ME16301 **ENGINEERING THERMODYNAMICS** **3 2 0 4**

COURSE OBJECTIVES

- To provide knowledge in the basic concepts, processes, first law and applications of thermodynamic system.
- To know about the second law, Carnot cycle and the concept of entropy.
- To familiarize the properties of pure substance and steam power cycle.
- To understand the concepts of ideal and real gases and thermodynamics relations.
- To study the concepts of psychometric properties and processes.

UNIT I BASIC CONCEPT AND FIRST LAW **15**

Basic concepts - concept of continuum, macroscopic approach, Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. Concept of ideal and real gases. First law of thermodynamics – application to closed and open systems, internal energy, specific heat capacities, enthalpy, steady flow process with reference to various thermal equipments.

UNIT II SECOND LAW **15**

Second law of thermodynamics – Kelvin‟s and Clausius statements of second law. Reversibility and irreversibility. Carnot theorem, Carnot cycle, reversed carnot cycle, efficiency, COP. Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy – availability

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE **15**

Properties of pure substances – Thermodynamic properties of pure substances in solid,liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam. Calculations of work done and heat transfer in nonflow and flow processes. Standard Rankine cycle, Reheat and regenerative cycle

UNIT IV IDEAL AND REAL GASES AND THERMODYNAMIC RELATIONS **15**

Gas mixtures – properties ideal and real gases, equation state, Avagadro‟s Law, Vander Waal‟s equation of state, compressability factor, compressability chart – Dalton‟s law of partial pressure, exact differentials, T-D relations, Maxwell‟s relations, ClausiusClapeyron equations, Joule –Thomson coefficient.

UNIT V PSYCHROMETRY **15**

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

TOTAL PERIODS 75

COURSE OUTCOMES

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

- comprehend the basic concept, first law, concept of ideal and real gases.
- demonstrate the real time applications of carnot theorem, COP, Clausius inequality and availability.
- enhance the knowledge on properties of pure substances and steam power cycle.
- illustrate the real time applications of ideal ,real gases and thermodynamic relations.
- explain the applications of psychrometry.

TEXT BOOKS

1. Nag.P.K., "Engineering Thermodynamics", Tata McGraw-Hill, New Delhi, 2013.
2. Cengel, „Thermodynamics – An Engineering Approach" Seventh Edition – 2011 – Tata McGraw Hill, New Delhi.

REFERENCES

1. Holman.J.P., "Thermodynamics", 3rd Ed. McGraw-Hill, 1995.
2. Venwylen and Sontag, "Classical Thermodynamics", Wiley Eastern, 2002.
3. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
4. Rathakrishnan.E, "Fundamentals of Engineering Thermodynamics", Second Edition, PHI Learning Pvt. Ltd, 2005
5. Achuthan.M "Engineering Thermodynamics" PHI Learning Private Limited, New Delhi, 2009

WEB LINKS

1. home.iitk.ac.in/~suller/lectures.html
2. http://personal.cityu.edu.hk/~bsapplec/psychrom.html

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

ME16302 **MANUFACTURING TECHNOLOGY I** **3 0 0 3**

COURSE OBJECTIVES

- To familiarize the concepts of basic manufacturing processes, metal casting processes and melting furnaces.
- To learn the working principles of arc welding, gas welding and special welding processes.
- To provide knowledge in manufacturing processes, hot and cold working processes with their typical applications
- To understand the sheet metal characteristics, operations, and special forming processes.
- To get exposure to various types of plastic injection molding processes and typical applications.

UNIT I METAL CASTING PROCESSES 9

Sand casting – Sand moulds - Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Methods of Sand testing – Moulding machines – Types of moulding machines - Melting furnaces –Working principle of Special casting processes – Shell, investment casting – Ceramic mould – Lost Wax process – Pressure die casting – Centrifugal casting – CO2 process – Sand Casting defects – Casting cleaning process - Inspection methods.

UNIT II JOINING PROCESSES 9

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding – Percusion welding - Gas metal arc welding – Flux cored – Submerged arc welding – Electroslag welding – TIG welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Diffusion welding – Weld defects – Brazing and soldering process – Methods and process capabilities – Filler materials and fluxes – Types of Adhesive bonding.

UNIT III BULK DEFORMATION PROCESSES 9

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Characteristics of the process – Types of Forging Machines – Typical forging operations – Rolling of metals – Typesof Rolling mills - Flat strip rolling – Shape rolling operations – Defects in rolled parts - Principle of rod and wire drawing - Tube drawing – Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion – Equipments used.

Case Study: Manufacturing solid rocket-motor case segment for the space shuttle.

UNIT IV SHEET METAL PROCESSES 9

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

UNIT V MANUFACTURING OF PLASTIC COMPONENTS 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the types of casting and molding processes and melting furnaces.
- discuss the various types of welding methods and their applications.
- analyze the various types of forging processes ,types of rolling and extrusion processes.
- comprehend Sheet metal characteristics and typical shearing operations.
- review different types of plastics and working of Injection molding machines.

TEXT BOOKS

1. Hajra Choudhury, "Elements of Workshop Technology, Vol. I and II", Media Promotors Pvt Ltd., Mumbai, 2001
2. S.Gowri, P.Hariharan, and A.SureshBabu, "Manufacturing Technology 1", Pearson Education, 2008.

REFERENCES

1. B.S. Magendran Parashar & R.K. Mittal, "Elements of Manufacturing Processes", Prentice Hall of India, 2003.
2. P.N. Rao,"ManufacturingTechnology",Tata McGraw-Hill Publishing Limited, II Edition, 2013.
3. P.C. Sharma, "A text book of Production Technology", S. Chand and Company, VII Edition, 2006.
4. Begman, „Manufacturing Process", John Wilely& Sons, VIII Edition, 2005.
5. Serope Kalpajian, Steven R.Schmid, Manufacturing Engineering and Technology, Pearson Education, Inc.2009 (Second Indian Reprint).

WEB LINKS

1. www.bookdepository.com
2. www.elsevier.com

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

ME16303 ENGINEERING MATERIALS AND METALLURGY 3 0 0 3

COURSE OBJECTIVES

- To learn about the micro-structure of materials, phase diagrams for different binary Alloys.
- To impart knowledge on different types of phase diagrams of alloys and types of heat treatments.
- To identify the various mechanical properties of materials through different types of tests and their significance.
- To know about different types of alloy steels with their applications, non-ferrous alloys with particular reference to copper, aluminum, magnesium, zinc, nickel, titanium, lead and tin alloys.
- To gain knowledge on the types, structure, properties and applications of polymers, ceramics and composites.

Review (Not for Exam)

Crystal structure – BCC, FCC and HCP structure – unit cell – crystallographic planes and directions, miller indices – crystal imperfections, point, line, planar and volume defects – Grain size, ASTM grain size number.

UNIT I CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams,Isomorphous, eutectoid, eutectic, peritectic and peritectroid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron, microstructure, properties and applications.

UNIT II HEAT TREATMENT 9

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

UNIT III MECHANICAL PROPERTIES AND TESTING 9

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep tests, fracture toughness tests.

UNIT IV FERROUS AND NON FERROUS METALS 9

Effect of alloying elements on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA - maraging steels – Cast Irons - Grey, White malleable, spheroidal – Graphite, Alloy cast irons, Copper and Copper alloys - Brass, Bronze and Cupronickel – Aluminum and Al-Cu alloy – precipitation hardening– Bearing alloys.

UNIT V NON-METALLIC MATERIALS 9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics – Introduction to Fibre reinforced plastics.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- demonstrate knowledge on micro-structure of materials, iron-carbon and other phase diagrams.
- explain isothermal transformation diagram and various types of heat treatments.

- discuss the concepts of plastic deformation, strengthening mechanisms and fracture of metals, various mechanical testing methods for properties and their engineering importance.
- write on different types alloy steels and their engineering applications, non-ferrous alloys with particular reference to copper, aluminium, magnesium, zinc, nickel, titanium, lead and tin alloys.
- reproduce the types, structure, properties and applications of polymers, composites materials.

TEXT BOOK

1. Kenneth G.Budinski and Michael K.Budinski "Engineering Materials" Prentice-Hall of India Private Limited, 4th Indian Reprint 2010.

REFERENCES

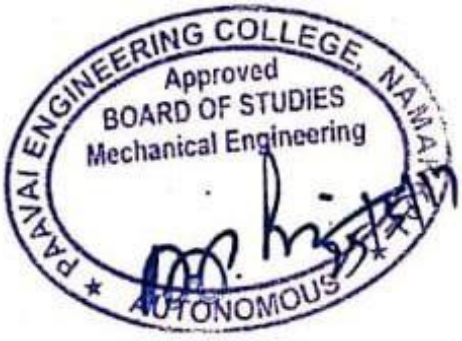
1. William D Callister "Material Science and Engineering", John Wiley and Sons 2007.
2. Raghavan.V "Materials Science and Engineering", Prentice Hall of India Pvt., Ltd., 2007.
3. Sydney H.Avner "Introduction to Physical Metallurgy" McGraw Hill Book Company, 2007.
4. Dieter G. E., Mechanical Metallurgy, McGraw Hill Book Company, 1988.
5. O.P. Khanna, A text book of Materials Science and Metallurgy, Khanna Publishers, 2014.

