PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018

(AUTONOMOUS)

B.E. MECHANICAL ENGINEERING

REGULATIONS 2015

CURRICULUM

SEMESTER V

Course Code	Course Title	L	T	P	C
ME15501	Design of Machine Elements	3	0	0	3
ME15502	Dynamics of Machinery	3	2	0	4
ME15503	Heat and Mass Transfer	3	2	0	4
ME15504	Hydraulic and Pneumatic systems	3	0	0	3
ME15505	Metrology and Measurements	3	0	0	3
ME1515*	Elective I	3	0	0	3
ME15506	Dynamics Laboratory	0	0	2	1
ME15507	Metrology and Measurements Laboratory	0	0	2	1
ME15508	Heat Transfer Laboratory	0	0	2	1
EN15501	Career Development Laboratory I	0	0	2	1

SEMESTER VI

Course Code	Course Title	L	T	P	C
ME15601	Industrial Robotics	3	0	0	3
ME15602	Power Plant Engineering	3	0	0	3
ME15603	Gas Dynamics and Jet Propulsion	3	0	0	3
ME15604	Design of Transmission Systems	3	2	0	4
ME15605	Finite Element Analysis	3	2	0	4
*******	Elective II	3	0	0	3
ME15606	Simulation and Analysis Laboratory	0	0	2	1
ME15607	Computer Aided Design Laboratory	0	0	2	1
ME15608	Design and Fabrication Project	0	0	2	1
EN15601	Career Development Laboratory II	0	0	2	1

LIST OF ELECTIVES

ELECTIVE I

Course Code	Course Title	L	T	P	C
ME15151	Unconventional Machining Processes	3	0	0	3
ME15152	Renewable Sources of Energy	3	0	0	3
ME15153	Theory of Metal Forming	3	0	0	3
ME15154	Solar Energy System	3	0	0	3
ME15155	Foundry Technology	3	0	0	3

ELECTIVE II

Course Code	Course Title	L	T	P	C
ME15251	Composite Materials	3	0	0	3
BA15352	Engineering Economics	3	0	0	3
ME15252	Rapid Prototyping	3	0	0	3
ME15253	CNC Technology	3	0	0	3
ME15254	Aerospace Engineering	3	0	0	3

SEMESTER V

ME15501 DESIGN OF MACHINE ELEMENTS 3 0 0 3

COURSE OBJECTIVES

- To familiarize the various steps involved in the design process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements
- To learn to use standard practices and standard data
- To know the usage catalogues and standard machine components
- To gain in- depth knowledge of bearings and connecting rods

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9

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

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9

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

UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9

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

UNIT IV DESIGN OF ENERGY STORING ELEMENTS 9

Design of various types of springs, modulus of resilience, optimization of helical springs - rubber springs – Design of flywheels considering stresses in rims and arms, for engines and punching machines.

UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 9

Sliding contact and rolling contact bearings - Design of hydrodynamic journal bearings, McKee's Equation, Sommerfield Number, Raimondi & Boyd graphs, - Selection of Rolling Contact bearings - Design of Seals and Gaskets - Design of Connecting Rod.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- design machine components successfully
- demonstrate the knowledge of designing the solid, hollow shafts and to find the critical speeds
- apply standard practices in designing bolted joints in eccentric loading
- use standard data for designing helical, leaf, disc and torsional springs
- analyse the requirements and design Sliding and rolling contact bearing

TEXT BOOKS

1. R.S.Khurmi and J.K.Gupta " A Text Book of Machine Design", S.Chand Publications, 2005.
2. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Sixth Edition, Tata McGraw Hill, 2003.

REFERENCES

1. Bhandari V.B, “Design of Machine Elements”, Second Edition, Tata McGraw-Hill Book Co. 2010
2. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
3. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2013.
4. Ugural A.C, “Mechanical Design – An Integral Approach, McGraw-Hill Book Co, 2015..
5. Spotts M.F., Shoup T.E “Design and Machine Elements” Pearson Education, 2008.

WEB LINKS

1. nptel.iitk.ac.in/courses/.../Machine%20design1/New_index1.html
2. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 1 :Construction
3. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 2 : Friction and Wear.
4. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 3 : Lubrication.

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO1 1**	**PO12**	**PSO 1**	**PSO2**
CO1	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO2	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO3	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO4	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO5	1	2	3	-	-	-	-	1	-	-	-	2	2	3

ME15502 DYNAMICS OF MACHINERY 3 2 0 4

COURSE OBJECTIVES

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.
- To familiarize the concepts of static and dynamic mass balancing.
- To get introduced to the approaches and mathematical models used in dynamical analysis of free vibrations.
- To know the approaches and analysis of forced vibrations.
- To learn the principles in mechanisms used for speed control and stability control.

UNIT I FORCE ANALYSIS AND FLYWHEELS 15

Static force analysis of mechanisms – D ‟ Alemberts principle - Inertia force and Inertia torque – Dynamic force analysis - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads – Crank shaft Torque–Engine shaking Forces - Turning moment diagrams - Flywheels of engines and punch press

UNIT II BALANCING 15

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine – Primary and secondary unbalanced forces - Balancing Multi-cylinder Engines – Firing order – Pivoted cradle balancing machines

UNIT III FREE VIBRATION 15

Basic features of vibratory systems - Basic elements and lumping of parameters - Degrees of freedom – Single degree of freedom - Free vibration - Equations of motion -natural frequency - Types of Damping - Damped free vibration – Whirling of shafts and critical speed - Torsional systems; Natural frequency of two and three rotor systems.

UNIT IV FORCED VIBRATION 15

Response to periodic forcing - Harmonic Forcing – Forced vibration caused by unbalance - Support motion – Force transmissibility and amplitude transmissibility Vibration isolation vibration measurement.

UNIT V MECHANISM FOR CONTROL 15

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

TOTAL PERIODS 75

COURSE OUTCOMES

At the end this course, students will be able to

- demonstrate the force analysis in mechanical system and related vibration issues and can solve problems in this area
- comprehend the basic concepts of balancing of rotating masses and reciprocating mass balancing.
- analyse the vibratory systems
- describe and analyze the transverse vibration
- explain the natural frequency of two and three rotor systems

TEXT BOOKS

1. Khurmi.R.S., Gupta.J.K., “Theory of Machines and Mechanisms”, 14th Edition, Eurasia Publishing House, New Delhi, 2005.
2. Uicker, J.J., Pennock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, 3rdEdition, Oxford University Press, 2009.

REFERENCES

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2015.
2. Cleghorn. W. L, “Mechanisms of Machines”, Oxford University Press, 2009.
3. Rattan, S.S, “Theory of Machines”, 3rd Edition, Tata McGraw-Hill, 2009.
4. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2012.
5. Allen S. Hall Jr., “Kinematics and Linkage Design”, Prentice Hall, 1961.

WEB LINKS

1. http://nptel.ac.in/courses/112104114/
2. http://encyclopedia2.thefreedictionary.com/Dynamics+of+Machines+and+Mechanisms
3. http://freevideolectures.com/Course/2364/Dynamics-of-Machines

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CO1	3	2	3	-	-	-	-	-	-	-	-	2	3	3
CO2	3	2	3	-	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	-	-	-	-	-	-	-	2	3	3
CO5	3	3	3	-	-	-	-	-	-	-	-	2	3	3

ME15503 HEAT AND MASS TRANSFER 3 2 0 4

COURSE OBJECTIVE

- To understand the concepts of conduction and its problem solving methodology
- To gain problem solving skills in convection mode of heat transfer
- To familiarize the working operation and design of heat exchangers
- To learn the concepts, laws involved in radiation and its effects.
- To study the concept of mass transfer and its applications

UNIT I CONDUCTION 15

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

UNIT II CONVECTION 15

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

UNIT III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGER 15

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

UNIT IV RADIATION 15

Basic Concepts, Laws of Radiation - Stefan Boltzman Law, Kirchoffs Law -Black Body Radiation -Grey body Radiation- heat exchange between two grey surfaces-Shape Factor Algebra - Electrical Analogy – Radiation Shields - Introduction to Gas Radiation.

UNIT V MASS TRANSFER 15

Basic Concepts - Diffusion Mass Transfer - Fick‟s Law of Diffusion - Steady state Molecular Diffusion - Convective Mass Transfer - Momentum, Heat and Mass Transfer Analogy - Convective Mass Transfer Correlations.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- apply steady state heat conduction problems for composite systems and fins.
- solve transient heat conduction problems
- analyse the factors involved in the design of heat exchangers.
- calculate the effectiveness of heat exchanger using LMTD and NTU methods.
- explain the phenomenon of diffusion and convective mass transfer.

TEXT BOOKS

1. Sachdeva R C, “Fundamentals of Engineering Heat and Mass Transfer”, New Age International, 2017.
2. Rajput. R.K, “Heat and Mass transfer”, S.Chand Publishing, 2015.

REFERENCES

1. Yunus A. Cengel and Afshin Jahanshahi Ghajar, “Heat and Mass Transfer: Fundamentals andApplications” Mcgraw-Hill Education, 2014.
2. Frank P. Incropera and David P. DeWitt, “Fundamentals of Heat and Mass Transfer”, John Wiley and sons, 2013
3. Nag P.K, “ Heat Transfer”, Tata McGraw-Hill, New Delhi, 2004
4. Holman J.P “Heat and Mass Transfer” Tata McGraw-Hill, 2002.
5. Kothandaraman C.P “Fundamentals of Heat and Mass Transfer”, New Age International, New Delhi.2006.

