ME16103 COMPUTER AIDED DRAFTING LABORATORY 0 0 2 1

(COMMON TO AGRI / CIVIL / MCT / MECH)

COURSE OBJECTIVES

- To acquire practical knowledge in designing the latest CAD systems and develop the assignments thefield of Mechanical, Civil or Architectural drafting.

LIST OF EXERCISES USING SOFTWARE CAPABLE OF DRAFTING

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

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

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

- develop their competency to draw basic drafting, enabling them to pursue design and modelling in engineering, professional arenas, or to further their academic pursuits.
- have practical experience in Drafting and designing.

CO - PO Mapping

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

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)													
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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

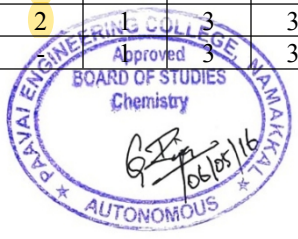
1. Raman Sivakumar, Introduction to Environmental Science and Engineering, 2nd Edn, Tata McGraw Hill Education Private Limited, New Delhi,(2010).
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, (2010).

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

PAVAI ENGINEERING COLLEGE, NAMAKKAL
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Mechanical Engineering
AUTONOMOUS

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

PAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Mechanical Engineering
AUTONOMOUS

EN16401 BUSINESS ENGLISH COURSE LABORATORY 0 0 2 1

COURSE OBJECTIVES

To enable the students to

- develop the reading skills of the students and make them familiarized in skimming and scanning.
- instill the communication concepts to enhance the students' conversational skills through various practice sessions.
- familiarize them with a variety of business correspondence.
- inculcate the receptive skills i.e. Listening and Reading and to make the students well versed in the Productive skills.

UNIT I READING &VOCABULARY

Understanding short, real notices, messages - detailed comprehension of factual material- skimming & scanning skills - interpreting visual information - reading for detailed factual information - reading for gist and specific information - reading for grammatical accuracy and understanding of text structure - reading and information transfer.

UNIT II WRITING

Re-arranging appointments - asking for permission - giving instructions - apologizing and offering compensation - making or altering reservations - dealing with requests - giving information about aproduct.

UNIT III LISTENING

Listening to short telephonic conversation - Listening to short conversation or monologue - Listening to specific information - Listening to conversation- interview, discussion.

UNIT IV SPEAKING

Conversation between the interlocutor and the candidate - general interaction and social language - A mini presentation by each candidate on a business theme - organizing a larger unit of discourse - giving information and expressing opinions - two way conversation between candidates followed by further prompting from the interlocutor- Expressing opinions- agreeing and disagreeing.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

- enrich the vocabulary through reading and to develop their pronunciation skills.
- prepare flawless reports and proposals.
- listen to speeches and conversations and answer the questions.
- communicate fluently and effectively on any given topic and appear with confidence for on-line tests.

TEXT BOOKS

1. Cambridge BEC Preliminary, Self-Study Edition, Cambridge University Press, New York, 2012.
2. Whitby, Norman. Business Benchmark, Pre-intermediate to intermediate, Business Preliminary, Shree Maitrey Printech Pvt. Ltd., Noida,2014.

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

ME16501 DESIGN OF MACHINE ELEMENTS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- familiarize the various steps involved in the Design Process
- understand the design procedure and functions of shaft and coupling
- learn the design of temporary and permanent joints
- acquire the knowledge of designing the energy storing element
- gain in- depth knowledge of bearings and connecting rods
  (Use of PSG design data book is permitted)

UNIT I STEADY STRESSES ANDVARIABLE 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 curved beams – crane hook and 'C' frame - Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations

UNIT II DESIGN OF SHAFTS ANDCOUPLINGS 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 ANDMISCELLANEOUS ELEMENTS 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- successfully design machine members
- gain knowledge of designing the coupling, solid, hollow shafts and to find the critical speeds
- design of both permanent and temporary joints

- design helical, leaf, disc and torsional springs
- design sliding, rolling contact bearings and connecting rod

TEXT BOOKS

1. R.S.Khurmi, J.K.Gupta, “A Text Book of Machine Design”, S. Chand, 2005
2. Bhandari V.B, “Design of Machine Elements”, Third Edition, Tata McGraw-Hill Book Co,2010

REFERENCES

1. Sundararajamoorthy. T. V, Shanmugam.N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
3. Ugural A.C, “Mechanical Design – An Integral Approach, McGraw-Hill Book Co, 2004.
4. Spotts M.F., Shoup T.E “Design of Machine Elements” Pearson Education, 2004.
5. Ansel Ugural, “Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2003.

WEB LINKS

1. nptel.iitk.ac.in/courses/.../Machine%20design1/New_index1.html
2. https://india.oup.com/product/design-of-machine-elements-9780199477647
3. www.nptelvideos.in/2012/12/design-of-machine-elements.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	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

ME16502 DYNAMICS OF MACHINERY 3 2 0 4

COURSE OBJECTIVES

To enable the students to

- understand the force-motion relationship in components subjected to external forces and analysis ofstandard mechanisms.
- familiarize the concepts of static and dynamic mass balancing.
- get introduced to the approaches and mathematical models used in dynamical analysis of free vibrations.
- know the analysis of forced vibrations.
- learn various control mechanism for governors and gyroscopes.

UNIT I FORCE ANALYSIS AND FLYWHEELS 9+6

Static force analysis of mechanisms – D'Alembert's 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 9+6

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 9+6

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 9+6

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 9+6

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

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

- demonstrate the force analysis in mechanical system and related vibration issues and can solve problems in this area
- understand the basic concepts of balancing of rotating masses

- gain deep knowledge in free vibration for both damping and undamping conditions
- have knowledge in forced vibrations for both periodic and aperiodic
- explain control mechanisms in gyroscope and governors for various applications like automobile, ship and aero planes.

TEXT BOOKS

1. R.S.Khurmi,J.K.Gupta, "Theory of Machines",S.Chand and Co, New delhi, 2005.
2. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill, 2009.

REFERENCES

1. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
3. Benson H. Tongue, "Principles of Vibrations", Oxford University Press, 2nd Edition, 2007.
4. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
5. Allen S. Hall Jr., "Kinematics and Linkage Design", Prentice Hall, 2002.

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

ME16503 HEAT AND MASS TRANSFER 3 2 0 4

COURSE OBJECTIVES

To enable the students to

- understand the concepts of conduction modeof heat transfer
- gain problem solving skill of convection mode of heat transfer
- familiarize the working principle of heat exchangers and phase change hear transfer phenomena
- learn the loss and concepts of radiation and its effects.
- understand the concept of mass transfer and its applications

(Use of standard HMT data book is permitted)

UNIT I CONDUCTION 9+6

Basic Concepts - Mechanism of Heat Transfer - Conduction, Convection and Radiation - Fourier Law ofConduction - 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 and semi-infinite solids

UNIT II CONVECTION 9+6

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 9+6

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 9+6

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 - Radiation Shields - Introduction to Gas Radiation.