WEB LINKS

1. nptel.ac.in/courses/113106032/9%20-%20Phase%20diagrams.pdf
2. https://books.google.co.in/books?isbn=1856178099

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	3	1	-	-	-	-	-	-	-	-	-	-	1
CO2	3	3	-	1	2	-	-	-	-	-	-	-	-	2
CO3	2	-	1	-	-	-	-	-	-	-	-	-	-	1
CO4	3	3	1	2	-	2	-	-	-	-	-	-	-	1
CO5	2	-	-	-	2	-	-	-	-	-	-	-	-	1



ME16304 **FLUID MECHANICS AND MACHINERY** **3 0 0 3**

COURSE OBJECTIVES

- To introduce the basic concepts of fluid mechanics for thorough understanding of the properties of fluids.
- To gain knowledge on the dynamics of fluids through the control volume approach.
- To understand the concepts of dimensionless parameters and its applications.
- To study the working principles of pumps and turbines, also their applications.
- To describe and learn the working of reciprocating and rotodynamic hydraulic machines

UNIT I INTRODUCTION **9**

Units and Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equiation, energy equation, momentum equation and moment of momentum equation.

UNIT II FLOW THROUGH CIRCULAR CONDUITS **9**

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

UNIT III DIMENSIONAL ANALYSIS **9**

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

UNIT IV ROTO DYNAMIC MACHINES **9**

Homologus units. Specific speed. Elementary cascade theory. Theory of turbo machines. Euler"s equation. Hydraulic efficiency. Velocity components at the entry and exit of the rotor. Velocity triangle for single stage radial flow and axial flow machines. Centrifugal pumps, turbines, performance curves for pumps and turbines.

UNIT V POSITIVE DISPLACEMENT MACHINES **9**

Recriprocating pumps, Indicator diagrams, Work saved by air vessels. Rotary pumps. Classification. Working and performance curves.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- discuss the fundamentals of fluid mechanics, including the basics of hydraulics, types of fluids-water, oils and its uses along with fluid properties.
- analyze fluid flow phenomena with the application of momentum and energy equation.
- perform dimensional analysis and to learn the several non-dimensional numbers with real time applications.
- comprehend the working principle of turbo machinery.
- compare different types of pumps, fluid machineries and its working principles.

TEXT BOOKS

1. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 1985.
2. Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.

REFERENCES

1. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, DhanpatRai & Sons, Delhi, 2006.
2. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 2008
3. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., IX Edition, New Delhi. 2017
4. Grabel.W.P, Engineering Fluid Mechanics, Taylor Francis, Indian Reprint, 2011
5. Modi P.N and Seth S.M, Hydraulics and Fluid Mechanics, Standard Book House, New Delhi 2013.

WEB LINKS

1. www.mechanical.in/fluid-mechanics-and-machinery
2. http://nptel.ac.in/courses/105101082/1

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

EE16305 **ELECTRICAL MACHINES AND DRIVES (COMMON TO MECH & MCT)** **3 0 0 3**

COURSE OBJECTIVES

- To impart students with fundamentals of energy conversion, construction and principle of operation.
- To facilitate students to understand the characterization of electrical machines and various drives.
- To familiarize the concepts of starting methods and speed control of electrical machines.
- To analyze the operation of solid state speed control of DC drives.
- To understand the solid state speed control of AC drives.

UNIT I DC MACHINES **9**

DC Generator-Construction and Principle of operation, EMF Equation, types, OCC and External characteristics cures. DC Motors- Principle of operation, types, Characteristics – Starters - Braking methods.

UNIT II AC MACHINES **9**

AC Generator-Construction and working principle - Three phase Induction motors, Construction, types, principle of operation, characteristics and starting methods, Single phase induction motor- Construction and working principle of operation.

UNIT III FUNDAMENTALS OF ELECTRIC DRIVES **9**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – loading conditions and classes of duty – Selection of power rating for drive motors - Load variation factors.

UNIT IV CONVENTIONAL AND SOLID STATE CONTROL OF D.C. DRIVES **9**

Speed control of DC series and shunt motors – Armature and field control, Ward- Leonard control system – Solid state control using controlled rectifiers (Single phase Half & Full wave) and DC choppers – applications.

UNIT V CONVENTIONAL AND SOLID STATE CONTROL OF A.C. DRIVES **9**

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- select and utilize various types of DC machines.
- employ effective control techniques to electrical motors.
- comprehend various elements involved in Electric drives.
- describe different solid state speed control methods of DC drives.
- identify appropriate electrical drive for engineering applications.

TEXT BOOKS

1. Nagrath .I.J. & Kothari .D.P, “Electrical Machines”, Tata McGraw-Hill, 2004.
2. Vedam Subrahmaniam, “Electric Drives (concepts and applications)”, Tata McGraw- Hill, 2001.
3. Pillai S.K., “A First course on Electrical Drives”, New Age International Publishers, 2011.

REFERENCES

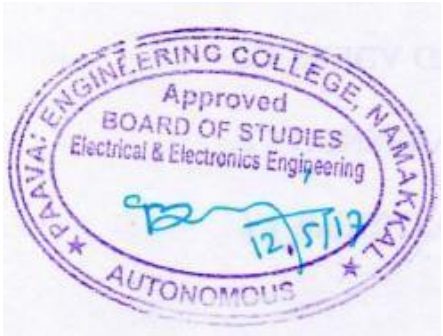
1. Theraja B.L and Theraja A.K., "A Text book of Electrical Technology", Volume – II, S,Chand & Co., 2007.
2. M.D.Singh, K.B.Khanchandani, "Power Electronics", Tata McGraw-Hill, 1998
3. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., 2003
4. Bimal K Bose, "Modern Power Electronics and AC Drives", Prentice-Hall of India Pvt. Ltd., 2003.
5. Muhammad.H.Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, 2004.

WEBLINKS

1. https://en.wikipedia.org/wiki/DC_motor
2. https://en.wikipedia.org/wiki/AC_motor

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	-	-	-	-	-	1	1	-	-	-	2	2	2
CO2	3	-	-	-	-	-	1	1	-	-	-	2	2	2
CO3	3	-	-	-	-	-	1	1	-	-	-	2	2	2
CO4	3	-	-	-	-	-	1	1	-	-	-	2	2	2
CO5	3	-	-	-	-	-	1	1	-	-	-	2	2	2



ME16305 MANUFACTURING TECHNOLOGY LABORATORY I 0 0 4 2

COURSE OBJECTIVES

- To gain hands on experience on working of general purpose machine tools and various manufacturing processes.
- To acquire real-time knowledge on Injection molding process and metal joining methods like Welding and Brazing.
- To gain practical knowledge on fabrication of sheet metal work.
- To understand the design and manufacturing of simple patterns.

Lathe

1.1. Facing, plain turning and step turning

1.2. Taper turning using compound rest, Tailstock set over, etc

1.3. Single start V thread (LH & RH), Knurling (Diamond & Single Start)

1.4. Internal thread cutting (Metric & BSW)

Welding exercises

2.1. Horizontal, Vertical and overhead welding.

2.2. Gas Cutting, Gas Welding

2.3. Brazing - for demonstration purpose

Sheet metal work

3.1. Fabrication of sheet metal tray

3.2. Fabrication of a funnel

Preparation of sand mould

4.1. Mould with solid, split patterns

4.2. Mould with loose-piece pattern

4.3. Mould with Core

Metal Casting – Demo

5.1. Cube (or) Gear Blank - for demonstration purpose

TOTAL PERIODS 60

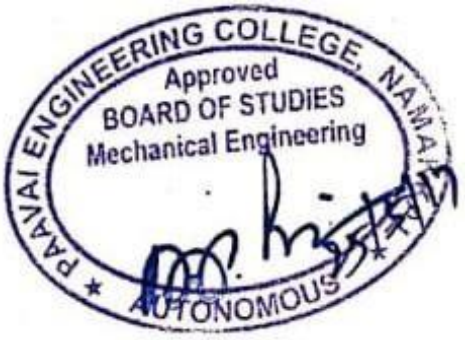
COURSE OUTCOMES

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

- handle the capstan or turret lathe and carry out various lathe operations.
- perform the metal joining welding operations such as lap-joint, butt joint and T-joint.
- carry out various sheet metal operations
- comprehend practical elements of foundry technology and its applications.

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



ME16306 **FLUID MECHANICS AND MACHINERY LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

- To compute Coefficient of discharge of given Orifice meter.
- To calculate the rate of flow using Rota meter.
- To determine friction factor for a given set of pipes.
- To characterize reciprocating and gear pump.

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Rota meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump/ submersible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL PERIODS 60

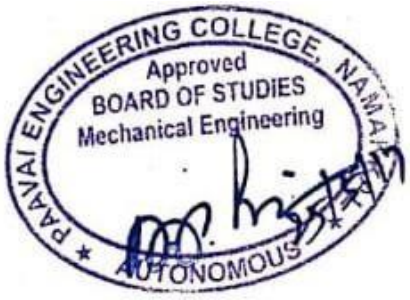
COURSE OUTCOMES

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

- determine the coefficient of discharge of given orifice meter.
- analyze the rate of flow using rota meter
- explain the friction factor for a given set of pipes.
- choose an appropriate pump for a specific application.

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



ME16401 **THERMAL ENGINEERING** **3 0 0 3**

COURSE OBJECTIVES

- To introduce the basic principles of thermodynamics via real-world engineering examples, to show students how thermodynamics is applied in engineering practice.
- To understand the fundamentals of operation of internal combustion engines, the factors affecting their performance, operation, fuel requirements and environmental impact.
- To impart knowledge on the analysis of various cycles used for power generation, combustion and kinetics involved in turbines.
- To study the design and working principles of compressors.
- To learn the concepts of refrigeration and its types, psychrometry and its principles.

UNIT I GAS POWER CYCLES **9**

Otto, Diesel, Dual, Brayton cycles, Calculation of mean effective pressure, and air standard efficiency - Actual and theoretical PV diagram of four stroke and two stroke engines.