WEB LINKS

1. https://www.youtube.com/playlist?list=PLA3944D0DC8277C0B
2. http://freevideolectures.com/Course/2366/Heat-and-Mass-Transfer
3. http://www.nptelvideos.in/2012/12/heat-and-mass-transfer.html

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
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CO1	3	3	1	1	-	-	1	1	-	-	-	2	3	3
CO2	3	3	2	1	-	-	1	1	-	-	-	2	3	3
CO3	2	2	1	1	-	-	1	1	-	-	-	2	3	3
CO4	3	3	2	1	-	-	1	1	-	-	-	2	3	3
CO5	3	2	1	1	-	-	1	1	-	-	-	2	3	3

ME15504 HYDRAULICS AND PNEUMATIC SYSTEMS 3 0 0 3

COURSE OBJECTIVES

- To study about the fluid power systems and fundamentals of hydraulics and pneumatics.
- To learn about hydraulic System and its components.
- To understand the construction of control valves and accumulators in hydraulics.
- To acquire knowledge on pneumatic system components, pneumatic actuators, Sequential circuit design for simple applications using cascade method.
- To know the design aspects of pneumatic circuits and PLC applications in fluid power control circuits.

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 9

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols. Basics of Hydraulics - Applications of Pascal‟s Law- Laminar and Turbulent flow – Reynolds number – Darcy‟s equation – Losses in pipe, valves and fittings.

UNIT II HYDRAULIC SYSTEM & 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 : Directional 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.

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, mufflers. 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. Low cost automation Fluid power circuits failure and troubleshooting. Pneumatic circuits for industrial applications in the field of Machine tools, material handling, hydraulic presses, clamping & indexing devices.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- analyze properties of hydraulic fluids, laminar flow and turbulent flow
- demonstrate pump performance and working process of gear pump, vane pump & piston pump
- describe control components like 3/2 way valve, 4/2 way valve, Shuttle valve, check valve and pressure control valve
- explain Properties of air, Compressors, Filter, Regulator and Lubricator Unit
- distinguish and explain hydro mechanical servo systems, Electro hydraulic servo systems and proportional valves and how to use the PLC in fluid power systems

TEXT BOOKS

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2013.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2001.

REFERENCES

1. Srinivasan.R, "Hydraulic and Pneumatic controls", Vijay Nicole, 2006..
2. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2013.
3. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 2002.
4. W.Bolten, "Pneumatic and Hydraulic Systems", Butterworth-Heinemann Ltd, 1997.
5. S. Ilango and V. Soundararajan, **"**Introduction to Hydraulics and Pneumatics" PHI Learning Private Limited; 2012.

WEB LINKS

1. nptel.ac.in/courses/112106175/Module%201/Lecture%201.pdf
2. https://www.elsevier.com/books/hydraulics-and-pneumatics/parr/978-0-08-096674-8
3. http://www.sciencedirect.com/science/book/9780080966748

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	-	1	-	-	-	-	2	3	2
CO2	3	-	-	-	1	-	1	-	-	-	-	2	3	2
CO3	3	-	2	-	-	-	1	-	-	-	-	2	3	2
CO4	3	-	-	-	1	-	1	-	-	-	-	2	3	2
CO5	3	-	2	-	-	-	1	-	-	-	-	2	3	2

ME15505 METROLOGY AND MEASUREMENTS 3 0 0 3

COURSE OBJECTIVES

- To familiarize with various Metrological equipment available to measure the dimension of the components and various parameters like pressure, temperature, torque etc
- To know about linear and angular measurements with working principles of measuring instrument
- To study the concepts of straightness, flatness and roundness measurements on machine components
- To learn about different precision measurement systems
- To acquire knowledge on the correct procedure to be adopted to measure the mechanical parameters of the components

UNIT I CONCEPT OF MEASUREMENT 9

General concept – Generalised measurement system-Units and standards-measuring instruments: sensitivity, stability, range, accuracy,precision and uncertainity-static and dynamic response-repeatability-systematic and random errors-correction, calibration – Limits, fits and tolerances – terminology – simple problems. Introduction to Dimensional and Geometric Toleranceing – interchangeability- first order and second order instruments.

UNIT II LINEAR AND ANGULAR MEASUREMENT 9

Definition of metrology-Linear measuring instruments: Vernier, micrometer, Slip gauges and classification - Tool Makers Microscope, Profile projector - interferometery, optical flats, -Comparators: limit gauges Mechanical, pneumatic and electrical comparators, applications. Angular measurements: -Sine bar, Sine center, bevel protractor and angle Decker, Auto collimators.

UNIT III FORM MEASUREMENT 9

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

UNIT IV MEASUREMENT OF POWER, FLOW AND TEMPERATURE 9

Power:-mechanical, pneumatic, hydraulic and electrical type-Pressure measurement - Flow: Venturi, orifice, rotameter, pitot tube –Temperature: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor.

UNIT V LASER AND ADVANCES IN METROLOGY 9

Precision instruments based on laser-Principles- laser interferometer-application in measurements and machine tool metrology- Coordinate measuring machine (CMM): need, construction, types, applications - computer aided Inspection- .Nanometrology – Introduction – Principles- Introduction to Data acquisition system.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- explain the general concepts, units, standards, methods errors and calibration involved in the process of measurements
- comprehend the principle and working of instruments like vernier, micrometer and the significance of slip gauges in precision measurements and discuss about interferometer, optical flats, limit gauges, sine bar, bevel protractor and taper measurements.

- describe about the measurements of various parameters of screw threads, gears, surface finish and other geometrical measurements
- demonstrate knowledge on the recent trends in metrology like laser measurements, coordinate measurement machine and machine vision
- employ various techniques involved in the measurements of power, flow, temperature and other related properties.

TEXT BOOKS

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

REFERENCES

1. Gupta S.C, "Engineering Metrology", Dhanpat rai Publications, 2005.
2. Jayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications 2000.
3. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2007.
4. Holman.J.P, "Experimental Methods for Engineers" McGraw-Hill Companies, Inc, 2012.
5. Bewoor, "Metrology and Measurement",Tata Mc Graw-Hill Education Pvt. Ltd, 2009.

WEB LINKS

1. nptel.ac.in/courses/112106138
2. http://www.worldmetrologyday.org/
3. https://www.oiml.org/en

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	1	-	-	-	-	-	-	2	3	2
CO2	3	1	-	-	1	-	-	-	-	-	-	2	3	2
CO3	3	-	-	-	1	-	-	-	-	-	-	2	3	2
CO4	3	-	-	-	1	-	-	-	-	-	-	2	3	2

ME15506 **DYNAMICS LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

- study various gear parameters and their practical significance
- understand the concept of balancing of machinery and mechanisms involved like four bar, slider crank,universal joints etc.,
- learn the working principles and analyze the mechanism of gyroscope, governor and cams
- understand the fundamental concepts of various types of vibrating systems and their elements

List of Experiments

1. a) Study of gear parameters
   b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.
2. Kinematics of single and double universal joints.
3. Determination of Mass moment of inertia of Connecting Rod.
4. Determination of Mass Moment of Inertia of axis symmetric bodies using Turn Table apparatus.
5. Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
6. Motorized gyroscope – Study of gyroscopic effect and couple.
7. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
8. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
9. Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
10. Determination of torsional natural frequency of single rotor systems- Undamped and Damped Natural frequencies.
11. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
12. a) Balancing of rotating masses.
    b) Balancing of reciprocating masses.
13. a) Transverse vibration of Free-Free beam – with and without concentrated masses.
    b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.
    c) Determination of transmissibility ratio using vibrating table.

Students should be familiar with the use of the following device/equipments depending upon availability.

Tachometers – Contact and non contact, Dial gauge

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- perform experiments to demonstrate the concepts of balancing of machinery and mechanisms
- demonstrate practically factors involved in causing vibration and how to damp the vibration
- internalize the calculations and the elements considered for designing gear parameters
- describe the working principles and mechanisms involved in the functioning of gyroscopes, governorsand cams

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CO2	3	2	1	-	-	-	-	-	1	1	-	2	2	3
CO3	3	2	1	-	-	-	-	-	1	1	-	2	2	3
CO4	3	2	1	-	-	-	-	-	1	1	-	2	2	3

ME15507 **METROLOGY AND MEASUREMENTS LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

- To understand the calibration and measurement processes through experiments
- To conduct experiments to familiarize with different measuring equipment and their usage in industries for inspection
- To practice practical measurements of different parameters like length, angle, torque, pressure, temperature etc.,
- To carry out form measurements on gear, screw thread etc. for practical knowledge

List of Experiments

1. Calibration of Vernier / Micrometer / Dial Gauge
2. Checking Dimensions of part using slip gauges
3. Measurements of Gear Tooth Dimensions
4. Measurement of Angle using sine bar / sine center / tool makers microscope
5. Measurement of straightness and flatness
6. Measurement of thread parameters
7. Setting up of comparators for inspection (Mechanical / Pneumatic / Electrical)
8. Measurement of Temperature using Thermocouple / Pyrometer
9. Measurement of Displacement
10. Measurement of Force
11. Measurement of Torque
12. Measurement of Vibration

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- describe different standards and calibration processes
- handle different measurement tools and measuring techniques
- study and analyze the characteristics of precision instruments
- demonstrate the usage of contact and non contact measuring instruments, limit gauges and comparators

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Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	-	-	1	1	-	2	2	3
CO2	3	2	-	-	-	-	-	-	1	1	-	2	2	3
CO3	3	2	-	-	-	-	-	-	1	1	-	2	2	3
CO4	3	2	-	-	-	-	-	-	1	1	-	2	2	3

ME15508 **HEAT TRANSFER LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

- To get practical hands-on training on heat transfer in conduction, convection and radiation
- To get practice in refrigeration and air conditioning systems through performance tests

Heat Transfer **30**

1. Thermal conductivity measurement using guarded plate apparatus.
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
4. Determination of heat transfer coefficient under forced convection from a tube.
5. Heat transfer from pin-fin apparatus (natural and forced convection modes)
6. Determination of Stefan – Boltzmann constant.
7. Determination of emissivity of a grey surface.
8. Effectiveness of Parallel / counter flow heat exchanger.