UNIT V MASS TRANSFER 9+6

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

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

- apply steady state heat conduction problems for composite systems and fins.
- solve convection mode of heat transfer problems
- attain knowledge on providing the problems on heat exchangers and phase change heat transfer
- describe the various laws of radiation and concerts of shape factor algebra
- 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, 2004.
2. Kothandaraman C.P "Fundamentals of Heat and Mass Transfer" New Age International, New Delhi, 2012

REFERENCES

1. Yunus A. Cengel and Afshin JahanshahiGhajar, "Heat and Mass Transfer: Fundamentals and Applications", Mcgraw-Hill Education., 2014.
2. Ozisik M.N, "Heat Transfer", McGraw-Hill Book Co., 2001.
3. Nag P.K,"Heat Transfer", Tata McGraw-Hill, New Delhi, 2002
4. Holman J.P "Heat and Mass Transfer" Tata McGraw-Hill, 2000.
5. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer", John Wiley and sons,2007

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

ME16504 HYDRAULIC AND PNEUMATIC SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- study about fluid power systems and fundamentals of hydraulics and pneumatics.
- learn about hydraulic System and components.
- understand the construction of control valves, accumulators and its operations in hydraulic system
- acquire the knowledge of pneumatic systemcomponents, pneumatic actuators, Sequential circuit design for simple applications using cascade method.
- know the design 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 Pascals Law - Laminar and Turbulent flow – Reynold's number – Darcy's equation – Losses inpipe, valves and fittings.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 9

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps. Fluid Power Actuators:Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, double acting specialcylinders 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 – 3/2way valve – 4/2way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve, sequence valve, Flow control valve – Fixed andadjustable, electrical control solenoid valves, Relays, ladder diagram. Accumulators and Intensifiers: Types ofaccumulators – 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 cascadeMethod.

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 circuitsfailure and troubleshooting. Pneumatic circuits for industrial applications in the field of Machine tools, materialhandling, hydraulic presses, clamping and indexing devices.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the 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 and piston pump
- gain knowledge on 3/2way valve, 4/2way valve, Shuttle valve, check valve and pressure control valve
- have good grounding on properties of air, compressors, filter, regulator and lubricator unit
- have an in-depth knowledge of Hydro Mechanical servo systems, Electro hydraulic servo systems andProportional valves and use of PLC in fluid power systems

TEXT BOOKS

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
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", S.Chandand Co, 2006.
3. Majumdar S.R., "Pneumatic systems – Principles and Maintenance", Tata McGraw Hill, 2004.
4. W.Bolten, "Pneumatic and Hydraulic Systems", Butterworth-Heinemann Ltd ,1997.
5. S.IlangoandV.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

ME16505 METROLOGY AND MEASUREMENTS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- gain knowledge on various metrological equipment available to measure the dimension of thecomponents and various parameters like pressure, temperature, torque etc
- know about linear and angular measurements with various measuring instruments
- familiarize students with straightness, flatness and roundness measurements on machine components
- learn about different precision measurement systems
- 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 uncertainty - static and dynamic response-repeatability-systematic and random errors- correction, calibration – problems on limits - fits and tolerances - terminology - Introduction to Dimensional and Geometric Tolerancing – 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, electricalresistance thermistor.

UNIT V LASER AND ADVANCES IN METROLOGY 9

Precision instruments based on laser-Principles- laser interferometer-application in measurements and machinetool 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

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

- have knowledge about the general concepts, units, standards, methods errors and calibration involved in the process of measurements
- understand the principle and working of instruments like vernier, micrometer and the significance of slip gauges in precision measurements
- explain about the measurements of various parameters of screw threads, gears, surface finish and other geometrical measurements
- demonstrate about the recent trends in metrology like laser measurements, coordinate measurement machine and machine vision
- have an in-depth knowledge of various techniques involved in the measurements of power, flow, temperature and other related properties.

TEXT BOOKS

1. Jain R.K., "Engineering Metrology", Khanna Publishers, 2005.
2. Gupta S.C, "Engineering Metrology", Dhanpat Rai Publications, 2005.

REFERENCES

1. Alan S. Morris, "The Essence of Measurement", Prentice Hall of India, 1997.
2. Jayal A.K, "Instrumentation and Mechanical Measurements", Galgotia Publications 2000.
3. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", Pearson Education, 2006.
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
CO5	3	-	-	-	1	-	-	-	-	-	-	2	3	2

ME16506 **DYNAMICS LABORATORY** **0 0 2 1**

COURSE OBJECTIVES:

To enable the students to

- 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. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.
   b) Kinematics of single and double universal joints.
3. a) Determination of Mass moment of inertia of Fly wheel and Axle system.
   b) Determination of Mass Moment of Inertia of axis symmetric bodies using Turn Table apparatus.
   c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.
4. Motorized gyroscope – Study of gyroscopic effect and couple.
5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon
7. a) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification ofLaws of springs – Damping coefficient determination.
   b) Multi degree freedom suspension system – Determination of influence coefficient.
8. a) Determination of torsional natural frequency of single and Double Rotor systems- Undamped and Damped Natural frequencies.
   b) Vibration Absorber – Tuned vibration absorber.
9. Vibration of Equivalent Spring mass system – undamped and damped vibration.
10. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
11. a) Balancing of rotating masses
    b) Balancing of reciprocating masses
12. 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/equipment depending upon availability.

Tachometers – Contact and non-contact, Dial gauge, Stroboscope

TOTAL PERIODS 30

COURSE OUTCOMES

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

- gain practical knowledge by exposure about how Mechanical systems get balanced by design.
- internalize the calculations and the elements considered for designing gear parameters
- describe the working principles and mechanisms involved in the functioning of gyroscopes, governors and cams
- analyze and explain various vibrating systems and different factors associated with the systems

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

ME16507 METROLOGY AND MEASUREMENTS LABORATORY 0 0 2 1

COURSE OBJECTIVES

To enable the students to

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

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

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

- handle the different measurement tools and measuring techniques and different standards and calibration processes
- study and analyze the characteristics of precision instruments
- usage of contact and non-contact measuring instruments, limit gauges and comparators
- acquire knowledge on geometrical parameters like straightness, flatness, roundness, parallelism etc.,

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

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ME16508 **HEAT TRANSFER LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- get practical hands-on training and thermal conductivity measurement using different apparatus
- get practical exposure to determine heat transfer coefficient of convection through tube and cylinder
- get practical knowledge on determining COP and other performance factors of refrigeration and air conditioning
- get practiced in refrigeration and air conditioning systems through performance test

Heat Transfer

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

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

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

- conduct thermal conductivity measurement test
- determine heat transfer coefficient of convection of heat through different geometrical areas
- determine the sensitivity of grey surfaces
- conduct refrigeration and airconditioning experiments and determine the COP of the system