UNIT II INTERNAL COMBUSTION ENGINES **9**

Classification - Components and their function. Valve timing diagram and port timing diagram - actual and theoretical p-V diagram of four stroke and two stroke engines. Governing of I.C. engines -Simple and complete Carburetor. MPFI, Diesel pump and injector system. Battery and Magneto Ignition System - Principles of Combustion and knocking in SI and CI Engines. Turbulence in S.I. engines - Lubrication and Cooling systems. Performance calculation.

UNIT III STEAM NOZZLES AND TURBINES **9**

Flow of steam through nozzles, shapes of nozzles, effect of friction, critical pressure ratio, supersaturated flow, Impulse and Reaction principles, compounding, velocitydiagram for simple and multi-stage turbines, speed regulations –Governors.

UNIT IV AIR COMPRESSORS **9**

Classification and working principle of various types of compressors, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency of reciprocating compressors, Multistage air compressor and inter cooling –work of multistage air compressor.

UNIT V REFRIGERATION AND AIR CONDITIONING **9**

Refrigerants classification, properties and applications - Vapour compression refrigeration cycle- super heat, sub cooling – Performance calculations - working principle of vapour absorption system, Ammonia – Water, Lithium bromide – water systems (Description only). Air conditioning system - Processes, Types and Working Principles - Concept of RSHF, GSHF, ESHF- Cooling Load calculations.

TOTAL PERIODS **45**

COURSE OUTCOMES

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

- analyze and apply the different gas power cycles for various requirements.
- describe the internal combustion engine components, operation and its performance.
- comprehend the basic concepts of steam nozzles, turbines and their functions.
- explain the performance characteristics of air compressors.

- discuss various refrigeration techniques, psychrometric principles and cooling load calculations.

TEXT BOOKS

1. Rajput. R. K., "Thermal Engineering" S.ChandPublishers, 2010.
2. Kothandaraman.C.P., Domkundwar.S and Domkundwar. A.V., "A Course in Thermal Engineering," Dhanpat Rai & Sons, Fifth edition, 2004.

REFERENCES

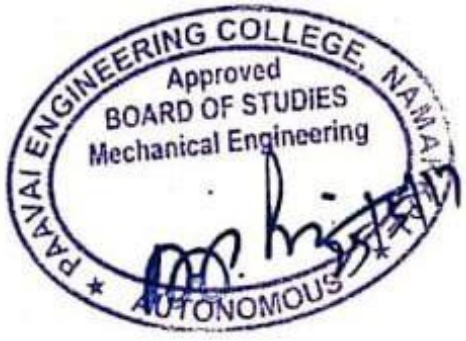
1. Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007.
2. Arora.C.P,"Refrigeration and Air Conditioning," Tata McGraw-Hill Publishers 2006.
3. Ganesan V." Internal Combustion Engines", Third Edition, Tata Mcgraw-Hill 2008.
4. Rudramoorthy, R, "Thermal Engineering ", Tata McGraw-Hill, New Delhi, 2006.
5. R.S.Khurmi & J.K. Gupta "A Textbook Of Thermal Engineering" S. Chand, 2008.

WEB LINKS

1. http://www.rejinpaul.com/2013/06/anna-university-me2301-thermal-engineering-notes-mech-5th-sem.html
2. www.iannauniversity.com/.../me2301-thermal-engineering-lecture.html

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



ME16402 KINEMATICS OF MACHINERY 3 0 0 3

COURSE OBJECTIVES

- To familiarize the concepts of machines, mechanisms and related terminology.
- To analyze the parameters of displacement, velocity and acceleration for planer mechanism graphically.
- To understand the importance of cam profiles for different types of motions.
- To study the types of gear trains and its variation in speed through theoretical approach.
- To know the role of friction in belt drives and brakes.

UNIT I BASICS OF MECHANISMS 7

Definitions – Link, Kinematic pair, Kinematic chain, Mechanism, and Machine. –Degree of Freedom – Mobility - Kutzbach criterion (Gruebler‟s equation) -Grashoff'slawKinematic Inversions of four-bar chain and slider crank chain - Mechanical Advantage-Transmission angle. Description of common Mechanisms - Offset slider mechanism as quick return mechanisms, Pantograph, Straight line generators (Peaucellier and Watt mechanisms), Steering gear for automobile, Hooke‟s joint, Toggle mechanism, Ratchets and escapements - Indexing Mechanisms.

UNIT II KINEMATIC ANALYSIS 10

Analysis of simple mechanisms (Single slider crank mechanism and four bar mechanism) - Graphical Methods for displacement, velocity and acceleration; Shaping machine mechanism - Coincident points – Coriolis acceleration - Analytical method of analysis of slider crank mechanism and four bar mechanism. Approximate analytical expression for displacement, velocity and acceleration of piston of reciprocating engine mechanism**.**

UNIT III KINEMATICS OF CAMS 8

Classifications - Displacement diagrams - Parabolic, Simple harmonic and Cycloidal motions – Graphical construction of displacement diagrams and layout of plate cam profiles - circular arc and tangent cams - Pressure angle and undercutting.

UNIT IV GEARS 10

Classification of gears – Gear tooth terminology - Fundamental Law of toothed gearing and involute gearing - Length of path of contact and contact ratio - Interference and undercutting - Gear trains – Simple, compound and Epicyclic gear trains - Differentials.

UNIT V FRICTION 10

Dry friction – Friction in screw jack – Pivot and collar friction - Plate clutches - Belt and rope drives - Block brakes, band brakes.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the types of motion, joints and degree of freedom.
- demonstrate the knowledge on displacement, velocity and acceleration for planer mechanism graphically.
- design cam profile for different types of motions.
- choose a gear and gear train depending on the application.
- apply the friction concepts to belt drives and brakes.

TEXT BOOKS

1. R.S.Khurmi&J.K.Gupta, "Theory of Machines", 14th Edition, Eurasia Publishing House, Delhi, 2005.
2. Uicker J.J.,Pennock G.R., Shigley J.E., "Theory of Machines and Mechanisms"(Indian Edition), Oxford University Press, 2003.

REFERENCES

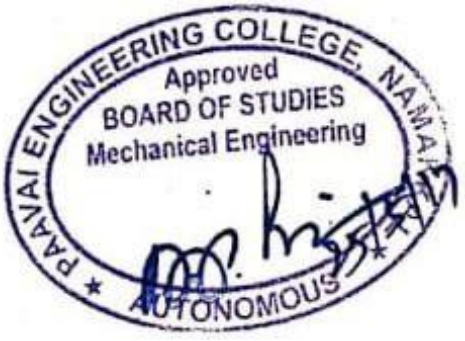
1. S.S.Rattan,"Theory of Machines", second edition, Tata Mc-Graw Hill, Delhi, 2008.
2. P.L.Ballaney, "Theory of Machines: A textbook for Engg students", 15th edition, Khanna, Delhi, 1987.
3. Ambekar A. G., Mechanism and Machine Theory, Prentice Hall of India, New Delhi, 2007.
4. V.Jayakumar, "Kinematics of Machinery", 1st Edition, Lakshmi Publisher, Chennai, 2004.
5. Ghosh, A, and Malick, A. K., "Theory of Mechanisms and Machines" 3rd Edition, East West Press Pvt Ltd., 2000.

WEB LINKS

1. ebooks.library.cornell.edu/k/kmoddl/pdf/016_002.pdf
2. https://www.vidyarthiplus.com/vp/Thread-ME2203-KINEMATICS-OF-MACHINERY-Lecture-Notes-adhithya-edition

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	2	1	-	-	-	2	2	3	3
CO2	3	2	2	2	2	2	1	-	-	-	2	2	3	3
CO3	3	2	2	2	2	2	1	-	-	-	2	2	3	3
CO4	3	2	2	2	2	2	1	-	-	-	2	2	3	3
CO5	3	2	2	2	2	2	1	-	-	-	2	2	3	3



ME16403 MANUFACTURING TECHNOLOGY II 3 0 0 3

COURSE OBJECTIVES

- To make the student to understand the basic principles of theory of metal cutting.
- To learn details of the construction of conventional lathe and metal cutting machine tools.
- To study the concept of Machine tools like shaping, slotting, planning, milling, drilling, grinding machines.
- To familiarize with the manufacturing operations for gears and surface finishing processes.
- To acquire knowledge on the CNC programming and part programming used for APT programming.

UNIT I THEORY OF METAL CUTTING 9

Introduction: Material removal processes, Types of machine tools – theory of metal cutting: chip formation, orthogonal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids.

UNIT II CENTRE LATHE AND SPECIAL PURPOSE LATHES 9

Centre lathe, constructional features, cutting tool geometry, various operations, taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes – automats – single spindle, Swiss type, automatic screw type, multi spindle - Turret Indexing mechanism, Bar feed mechanism**.**

UNIT III OTHER MACHINE TOOLS 9

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

UNIT IV ABRASIVE PROCESSES AND GEAR CUTTING 9

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

UNIT V CNC MACHINE TOOLS AND PART PROGRAMMING 9

Numerical control (NC) machine tools – CNC: types, constructional details, special features – design considerations of CNC machines for improving machining accuracy –structural members – slide ways – linear bearings – ball screws – spindle drives and feed drives. Part programming fundamentals – manual programming – computer assisted part programming-APT Languages.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply the concepts of theory of metal cutting in real life machining.
- describe about the centre lathe, its accessories and relative operations which are performed in machine shop.
- comprehend the basic concepts and working principles of other machines tools like Shaper, Drilling, Milling and all allied machines.
- discuss about the surface machining processes, design and fabrication of important machine elements.

- explain CNC machining, respective equipment and its parts along with the ability to develop CNC programs for machining of materials.