Refrigeration and Air Conditioning **15**

1. Study of Refrigeration and Air conditioning systems.
2. Determination of COP of a refrigeration system
3. Experiments on air-conditioning system
4. Performance test on a reciprocating air compressor

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- conduct thermal conductivity measurement by guarded plate
- explain practically the Natural convection heat transfer from a vertical cylinder
- demonstrate the methodology of Heat transfer from pin fin
- determine the emissivity of grey surface
- expose practical knowledge on Effectiveness of heat exchanger in parallel flow

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	-	1	-	-	-	-	-	-	1	2	2
CO2	3	2	1	-	1	-	-	-	-	-	-	1	2	2
CO3	3	2	1	-	1	-	-	-	-	-	-	1	2	2
CO4	3	2	1	-	1	-	-	-	-	-	-	1	2	2

EN15501 CAREER DEVELOPMENT LABORATORY I 0 0 2 1

COURSE OBJECTIVES

- To understand their capabilities and enhance their grooming and showcasing his/ her capabilities to a prospective employer
- To provide opportunity for the students to become acquainted with corporate opportunities relevant to their academic learning
- To articulate their thoughts on a given topic – in english and also to make decent write ups in english on any given topic
- To practice and score well in Aptitude tests conducted by corporates / prospective employers
- To prepare for any group discussion evaluation or presenting their credentials during a face- to-face interview leading to selection and employment
- To become a knowledgeable person on the various evaluation processes leading to employment.

UNIT I PERSONALITY DEVELOPMENT 1 6

Introduction – self explorations – character building – self esteem- self confidence- positive thinking – leadership qualities- time management.

UNIT II PERSONALITY DEVELOPMENT 2 6

Grooming- role play – good etiquettes - extempore - writing skills: email, paragraph – team building- body language - non verbal communication

UNIT III QUANTITATIVE APTITUDE (QA) 1 6

Time , speed & distance -- simple interest & compound interest – percentage – height and distance – time and work – number systems – L.C.M and H.C.F – ratio proportion- area – directions.

UNIT IV LOGICAL REASONING (LR) 1 6

Analogies - letter and symbol series – number series – cause and effect – essential part – verbal reasoning.

UNIT V VERBAL REASONING (VR) 1 6

Blood relation – venn diagrams – analogy – character puzzles – logical sequence – classifiction –verification of truth – seating arrangement

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- demonstrate aptitude and reasoning skills
- enhance verbal and written ability.
- improve his/her grooming and presentation skills.
- interact effectively on any recent event/happenings/ current affairs.
- be a knowledgeable person on the various evaluation processes leading to employment and face the same with confidence.

REFERENCES

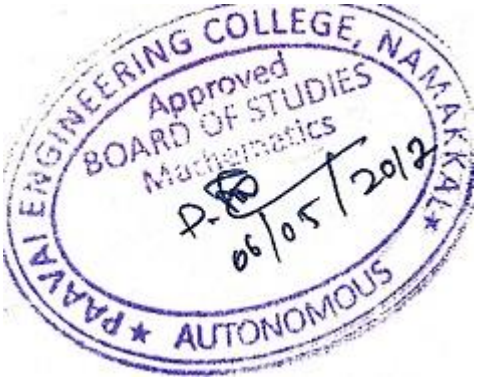
1. Agarwal, R.S." A Modern Approach to Verbal & Non Verbal reasoning", S.Chand & co ltd, New Delhi.
2. Abhijit guha, "Quantitative Aptitude ", Tata-Mcgraw hill.
3. word power made easy by norman lewis ,W.R.Goyal publications.
4. Johnson, D.W. reaching out – interpersonal effectiveness and self actualization.Boston: Allyn and Bacon.
5. Agarwal, R.S." objective general English",S.Chand & co

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	-	1	-	-	-	-	-	-	1	2	2
CO2	3	2	1	-	1	-	-	-	-	-	-	1	2	2
CO3	3	2	1	-	1	-	-	-	-	-	-	1	2	2
CO4	3	2	1	-	1	-	-	-	-	-	-	1	2	2
CO5	3	2	1	-	1	-	-	-	-	-	-	1	2	2



ELECTIVE I

ME15151 UNCONVENTIONAL MACHINING PROCESSES 3 0 0 3

COURSE OBJECTIVES

- To learn about various unconventional machining processes, various process parameters and their influence on performance and their applications
- To know about working principles of various mechanical processes like abrasive jet machining, water jet machining and ultrasonic machining
- To gain in depth knowledge on electro chemical machining processes
- To familiarize with thermal metal removal processes like electric discharge machining, grinding and wire cutting processes
- To understand the general principle and application of laser beam machining, plasma for machining and metal removal mechanism

UNIT I INTRODUCTION 9

Need for non-traditional machining methods-Classification of modern machining processes – considerations in process selection. Materials, applications. Ultrasonic machining – Elements of the process, mechanics of metal removal process parameters, economic considerations, applications and limitations, recent development.

UNIT II MECHANICAL PROCESSES 9

Abrasive jet machining, Water jet machining and abrasive water jet machining Basic principles, equipments, Process parameters, mechanics of metal removal, MRR-Variation in techniques used – applications and limitations.

UNIT III ELECTRO – CHEMICAL PROCESSES 9

Fundamentals of electro chemical machining, electrochemical grinding, electro chemical honing and deburring process, electro chemical reactions-metal removal rate in ECM, Tool design, Surface finish and accuracy, economic aspects of ECM – Fundamentals of chemical, machining, advantages and applications.

UNIT IV THERMAL METAL REMOVAL PROCESSES –I 9

General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electric discharge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Process parameters, selection of tool electrode and dielectric fluids, methods surface finish and machining accuracy, characteristics of spark eroded surface and machine tool selection.

UNIT V THERMAL METAL REMOVAL PROCESSES - II 9

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes –General Principle, types and application of laser beam machining – thermal features, cutting speed and accuracy of cut. Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries. Chemical machining-principle mask-ants etchants- applications. Magnetic abrasive finishing, Abrasive flow finishing.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- explain about the classification, applications and recent updations in modern machining process.,
- comprehend the working principle, process parameters and equipment used in machining process.
- describe fundamentals of electro chemical process.
- illustrate the principles, applications and selection parameters of thermal metal removal process.
- demonstrate different unconventional machining processes along with the influence of different process parameters on the performance and their applications.

TEXT BOOKS

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi (2005).
2. Amitadha Bhattacharyya, "New Technology", The Institution of Engineers (India) 1973.
3. Unconventional Machining processes – M.K Singh New age International publishers 2008.

REFERENCES

1. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing". Prentice Hall of India Pvt. Ltd., New Delhi, 2011
2. Benedict. G.F. "Nontraditional Manufacturing Processes" Marcel Dekker Inc., New York,1987
3. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi ,2004.
4. Elanchezhian,B. Vijaya Ramnath and M.Vijayan, "Unconventional Machining processes", Anuradha Publications 2005.

WEB LINKS

1. www.nptel.ac.in/courses/112105127/pdf/LM-37.pdf
2. www.iitk.ac.in/me/Presentation/Mechanical.pdf
3. http://freevideolectures.com/Course/2369/Manufacturing-Processes-II/37

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO2	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO3	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO4	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO5	3	-	-	-	2	-	1	-	-	-	-	2	3	2

MEE15152 **RENEWABLE SOURCES OF ENERGY** **3 0 0 3**

COURSE OBJECTIVES

- To know about the general principles and technology of energy systems.
- To study the basic concepts of economic, political and environmental issues involved in the use of renewable energy sources.
- To gain knowledge on the technological principles of residential-scale solar and green building.
- To get introduced to the principles involved in design of biomass energy.
- To understand the fundamental principles of other renewable energy resources and technologies.

UNIT I INTRODUCTION **9**

World Energy Use – Reserves of Energy Resources – Environmental Aspects of Energy Utilisation – Renewable Energy Scenario in Tamil nadu, India and around the World – Potentials - Achievements / Applications – Economics of renewable energy systems.

UNIT II SOLAR ENERGY **9**

Solar Radiation – Measurements of Solar Radiation - Flat Plate and Concentrating Collectors – Solar direct Thermal Applications – Solar thermal Power Generation - Fundamentals of Solar Photo Voltaic Conversion – Solar Cells – Solar PV Power Generation – Solar PV Applications.

UNIT III WIND ENERGY **9**

Wind Data and Energy Estimation – Types of Wind Energy Systems – Performance – Site Selection – Details of Wind Turbine Generator – Safety and Environmental Aspects

UNIT IV OTHER RENEWABLE ENERGY SOURCES **9**

Biomass direct combustion – Biomass gasifiers – Biogas plants – Digesters – Ethanol production – Bio diesel – Cogeneration - Biomass Applications

UNIT V OTHER RENEWABLE ENERGY SOURCES **9**

Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydro-Geothermal Energy – Hydrogen and Storage - Fuel Cell Systems – Hybrid Systems.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- create awareness about technologies related to non-conventional energy sources.
- comprehend the technological principles of Solar energy in green building.
- describe the fundamentals of wind, tidal and geo-thermal energy systems.
- discuss about bio-energy sources and their utilization.
- show indepth knowledge on other renewable sources like magneto hydrodynamic, thermo electric, thermionic energy systems.