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

ME16601 INDUSTRIAL ROBOTICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

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

UNIT I FUNDAMENTALS OF ROBOT 7

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

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 10

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION 10

Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters),Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors,(Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors Camera, Frame Grabber,Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processingand Analysis – Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms.Applications – Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 10

Forward Kinematics, Inverse Kinematics and Differences –Forward Kinematics and ReverseKinematics of Manipulators with Two, Three Degrees of Freedom (In 2-Dimensional), Four Degrees of Freedom (In 3- Dimensional) – DH matrices - Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands,End effecter commands and Simple programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 8

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- learn about the fundamentals of robot working, Robot characteristics, subsystems, classifications andtheir applications.
- gained knowledge onRobot power system (electrical, pneumatic and hydraulic motors) and also learn about the Robot mechanical system (links, bearings, shafts, gearboxes, grippers).
- have good understanding on Robot measuring system, internal sensingand external robot sensing (Proximity sensors, range finders, tactile sensors, vision),high and low value of resistance.
- acquire knowledge about robot kinematics, frames and standard names
- get knowledgeimparted about safety requirements associated with installation and maintenance.

TEXT BOOKS

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

REFERENCES

1. Harry clestock, "Industrial Robotics" Tata McGraw Hill, 2005.
2. Deb. S.R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi,2004.
3. Janakiraman.P.A, "Robotics and Image Processing", Tata McGraw Hill, New Delhi,2007.
4. Fu K.S, Gonzalz R.C.and Lee C.S.G, "Robotics control, Sensing, Vision and intelligence" McGraw Hill Book Co,2001
5. Saeed and Niku, "Introduction to robotics, Analysis, Control and Applications," Wiley India Pvt. Ltd, 2011

WEB LINKS

1. nptel.ac.in/courses/112103174/39
2. www.ent.mrt.ac.lk/rohan/.../LectureNotes/Lec%202%20Robot%20Manipulators
3. https://freevideolectures.com/course/2373/robotics/3

CO-PO Mapping

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

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ME16602 POWER PLANT ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of Power Plants and boilers
- acquire knowledge about Steam Power Plant and its importance
- know the working principles of Nuclear Power Plant and its elements
- understand the operation of Diesel and gas Turbine Power Plants
- learn the concept of Power Plant Economics

UNIT I INTRODUCTION TO POWER PLANTS AND BOILERS 9

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

UNIT II STEAM POWER PLANT 9

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

UNIT III NUCLEAR POWER PLANTS 9

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

UNIT IV DIESEL AND GAS TURBINE POWER PLANTS 9

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

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

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- learn about the real time applications of Power Plant Engineering.
- know about the real time applications of Steam Power Plant.
- enhance their knowledge of design skills of Nuclear Power Plant Generation
- know about the real time applications of Diesel and gas Turbine Power Plants operation.
- learn about economics involved in power plant operations

TEXT BOOKS

1. Arora S.C. and Domkundwar.S, "A Course in Power Plant Engineering", Dhanpat Rai, 2001
2. Nag P.K, "Power Plant Engineering", Tata-McGraw Hill, 1998

REFERENCES

1. Frank D.Graham,'Power Plant Engineers Guide', D.B. TaraporevalaSons and Co., New Delhi,1993
2. T.MorseFrederick, "Power Plant Engineering", Prentice Hall of India, 1998.
3. R.K.Rajput, "Power Plant Engineering", Laxmi Publications,1995.
4. G.D.Rai, "Introduction to Power Plant Technology", Khanna Publishers, 1995.
5. Nagpal, G.R. "Power Plant Engineering", Khanna Publishers, 15th Edition (7th Reprint),2008

WEB LINKS

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

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

CO-PO Mapping

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

ME16603 GAS DYNAMICS AND JET PROPULSION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic difference between incompressible and compressible flow
- analyze to solve the problems in Rayleigh and Fanno flow
- know the concepts of phenomenon of shock waves and its effect on flow
- gain basic knowledgeabout Jet Propulsion
- learn basic conceptsabout Rocket Propulsion

(Use of Standard Gas Tables permitted)

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 6

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable area – Nozzle and Diffusers – Use of Gas tables.

UNIT II FLOW THROUGH CONSTANT AREA DUCT 9

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

UNIT III NORMAL AND OBLIQUE SHOCKS 10

Wave Motion - Steep, Non-steep Finite Pressure Waves - Governing equations – Variation of flow parameters. Across the normal and oblique shocks – Prandtl – Meyer relations – Use of table and charts – Applications.

UNIT IV JET PROPULSION 10

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V SPACE PROPULSION 10

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply basic concepts and various regimes of flow characteristics.
- learn about the types of flowin constant area ducts for rayleigh and fanno flow.
- gain knowledge of different types of governing equations of Normal Shock and Oblique Shockand Prandtl- Meyer equation.
- understand the concepts of Air craft propulsion and different types of Jet engines.
- acquire knowledge on propulsive and overall efficiencies in various jet engines.

TEXT BOOKS

1. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, NewDelhi,2016.
2. Anderson, J.D., “Modern Compressible flow”, McGraw Hill, 3rd Edition, 2013.

REFERENCES

1. HillP.andPetersonC., “Mechanics and Thermodynamics of Propulsion”, Addison – WesleyPublishingcompany, 1992.
2. Zucrow. N.J, “Aircraft and Missile Propulsion”, vol. Iand II, John Wiley, 1975.
3. Balachandran. P, “Fundamentals of Compressible Fluid Dynamics”,PHI Learning,New Delhi,2012
4. Sutton G.P, “Rocket Propulsion Elements”, John wiley, 2013, New York.
5. Ganesan V, “Gas Turbines”, Tata McGraw Hill Publishing Co., New Delhi, 2010.

WEB LINKS

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

CO - PO Mapping

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

ME16604 DESIGN OF TRANSMISSION SYSTEMS 3 2 0 4

COURSE OBJECTIVES

To enable the students to

- study the different types of flexible elements in transmission systems
- learn the design of spur gears and parallel axis helical gears and its parameters
- understand the design of bevel gears and worm gears and their parameters
- study the design of gear boxes
- gain knowledge onthe design of power screws, clutches and brakes

(Use of PSG design data book is permitted)

UNIT I TRANSMISSION SYSTEMS USING FLEXIBLE ELEMENTS 9+6

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

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9+6

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

UNIT III BEVEL AND WORM GEARS 9+6

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

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

UNIT IV DESIGN OF GEAR BOXES 9+6

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

UNIT V DESIGN OF POWER SCREWS, CLUTCHES AND BRAKES 9+6

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

TOTAL PERIODS 75

COURSE OUTCOMES

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

- students will be able to learn about the design of different types of flexible elements.
- understand the concept of the design of spur gears and parallel axis helical gears andtheir parameters.
- get familiarized with design of bevel gears and worm gears, their parameters and merits and demerits of the above gears.
- acquire knowledge on different types of gear boxes and their design.
- understand the concept ofthe power screws, clutches and brakes used in powertransmission system.