TEXT BOOKS

1. Hajra Choudry, "Elements of Work Shop Technology – Vol. II", Media Promoters. 2002
2. HMT – "Production Technology", Tata McGraw-Hill, 1998.

REFERENCES

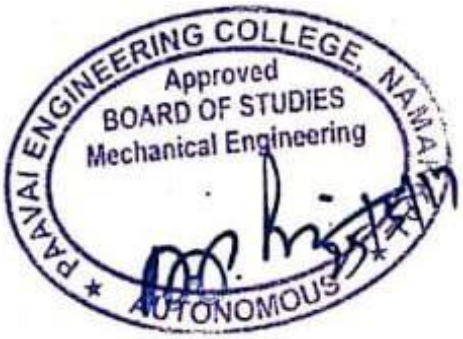
1. Rao, P.N. "Manufacturing Technology", Metal Cutting and Machine Tools, Tata McGraw–Hill, New Delhi, 2013.
2. P.C. Sharma, "A Text Book of Production Engineering", S. Chand and Co. Ltd, IV edition, 2009.
3. Shrawat N.S. and Narang J.S, „CNC Machines", DhanpatRai&Co., 2002.
4. P.N.Rao, „CAD/CAM Principles and Applications", TATA Mc Graw Hill, 2010.
5. M.P.Groover and Zimers Jr., „CAD/CAM" Prentice Hall of India Ltd., 2008.

WEB LINKS

1. http://www.notesengine.com/dept/mech/4sem/anna-university-4-sem-mech-notes.html.
2. https://www.youtube.com/playlist?list=PL2C105C94D2955C8B.

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	3	-	-	2	-	-	-	3	3	-	3	3	3
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



ME16404 **STRENGTH OF MATERIALS** **3 2 0 4**

COURSE OBJECTIVES

- To familiarize the terminology like simple stresses, strains and deformation in components due to external loads.
- To understand the stresses and deformations through mathematical models of beams, twisting bars or combinations of both.
- To analyze torsion of circular bars and springs.
- To know about the deflection and slope of the beams and columns by using Euler equation.
- To learn about the stresses involved in two dimensional approach of thin cylindrical and spherical shells

UNIT I STRESS STRAIN DEFORMATION OF SOLIDS 15

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load –Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

UNIT II BEAMS - LOADS AND STRESSES 15

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and over hanging beams – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams – Shear flow.

UNIT III TORSION 15

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section, Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads.

UNIT IV BEAM DEFLECTION 15

Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method, and Moment-area Method –Columns – End conditions – Equivalent length of a column – Euler equation – Slenderness ratio – Rankine formula for columns.

UNIT V ANALYSIS OF STRESSES IN TWO DIMENSIONS 15

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Stresses on inclined plane – Principal planes and stresses – Mohr‟s circle for biaxial stresses – Maximum shear stress - Strain energy in bending and torsion.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- apply the concepts of strength of materials to obtain solutions to real time Engineering problems.
- calculate the deformation behavior of simple structures.

- analyse critical problems related to mechanical elements and the deformation behavior for different types of loads.
- comprehend the torsion of circular bars and springs.
- evaluate the deflection and slope of the beams and columns by using Euler equation.

TEXT BOOKS

1. Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1998.
2. Beer F. P. and Johnston R," Mechanics of Materials", McGraw-Hill Book Co, Third Edition, 2008.

REFERENCES

1. Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill BookCo, New York, 1995.
2. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2006.
3. Ryder G.H, "Strength of Materials, Macmillan India Ltd"., Third Edition, 2002.
4. Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2004.
5. Singh D.K "Mechanics of Solids" Pearson Education 2002.

WEB LINKS

1. http://nptel.ac.in/courses/Webcourse-contents/IIT-ROORKEE/strength%20of%20materials /homepage.htm
2. https://www.vidyarthiplus.com/vp/Thread-CE2252-STRENGTH-OF-MATERIALS-Lecture-notes-collections

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

CH 16403 ENVIRONMENTAL SCIENCE AND ENGINEERING 3 0 0 3

COURSE OBJECTIVES

At the end of this course the student is expected

- To know the constituents of the environment and the precious resources in the environment.
- To conserve all biological resources.
- To understand the role of human being in maintaining a clean environment and useful environment for the future generations
- To maintain the ecological balance and preserve bio-diversity.
- The role of government and non-government organizations in environment management.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 9

Environment: Definition- scope - importance – need for public awareness. Forest resources: Use –over exploitation- deforestation - case studies- mining - effects on forests and tribal people. Water resources: Use – over utilization of surface and ground water- floods – drought - conflicts over water. Mineral resources Use – exploitation - environmental effects of extracting and using mineral resources – Food resources: World food problems - changes caused by agriculture and overgrazing – effects of modern agriculture - fertilizer-pesticide problems - water logging - salinity. Energy resources: Growing energy needs - renewable and non renewable energy sources. Role of an individual in conservation of natural resources.

UNIT II ECOSYSTEMS AND BIODIVERSITY 9

Concept of an ecosystem: Structure and function of an ecosystem – producers - consumers –decomposers – energy flow in the ecosystem – ecological succession – food chains - food webs and ecological pyramids. Types of ecosystem: Introduction - characteristic features - forest ecosystem – grassland ecosystem - desert ecosystem - aquatic ecosystems (lakes, rivers, oceans, estuaries). Biodiversity: Introduction– definition (genetic - species –ecosystem) diversity. Value of biodiversity: Consumptive use - productive use – social values – ethical values - aesthetic values. Biodiversity level: Global - national - local levels- India as a mega diversity nation- hotspots of biodiversity. Threats to biodiversity : Habitat loss - poaching of wildlife – man wildlife conflicts – endangered and endemic species of India. Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III POLLUTION 9

Pollution: Definition –air pollution - water pollution - soil pollution - marine pollution - noise pollution - thermal pollution – nuclearhazards. Solid waste management: Causes - effects - control measures of urban and industrial wastes. Role of an individual in prevention of pollution - pollution. Disaster management :Floods – earthquake - cyclone - landslides. Electronic waste-Sources-Causes and its effects.

UNIT IV SOCIAL ISSUES AND ENVIRONMENT 9

Sustainable development : Unsustainable to sustainable development – urban problems related to energy.

Water conservation - rain water harvesting - watershed management. Resettlement and rehabilitation of people. Environmental ethics: Issues - possible solutions – climate change - global warming and its effects on flora and fauna - acid rain - ozone layer depletion - nuclear accidents - nuclear holocaust - Environment protection act: Air (Prevention and Control of Pollution) act – water (Prevention and control of Pollution) act – wildlife protection act – forest conservation act – issues involved in enforcement of environmental legislation.

UNIT V HUMAN POPULATION AND ENVIRONMENT 9

Human population: Population growth - variation among nations – population explosion – family welfare programme and family planning – environment and human health – Human rights – value education – HIV/AIDS Swine flu – women and child welfare. Role of information technology in environment and human health.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- Know the relationship between the human population and environment.
- Understand the basic concepts of environment studies and natural resources.
- Gaining the knowledge about ecosystem and biodiversity.
- Have knowledge about causes, effects and control measures of various types of pollution.
- Understand the social issues and various environmental acts.

TEXT BOOKS

1. Raman Sivakumar, Introduction to Environmental Science and Engineering, 2nd Edn, Tata McGraw Hill Education Private Limited, New Delhi,(2010).
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, (2010).

REFERENCES

1. S. Divan, Environmental Law and Policy in India, Oxford University Press, New Delhi, 2001.
2. A.K.De, EnvironmentalChemistry, VI edition,2015 NewAge International (P) ltd Publication,NewDelhi.
3. C.S.Rao, Environmental Pollution and Control engineering, Vedition,NewAge International (P) ltd Publication, NewDelhi 110002
4. Clair Nathan Sawyer, Perry L. McCarty, Gene F. Parkin, "Chemistry for Environmental Engineering and Sciences, V Edition,2013,Tata M'c Graw Hill pub,Newdelhi110008

Mapping of course outcome with Programme Outcomes
(S/M/W indicates strength of correlation) S-Strong-3, M-Medium=2 , W-Weak=1.

CO	Programmes Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	1	3	3	2	-	-	3	1	-
CO2	-	-	2	-	-	1	-	3	-	2	-	3	1	-
CO3	2	-	2	-	2	1	-	3	-	2	-	3	1	-
CO4	2	2	2	-	2	1	3	3	-	2	-	3	1	-
CO5	-	2	-	-	-	1	3	3	2	2	-	2	1	-

ME16405 **THERMAL LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

- To understand the thermodynamic concepts used in various thermal applications like IC engines, steam Generator, turbine and other thermal devices.
- To study valve timing diagram and performance of IC Engines
- To learn the characteristics of fuels/Lubricants used in IC Engines
- To analyze the Performance of steam generator/ turbine

LIST OF EXPERIMENTS

I.C Engine lab and Fuels lab

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

STEAM LABORATORY

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

TOTAL PERIODS 60

COURSE OUTCOMES

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

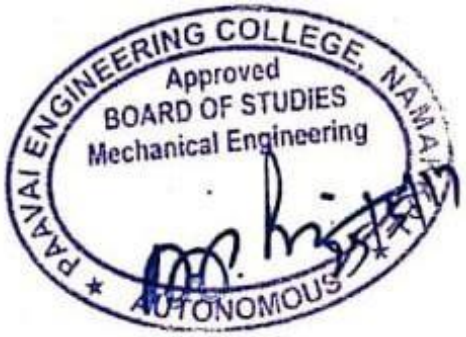
- comprehend the valve and port timing diagrams involved in the operation of engines
- evaluate the performance of an IC engine
- demonstrate knowledge in determining the viscosity of oils
- find out the flash and fire point of fuels

WEB LINKS

1. http://web.csulb.edu/colleges/coe/mae/views/courses/upper/upper_337.shtml
2. http://ocw.mit.edu/courses/architecture/4-411-building-technology-laboratory-spring-2004/lecture-notes/

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



ME16406 MANUFACTURING TECHNOLOGY LABORATORY II 0 0 4 2

COURSE OBJECTIVES

- To give practical hands-on exposure to students in the various metal cutting operations through commonly used machine tools
- To provide hands on experience on the working of general purpose machine tools and various manufacturing processes.
- To provide hands on experience on the manufacturing of various types of gears.
- To give the practical training on surface finishing operation by grinding machines.