TEXT BOOKS

1. G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 2009.
2. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 2015.

REFERENCES

1. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 2012.
2. G.N. Tiwari, solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2013.
3. L.L. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.
4. David M.Mousdale- "Introduction to Biofuels",CRC press, Taylor and Francis Group, USA 2010
5. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications",PHI Learning Private Limited, New Delhi, 2009

WEB LINKS

1. study.com/academy/lesson/what-is-a-renewable-energy-source-definition-example-quiz.html
2. https://www.youtube.com/watch?v=UW4HYJ36q0Y
3. freevideolectures.com/Course/2352/Power-System-Generation-Transmission-and-Distribution/6

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak**														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO2	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO3	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO4	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO5	3	-	-	-	2	-	1	-	-	-	-	2	3	2

ME15153 **THEORY OF METAL FORMING** **3 0 0 3**

COURSE OBJECTIVES

- To have an in-depth understanding of mechanics of metal forming and metal behavior
- To learn about mechanical properties and plastic instability in biaxial tension stress
- To understand the analysis of metal forming process
- To attain knowledge on basic sheet metal forming techniques
- To know about the equipment and sequence of technological operations involved in various methods of Special metal forming processes.

UNIT I THEORY OF PLASTICITY **9**

Theory of plastic deformation – Engineering stress and strain relationship – Strees tensor – Strain tensor – Yield criteria – Plastic stress strain relationship – Plastic work.

UNIT II CONSTITUTIVE RELATIONSHIPS AND INSTABILITY **9**

Uniaxial tension test – Mechanical properties – Work hardening, Compression test, bulge test, plane strain compression stress, plastic instability in uniaxial tension stress, plastic instability in biaxial tension stress

UNIT III ANALYSIS OF METAL FORMING **9**

Slab analysis – Slip line method, upper bound solutions, numerical methods, contact problems, effect of friction, thermo elastic- Elasto plasticity, elasto visco plasticity – analysis of forging, rolling, extrusion and wire drawing processes- Cold and Hot Forging

UNIT IV SHEET METAL FORMING **9**

Sheet Metal Forming methods – Bending – Drawing – Deep Drawing – Stretch Forming – Tooling and applications – Analysis of Sheet Metal Forming – HERF Techniques – Principles and Process Parameters – Super plastic Forming.

UNIT V SPECIAL METAL FORMING PROCESSES **9**

Orbital forging, Isothermal forging, Warm forging, Hot and Cold isotrophical pressing, high speed extrusion, rubber pad forming, micro blanking – Overview of Powder Metal Techniques – Powder rolling.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- explain the techniques of plasticity and stress strain relationships
- discuss about mechanical behavior and analysis of residual stresses in metals during
- processing
- comprehend the significance of mechanical behavior of metals in terms of deformation characteristics.
- analyse the techniques of special metal forming processes

TEXT BOOKS

1. Surender kumar, “Technology of Metal Forming Processes”, Prentice Hall India Publishers, 2010
2. Nagpal G.R “Metal Forming Process”, Kanna Pub, New Delhi – 2000.

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1. Wagoner, R.H and Chenot, JJ Metal Forming Analysis, Cambridge University Press, 2002.
2. Dieter G.E, "Mechanical Metallurgy" Mc Graw – Hill Co. S1. Edition 1995
3. Shiro Kobayshi,Altan. T, Metal Forming and Finite Element Method, Oxford University Press, 1989.
4. Hosford, W.F and Caddell, R.M., Metal Forming Mechanics and Metallurgy, Prentice Hall Eaglewood Cliffs, 2011.
5. Narayanaswamy. R, Theory of Metal Forming and Plasticity Narosa Publishers, 1999.

WEB LINKS

1. https://www.accessengineeringlibrary.com/browse/metal-forming-technology-and-process-modelling
2. http://nptel.ac.in/courses/112106153/
3. https://www.youtube.com/watch?v=R1ifDegeq-g

CO-PO Mapping

COs	Mapping of Course outcomes with Programme outcomes **(1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1-Week**													
	Programme Outcomes(POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO2	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO3	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO4	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO5	3	2	2	-	2	2	1	-	-	-	2	2	3	3

ME15154 SOLAR ENERGY SYSTEM 3 0 0 3

COURSE OBJECTIVES

- To understand the basic principles of design and operation of solar thermal energy conversions
- To learn about the other applications and the devices used to collect solar energy.
- To study the fundamental concepts about solar energy storage systems and devices.
- To gain knowledge on the variety of solar systems used to collect solar energy.
- To know about the solar heating systems, liquid based solar heating systems for buildings.

UNIT I INTRODUCTION AND SOLAR RADIATION 9

Introduction – Energy alternatives – New energy technologies – Solar thermal process – heat transfer devices. Solar Radiation – Solar constant – extra terrestrial radiation – clear sky irradiation – solar radiation measurement – estimation of average solar radiation – solar radiation on titled surface – synthesized radiation data.

UNIT II SOLAR COLLECTOR 9

Flat plate collectors – cover plates – collectors plate surfaces energy balances equation and collectors efficiency – collector performance – collector improvements effect of incident angle, dust and shading – Thermal analysis of flat plate collector and useful heat gained by the fluid – collector design – Heat transfer factors.

UNIT III CONCENTRATORS 9

Concentration collectors and reflectors – Parabolic concentrators, non-imaging concentrators, other forms of concentrating collectors. Tracking – receiver shape and orientation – performance analysis - reflectors – reflectors orientation – performance analysis.

UNIT IV SOLAR ENERGY STORAGE 9

Solar energy storage – stratified storage – well mixed storage – comparison – Hot water system – practical consideration – solar ponds – principle of operation and description of Non-convective solar pond – extraction of thermal energy application of solar ponds.

UNIT V SOLAR SYSTEMS 9

Solar Electric power generation, photo voltaic cells. Design of swimming pool heaters – power generation system. Tower concept – solar refrigeration system, thermo electric refrigeration system- solar still, solar drier & solar desalination

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- comprehend the principles behind thermal energy conversion into other form of energies.
- delineate the working principle of solar collectors and their applications.
- explain about the fundamentals of different types of solar concentration collectors and reflectors.
- show deep knowledge on variety of solar systems used to solar energy storage systems.
- discuss solar heating systems and liquid based solar heating systems for buildings knowledgeably

TEXT BOOKS

1. Rai, G.D., Solar Energy Utilization, Khanna Publishers, N. Delhi, 2010.
2. D. Yogi GoswamKreith, F and Kreider, J. F., Principles of Solar Engineering, McGraw.Hill, 2000.

REFERENCES

1. Goswami, D.Y., Kreider, J. F. and & Francis., Principles of Solar Engineering, Taylor and Francis, 2000.
2. Chetan Singh Solanki, Solar Photovoltatics –Fundamentals, Technologies and Applications, PHI Learning Private limited, 2011
3. Sukhatme S P, J K Nayak, Solar Energy–Principle of Thermal Storage and collection, TataMcGraw Hill, 2008.
4. Martin A. Green, Solar Cells Operating Principles, Technology, and System Applications Prentice-Hall, 2008.
5. Roger Messenger and Jerry Vnetre, Photovoltaic Systems Engineering, CRC Press, 2010.

WEB LINKS

1. http://nptel.ac.in/courses/112105051/
2. http://freevideolectures.com/Course/3496/Solar-Energy-Technology

CO-PO Mapping

COs	Mapping of Course outcomes with Programme outcomes **(1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1-Week**													
	Programme Outcomes(POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO2	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO3	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO4	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO5	3	2	2	-	2	2	1	-	-	-	2	2	3	3

ME15155 FOUNDRY TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

- To understand the basics of foundry practice and metal casting as important manufacturing moulding processes
- To gain knowledge on the fundamental aspects of moulding process and equipments and tools
- To get familiar with the sand moulding and permanent die moulding and other casting process in detail
- To learn about melting, pouring and testing stages involved in foundry processes.
- To become knowledgeable on pouring, feeding and automation systems involved in foundry techniques

UNIT I INTRODUCTION 9

Introduction to moulding and casting Processes – Steps involved – advantages, limitations and application of casting process. Patterns – Types, pattern allowances, Pattern materials and pattern making, Cores – Core prints, Core boxes and core making.

UNIT II MOULDING PROCESSES 9

Green sand moulding – equipments and tools – Moulding sand ingredients – Moulding sand properties, influence of ingredients on properties – sand preparation and control – sand testing – machine moulding – types of machines, applications – core blowers – core shooters.

UNIT III CASTING PROCESSES 9

Sand casting processes –permanent mould casting processes-pressure die casting, centrifugal casting - precision/investment casting-shell moulding, CO2 moulding – continuous casting –squeeze casting – electro slag casting processes, Vacuum process, full mould process, magnetic moulding process,-stir casting process

UNIT IV MELTING, POURING AND TESTING 9

Foundry – remelting, furnaces – selection of furnace – Crucible, oil fired furnace, electric furnaces – Resistance, arc, induction furnaces – cupola furnace -steel melting, non-ferrous melting practices, pouring equipments, Inspection of castings, destructive and non destructive, Casting defects – Occurrence, causes and remedies.