TEXT BOOKS

1. S.Md.Jalaludeen, "Machine Design", Vol – 2, Anurada publications, 2016
2. Bhandari.V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Ltd., 2012

REFERENCES

1. Maitra G.M., Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGraw-Hill, 1985
2. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", McGraw-Hill International Editions,1989.
3. Norton R.L, "Design of Machinery", McGraw-Hill Book, 2004.
4. Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", McGraw- Hill Book, 2004
5. Hall A.S. Holowenko A.R. and Laughlin H.G., "Theory and Problems in MachineDesign", Schaum's Series,2000.

STANDARDS

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

WEB LINKS

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

CO-PO Mapping

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

ME16605 **FINITE ELEMENT ANALYSIS** **3 2 0 4**

COURSE OBJECTIVES

To enable the students to

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

UNIT I INTRODUCTION **9+6**

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

UNIT II ONE DIMENSIONAL PROBLEMS **9+6**

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

UNIT III TWO DIMENSIONAL PROBLEMS – SCALAR VARIABLE PROBLEMS **9+6**

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

UNIT IV TWO DIMENSIONAL PROBLEMS – VECTOR VARIABLE PROBLEMS **9+6**

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

UNIT V ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL PROBLEMS **9+6**

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

TOTAL PERIODS 75

COURSE OUTCOMES

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

- gain the basic idea of Finite Element Method and understand different mathematical Techniques used in FEM analysis

- understand methods to assemble finite element equation of structural problems and non-structural problems.
- attain knowledge of basic idea about CST element, plane stress, plane strain conditions andapplication to heat transfer problems.
- acquire knowledge on basic idea about axi-symmetric element, plane stress conditions with differentboundary conditions.
- understand the concept in Mapping of elements from natural to local coordinatesystem, displacement and stress calculations with numerical integration.

TEXT BOOKS

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

REFERENCES

1. Rao S.S., "The Finite Element Method in Engineering", Pergammon Press, 1989.
2. David V Hutton "Fundamentals of Finite Element Analysis", Third Edition,McGraw-Hill Int, 2004.
3. Robert D.Cook, David.S, Malkucs Michael E Plesha, "Concepts and Applications of FiniteElementAnalysis", Fourth Edition, Wiley, 2003.
4. Reddy. J.N, "An Introduction to Finite Element Method", McGraw-Hill InternationalStudent Edition, 2005.
5. Victor N. Kaliakin, "Introduction to Approximate Solution Techniques, Numerical Modeling and Finite Element Methods", Fifth Edition, Marker Dekker AG publications, 2001.

WEB LINKS

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

CO-PO Mapping

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

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ME16606 SIMULATION AND ANALYSIS LABORATORY 0 0 2 1

COURSE OBJECTIVES

To enable the students to

- give exposure to software tools needed to analyze engineering problems.
- expose the students to different applications of simulation and analysis tools
- give practise to solve real time problems in air conditioning, hydraulic/pneumatic systems and cam mechanisms through simulation software C / MAT lab
- expose to stress analysis(Mechanical, thermal) and heat transfer analysis through simulation software

A. Simulation **6**

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

B. Analysis (Simple Treatment Only) **24**

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

TOTAL PERIODS 30

COURSE OUTCOMES

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

- simulate components like Air conditioning system, Hydraulic and pneumatic cylinder and camfollower mechanism.
- do simple analysis in both structural and non-structural problems.
- Solve thermal conductivity and thermal stress related problems using simulation software
- do model, analyse and simulate experiments to meet realworld system and evaluate the performance.

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

ME16607 COMPUTER AIDED DESIGN LABORATORY 0 0 2 1

COURSE OBJECTIVES

To enable the students to

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

List of Experiments

Introduction of 3D Modelling software

Drawing and assembling of following Machine components

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

TOTAL PERIODS 30

COURSE OUTCOMES

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

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

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO2	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO3	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO4	3	-	-	-	2	-	-	-	-	-	-	2	2	2

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ME16608 **DESIGN AND FABRICATION PROJECT** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

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

GUIDELINE FOR REVIEW AND EVALUATION

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

TOTAL PERIODS 30

COURSE OUTCOMES

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

- learn elements of various modeling software for modeling and analyzing real time components in a part or assembly and study their Static and dynamic characteristics
- learn the uses of design principles and develop conceptual and engineering design elementsofany components.
- fabricate any components using proper manufacturing tools.
- design a system, component, or process to meet desired needs within realisticconstraints such as economic, environmental, social, politicalsafety, manufacturability and sustainabilityaspects.

WEB LINKS

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

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO2	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO3	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2

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ME16151 UNCONVENTIONAL MACHINING PROCESSES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications
- know about working principles of various mechanical processes like Abrasive jet machining, Water jet machining and Ultrasonic Machining
- gain in depth knowledge on electro chemical processes and its applications
- familiarize with thermal metal removal processes like electric discharge machining, grinding and wire cutting processes
- 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 metalremoval 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, equipment, Process parameters, mechanics of metal removal, MRR - Variation in techniquesused – applications andlimitations.

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 andapplications.

UNIT IV THERMAL METAL REMOVAL PROCESSES –I 9

General Principle and applications of Electric Discharge Machining, Electric Discharge Grinding and electricdischarge wire cutting processes – Power circuits for EDM, Mechanics of metal removal in EDM, Processparameters, 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

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

- explain about classification, applications and recent updations in modern machining process.,
- understand the working principle, process parameters and equipment used in machining process.
- have a good knowledge on fundamentals of electro chemical process.
- illustrate the principles, applications and selection parameters of thermal metal removal process.
- demonstrate different unconventional machining processes and can know the processes and can know theinfluence 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,2002
2. M.K Singh “Unconventional Machining processes”, New age International publishers,2008

REFERENCES

1. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, “Material and Processes in Manufacturing”. Prentice Hall ofIndia Pvt. Ltd., New Delhi, 2001
2. Benedict. G.F. “Nontraditional Manufacturing Processes” Marcel Dekker Inc., New York,1987
3. Pandey P.C. and Shan H.S. “Advanced Machining Processes” Tata McGraw-Hill, New Delhi ,1980
4. “Production Technology” HMT Bengaluru, Tata McGraw Hill Publishing company Limited, New Delhi, 2006
5. Elanchezhian.B, Vijaya Ramnath andVijayan.M, “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	3	-	-	-	2	-	1	-	-	-	-	2	3
CO2	3	3	-	-	-	2	-	1	-	-	-	-	2	3
CO3	3	3	-	-	-	2	-	1	-	-	-	-	2	3
CO4	3	3	-	-	-	2	-	1	-	-	-	-	2	3
CO5	3	3	-	-	-	2	-	1	-	-	-	-	2	3

ME16152 **RAPID PROTOTYPING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the various rapid prototyping, rapid tooling and reverse engineering technologies
- gain knowledge to select appropriate technologies for product development purposes
- learn various methods of prototyping systems
- gain knowledge on selection of material for rapid prototyping
- understand 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 - Stereolithography 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 sintering materials, 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, e-manufacturing 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 – Casestudy.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply the basic principles of rapid prototyping (RP), rapid tooling(RT), and reverse engineering (RE) technologies to product development
- learn about deciphering the limitations of RP, RT, and RE technologies for product development
- realize the application of RP, RT, and RE technologies for product development
- learn about polymers, metals, ceramics and composites liquid based materials and photo polymer development
- learn about applications with influences of software in this technique.

