.

CO4 Describe the importance of Industrial applicable acts and rules

CO5 Explain the Disaster Management and Emergency Preparedness

Course Content

UNIT I INTRODUCTION TO SAFETY MANAGEMENT 9

Principles of Safety Management ,Need of safety in organisation, Occupational Health & hygiene, modern safety concept-Safe operating procedure (SOP's), Safety permits, Social and physiological effects, Accident - Near Miss, injury, Cost of accident, Unsafe act , Unsafe condition, Environmental safety - air pollution, water pollution ,industrial noise & vibration control ,physical hazards - chemical hazards , biological hazards, electrical hazards.

UNIT II SAFETY PERFORMANCE MONITORING 9

Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, Components of safety audit, types of audit, audit methodology, permanent total disabilities, permanent partial disabilities, temporary total disabilities - Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – principles of accident prevention incident rate, accident rate, safety "t" score, safety activity rate Records of accidents, accident reports.

UNIT III SAFETY ORGANISATION 9

Role and responsibilities of management and line staffs Supervisors and Employees, Safety committee, Motivation, budgeting for safety, safety policy, Safety Education and Training, Importance of training-identification of training needs-Training methods –programme, seminars, conferences, 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, Personal Protective Equipment (PPE) - Requirements of PPE, Selection and Usage of PPE, Importance of IS Standard, Types of PPE

UNIT IV INDUSTRIAL ACTS 9

Indian Factories act 1948, Tamilnadu Factories rule 1950 – Environmental protection act 1986- Indian electricity act 1910, Indian electricity rule 1956 – Indian boiler act 1923 – Workmen's compensation act 1923 – Explosive act1983 - Noise pollution rules 2000

UNIT V DISASTER MANAGEMENT AND EMERGENCY PREPAREDNESS 9

Fire properties of solid, liquid and gases - fire spread - toxicity of products of Combustion - sources of ignition – fire triangle – principles of fire extinguishing – active and passive fire protection systems – various classes of fires – a, b, c, d, e – fire extinguishing agents - fire stoppers, Emergency preparedness and responsibilities, On site and off site emergency plan, Mock drill Bhopal Gas tragedy - faulty handling of equipment's, failure of hoist, crane.

Text Book

1. Deshmukh .L.M "Industrial Safety Management" McGraw-Hill 2006.
2. C.RayAsfahl "Industrial Safety and Health management" Pearson Prentice Hall,2003

References

1. John V. Grimaldi and Rollin H. Simonds, "Safety Management", All India Travellers bookseller, New Delhi-1989.
2. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980
3. Subramanian.V., "The Factories Act 1948 with Tamilnadu factories rules 1950", Madras Book Agency, 21st ed., Chennai, 2000.

Web References

- http://www.icebookshop.com
- http://nptel.ac.in/courses/112107143/40

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

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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/