UNIT V POURING, FEEDING AND AUTOMATION 9

Gating system – functions-types of gating system-Gating Ratio-Riser – function –types of risers – riser design foundry layout and automation.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- comprehend on the basics of foundry practice and metal casting as important manufacturing moulding processes
- explain the fundamental principles of moulding processes, equipment and tools.
- discuss about various Sand molding and permanent die molding and other casting process in detail.
- demonstrate knowledge on melting, pouring and testing stages involved in foundry process
- explain various elements like pouring, feeding and automation systems involved in foundry techniques

TEXT BOOKS

1. Jain P.L. "Principles of Foundry Technology", Tata McGraw-Hill, 2009.
2. R.W. Heine, C.R.Loper & P.C. Rosenthal, "Principles of Metal casting", Tata McGraw Hill, 2001

REFERENCES

1. Heine, Lpoer et al "Principles of Metal Casting" McGraw-Hill Publishing Company Ltd 1999.
2. Taylor H.F. Fleming M.C. & Wulff.J "Foundry engineering"; Wiley Eastern Ltd.1993.
3. Gupta R.B "Foundry Engineering"; Satyaprakashan, New Delhi, 1989.
4. Lal,Mand Khanna O.P "A Text Book of Foundry Technology" Dhanpat Rai and Sons, New Delhi1986.
5. Lindberg R. a "Processes and Materials of Manufacture" Prentice Hall of India Pvt., Ltd., 2000.

WEB LINKS

1. www.ibm.com/chips/techlib/techlib.nsf/literature/Foundry
2. https://onlinecourses.nptel.ac.in/noc17_me11/preview

CO-PO Mapping

COs	Mapping of Course outcomes with Programme outcomes **(1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1-Week**													
	Programme Outcomes(POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO2	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO3	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO4	3	2	2	-	2	2	1	-	-	-	2	2	3	3
CO5	3	2	2	-	2	2	1	-	-	-	2	2	3	3

ME15601 INDUSTRIAL ROBOTICS 3 0 0 3

COURSE OBJECTIVES

- To understand the basic concepts associated with the design, functioning and applications of Robots.
- To study about the drives and end of tooling in robots.
- To know about the sensors used in robotics.
- To learn analyzing robot kinematics and robot programming.
- To gain knowledge about the safety requirement associated with installation testing and maintenance.

UNIT I FUNDAMENTALS OF ROBOT 7

Robot – Definition – Robot Anatomy – Co-ordinate Systems, Work Envelope, types and classification –Functions Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their 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 all these 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, Segmentation, Feature Extraction, Object Recognition, Other 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) – DH matrices - 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

RGV, AGV; Implementation of Robots in Industries – Various Steps; Safety Considerations for Robot Operations; Economic Analysis of Robots – Pay back Method, EUAC Method, Rate of Return Method.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the fundamentals of robot working, Robot characteristics, subsystems, classifications and their applications.
- demonstrate gained knowledge on Robot power system (electrical, pneumatic and hydraulic motors) and also discuss about the Robot mechanical system (links, bearings, shafts, gearboxes, grippers).
- show good comprehension over Robot measuring system, internal sensing (position, velocity, acceleration, force) and external robot sensing (Proximity sensors, range finders, tactile sensors, vision), high & low value of resistance & measure unknown R,L,C value.
- illustrate knowledge on Robot kinematics, joint and Cartesian space, homogenous transformation frames and standard names, denavit-hartenberg notation, direct and inverse kinematics solution, Euler angels, jacobian matrix, velocity transformation, Robot programming, motion oriented and task oriented languages. Students also learn Robot application in typical operations and tasks.
- apply with understanding the safety requirements associated with installation and maintenance.

TEXT BOOKS

1. M.P.Groover, " Industrial Robotics – Technology, Programming and Applications", McGraw Hill, 2001.
2. Richard. D.Klaftr, Thomas Achmielewski and Mickelnegin, "Robotics Engineering - Integrated Approach", Prentice Hall India, New Delhi, 2001.

REFERENCES

1. Harry clestock, "Industrial Robotics" Tata McGraw Hill, 2005.
2. Deb. S.R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 2004.
3. Janakiraman.P.A, "Robotics and Image Processing", Tata McGraw Hill, New Delhi,2007.
4. Fu K.S, Gonzalz R.C.and Lee C.S.G, "Robotics control, Sensing, Vision and intelligence" McGraw Hill Book Co, 2001.
5. Saeed and Niku, "Introduction to robotics, Analysis, Control and Applications," Wiley India Pvt. Ltd, 201

WEB LINKS

1. http://nptel.ac.in/courses/112101099/5
2. http://freevideolectures.com/Course/2373/Robotics/3
3. http://freevideolectures.com/Course/2373/Robotics

CO-PO Mapping

COs	Mapping of Course outcomes with Programme outcomes (1/2/3 indicates strength of correlation)3-Strong, 2-Medium, 1-Week													
	Programme Outcomes(POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	2	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	2	2	2
CO4	3	2	-	-	2	-	-	-	-	-	-	2	2	2
CO5	3	-	-	-	-	-	-	-	-	-	-	2	2	2

ME15602 POWER PLANT ENGINEERING 3 0 0 3

COURSE OBJECTIVES

- To understand the concepts of power plants and boilers
- To acquire knowledge about steam power plant and its importance
- To know the working principles of nuclear power plant and its elements
- To study the operation of diesel and gas turbine power plants
- To learn the concept of power plant economics

UNIT I INTRODUCTION TO POWER PLANTS & BOILERS 9

Layout of Hydel power plants – Types – Standalone – Pumped Storage. Steam Boilers and cycles – High pressure and supercritical boilers – Fluidized bed boilers – Analysis of power Plant cycles - Combined power cycles – comparison and selection.

UNIT II STEAM POWER PLANT 9

Layout and types of Steam Power Plants - Fuel and Ash handling systems – combustion Equipment for burning coal – Mechanical stokers – Pulverizers – Electrostatic precipitator – Draught – different types, Surface condenser types, Cooling towers, Pollution Controls.

UNIT III NUCLEAR POWER PLANTS 9

Nuclear energy - Fission, Fusion reaction - Layout of nuclear power plants - Types of reactors, pressurized water reactor - Boiling water reactor - Gas cooled reactor - Fast breeder reactor - Waste disposal and safety.

UNIT IV DIESEL AND GAS TURBINE POWER PLANTS 9

Layout and types of Diesel power plants and components, selection of engine type, applications. Gas Turbine power plant – Layout - Fuels, gas turbine material, types of combustion chambers - reheating, regeneration and inter – cooling-Performance calculations.

UNIT V SOLAR, WIND POWER PLANT AND POWER PLANT ECONOMICS 9

Solar- Solar Thermal Power Generation, Thermal Energy Storage, Wind-Wind Power Generation, Types of wind rotors, aero dynamics-Solar-wind Hybrid power plant – Types of Tariffs – Economics of load sharing – variable load operation - comparison of economics of various power plants-case study.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- summarise the real time applications of power plant engineering.
- discuss about the real time applications of steam power plant.
- illustrate their knowledge of design skills of nuclear power plant generation.
- show the real time applications of diesel and gas turbine power plants operation.
- explain the economics involved in power plant operations.

TEXT BOOKS

1. Arora S.C. and Domkundwar.S, „A Course in Power Plant Engineering", Dhanpatrai, 2001
2. Nag P.K., „Power Plant Engineering", Tata-McGraw Hill, 2014.

REFERENCES

1. Frank D.Graham,"Power Plant Engineers Guide", D.B. Taraporevala Sons&Co., New Delhi.
2. T.Morse Frederick,"Power Plant Engineering", Prentice Hall of India, 1998.
3. R.K.Rajput,"Power Plant Engineering", Laxmi Publications, 2008.
4. G.D.Rai,"Introduction to Power Plant Technology", Khanna Publishers, 1995.
5. Nagpal, G.R. "Power Plant Engineering", Kanna Publishers, 15th Edition (7th Reprint) 2008.

WEB LINKS

1. http://freevideolectures.com/Course/2342/Energy-Resources-and-Technology/9
2. http://www.volker-quaschning.de/articles/fundamentals2/index_e.php
3. https://www.solaronline.com.au/solar_wind_hybrid_systems.html

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	-	1	2	3	1	-	-	-	-	2	-
CO2	3	-	2	-	1	2	3	1	-	-	-	-	2	-
CO3	3	1	2	-	1	2	3	1	-	-	-	-	2	1
CO4	3	-	2	-	1	2	3	1	-	-	-	-	2	-
CO5	3	3	2	3	1	2	3	1	-	-	-	-	2	3

ME15603 GAS DYNAMICS AND JET PROPULSION 3 0 0 3

COURSE OBJECTIVES

- To understand the basic difference between incompressible and compressible flow
- To analyze to solve the problems in rayleigh and Fanno flow
- To know the concepts of phenomenon of shock waves and its effect on flow
- To gain basic knowledge about jet propulsion
- To learn basic concepts about rocket propulsion

(Use of Standard Gas Tables permitted)

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 6

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 – Nozzle and Diffusers – Use of Gas tables.

UNIT II FLOW THROUGH CONSTANT AREA 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fannoflow) – variation of flow properties – Use of tables and charts – Generalized gas dynamics.

UNIT III NORMAL AND OBLIQUE SHOCKS 10

Wave Motion-Steep, Non-steep Finite Pressure Waves-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 10

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.