LIST OF EXPERIMENTS

1. Measurement of Cutting Force using tool dynamometer
2. Single point tool profile
3. Dove Tail ,Surface Finishing, Spline
4. Generating of Contour Profile (Concave & Convex)
5. Making a Keyway(External & Internal)
6. Making Spur gear & Helical gear.
7. Cylindrical grinding & Surface Grinding operations

TOTAL PERIODS 60

COURSE OUTCOMES

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

- fabricate spur gear, helical gear by gear hobbing machine and vertical milling machine.
- carry out cylindrical grinding and surface grinding operations.
- ability to manufacture tool by cutter grinder.
- perform the internal and external keyway using machine tools.

WEB LINKS

1. http://home.iitk.ac.in/~bhattacs/LABORATORY_MANUAL.pdf
2. http://ggnindia.dronacharya.info/medept/Downloads/Labmanuals/Odd/Sem_V/MT -II_LM-319F_VSem.pdf

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

ME16407 STRENGTH OF MATERIALS LABORATORY 0 0 4 2

COURSE OBJECTIVES

- To conduct tension test on different metals.
- To conduct compression tests on spring and concrete.
- To conduct flexural and torsion tests to determine elastic constants.
- To determine hardness of metals.

LIST OF EXPERIMENTS

1. Tension test on mild steel rod
2. Compression test on wood
3. Double shear test on metal
4. Torsion test on mild steel rod
5. Impact test on metal specimen (Izod and Charpy)
6. Hardness test on metals (Rockwell and Brinell Hardness Tests)
7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring
10. Test on Cement

TOTAL PERIODS 60

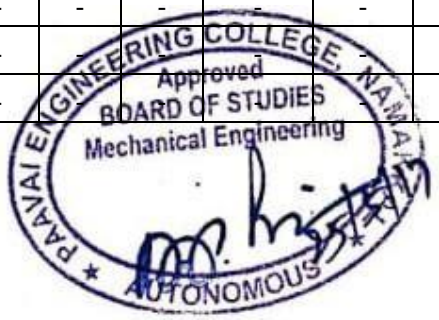
COURSE OUTCOMES

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

- apply the concepts of mechanics for determining stresses and strains from the member forces
- solve the problems by knowing the effects of axial loads, bending, shear and torsion on structural components.
- determine the behavior of structural elements such as bars, beams and columns subjected to tension, compression, shear, bending and torsion by means of experiments.
- comprehend practically the behavior of materials and structural elements including distribution of stresses, strains, deformations and failure modes.

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



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

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	-	-	-	-	-	-	-	-	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

COs	Programme Outcomes(POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
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

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**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	-	-	-	-	-	1	1	-	2	2	3
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

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	-	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

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.

REFERENCES

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

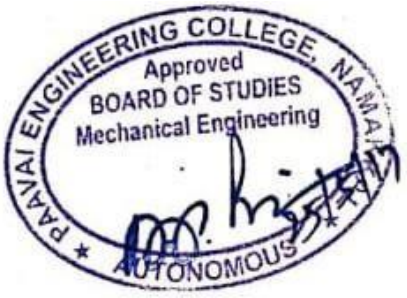
1. Goswami, D.Y., Kreider, J. F. and & Francis., Principles of Solar Engineering, Taylor and Francis, 2000.
2. Chetan Singh Solanki, Solar Photovoltatics –Fundamentals, Technologies and Applications, PHI Learning Private limited, 2011
3. Sukhatme S P, J K Nayak, Solar Energy–Principle of Thermal Storage 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

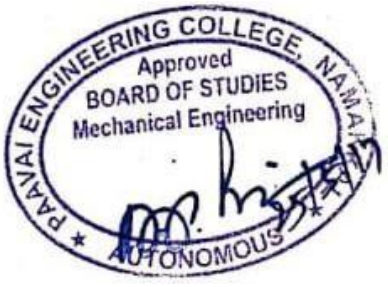
1. Heine, Lpoer et al “Principles of Metal Casting” McGraw-Hill Publishing Company Ltd 1999.
2. Taylor H.F. Fleming M.C. & Wulff.J “Foundry engineering”; Wiley Eastern Ltd.1993.
3. Gupta R.B “Foundry Engineering”; Satyaprakashan, New Delhi, 1989.
4. Lal,Mand Khanna O.P “A Text Book of Foundry Technology” 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



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

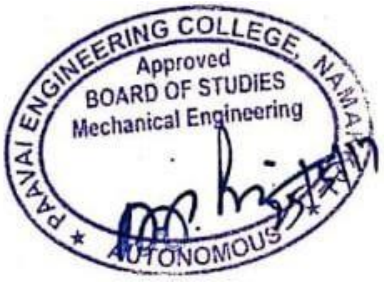
1. Agarwal, B.D., and Broutman L.J., “Analysis and Performance of Fiber Composites”, John Wiley and Sons, New York, 2006.
2. Issac M. Daniel and Ori Ishai, “Engineering Mechanics of Composite Materials”, Oxford University Press 2006, First Indian Edition 2007.
3. Hyer, M.W., “Stress Analysis of Fiber – 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

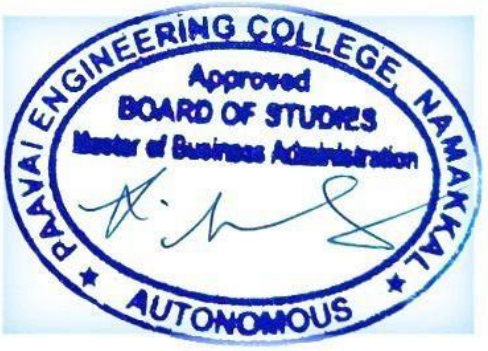
1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

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

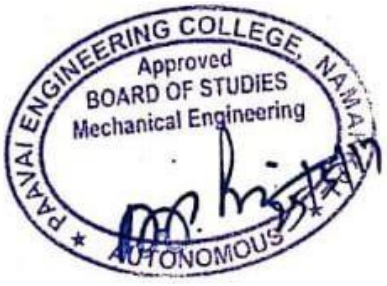
1. Cornelisse, J.W., Rocket Propulsion and Space Dynamics, W.H. Freeman & Co., New York, 1984
2. Parker, E. R., Materials for Missiles and Spacecraft, McGraw Hill Book Co., New York, 1982
3. Rudolph X. Meyer., Elements of Space Technology, Acadamic press, London, 1999
4. Arnold M. Kuethe, Kuethe, Chuen-Yen 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														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	1	1	1	1	2	1	-	-	-	-	1	1	1
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



6. Robert M Sherfield and et al. **"Developing Soft Skills"** 4th edition, New Delhi: Pearson Education, 2009.

Web Sources:

http://www.slideshare.net/rohitjsh/presentation-on-group-discussion
http://www.washington.edu/doit/TeamN/present_tips.html
http://www.oxforddictionaries.com/words/writing-job-applications
http://www.kent.ac.uk/careers/cv/coveringletters.htm
http://www.mindtools.com/pages/article/newCDV_34.htm

ME6701 POWER PLANT ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

UNIT I COAL BASED THERMAL POWER PLANTS 10

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS 10

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimisation. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III NUCLEAR POWER PLANTS 7

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boil*ing Water Reactor* (BWR), P*ressurized Water Reactor* (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV POWER FROM RENEWABLE ENERGY 10

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, *Solar* Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS 8

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to understand different types of power plant, and its functions and their flow lines and issues related to them.
- Analyse and solve energy and economic related issues in power sectors.

TEXT BOOK:

1. Nag. P.K., "Power Plant Engineering", Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.

REFERENCES:

1. El-Wakil. M.M., "Power Plant Technology", Tata McGraw – Hill Publishing Company Ltd., 2010.
2. Black & Veatch, Springer, "Power Plant Engineering", 1996.
3. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998.
4. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

ME6702 MECHATRONICS L T P C
3 0 0 3

OBJECTIVES:

- To impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.

UNIT I INTRODUCTION 12

Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers**:** Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors

UNIT II 8085 MICROPROCESSOR AND 8051 MICROCONTROLLER 10

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram,.

UNIT III PROGRAMMABLE PERIPHERAL INTERFACE 8

Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.

UNIT IV PROGRAMMABLE LOGIC CONTROLLER 7

Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.

UNIT V ACTUATORS AND MECHATRONIC SYSTEM DESIGN 8

Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to design mechatronics system with the help of Microprocessor, PLC and other electrical and Electronics Circuits.

TEXT BOOKS:

1. Bolton, “Mechatronics”, Printice Hall, 2008
2. Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Prentice Hall, 2008.