TEXT BOOKS

1. Rafiq I. Noorani, Rapid Prototyping – Principles and Applications, Wiley and 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, 2001
4. Joe Cecil, “Virtual Enginering”, Momentum Press, 2010.
5. Chua C.K, Leong K.F and Lim C.S, Rapid Prototyping: Principles and Applications, secondedition, World Scientific, 2003.

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

ME16153 THEORY OF METAL FORMING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- have an in-depth understanding of mechanics of metal forming and metal behavior
- learn about Mechanical properties and plastic instability in biaxial tension stress
- understand the analysis of Metal forming process
- attain knowledge on basic sheet metal forming techniques
- 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 – Stress 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, elastovisco 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 – Superplastic Forming.

UNIT V SPECIAL METAL FORMING PROCESSES 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- gain ground on the techniques of plasticity and stress strain relationships
- have an in-depth knowledge of Mechanical behavior and analysis of residual stresses in metals during processing
- explain about the significance of mechanical behavior of metals in terms of deformation characteristics.
- get familiarized with Special Metal Forming Processes
- understand the principles of sheet 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. J.J, "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, 1993.
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

ME16154 **SOLAR ENERGY SYSTEM** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the basic principles of design and operation of solar thermal energy conversions
- delineate the other applications and the devices used to collect solar energy.
- learn the fundamental concepts about solar energy storage systems and devices.
- gain knowledge on the variety of solar systems used to collect solar energy.
- 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 andsolar desalination

TOTAL PERIODS 45

COURSE OUTCOMES

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

- know about thermal energy conversion into other form of energies.
- understand the working principle of solar collectors and their applications.
- explain about fundamentals of different types of solar concentration collectors and reflectors.
- have a deep knowledge on variety of solar systems used to solar energy storage systems.
- gain knowledge on solar heating systems and liquid based solar heating systems for buildings.

TEXT BOOKS

1. Rai,G.D, "Solar Energy Utilization", Khanna Publishers, New Delhi, 2010.
2. Kreith. F and Kreider. J. F., "Principles of Solar Engineering", McGrawHill, 1978.

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 and 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
3. iitsolar.in/

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

ME16155 FOUNDRY TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basics of foundry practice and metal casting as important manufacturing moulding processes
- gain knowledge on the fundamental process of moulding process and equipment and tools
- get familiar with the sand moulding and permanent die moulding and other casting process in detail
- learn about melting, pouring and testing stages involved in foundry processes.
- acquire knowledge 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 –equipment and tools – Moulding sand ingredients – Moulding sand properties, influence of ingredients on properties – sand preparation and control – sand testing – machine moulding – typesof 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, CO_2moulding – continuous casting – squeeze casting – electro slagcasting 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 equipment, Inspection of castings, destructive and non-destructive, Casting defects – Occurrence, causes and remedies.

UNIT V 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

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

- have good understanding on the basics of foundry practice and metal casting as important manufacturing moulding processes
- acquire knowledge on the fundamental principles of moulding processes, equipment and tools.

- know about various Sand molding and permanent die molding and other casting process in detail.
- demonstratemelting, pouring and testing stages involved in foundry process
- explain about pouring, feeding and automation systems involved in foundry techniques

TEXT BOOKS

1. Jain P.L. "Principles of Foundry Technology", Tata McGraw-Hill, 2003.
2. R.W. Heine, C.R.Loper and 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. and 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
3. efoundry.iitb.ac.in/weblinks/castlinks-india.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	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

ME16601 INDUSTRIAL ROBOTICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

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

UNIT I FUNDAMENTALS OF ROBOT 7

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

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 10

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

UNIT III SENSORS AND MACHINE VISION 10

Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, Pneumatic Position Sensors), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Time of Flight Range Finders, Laser Range Meters),Proximity Sensors (Inductive, Hall Effect, Capacitive, Ultrasonic and Optical Proximity Sensors), Touch Sensors,(Binary Sensors, Analog Sensors), Wrist Sensors, Compliance Sensors, Slip Sensors Camera, Frame Grabber,Sensing and Digitizing Image Data – Signal Conversion, Image Storage, Lighting Techniques. Image Processingand Analysis – Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms.Applications – Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 10

Forward Kinematics, Inverse Kinematics and Differences –Forward Kinematics and ReverseKinematics of Manipulators with Two, Three Degrees of Freedom (In 2-Dimensional), Four Degrees of Freedom (In 3- Dimensional) – DH matrices - Deviations and Problems. Teach Pendant Programming, Lead through programming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Commands,End effecter commands and Simple programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 8

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- learn about the fundamentals of robot working, Robot characteristics, subsystems, classifications andtheir applications.
- gained knowledge onRobot power system (electrical, pneumatic and hydraulic motors) and also learn about the Robot mechanical system (links, bearings, shafts, gearboxes, grippers).
- have good understanding on Robot measuring system, internal sensingand external robot sensing (Proximity sensors, range finders, tactile sensors, vision),high and low value of resistance.
- acquire knowledge about robot kinematics, frames and standard names
- get knowledgeimparted about safety requirements associated with installation and maintenance.

TEXT BOOKS

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

REFERENCES

1. Harry clestock, "Industrial Robotics" Tata McGraw Hill, 2005.
2. Deb. S.R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi,2004.
3. Janakiraman.P.A, "Robotics and Image Processing", Tata McGraw Hill, New Delhi,2007.
4. Fu K.S, Gonzalz R.C.and Lee C.S.G, "Robotics control, Sensing, Vision and intelligence" McGraw Hill Book Co,2001
5. Saeed and Niku, "Introduction to robotics, Analysis, Control and Applications," Wiley India Pvt. Ltd, 2011

WEB LINKS

1. nptel.ac.in/courses/112103174/39
2. www.ent.mrt.ac.lk/rohan/.../LectureNotes/Lec%202%20Robot%20Manipulators
3. https://freevideolectures.com/course/2373/robotics/3

CO-PO Mapping

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

PAAVAI ENGINEERING COLLEGE, NAMAKKAL
Approved
BOARD OF STUDIES
Mechanical Engineering
26/4/18
AUTONOMOUS