UNIT V SPACE PROPULSION 10

Types of rocket engines – Propellants-feeding systems – Ignition and combustion –Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply gas dynamics principles in the Jet and Space Propulsion.
- describe the flow through constant area ducts with friction and constant area ducts with Heat transfer.
- explain in detail about different types of governing equations of Normal Shock and Oblique Shock and Prandtl- Meyer equation.
- state the concepts of Air craft propulsion and different types of Jet engines.
- write elaborately on propulsive and overall efficiencies in turbo jet engines.

TEXT BOOKS

1. Anderson, J.D., “Modern Compressible flow”, McGraw Hill, 3rd Edition, 2003.
2. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, New Delhi, 2003.

REFERENCES

1. Hill and C. Peterson, "Mechanics and Thermodynamics of Propulsion", Addison –Wesley Publishing company, 1992.
2. N.J. Zucrow, "Aircraft and Missile Propulsion", vol.1 & II, John Wiley, 1975.
3. Balachandran, P., "Fundamentals Of Compressible Fluid Dynamics" , PHI Learning, New Delhi, 2012
4. G.P. Sutton, "Rocket Propulsion Elements", John wiley, 2016, New York.
5. V. Ganesan, "Gas Turbines", Tata McGraw Hill Publishing Co., New Delhi, 2010.
6. Gas Table by S.M. Yahya

WEB LINKS

1. www.nptel.ac.in/syllabus/112102013/
2. http://freevideolectures.com/Course/3008/Jet-Aircraft-Propulsion
4. https://www.youtube.com/watch?v=S0Z67cvqna0

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium , 1-Weak

COs	Programme Outcomes(POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	-	-	-	1	-	-	-	3	-	3	-
CO2	3	3	3	-	-	1	-	-	-	-	1	-	-	1
CO3	3	3	3	-	-	1	-	-	-	-	1	-	-	1
CO4	3	3	3	-	-	1	1	-	-	-	1	-	-	1
CO5	3	3	3	2	-	1	1	-	-	-	3	-	3	-

ME15604 DESIGN OF TRANSMISSION SYSTEMS 3 2 0 4

COURSE OBJECTIVES

- To study the different types of flexible elements like belts (V belt, flat belt and pulleys)
- To learn the design of spur gears and parallel axis helical gears and its parameters
- To understand the design of bevel gears and worm gears and their parameters
- To study the design of gear boxes (Six, Nine, Twelve and Eighteen speed)
- To gain knowledge on the design of power screws, clutches and brakes

UNIT I TRANSMISSION SYSTEMS USING FLEXIBLE ELEMENTS 15

Selection of V belts and pulleys – selection of Flat belts and pulleys – Selection of Transmission chains and Sprockets. Design of pulleys and sprockets.

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 15

Gear Terminology-Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength - Factor of safety - Gear materials – Module and Face width-power rating calculations based on strength and wear considerations - Parallel axis Helical Gears – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces and stresses. Estimating the size of the helical gears.

UNIT III BEVEL AND WORM GEARS 15

Straight and spiral bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight and spiral bevel gears.

Worm Gear: Merits and demerits- terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair.

UNIT IV DESIGN OF GEAR BOXES 15

Geometric progression - Standard step ratio - Ray diagram, kinematics layout - Design of sliding mesh gear box - Constant mesh gear box. – Design of multi speed gear box.

UNIT V DESIGN OF POWER SCREWS, CLUTCHES AND BRAKES 15

Types of screw threads used for power screws – Torque requirements – Stresses in Power screws, Design of Screw Jack. Design of plate clutches – axial clutches - cone clutches - internal expanding rim clutches – Types of brakes and their applications – Design of internal and external shoe brakes.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- apply design principles for designing of different types of flexible elements.
- illustrate the design basics of spur gears and parallel axis helical gears and their parameters
- carry out designing of bevel gears and worm gears with understanding of their parameters and Merits and demerits
- describe different types of gear boxes and their design principles with examples
- show knowledge of designing power screws, clutches and brakes used in power transmission system

TEXT BOOKS

1. Juvinall R. C., Marshek K.M., "Fundamentals of Machine component Design", – John Wiley & Sons Third Edition, 2017.
2. Bhandari, V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Ltd., 2010.

REFERENCES

1. Maitra G.M., Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGraw-Hill, 2009
2. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", McGraw-Hill International Editions, 2004.
3. Norton R.L, "Design of Machinery", McGraw-Hill Book co, 2008.
4. Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", McGraw- Hill Book 2013
5. Hall A.S. Holowenko A.R. and Laughlin H.G., „Theory and Problems in Machine Design", Schaum"s Series, 2000.

STANDARDS

1. IS 4460: Parts 1 to 3: 1995, Gears – Spur and Helical Gears – Calculation of Load Capacity
2. IS 7443: 2002, Methods of Load Rating of Worm Gears
3. IS 15151: 2002, Belt Drives – Pulleys and V-Ribbed belts for Industrial applications – PH, PJ, PK, Pl and PM Profiles: Dimensions.
4. IS 2122: Part 1: 1973, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 1 Flat Belt Drives.
5. IS 2122: Part 2: 1991, Code of practice for selection, storage, installation and maintenance of belting for power transmission: Part 2 V-Belt Drives.

WEB LINKS

1. http://nptel.ac.in/course.php?disciplineId=112
2. https://en.wikipedia.org/wiki/Gear

5. https://en.wikipedia.org/wiki/Gear#Manufacture

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes(POs)													
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO2	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO3	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO4	1	2	3	-	-	-	-	1	-	-	-	2	2	3
CO5	1	2	3	-	-	-	-	1	-	-	-	2	2	3

ME15605 FINITE ELEMENT ANALYSIS 3 2 0 4

COURSE OBJECTIVES

- To make the students understand the basics of FEA and classical techniques in FEA.
- To study the methods to assemble finite element equations, boundary conditions and post processing.
- To learn about the CST element, load vectors, applications to heat transfer etc.
- To study about plane stress, plane strain and axi -symmetric problems formulation etc.
- To gain knowledge on iso- parametric formulation, shape functions, numerical integration and stiffness integration.

UNIT I INTRODUCTION 15

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

UNIT II ONE DIMENSIONAL PROBLEMS 15

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

UNIT III TWO DIMENSIONAL PROBLEMS – SCALAR VARIABLE PROBLEMS 15

Finite element modeling – CST element – Element equations, Load vectors and boundary conditions – Assembly – Application to heat transfer – Examples.

UNIT IV TWO DIMENSIONAL PROBLEMS – VECTOR VARIABLE PROBLEMS 15

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

UNIT V ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL PROBLEMS 15

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

TOTAL PERIODS 75

COURSE OUTCOMES

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

- comprehend the idea of finite element method and its historical background.
- assemble finite element equation, apply gauss elimination method to solve structural problems and non-structural problems.
- utilize FEM components like CST element, plane stress, plane strain conditions and application to heat transfer problems.
- demonstrate knowledge on axi symmetric element, plane stress conditions with different boundary conditions.

- restate the concept in mapping of elements from natural to local coordinate system, displacement and stress calculations with numerical integration.

TEXT BOOKS

1. Chandrupatla T.R., and Belegundu A.D., "Introduction to Finite Elements in Engineering", Pearson Education 2011, 4th Edition.
2. Logan D.L., "A First course in the Finite Element Method", Third Edition, Thomson Learning, 2011.

REFERENCES

1. Rao S.S., "The Finite Element Method in Engineering", Pergammon Press, 2011.
2. David V Hutton "Fundamentals of Finite Element Analysis"2005. McGraw-Hill Int. Ed.
3. Robert D.Cook., David.S, Malkucs Michael E Plesha, "Concepts and Applications of Finite Element Analysis", 4 Ed. Wiley, 2003.
4. Reddy J.N., "An Introduction to Finite Element Method", McGraw-Hill International Student Edition, 2006.
5. Victor N. Kaliakin "Introduction to Approximate Solution Techniques, Numerical Modeling, & Finite Element Methods", 2001.

WEB LINKS

1. http://textofvideo.nptel.iitm.ac.in/105106051/lec1.pdf
2. http://www.math.tifr.res.in/~publ/ln/tifr49.pdf
3. http://nptel.ac.in/courses/112104115/

2. https://en.wikipedia.org/wiki/Gear#Manufacture

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO2	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO5	3	3	3	-	2	-	-	-	-	-	-	2	3	3

ME15606 SIMULATION AND ANALYSIS LABORATORY 0 0 2 1

COURSE OBJECTIVES

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools
- To make students solve real time problems using simulation and analysis software like MATLAB & ANSYS
- expose to stress analysis(Mechanical, thermal) and heat transfer analysis through simulation software

A. Simulation 8

1. Simulation of Air conditioning system with condenser temperature and evaporator temperatures as input to get COP using C /MAT Lab.
2. Simulation of Hydraulic / Pneumatic cylinder using C / MAT Lab.
3. Simulation of cam and follower mechanism using C / MAT Lab.