REFERENCES:

1. Michael B.Histand and Davis G.Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International edition, 2007.
2. Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
3. Smaili.A and Mrad.F , “Mechatronics Integrated Technologies for Intelligent Machines”, Oxford University Press, 2007.
4. Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.
5. Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2007.
6. Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013

ME6703 COMPUTER INTEGRATED MANUFACTURING SYSTEMS L T P C
3 0 0 3

OBJECTIVES:

- To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT I INTRODUCTION 10

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

UNIT II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING 10

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III CELLULAR MANUFACTURING 9

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED

GUIDED VEHICLE SYSTEM (AGVS) **8**

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V INDUSTRIAL ROBOTICS **8**

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the student can able to understand the use of computers in process planning and use of FMS and Robotics in CIM

TEXT BOOK:

1. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCES:

1. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India, 2003.
2. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach” Chapman & Hall, London, 1995.
3. Rao. P, N Tewari &T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill Publishing Company, 2000.

GE6757 TOTAL QUALITY MANAGEMENT **L T P C**
3 0 0 3

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES **9**

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II **9**

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors..

TOTAL: 45 PERIODS

OUTCOMES:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2006.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

ME6711 SIMULATION AND ANALYSIS LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To give exposure to software tools needed to analyze engineering problems.
- To expose the students to different applications of simulation and analysis tools.

LIST OF EXPERIMENTS

A. SIMULATION

1. MATLAB basics, Dealing with matrices, Graphing-Functions of one variable and two variables
2. Use of Matlab to solve simple problems in vibration
3. Mechanism Simulation using Multibody Dynamic software

B. ANALYSIS

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the Students can model, analyse and simulate experiments to meet real world system and evaluate the performance.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S. NO.	NAME OF THE EQUIPMENT	Qty.
1	Computer Work Station	15
2	Color Desk Jet Printer	01
3	Multibody Dynamic Software Suitable for Mechanism simulation and analysis	15 licenses
4	C / MATLAB	5 licenses

ME6712 **MECHATRONICS LABORATORY** **L T P C**
0 0 3 2

OBJECTIVES:

- To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.

LIST OF EXPERIMENTS:

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.
2. Stepper motor interface.
3. Traffic light interface.
4. Speed control of DC motor.
5. Study of various types of transducers.
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.
7. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.
8. Study of PLC and its applications.
9. Study of image processing technique.

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to design mechatronics system with the help of Microprocessor, PLC and other electrical and Electronics Circuits.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

Sl. No.	NAME OF THE EQUIPMENT	Qty.
1	Basic Pneumatic Trainer Kit with manual and electrical controls/ PLC Control each	1 No.
2	Basic Hydraulic Trainer Kit	1 No
3	Hydraulics and Pneumatics Systems Simulation Software	10 No
4	8051 - Microcontroller kit with stepper motor and drive circuit sets	2 No
	Image processing system with hardware & software	1 No.

ME6713 **COMPREHENSION** **L T P C**

0 0 2 1

OBJECTIVES:

- To encourage the students to comprehend the knowledge acquired from the first Semester to Sixth Semester of B.E Degree Course through periodic exercise.

METHOD OF EVALUATION:

The students will be assessed 100% internally through weekly test with objective type questions on all the subject related topics

TOTAL : 30 PERIODS

OUTCOMES:

- ability to understand and comprehend any given problem related to mechanical engineering field.

MG6863 ENGINEERING ECONOMICS L T P C
3 0 0 3

OBJECTIVES:

- To enable students to understand the fundamental economic concepts applicable to engineering and to learn the techniques of incorporating inflation factor in economic decision making.

UNIT I INTRODUCTION TO ECONOMICS 8

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering Economics – Engineering efficiency, Economic efficiency, Scope of engineering economics - 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 10

Make or buy decision, Value engineering – Function, aims, Value engineering procedure. Interest formulae and their applications –Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor- equal payment series capital recovery factor - Uniform gradient series annual equivalent factor, Effective interest rate, 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 flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT IV REPLACEMENT AND MAINTENANCE ANALYSIS 9

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

UNIT V DEPRECIATION 9

Depreciation- 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: 45 PERIODS

OUTCOMES :

- Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions.

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

ME6811 **PROJECT WORK** **L T P C**
0 0 12 6

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. 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: 180 PERIODS

OUTCOMES:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

MG6072 **MARKETING MANAGEMENT** **L T P C**

ME6005 PROCESS PLANNING AND COST ESTIMATION L T P C
3 0 0 3

OBJECTIVES:

- To introduce the process planning concepts to make cost estimation for various products after process planning

UNIT I INTRODUCTION TO PROCESS PLANNING 10

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES 10

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION 8

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION 8

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION 9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use the concepts of process planning and cost estimation for various products.

TEXT BOOKS:

1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002.

REFERENCES:

1. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley, 1998.
2. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.
3. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.

ME6006 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS L T P C
3 0 0 3

OBJECTIVES:

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.

UNIT I LOCATING AND CLAMPING PRINCIPLES: 8

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

UNIT II JIGS AND FIXTURES 10

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 10

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

UNIT IV BENDING AND DRAWING DIES 10

Difference between bending and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing, reverse redrawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

UNIT V OTHER FORMING TECHNIQUES 7

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke.

TOTAL: 45 PERIODS

Note: (Use of P S G Design Data Book is permitted in the University examination)

OUTCOMES:

- Upon completion of this course, the students can able to design jigs, fixtures and press tools.

TEXT BOOKS:

1. Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.
2. Joshi P.H “Press tools - Design and Construction”, wheels publishing, 1996

REFERENCES:

1. Venkataraman. K., “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.
2. Donaldson, Lecain and Goold “Tool Design”, 3rd Edition, Tata McGraw Hill, 2000.
3. Kempster, “Jigs and Fixture Design”, Third Edition, Hoddes and Stoughton, 1974.
4. Hoffman “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore, 2004.
5. ASTME Fundamentals of Tool Design Prentice Hall of India.
6. Design Data Hand Book, PSG College of Technology, Coimbatore.

ME6007 COMPOSITE MATERIALS AND MECHANICS L T P C
3 0 0 3

OBJECTIVES:

- To understand the fundamentals of composite material strength and its mechanical behavior Understanding the analysis of fiber reinforced Laminate design for different
- combinations of plies with different orientations of the fiber.
- Thermo-mechanical behavior and study of residual stresses in Laminates during processing. Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.

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: 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 5

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 10

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

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to analyse the fiber reinforced Laminate for optimum design
- Apply classical laminate theory to study and analyse the residual stresses in Laminate.

TEXT BOOKS:

1. Gibson, R.F., "Principles of Composite Material Mechanics", Second Edition, McGraw-Hill, CRC press in progress, 1994, -.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw Hill, 1998

REFERENCES:

1. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition - 2007
2. Mallick, P.K., Fiber, "Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
3. Halpin, J.C., "Primer on Composite Materials, Analysis", Technomic Publishing Co., 1984.
4. Agarwal, B.D., and Broutman L.J., "Analysis and Performance of Fiber Composites", John Wiley and Sons, New York, 1990.
5. Mallick, P.K. and Newman, S., (edition), "Composite Materials Technology: Processes and Properties", Hansen Publisher, Munish, 1990.

ME6008 WELDING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES

- To understand the basics of welding and to know about the various types of welding processes

UNIT I GAS AND ARC WELDING PROCESSES: 9

Fundamental principles – Air Acetylene welding, Oxyacetylene welding, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding and Electroslag welding processes - advantages, limitations and applications.

UNIT II RESISTANCE WELDING PROCESSES: 9

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.

UNIT III SOLID STATE WELDING PROCESSES: 9

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

UNIT IV OTHER WELDING PROCESSES: 9

Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

UNIT V DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS 9

Various weld joint designs – Weldability of Aluminium, Copper, and Stainless steels. Destructive and non destructive testing of weldments.

TOTAL : 45 HOURS

OUTCOMES:

- Upon completion of this course, the students can able to compare different types of Welding process for effective Welding of Structural components.

TEXT BOOKS:

1. Parmer R.S., "Welding Engineering and Technology", 1st edition, Khanna Publishers, New Delhi, 2008.
2. Parmer R.S., "Welding Processes and Technology", Khanna Publishers, New Delhi, 1992.

3. Little R.L., "Welding and welding Technology", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.

REFERENCES:

1. Schwartz M.M. "Metals Joining Manual". McGraw Hill Books, 1979.
2. Tylecote R.F. "The Solid Phase Welding of Metals". Edward Arnold Publishers Ltd. London, 1968.
3. AWS- Welding Hand Book. 8th Edition. Vol- 2. "Welding Process"
4. Nadkarni S.V. "Modern Arc Welding Technology", 1st edition, Oxford IBH Publishers, 2005.
5. Christopher Davis. "Laser Welding- Practical Guide". Jaico Publishing House, 1994.
6. Davis A.C., "The Science and Practice of Welding", Cambridge University Press, Cambridge, 1993

ME6009 ENERGY CONSERVATION AND MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

At the end of the course, the student is expected to

- understand and analyse the energy data of industries
- carryout energy accounting and balancing
- conduct energy audit and suggest methodologies for energy savings and
- utilise the available resources in optimal ways

UNIT I INTRODUCTION 8

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization –Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II ELECTRICAL SYSTEMS 12

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III THERMAL SYSTEMS 12

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES 8

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V ECONOMICS 5

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able to analyse the energy data of industries.

- Can carryout energy accounting and balancing

- Can suggest methodologies for energy savings

TEXT BOOKS:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCES:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.
3. Dryden. I.G.C., "The Efficient Use of Energy" Butterworths, London, 1982
4. Turner. W.C., "Energy Management Hand book", Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, "Energy Management", Butterworths, London 1987.

GE6083 DISASTER MANAGEMENT L T P C
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and

Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXTBOOK:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

ME6010 ROBOTICS L T P C
3 0 0 3

OBJECTIVES:

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors and Sensors
- To impart knowledge in Robot Kinematics and Programming
- To learn Robot safety issues and economics.