ME16602 POWER PLANT ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of Power Plants and boilers
- acquire knowledge about Steam Power Plant and its importance
- know the working principles of Nuclear Power Plant and its elements
- understand the operation of Diesel and gas Turbine Power Plants
- learn the concept of Power Plant Economics

UNIT I INTRODUCTION TO POWER PLANTS AND BOILERS 9

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

UNIT II STEAM POWER PLANT 9

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

UNIT III NUCLEAR POWER PLANTS 9

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

UNIT IV DIESEL AND GAS TURBINE POWER PLANTS 9

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

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

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- learn about the real time applications of Power Plant Engineering.
- know about the real time applications of Steam Power Plant.
- enhance their knowledge of design skills of Nuclear Power Plant Generation
- know about the real time applications of Diesel and gas Turbine Power Plants operation.
- learn about economics involved in power plant operations

TEXT BOOKS

1. Arora S.C. and Domkundwar.S, "A Course in Power Plant Engineering", Dhanpat Rai, 2001
2. Nag P.K, "Power Plant Engineering", Tata-McGraw Hill, 1998

REFERENCES

1. Frank D.Graham,'Power Plant Engineers Guide', D.B. TaraporevalaSons and Co., New Delhi,1993
2. T.MorseFrederick, "Power Plant Engineering", Prentice Hall of India, 1998.
3. R.K.Rajput, "Power Plant Engineering", Laxmi Publications,1995.
4. G.D.Rai, "Introduction to Power Plant Technology", Khanna Publishers, 1995.
5. Nagpal, G.R. "Power Plant Engineering", Khanna Publishers, 15th Edition (7th Reprint),2008

WEB LINKS

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

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

CO-PO Mapping

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

ME16603 GAS DYNAMICS AND JET PROPULSION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic difference between incompressible and compressible flow
- analyze to solve the problems in Rayleigh and Fanno flow
- know the concepts of phenomenon of shock waves and its effect on flow
- gain basic knowledgeabout Jet Propulsion
- learn basic conceptsabout Rocket Propulsion

(Use of Standard Gas Tables permitted)

UNIT I BASIC CONCEPTS AND ISENTROPIC FLOWS 6

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable area – Nozzle and Diffusers – Use of Gas tables.

UNIT II FLOW THROUGH CONSTANT AREA DUCT 9

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

UNIT III NORMAL AND OBLIQUE SHOCKS 10

Wave Motion - Steep, Non-steep Finite Pressure Waves - Governing equations – Variation of flow parameters. Across the normal and oblique shocks – Prandtl – Meyer relations – Use of table and charts – Applications.

UNIT IV JET PROPULSION 10

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operation principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V SPACE PROPULSION 10

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply basic concepts and various regimes of flow characteristics.
- learn about the types of flowin constant area ducts for rayleigh and fanno flow.
- gain knowledge of different types of governing equations of Normal Shock and Oblique Shockand Prandtl- Meyer equation.
- understand the concepts of Air craft propulsion and different types of Jet engines.
- acquire knowledge on propulsive and overall efficiencies in various jet engines.

TEXT BOOKS

1. Yahya, S.M. "Fundamentals of Compressible Flow", New Age International (P) Limited, NewDelhi,2016.
2. Anderson, J.D., “Modern Compressible flow”, McGraw Hill, 3rd Edition, 2013.

REFERENCES

1. HillP.andPetersonC., “Mechanics and Thermodynamics of Propulsion”, Addison – WesleyPublishingcompany, 1992.
2. Zucrow. N.J, “Aircraft and Missile Propulsion”, vol. Iand II, John Wiley, 1975.
3. Balachandran. P, “Fundamentals of Compressible Fluid Dynamics”,PHI Learning,New Delhi,2012
4. Sutton G.P, “Rocket Propulsion Elements”, John wiley, 2013, New York.
5. Ganesan V, “Gas Turbines”, Tata McGraw Hill Publishing Co., New Delhi, 2010.

WEB LINKS

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

CO - PO Mapping

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

ME16604 DESIGN OF TRANSMISSION SYSTEMS 3 2 0 4

COURSE OBJECTIVES

To enable the students to

- study the different types of flexible elements in transmission systems
- learn the design of spur gears and parallel axis helical gears and its parameters
- understand the design of bevel gears and worm gears and their parameters
- study the design of gear boxes
- gain knowledge onthe design of power screws, clutches and brakes

(Use of PSG design data book is permitted)

UNIT I TRANSMISSION SYSTEMS USING FLEXIBLE ELEMENTS 9+6

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

UNIT II SPUR GEARS AND PARALLEL AXIS HELICAL GEARS 9+6

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

UNIT III BEVEL AND WORM GEARS 9+6

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

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

UNIT IV DESIGN OF GEAR BOXES 9+6

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

UNIT V DESIGN OF POWER SCREWS, CLUTCHES AND BRAKES 9+6

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

TOTAL PERIODS 75

COURSE OUTCOMES

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

- students will be able to learn about the design of different types of flexible elements.
- understand the concept of the design of spur gears and parallel axis helical gears andtheir parameters.
- get familiarized with design of bevel gears and worm gears, their parameters and merits and demerits of the above gears.
- acquire knowledge on different types of gear boxes and their design.
- understand the concept ofthe power screws, clutches and brakes used in powertransmission system.

TEXT BOOKS

1. S.Md.Jalaludeen, "Machine Design", Vol – 2, Anurada publications, 2016
2. Bhandari.V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Ltd., 2012

REFERENCES

1. Maitra G.M., Prasad L.V., "Hand book of Mechanical Design", II Edition, Tata McGraw-Hill, 1985
2. Shigley J.E and Mischke C. R., "Mechanical Engineering Design", McGraw-Hill International Editions,1989.
3. Norton R.L, "Design of Machinery", McGraw-Hill Book, 2004.
4. Hamrock B.J., Jacobson B., Schmid S.R., "Fundamentals of Machine Elements", McGraw- Hill Book, 2004
5. Hall A.S. Holowenko A.R. and Laughlin H.G., "Theory and Problems in MachineDesign", Schaum's Series,2000.

STANDARDS

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

WEB LINKS

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

CO-PO Mapping

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

ME16605 **FINITE ELEMENT ANALYSIS** **3 2 0 4**

COURSE OBJECTIVES

To enable the students to

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

UNIT I INTRODUCTION **9+6**

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

UNIT II ONE DIMENSIONAL PROBLEMS **9+6**

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

UNIT III TWO DIMENSIONAL PROBLEMS – SCALAR VARIABLE PROBLEMS **9+6**

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

UNIT IV TWO DIMENSIONAL PROBLEMS – VECTOR VARIABLE PROBLEMS **9+6**

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

UNIT V ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL PROBLEMS **9+6**

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

TOTAL PERIODS 75

COURSE OUTCOMES

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

- gain the basic idea of Finite Element Method and understand different mathematical Techniques used in FEM analysis

- understand methods to assemble finite element equation of structural problems and non-structural problems.
- attain knowledge of basic idea about CST element, plane stress, plane strain conditions andapplication to heat transfer problems.
- acquire knowledge on basic idea about axi-symmetric element, plane stress conditions with differentboundary conditions.
- understand the concept in Mapping of elements from natural to local coordinatesystem, displacement and stress calculations with numerical integration.