B. Analysis (Simple Treatment Only) 22

1. Stress analysis of a plate with a circular hole.
2. Stress analysis of rectangular L bracket
3. Stress analysis of an axi-symmetric component
4. Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
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

TOTAL PERIODS 30

COURSE OUTCOMES

At the end of this course, Students will be able to

- simulate components like inverted pendulum, cam follower mechanism and spring mass damper system etc.
- do simple analysis in both structural and non structural problems.
- model, analyse and simulate experiments to meet real world system and evaluate the performance.
- Solve thermal conductivity and thermal stress related problems using simulation software

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO2	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO3	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO4	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO5	3	-	-	-	2	-	-	-	-	-	-	2	2	2

ME15607 COMPUTER AIDED DESIGN LABORATORY 0 0 2 1

COURSE OBJECTIVES

- To gain practical experience in handling 2D drafting and 3D modeling software systems
- To gain knowledge about design and detailed drawing using software
- get practice to draw machine components like flange coupling, plummer block etc.,
- get exposure and practice to various techniques available in software for assembling machine elements

List of Experiments

Introduction of 3D Modelling software

Drawing and assembling of following Machine components

1. Flange Coupling
2. Plummer Block
3. Screw Jack
4. Lathe Tailstock
5. Universal Joint
6. Machine Vice
7. Stuffing box
8. Crosshead
9. Safety Valves
10. Non-return valves
11. Connecting rod
12. Piston

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- develop 2D and 3D models using modeling software.
- draw part diagram using various features and options available in modeling software
- use the features of design and Modeling software to assemble various components of machine elements like Screw Jack, universal Joint and Safety valve etc.
- describe ability to draw and assemble any machine components using modeling sotware.

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO2	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO3	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO4	3	-	-	-	2	-	-	-	-	-	-	2	2	2

ME15608 DESIGN AND FABRICATION PROJECT 0 0 2 1

COURSE OBJECTIVES

- To give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them
- To revision of the fundamental knowledge acquired during earlier semesters and apply to real life problems.
- To form a small team and execute a simple project in the area of design, analysis, fabrication, and thermal engineering
- To identify, formulate and solve engineering problems

GUIDELINE FOR REVIEW AND EVALUATION

- The students may be grouped into 2 to 4 and work under a project supervisor.
- The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry.
- A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department.
- At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- use design software for modeling and analyzing real time components in a part or Assembly & study their static and dynamic characteristics.
- apply design principles and develop conceptual and engineering design elements of any components.
- fabricate any components using proper manufacturing tools.
- comprehend the impact of engineering solutions in a global, economic, environmental, and societal context

WEB LINKS

1. www.slideshare.net/.../mechanical-mechatronics-design-and-fabrication-...
2. *www.majesticproject.com/projects.php?ptype=51*
3. https://www.youtube.com/watch?v=jMwrkB4JQ4M

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO2	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO3	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2

EN15601 CAREER DEVELOPMENT LABORATORY II 0 0 2 1

COURSE OBJECTIVES

- To enhance career competency and employability skills
- To demonstrate effective leadership and interpersonal skills
- To improve professional capabilities through advanced study and researching current market strategy.
- To develop problem solving and decision making capabilities
- prepare for any group discussion evaluation or presenting their credentials during a face –to- face interview leading to selection and employment

UNIT I CORPORATE READINESS 6

Business Communication – Inter and Intra Personal skills – Business Etiquettes – Corporate ethics – Communication media Etiquette.

UNIT II INTERVIEW SKILLS 6

Resume building – Group discussions – Presentation skills – Entrepreneur skills – Psychometric assessment – Mock interview.

UNIT III QUANTITATIVE APTITUDE (QA) 2 6

Profit and Loss – Clock – Power and Square roots – Train – Boats and streams – Probability – Calendars – Permutations and Combinations - Partnership – Simplification – Pipes and Cisterns – Puzzles.

UNIT IV LOGICAL REASONING (LR) 2 6

Statements and Assumptions – Matching Definitions – Logical Games – Making judgments – Statements and conclusions – Verbal classifications.

UNIT V VERBAL REASONING (VR) 2 6

Syllogisms – Data sufficiency – Dice – Series completion – Character puzzles – cube and cuboids – Arithmetic Reasoning.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- develop team work capabilities
- boost their problem solving skills
- enhance the transformation from college to corporate.
- Be a knowledgeable person on the various evaluation processes leading to employment and face the same with Confidence

REFERENCES

1. Agarwal, r.s.” a modern approach to verbal & non verbal reasoning”, , S.Chand & co ltd, New Delhi.

2. Abhijit guha, “quantitative aptitude for competitive examinations “, Tata Mcgraw hill

3. Word power made easy by norman lewis ,wr.goyal publications.

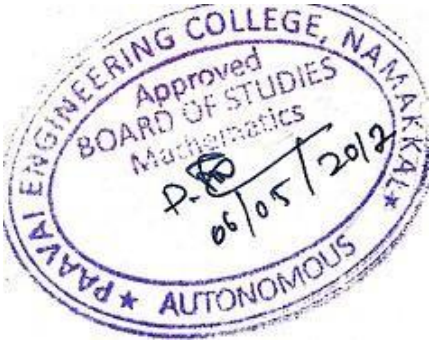
4. Johnson, d.w. (1997). Reaching out – interpersonal effectiveness and self Actualization -- Boston: Allyn and bacon.

5. Infosys Campus Connect Program – students‟ guide for soft skills.

6. Mitra ,barun.k, “ Personalaity Development & Softskills “ , Oxford University.

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO2	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO3	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO5	3	-	2	-	-	-	-	-	3	3	3	2	2	2



ELECTIVE II

ME15251 COMPOSITE MATERIALS 3 0 0 3

COURSE OBJECTIVES

- To learn the need, classification, applications and other aspects of composite materials.
- To understand different types of laminates and constitute equations.
- To study stress, strain and failure analysis for lamina strength of isotropic and anisotropic materials.
- To gain knowledge on thermal analysis of different laminate configurations
- To acquire knowledge on analysis of laminated flat plates

UNIT I INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS & MANUFACTURING 12

Definition –Need – General Characteristics, Applications. Fibers – Glass, Carbon, Ceramic and Aramid fibers. Matrices – Polymer, Graphite, Ceramic and Metal Matrices – Characteristics of fibers and matrices. Lamina Constitutive Equations: Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke‟s Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Typical Commercial material properties, Rule of Mixtures. Generally Orthotropic Lamina –Transformation Matrix, Transformed Stiffness. Manufacturing: Hand layup, Bag Moulding – Compression Moulding – Pultrusion – Filament Winding – Other Manufacturing Processes.

UNIT II FLAT PLATE LAMINATE CONSTITUTE EQUATIONS 10

Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated Anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates

UNIT III LAMINA STRENGTH ANALYSIS 7

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill‟s Criterion for Anisotropic materials. Tsai-Hill‟s Failure Criterion for Composites. Tensor. Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure.

UNIT IV THERMAL ANALYSIS 8

Assumption of Constant C.T.E‟s. Modification of Hooke‟s Law. Modification of Laminate Constitutive, Equations. Orthotropic Lamina C.T.E‟s. C.T.E‟s for special Laminate Configurations – Unidirectional, Off-axis Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi-Isotropic Laminates.

UNIT V ANALYSIS OF LAMINATED FLAT PLATES 8

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- recall thoroughly the basics of composite materials
- apply the equations governing different types of laminates
- consider the factors involved in the analysis of lamina strength

- carry out thermal analysis of laminate configurations
- discuss knowledgeably about the analysis of laminated flat plates

TEXT BOOKS

1. Mallick, P.K., Fiber ”Reinforced Composites: Materials, Manufacturing and Design”, Maneel Dekker Inc, 2007.
2. Mallick, P.K. and Newman, S., (edition), “Composite Materials Technology: Processes and Properties”, Hansen Publisher, Munish, 1990.

REFERENCES

1. Agarwal, B.D., and Broutman L.J., “Analysis and Performance of Fiber Composites”, John Wiley and Sons, New York, 2006.
2. Issac M. Daniel and Ori Ishai, “Engineering Mechanics of Composite Materials”, Oxford University Press 2006, First Indian Edition 2007.
3. Hyer, M.W., “Stress Analysis of Fiber – Reinforced Composite Materials”, McGraw- Hill, 2009.
4. Halpin, J.C., “Primer on Composite Materials, Analysis”, Techomic Publishing Co., 1984.
5. Madhujit Mukhopadhyay, “Mechanics of Composite Materials and Structures”, University Press (India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008).

WEB LINKS

1. www.netcomposites.com
2. https://en.wikipedia.org/wiki/Composite_material
3. http://nptel.ac.in/courses/101106038/mod02lec01.pdf

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO2	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO3	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO4	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO5	3	-	-	-	2	-	1	-	-	-	-	2	3	2

BA15352 ENGINEERING ECONOMICS 3 0 0 3

COURSE OBJECTIVES

- To understand the fundamental economic concepts applicable to engineering and to learn the techniques of economics
- To learn the applications on time value of money in value Engineering
- To impart knowledge on cash flow analysis
- To acquire knowledge on maintenance and replacement analysis
- To inculcate knowledge on depreciation and its methods

UNIT I INTRODUCTION TO ECONOMICS 9

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis - V ratio, Elementary economic Analysis – Material selection for product Design selection for a product, Process planning.