UNIT I FUNDAMENTALS OF ROBOT 6

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification-Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, 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 12

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, 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 13

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 5

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the basic engineering knowledge for the design of robotics

TEXT BOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2001.

REFERENCES:

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 1994.
3. Koren Y., “Robotics for Engineers", Mc Graw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”, McGraw Hill Book Co., 1987.
5. Janakiraman P.A., “Robotics and Image Processing”, Tata McGraw Hill, 1995.
6. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company, 2008.
7. Surender Kumar, “Industrial Robots and Computer Integrated Manufacturing”, Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

GE6081 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

OBJECTIVES

- To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION 8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

UNIT V APPLICATIONS 7

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery

TOTAL : 45 PERIODS

OUTCOMES

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS

1. Edelstein. A.S. and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. John Dinardo. N, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000

REFERENCES

1. Timp .G, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia (Editor),“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.

ME6011 **THERMAL TURBO MACHINES** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the various systems, principles, operations and applications of different types of turbo machinery components.

UNIT I PRINCIPLES **9**

Energy transfer between fluid and rotor-classification of fluid machinery,-dimensionless parameters-specific speed-applications-stage velocity triangles-work and efficiency.

UNIT II CENTRIFUGAL FANS AND BLOWERS **9**

Types- stage and design parameters-flow analysis in impeller blades-volute and diffusers, losses, characteristic curves and selection, fan drives and fan noise.

UNIT III CENTRIFUGAL COMPRESSOR **9**

Construction details, impeller flow losses, slip factor, diffuser analysis, losses and performance curves.

UNIT IV AXIAL FLOW COMPRESSOR **9**

Stage velocity diagrams, enthalpy-entropy diagrams, stage losses and efficiency, work done simple stage design problems and performance characteristics.

UNIT V AXIAL AND RADIAL FLOW TURBINES **9**

Stage velocity diagrams, reaction stages, losses and coefficients, blade design principles, testing and performance characteristics.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to explain the various systems, principles and applications and different types of turbo machinery components.

TEXT BOOKS:

1. Yahya, S.H., Turbines, Compressor and Fans, Tata McGraw Hill Publishing Company, 1996.

REFERENCES:

1. Bruneck, Fans, Pergamom Press, 1973.
2. Earl Logan, Jr., Hand book of Turbomachinery, Marcel Dekker Inc., 1992.
3. Dixon, S.I., "Fluid Mechanics and Thermodynamics of Turbomachinery", Pergamon Press, 1990.
4. Shepherd, D.G., "Principles of Turbomachinery", Macmillan, 1969.
5. Ganesan, V., "Gas Turbines", Tata McGraw Hill Pub. Co., 1999.
6. Gopalakrishnan .G and Prithvi Raj .D, "A Treatise on Turbo machines", Scifech Publications (India) Pvt. Ltd., 2002.

ME6012 **MAINTENANCE ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES:

- To enable the student to understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To illustrate some of the simple instruments used for condition monitoring in industry.

UNIT I PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING 9

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

UNIT II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9

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

UNIT III CONDITION MONITORING 9

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

UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 10

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT V REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 8

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

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the programme, the students can able to implement the maintenance function and different practices in industries for the successful management of maintenance activities
- To identify the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.

TEXT BOOKS:

1. Srivastava S.K., “Industrial Maintenance Management”, S. Chand and Co., 1981
2. Venkataraman .K “Maintancence Engineering and Management”, PHI Learning, Pvt. Ltd., 2007

REFERENCES:

1. Bhattacharya S.N., “Installation, Servicing and Maintenance”, S. Chand and Co., 1995
2. White E.N., “Maintenance Planning”, I Documentation, Gower Press, 1979.
2. Garg M.R., “Industrial Maintenance”, S. Chand & Co., 1986.
3. Higgins L.R., “Maintenance Engineering Hand book”, 5th Edition, McGraw Hill, 1988.
4. Armstrong, “Condition Monitoring”, BSIRSA, 1988.
5. Davies, “Handbook of Condition Monitoring”, Chapman & Hall, 1996.
6. “Advances in Plant Engineering and Management”, Seminar Proceedings - IIPE, 1996.

EE6007 MICRO ELECTRO MECHANICAL SYSTEMS L T P C
3 0 0 3

OBJECTIVES

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I INTRODUCTION 9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I 9

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys

UNIT III SENSORS AND ACTUATORS-II 9

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING 9

Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS 9

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL : 45 PERIODS

OUTCOMES

- Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.
- Ability to understand and analyse, linear and digital electronic circuits.

ME6021 **HYDRAULICS AND PNEUMATICS** **L T P C**
3 0 0 3

OBJECTIVES:

- This course will give an appreciation of the fundamental principles, design and operation of hydraulic and pneumatic machines, components and systems and their application in recent automation revolution.

UNIT I FLUID POWER PRINCIPLES AND FUNDEMENTALS (REVIEW) 3

Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids- Properties of fluids Basics of Hydraulics – Pascal's Law- Principles of flow – Work, Power and Torque. Properties of air– Perfect Gas Laws.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 13

Sources of Hydraulic power: Pumping Theory – Pump Classification- Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps, Hydraulic Actuators: Cylinders – Types and construction, Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation- Applications – Types of actuation. Accessories: Reservoirs, Accumulators, Intensifiers, Pressure Switches- Applications- Fluid Power ANSI Symbol.

UNIT III HYDRAULIC CIRCUITS 9

Industrial hydraulic circuits- Regenerative, Pump Unloading, Double-pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Accumulators, Electro hydraulic circuits, Mechanical Hydraulic servo systems.

UNIT IV PNEUMATIC SYSTEM 8

Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Servo systems. Introduction to Fluidics, Pneumatic logic circuits.

UNIT V DESIGN OF HYDRALIC AND PNEMATIC CIRCUITS 12

Design of circuits using the components of hydraulic system for Drilling, Planning, Shaping, Punching, Press. – Selection, fault finding and maintenance of hydraulic components- Sequential circuit design for simple application using cascade method, Electro pneumatic circuits. Selection criteria of pneumatic components – Installation fault finding and maintenance of pneumatic components. Microprocessor and PLC- Applications in Hydraulic and Pneumatics- Low cost Automation – Hydraulic and Pneumatic power packs.

TOTAL: 45 PERIODS

OUTCOMES:

- Identify hydraulic and pneumatics components.
- Ability to design hydraulic and pneumatic circuits.

TEXT BOOK

1. Anthony Esposito," Fluid Power with Applications", PHI / Pearson Education, 2005.

REFRENCES

1. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.
2. Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw Hill, 2001
3. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGraw Hill, 2007.
4. Micheal J, Pinches and Ashby, J.G., "Power Hydraulics", Prentice Hall, 1989.
5. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
6. Srinivasan. R, "Hydraulic and Pneumatic Control", IInd Edition, Tata McGraw - Hill Education, 2012.

IE6605 PRODUCTION PLANNING AND CONTROL L T P C
3 0 0 3

OBJECTIVES:

- To understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.
- To know the recent trends like manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

UNIT I INTRODUCTION 9

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

UNIT II WORK STUDY 9

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

UNIT III PRODUCT PLANNING AND PROCESS PLANNING 9

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

UNIT IV PRODUCTION SCHEDULING 9

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

UNIT V INVENTORY CONTROL AND RECENT TRENDS IN PPC 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to prepare production planning and control activities such as work study, product planning, production scheduling, Inventory Control.
- They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS:

1. Martand Telsang, “Industrial Engineering and Production Management”, First edition, S. Chand and Company, 2000.
2. James.B.Dilworth,”Operations management – Design, Planning and Control for manufacturing and services” Mcgraw Hill International edition 1992.

REFERENCES:

1. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corpn.1984
2. Elwood S.Buffa, and Rakesh K.Sarin, “Modern Production / Operations Management”, 8th Edition, John Wiley and Sons, 2000.
3. Kanishka Bedi, “ Production and Operations management”, 2nd Edition, Oxford university press, 2007.
4. Melynk, Denzler, “ Operations management – A value driven approach” Irwin Mcgraw hill.
5. Norman Gaither, G. Frazier, “Operations Management”, 9th edition, Thomson learning IE, 2007
6. Jain. K.C & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers, 1990.
7. Chary. S.N. “Theory and Problems in Production & Operations Management”, Tata McGraw Hill, 1995.
8. Upendra Kachru, “Production and Operations Management – Text and cases”, 1st Edition, Excel books 2007.

MG6071 ENTERPRENEURSHIP DEVELOPMENT L T P C
3 0 0 3

OBJECTIVES:

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

UNIT I ENTREPRENEURSHIP 9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION 9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III BUSINESS 9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING 9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL : 45 PERIODS

OUTCOMES :

- Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.

TEXT BOOKS :

1. Khanka. S.S., “Entrepreneurial Development” S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.

2. Donald F Kuratko, “Entreprenuership – Theory, Process and Practice”, 9th Edition, Cengage Learning, 2014.

REFERENCES :

1. Hisrich R D, Peters M P, “Entrepreneurship” 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis” 2nd Edition Dream tech, 2005.
3. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
4. EDII “Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development”, Institute of India, Ahmadabad, 1986.

ME6013 DESIGN OF PRESSURE VESSELS AND PIPING L T P C 3 0 0 3

OBJECTIVES:

- To understand the Mathematical knowledge to design pressure vessels and piping
- To understand the ability to carry of stress analysis in pressure vessels and piping

UNIT I INTRODUCTION 3

Methods for determining stresses – Terminology and Ligament Efficiency – Applications.