TEXT BOOKS

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

REFERENCES

1. Rao S.S., "The Finite Element Method in Engineering", Pergammon Press, 1989.
2. David V Hutton "Fundamentals of Finite Element Analysis", Third Edition,McGraw-Hill Int, 2004.
3. Robert D.Cook, David.S, Malkucs Michael E Plesha, "Concepts and Applications of FiniteElementAnalysis", Fourth Edition, Wiley, 2003.
4. Reddy. J.N, "An Introduction to Finite Element Method", McGraw-Hill InternationalStudent Edition, 2005.
5. Victor N. Kaliakin, "Introduction to Approximate Solution Techniques, Numerical Modeling and Finite Element Methods", Fifth Edition, Marker Dekker AG publications, 2001.

WEB LINKS

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

CO-PO Mapping

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

ME16606 SIMULATION AND ANALYSIS LABORATORY 0 0 2 1

COURSE OBJECTIVES

To enable the students to

- give exposure to software tools needed to analyze engineering problems.
- expose the students to different applications of simulation and analysis tools
- give practise to solve real time problems in air conditioning, hydraulic/pneumatic systems and cam mechanisms through simulation software C / MAT lab
- expose to stress analysis(Mechanical, thermal) and heat transfer analysis through simulation software

A. Simulation **6**

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

B. Analysis (Simple Treatment Only) **24**

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

TOTAL PERIODS 30

COURSE OUTCOMES

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

- simulate components like Air conditioning system, Hydraulic and pneumatic cylinder and camfollower mechanism.
- do simple analysis in both structural and non-structural problems.
- Solve thermal conductivity and thermal stress related problems using simulation software
- do model, analyse and simulate experiments to meet realworld system and evaluate the performance.

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

ME16607 COMPUTER AIDED DESIGN LABORATORY 0 0 2 1

COURSE OBJECTIVES

To enable the students to

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

List of Experiments

Introduction of 3D Modelling software

Drawing and assembling of following Machine components

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

TOTAL PERIODS 30

COURSE OUTCOMES

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

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

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO2	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO3	3	-	-	-	2	-	-	-	-	-	-	2	2	2
CO4	3	-	-	-	2	-	-	-	-	-	-	2	2	2

ME16608 DESIGN AND FABRICATION PROJECT 0 0 2 1

COURSE OBJECTIVES

To enable the students to

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

GUIDELINE FOR REVIEW AND EVALUATION

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

TOTAL PERIODS 30

COURSE OUTCOMES

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

- learn elements of various modeling software for modeling and analyzing real time components in a part or assembly and study their Static and dynamic characteristics
- learn the uses of design principles and develop conceptual and engineering design elementsofany components.
- fabricate any components using proper manufacturing tools.
- design a system, component, or process to meet desired needs within realisticconstraints such as economic, environmental, social, politicalsafety, manufacturability and sustainabilityaspects.

WEB LINKS

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

CO-PO Mapping

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programme Outcomes(POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO2	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO3	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2

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EN16601 CAREER DEVELOPMENT LABORATORY II 0 0 2 1

COURSE OBJECTIVES

To enable the students to

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

UNIT I CORPORATE READINESS 6

Business communication – Email, Paragraph, Letter Writing Skills - Public speaking skills: Rules of Public speaking skills; Extempore, JAM - Inter and intra personal skills: Introduction; Need for Inter and Intra personal skills in organizations - Stress management: Causes of stress and its impact, how to manage and distress, Circle of control, stress busters - Emotional Intelligence: What is emotional Intelligence, Why Emotional Intelligence Matters, Managing Emotions.

UNIT II INTERVIEW SKILLS 6

Interview Basics: General Selection process, Grooming, Dress code, Supporting Documents to carry - Resume Building: Impact of Powerful CV, Do's and don'ts in CV - Group Discussion: Introduction to GD, Important of Listening and Speaking skills, Do's and Don'ts in GD - Face to face interview / Hire me: Rules for face to face interview, body language, Self-Introduction - Psychometric Assessment: Importance of Psychometric assessment, Why psychometric assessment.

UNIT III QUANTITATIVE APTITUDE I 6

Simplification - Time and work - Pipes and cisterns - Ratio and Proportion - Partnership

UNIT IV QUANTITATIVE APTITUDE I 6

Simple interest and Compound interest - Profit and loss - Permutation and combination - Probability - Calendar

UNIT V LOGICAL AND VERBAL REASONING 6

Seating arrangement – Direction - Arithmetic reasoning – Syllogisms - Making Judgments - Statements and conclusions - Matching definition - Cause and effect.

TOTAL PERIODS 30

COURSE OUTCOMES

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

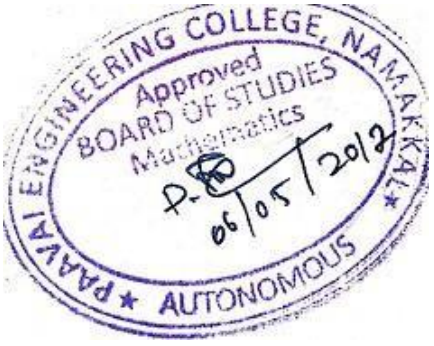
- Demonstrate aptitude and reasoning skills
- Enhance verbal and written ability
- Improve his/her grooming and presentation skills
- Interact effectively on any recent event / happenings / current affairs
- Be a knowledgeable person on the various evaluation processes leading to employment and face the same with Confidence

REFERENCES

1. Aggarwal, R.S." A Modern Approach to Verbal and Non-Verbal Reasoning", S.Chand and Co Ltd, New Delhi, 2017
2. Abhijit Guha, "Quantitative Aptitude for Competitive Examinations ", Tata McGraw Hill, 2010
3. Norman Lewis, "Word power made easy",W.R.Goyal Publications, 2011
4. Johnson, D.W," Reaching out: Interpersonal Effectiveness and Self Actualization", Allyn and Bacon, 1997.
5. Infosys campus connect program – students' guide for soft skills

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	-	-	-	-	-	3	3	3	2	2	2
CO2	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO3	3	-	2	-	-	-	-	-	3	3	3	2	2	2
CO4	3	-	2	-	-	-	-	-	3	3	3	2	2	2
C05	3	-	2	-	-	-	-	-	3	3	3	2	2	2



ME16901 **RENEWABLE ENERGY SOURCES** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand primary energy sources and global warming
- understand the principle of solar energy
- learn about wind, tidal and geo-thermal energy
- acquire knowledge about bio energy
- understand the other renewable sources like fuel cells and MHD

UNIT I ENERGY AND ENVIRONMENT **9**

Primary energy sources - world energy resources-Indian energy scenario-energy cycle of the earth-environmental aspects of energy utilisation, CO_2 emissions and Global warming–renewable energyresources and their importance. Potential impacts of harnessing the different renewable energyresources.