UNIT II VALUE ENGINEERING 9

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- equalpayment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

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 flowdiagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cashflow 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- 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.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply the fundamental economic concepts applicable to engineering and to learn the techniques of
- understand the applications on time value of money in value engineering
- familiar on cash flow analysis
- understand the maintenance and replacement analysis
- apply the depreciation methods

TEXT BOOKS

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

REFERENCES

1. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis" Engg. Press, Texas, 2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2011.
4. Zahid A khan: Engineering Economy, "Engineering Economy", Dorling Kindersley, 2012

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	-	-	-		-	-	-	-	2	2	2
CO2	3	2	1	-	-	-		-	-	-	-	2	2	2
CO3	3	2	1	-	-	-		-	-	-	-	2	2	2
CO4	3	2	1	-	-	-		-	-	-	-	2	2	2
CO5	3	2	1	-	-	-		-	-	-	-	2	2	2

ME15252 RAPID PROTOTYPING 3 0 0 3

COURSE OBJECTIVES

- To understand the various rapid prototyping, rapid tooling, and reverse engineering technologies
- To gain knowledge to select appropriate technologies for product development purposes
- To learn various methods of prototyping systems
- To study about selection of material for rapid prototyping
- To familiarize reverse engineering and learn the advanced technologies

UNIT I INTRODUCTION 8

History – Development of RP systems – Applications in Product Development, Reverse Engineering, Rapid Tooling, Rapid Manufacturing- Principle – Fundamental – File format – Other translators – medical applications of RP - On demand manufacturing – Direct material deposition - Shape Deposition Manufacturing.

UNIT II LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS 10

Classification – Liquid based system - Stereolitho graphy Apparatus (SLA), details of SL process, products, Advantages, Limitations, Applications and Uses. Solid based system - Fused Deposition Modeling, principle, process, products, advantages, applications and uses - Laminated Object Manufacturing.

UNIT III POWDER BASED RAPID PROTOTYPING SYSTEMS 10

Selective Laser Sintering – principles of SLS process, principle of sinter bonding process, Laser sinteringmaterials, products, advantages, limitations, applications and uses. Three Dimensional Printing – process, major applications, research and development. Direct shell production casting – key strengths, process, applications and uses, case studies, research and development. Laser Sintering System, emanufacturing using Laser sintering, customized plastic parts, customized metal parts, e-manufacturing - Laser Engineered Net Shaping (LENS).

UNIT IV MATERIALS FOR RAPID PROTOTYPING SYSTEMS 10

Nature of material – type of material – polymers, metals, ceramics and composites liquid based materials, photo polymer development – solid based materials, powder based materials – case study.

UNIT V REVERSE ENGINEERING AND NEW TECHNOLOGIES 7

Introduction, measuring device- contact type and non-contact type, CAD model creation from point clouds preprocessing, point clouds to surface model creation, medical data processing - types of medical imaging, software for making medical models, medical materials, other applications – Case study.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- apply the basic principles of rapid prototyping (RP), rapid tooling (RT), and reverse engineering (RE) technologies to product development
- describing limitations of RP, RT, and RE technologies for product development
- make products using RP, RT, and RE technologies
- compare different materials like polymers, metals, ceramics and composites liquid based materials to select appropriate work material.
- use software for modeling in this technique.

TEXT BOOKS

1. Rafiq I. Noorani, Rapid Prototyping – Principles and Applications, Wiley & Sons, 2006.
2. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications, second edition, World Scientific, 2003.

REFERENCES

1. N.Hopkinson, R.J.M, Hauge, P M, Dickens, "Rapid Manufacturing – An Industrial revolution for the digital age", Wiley, 2006.
2. Ian Gibson, "Advanced Manufacturing Technology for Medical applications: Reverse Engineering, Software conversion and Rapid Prototying", Wiley, 2006
3. Pham,D.T. and Dimov.S.S., "Rapid manufacturing" , Springer, London, 2012
4. Joe Cecil, "Virtual Enginering", Momentum Press, 2010.
5. Ali K. Kamrani, Emad Abouel Nasr, "Rapid Prototyping: Theory and Practise", Springer, Houston, 2006

WEB LINKS

1. www.elearningnetwork.org/wiki/rapid-prototyping
2. http://nptel.ac.in/courses/112107078/39
3. http://nptel.ac.in/courses/112107078/37

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO2	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO3	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO4	3	-	-	-	2	-	1	-	-	-	-	2	3	2
CO5	3	-	-	-	2	-	1	-	-	-	-	2	3	2

ME15253 CNC TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

- To understand the basic concepts of computer numerical control (CNC) of machine tools and CNC Programming.
- To know about the various drives and controls, cutting tool materials and work holding devices for rotating and fixed work parts.
- To learn the fundamentals of machining processes and machine tools.
- To gain knowledge of basic mathematics to calculate the machining parameters for different machining processes
- To familiarize with metal cutting parameters.

UNIT I INTRODUCTION TO CNC MACHINE TOOLS 6

Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, CNC controllers, characteristics, interpolators

UNIT II STRUCTURE OF CNC MACHINE TOOL 10

CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.

UNIT III DRIVES AND CONTROLS 9

Feed drives – stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer, feedback device

UNIT IV CNC PROGRAMMING 11

Coordinate system, Manual part progamming, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages.

UNIT V TOOLING AND WORK HOLDING DEVICES 9

Introduction to cutting tool materials – Carbides, Ceramics, CBN, PCD–inserts classification- PMK, NSH, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- comprehend classification of CNC machines and types of control systems.
- discuss structural details, types of guide ways, rotary motion to a linear Motion and torque transmission elements.

- explain Spindle drives, DC and AC servomotors, axis measuring system.
- demonstrate knowledge on programming for machining centre and turning centre for well known controllers.
- recognize cutting tool materials, work holding devices for rotating and fixed work parts.

TEXT BOOKS

1. Michael Fitzpatrick, "Machining and CNC Technology", McGraw-Hill Company, 2004.
2. Warren S.Seamers, "Computer Numeric Control", Fourth Edition – Thomson Delmar, 2002.

REFERENCES

1. James Madison, "CNC Machining Hand Book", Industrial Press Inc., 1996.
2. Ken Evans, John Polywka & Stanley Gabrel, "Programming of CNC Machines", Second Edition – Industrial Press Inc, New York, 2002.
3. Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2008.
4. Yoram Koren" Computer control of manufacturing systems" McGraw-Hill, 2005.
5. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency, 2014.

WEB LINKS

1. www.cncmodes.com
2. https://www.google.co.in/#q=TOOLING+AND+WORK+HOLDING+DEVICES
3. https://www.youtube.com/watch?v=oMOJcfkOI

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO2	3	2	-	-	2	-	-	-	2	2	-	2	2	2
CO3	2	2	-	-	2	-	-	-	3	3	-	2	3	3
CO4	3	2	-	-	3	-	-	-	3	3	-	2	2	3
CO5	3	2	-	-	3	-	-	-	2	3	-	2	3	3

ME15254 AEROSPACE ENGINEERING 3 0 0 3

COURSE OBJECTIVES

- To familiarize on the basic concepts of solar systems
- To analyze and understand the different types of bodies
- To gain knowledge on satellite performances
- To learn about interplanetary and Ballistic missile Trajectories
- To study about the materials used for spacecraft production

UNIT I BASIC CONCEPTS 9

The solar system - Reference frames and coordinate systems - The celestial sphere -The ecliptic - Motion of vernal equinox - Sidireal time - Solar time - Standard time - The earth's atmosphere.

UNIT II THE GENERAL N-BODY PROBLEM 9

The Many body problem - Lagrange - Jacobi identity - The circular restricted three body problem - Libration points - Relative Motion in the N-body problem - The two - body problem - Satellite orbits - Relations between position and time - Orbital elements.

UNIT III SATELLITE INJECTION AND SATELLITE ORBIT PERTURBATIONS 10

General aspects of satellite injections - Satellite orbit transfer - Various cases - Orbit deviations due to injection errors - Special and general perturbations - Cowell's Method - Encke's method - Method of variations of orbital elements - General perturbations approach.

UNIT IV INTERPLANETARY TRAJECTORIES BALLISTIC MISSILE- TRAJECTORIES 10

Two-dimensional interplanetary trajectories - Fast interplanetary trajectories - Three dimensional interplanetary trajectories - Launch of interplanetary spacecraft - Trajectory about the target plant.The boost phase – The ballistic phase - Trajectory geometry - Optimal flights - Time of flight - Re-entry phase -The position of the impact point - Influence coefficients.

UNIT V MATERIALS FOR SPACECRAFT 7

Space environment - Peculiarities -Effect of space environment on the selection of materials of spacecraft.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- restate basics of aerospace engineering.
- compute the N body problems
- describe about various methods in satellite perturbations
- comprehend the concepts involved in the trajectory geometry.
- distinguish the factors influencing selection of materials for spacecraft

TEXT BOOKS

1. Sutton, G. P., Rocket Propulsion Elements, 7th Edition, John Wiley & Sons, New York, 2010.
2. Van de Kamp, P., Elements of Astromechanics, 2nd Edition, Pitman, London, 1979.

REFERENCES

1. Cornelisse, J.W., Rocket Propulsion and Space Dynamics, W.H. Freeman & Co., New York, 1984
2. Parker, E. R., Materials for Missiles and Spacecraft, McGraw Hill Book Co., New York, 1982
3. Rudolph X. Meyer., Elements of Space Technology, Acadamic press, London, 1999
4. Arnold M. Kuethe, Kuethe, Chuen-Yen Chow Foundations of Aerodynamics: Bases of Aerodynamic Design.
5. T.H.G. Megson Aircraft Structures for Engineering Students, Elsevier, 2012.

WEB LINKS

1. nptel.ac.in/downloads/101101001/
2. nptel.ac.in/downloads/101106035/
3. http://nptel.ac.in/courses/101101001/4

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
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CO2	3	3	3	2	2	2	1	-	-	-	-	2	2	2
CO3	3	3	3	2	3	2	1	-	-	-	-	2	2	2
CO4	2	3	2	2	3	2	1	-	-	-	-	2	2	2
CO5	2	1	1	1	2	2	1	-	-	-	-	1	1	1