UNIT II STRESSES IN PRESSURE VESSELS 15

Introduction – Stresses in a circular ring, cylinder –Dilation of pressure vessels, Membrane stress Analysis of Vessel – Cylindrical, spherical and, conical heads – Thermal Stresses – Discontinuity stresses in pressure vessels.

UNIT III DESIGN OF VESSELS 15

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

UNIT IV BUCKLING AND FRACTURE ANALYSIS IN VESSELS 8

Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading.

UNIT V PIPING 4

Introduction – Flow diagram – piping layout and piping stress Analysis.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the mathematical fundamental for the design of pressure vessels and pipes. Further they can able to analyse and design of pressure vessels and piping.

TEXT BOOKS:

1. John F. Harvey, "Theory and Design of Pressure Vessels", CBS Publishers and Distributors,1987.

REFERENCES:

1. Henry H. Bedner, “Pressure Vessels, Design Hand Book", CBS publishers and Distributors, 1987.
2. Stanley, M. Wales, “Chemical process equipment, selection and Design". Buterworths series in Chemical Engineering, 1988.
3. William. J., Bees, “Approximate Methods in the Design and Analysis of Pressure Vessels and Piping”, Pre ASME Pressure Vessels and Piping Conference, 1997.
4. Sam Kannapan, “Introduction to Pipe Stress Analysis”. John Wiley and Sons, 1985.

ME6014 COMPUTATIONAL FLUID DYNAMICS L T P C
3 0 0 3

OBJECTIVES:

- To introduce Governing Equations of viscous fluid flows
- To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 8

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.

UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 10

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness, Boundedness, Transportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT IV FLOW FIELD ANALYSIS 9

Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms.

UNIT V TURBULENCE MODELS AND MESH GENERATION 9

Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the students can able

- To create numerical modeling and its role in the field of fluid flow and heat transfer
- To use the various discretization methods, solution procedures and turbulence modeling to solve flow and heat transfer problems.

TEXT BOOKS:

1. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics: The finite volume Method", Pearson Education Ltd.Second Edition, 2007.
2. Ghoshdastidar, P.S., "Computer Simulation of flow and heat transfer", Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCES:

1. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
2. Chung, T.J. "Computational Fluid Dynamics", Cambridge University, Press, 2002.
3. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005
4. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 1995.
5. ProdipNiyogi, Chakrabarty, S.K., Laha, M.K. "Introduction to Computational Fluid Dynamics", Pearson Education, 2005.
6. Anil W. Date "Introduction to Computational Fluid Dynamics" Cambridge University Press, 2005.

ME6015 OPERATIONS RESEARCH L T P C
3 0 0 3

OBJECTIVES:

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

UNIT I LINEAR MODELS 15

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS 8

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

UNIT III INVENTORY MODELS 6

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV QUEUEING MODELS 6

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

UNIT V DECISION MODELS 10

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use the optimization techniques for use engineering and Business problems

TEXT BOOK:

1. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.

REFERENCES:

1. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
2. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", John Wiley, 1992.
4. Hillier and Libeberman, "Operations Research", Holden Day, 1986
5. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
6. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

GE6084 HUMAN RIGHTS L T P C
3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I 9

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II 9

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III 9

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV 9

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V 9

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOME :

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., “Human Rights under International law and Indian Laws”, Central Law Agency, Allahabad, 2014.
2. Chandra U., “Human Rights”, Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

ME6016 ADVANCED I.C ENGINES L T P C
3 0 0 3

OBJECTIVES:

- To understand the underlying principles of operation of different IC Engines and components.
- To provide knowledge on pollutant formation, control, alternate fuel etc.

UNIT I SPARK IGNITION ENGINES 9

Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustion chambers.

UNIT II COMPRESSION IGNITION ENGINES 9

Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behaviour – Spray structure and spray penetration – Air motion - Introduction to Turbocharging.

UNIT III POLLUTANT FORMATION AND CONTROL 9

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.

UNIT IV ALTERNATIVE FUELS 9

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.

UNIT V RECENT TRENDS 9

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx Adsorbers - Onboard Diagnostics.

TOTAL : 45 PERIODS

OUTCOME:

- Upon completion of this course, the students can able to compare the operations of different IC Engine and components and can evaluate the pollutant formation, control, alternate fuel

TEXT BOOKS:

1. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 2002.
2. Ganesan, "Internal Combustion Engines", II Edition, TMH, 2002.

REFERENCES:

1. Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines"., Dhanpat Rai & Sons 2007.
2. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
3. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995

ME6017 DESIGN OF HEAT EXCHANGERS L T P C
3 0 0 3

OBJECTIVES:

- To learn the thermal and stress analysis on various parts of the heat exchangers
- To analyze the sizing and rating of the heat exchangers for various applications

UNIT I INTRODUCTION 9

Types of heat exchangers, shell and tube heat exchangers – regenerators and recuperators - Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA)

UNIT II PROCESS DESIGN OF HEAT EXCHANGERS 9

Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers – LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.

UNIT III STRESS ANALYSIS 9

Stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures, buckling of tubes, flow induced vibration.

UNIT IV COMPACT AND PLATE HEAT EXCHANGER 9

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

UNIT V CONDENSERS AND COOLING TOWERS 9

Design of surface and evaporative condensers – cooling tower – performance characteristics.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to apply the mathematical knowledge for thermal and stress analysis on various parts of the heat exchangers components.

TEXT BOOKS:

1. SadikKakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRC Press, 2002.
2. Shah,R. K., Dušan P. Sekulić, "Fundamentals of heat exchanger design", John Wiley & Sons, 2003.

REFERENCES:

1. Robert W. Serth, "Process heat transfer principles and applications", Academic press, Elesevier, 2007.
2. Sarit Kumar Das, "Process heat transfer", Alpha Science International, 2005
3. John E. Hesselgreaves, "Compact heat exchangers: selection, design, and operation", Elsevier science Ltd, 2001.
4. Kuppan. T., "Heat exchanger design hand book", New York : Marcel Dekker, 2000.

5. Eric M. Smith, "Advances in thermal design of heat exchangers: a numerical approach: direct-sizing, step-wise rating, and transients", John Wiley & Sons, 1999.

ME6018 ADDITIVE MANUFACTURING L T P C
3 0 0 3

OBJECTIVES:

- To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies
- To be familiar with the characteristics of the different materials those are used in Additive Manufacturing.

UNIT I INTRODUCTION 10

Overview – History - Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling - Applications.

UNIT II CAD & REVERSE ENGINEERING 10

Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS 10

Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS 10

Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.

UNIT V MEDICAL AND BIO-ADDITIVE MANUFACTURING 5

Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to compare different method and discuss the effects of the Additive Manufacturing technologies and analyse the characteristics of the different materials in Additive Manufacturing.

TEXT BOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., “Rapid prototyping”, Hanser Gardener Publications, 2003.

REFERENCES:

1. Liou L.W. and Liou F.W., “Rapid Prototyping and Engineering applications : A tool box for prototype development”, CRC Press, 2007.

2. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.
3. Hilton P.D. and Jacobs P.F., “Rapid Tooling: Technologies and Industrial Applications”, CRC press, 2000.

ME6019 NON DESTRUCTIVE TESTING AND MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- To study and understand the various Non Destructive Evaluation and Testing methods, theory and their industrial applications.

UNIT I OVERVIEW OF NDT 7

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided.

UNIT II SURFACE NDE METHODS 8

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET) 10

Thermography- Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications.Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE) 10

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications

UNIT V RADIOGRAPHY (RT) 10

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

TOTAL : 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use the various Non Destructive Testing and Testing methods understand for defects and characterization of industrial components

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.

2. Ravi Prakash, “Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010

REFERENCES:

1. ASM Metals Handbook,”Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier,“ Handbook of Nondestructive evaluation”, McGraw Hill, New York 2001.
4. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook,Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing

ME6020 VIBRATION AND NOISE CONTROL L T P C
3 0 0 3

OBJECTIVES:

- The student will be able to understand the sources of vibration and noise in automobiles and make design modifications to reduce the vibration and noise and improve the life of the components

UNIT I BASICS OF VIBRATION 9

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.

UNIT II BASICS OF NOISE 9

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT III AUTOMOTIVE NOISE SOURCES 9

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

UNIT IV CONTROL TECHNIQUES 9

Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT V SOURCE OF NOISE AND CONTROL 9

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers

TOTAL: 45 PERIODS

OUTCOMES:

- Understanding causes, source and types of vibrations in machineries
- Gaining knowledge in sources and measurement standard of noise
- Ability to design and develop vibrations and noise control systems.

TEXT BOOKS:

1. Singiresu S.Rao, "Mechanical Vibrations", 5th Edition, Pearson Education, 2010

REFERENCES:

1. Benson H. Tongue, "Principles of Vibrations", 2nd Edition, Oxford University, 2007
2. David Bies and Colin Hansen, "Engineering Noise Control – Theory and Practice",4th Edition, E and FN Spon, Taylore & Francise e-Library, 2009
3. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, "**Theory of Vibration with Application",** 5th Edition Pearson Education, 2011
4. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 1996
5. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book", Second Edition, SAE International, 1999.
6. Julian Happian-Smith - "An Introduction to Modern Vehicle Design"- Butterworth-Heinemann, 2004
7. Rao, J.S and Gupta, K., "Introductory course on Theory and Practice of Mechanical Vibration", 2nd Edition, New Age International Publications, 2010
8. Shabana. A.A., "Theory of vibrations – An introduction", 2nd Edition, Springer, 2010
9. Balakumar Balachandran and Edward B. Magrab, "Fundamentals of Vibrations", 1st Editon, Cengage Learning, 2009
10. John Fenton, "Handbook of Automotive body Construction and Design Analysis – Professional Engineering Publishing, 1998