UNIT II SOLAR ENERGY **9**

Principles of solar energy collection -solar radiation - measurements - instruments - data andestimation- types of collectors - characteristics and design principles of different type of collectors - performance of collectors - testing of collectors. Solar thermal applications - water heaters and air heaters - performance and applications - simple calculations - solar cooling - solar drying- solar distillation -solar ponds - solar tower concept - solar furnace.

UNIT III WIND, TIDAL AND GEO THERMAL ENERGY **9**

Energy from the wind - general theory of windmills - types of windmills - design aspects of horizontalaxis windmills - Wind Power estimation techniques - Betz criteria - applications. Energy from tides and waves – working principles of tidal plants and ocean thermal energy conversion plants - power from geothermal energy - principle of working of Geo-thermal power plants.

UNIT IV BIO ENERGY **9**

Energy from bio mass and bio gas plants -various types - design principles of biogas plants - applications. Energy from wastes - waste burning power plants - utilization of industrial and municipal wastes – energy from the agricultural wastes – Synthesis biofuel

UNIT V OTHER RENEWABLE ENERGY SOURCES **9**

Direct energy conversion (Description, principle of working and basic design aspects only) – Magneto hydrodynamic systems (MHD) - thermoelectric generators – thermionic generators - fuel cells - solar cells -types, emf generated, power output, losses and efficiency and applications. Hydrogen conversion and storage systems

TOTAL PERIODS 45

COURSE OUTCOMES

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

- learn about the importance of various energy sources available in the energy cycle.
- know about design and performance calculations of solar energy.
- know about new methodologies of Wind, Tidal and Geo Thermal Energy.
- abouteffective utilization of bio gas and its techniques.
- identify the new methodologies and technologies for effective utilization of renewable energy Sources.

TEXT BOOKS

1. G.D.Rai., "Non-Conventional Sources of Energy", Fifth Edition, Khanna Publishers, Delhi, 2011.
2. Twidell. J.W and Weir. A, "Renewable Energy Sources",Third Edition, EFN Spon Ltd., UK, 2015.

REFERENCES

1. D.P.Kothari, K.C.Singal, RakeshRanjan, "Renewable energy sources and emerging technologies", second edition, PHI learning pvt ltd, Delhi, 2013.
2. David M. Mousdale, "Introduction to Biofuels", CRC Press, Taylor and Francis Group, USA 2010.
3. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2009.
4. Boyle Godfrey, Renewable Energy (2nd edition). Oxford University Press, 450 pages (ISBN: 0-19- 926178-4), 2004
5. Boyle, Godfrey, Bob Everett, and Janet Ramage (eds.),"Energy Systems and Sustainability: Power for a Sustainable Future", Oxford University Press,619 pages (ISBN: 0-19-926179-2), 2004.

WEB LINKS

1. http://www.nrel.gov/analysis/re_futures
2. http://www.sosmath.com/matrix/matrix.html
3. http://www.sosmath.com/matrix/matrix.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	3	-	2	-	-	-	-	-	-	2	3	3
CO2	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO4	3	3	3	-	2	-	-	-	-	-	-	2	3	3
CO5	3	3	3	-	2	-	-	-	-	-	-	2	3	3

ME16902 QUALITY CONTROL AND RELIABILITY ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know about quality and its assurance and control and SQC and six sigma concepts and control charts usage.
- study the basic use of p and np charts, C and U chartsin quality control to analyze and understand process variables.
- learn lot sampling and probability of acceptance techniques and sampling plans with AQL, LTPD, AOQL concepts.
- acquaint the student with the concepts of life testing and reliability test.
- explain the reliability improvements and its techniques and product analysis.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 10

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

UNIT II PROCESS CONTROL FOR ATTRIBUTES 8

Control chart for attributes – control chart for non conformings – p chart and np chart – control chart for non-conformities – C and U charts, State of control and process out of control identification in charts.

UNIT III ACCEPTANCE SAMPLING 9

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

UNIT IV LIFE TESTING – RELIABILITY 9

Life testing – Objective – failure data analysis, Mean failure rate, mean time to failure, mean time between failure, hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test - O.C Curves.

UNIT V QUALITY AND RELIABLITY 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply the concept of SQC in process control for reliable component production.
- gain knowledge on p chart, np chart, out to control identification.
- have Thorough understanding of standing sampling techniques AWL, LTPD, AOQL concepts.
- increase good grounding on reliability, failure rate, hazard rate, maintainability, availability.
- know about optimization in reliability, product design, product life cycle analysis which will give the student good authority over the subject.

TEXT BOOKS

1. Douglas. C. Montgomery, "Introduction to Statistical quality control", 4th edition, John Wiley, 2001.
2. Srinath. L.S, "Reliability Engineering", Affiliated East west press, 1991.

REFERENCES

1. John.S. Oakland, "Statistical process control", 5th edition, Elsevier, 2005.
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993.
3. Grant, Eugene.L, "Statistical Quality Control", McGraw-Hill, 1996.
4. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai and Sons, 2001.
5. Gupta. R.C, "Statistical Quality control", Khanna Publishers, 1997.

WEB LINKS

1. http://en.wikipedia.org/wiki/Quality_control
2. https://en.wikipedia.org/wiki/Accelerated_life_testing
3. https://www.infoq.com/articles/understanding-quality-reliability-qsm

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

ME16903 INDUSTRIAL PSYCHOLOGY AND WORK ETHICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the industry needs, scope and major influences on industrial psychology
- acquire knowledge on organization structure and function
- understand and apply interpersonal relationship
- learn social responsibility and decision-making skills
- get in-depth knowledge on professional values and ethics

UNIT I INDUSTRIAL PSYCHOLOGY 9

Introduction to Industrial Psychology – Definitions andScope Major influences on industrial Psychology- Scientific management and human relations schools Hawthorne Experiments. Individual behavior – Group behavior – Group Dynamics – Leadership Styles – Industrial Fatigue.

UNIT II ORGANIZATIONAL STRUCTURE 9

Key organizational design process, Structural differentiations, Forces reshaping organizations.Functions of organizational culture, Organizational Socialization, Assessing Cultural Values and Fit, Cross Cultural issues.Lewin's Change Model.

UNIT III INTERPERSONAL RELATIONSHIP 9

Managing emotions – Emotional Intelligence – Building Better interpersonal Relations – Managing the Boss – Dealing with Subordinates – Case Study.Basic Theories of Motivation – Importance of Perception – Need for Shaping Perception.

UNIT IV SOCIAL RESPONSIBILITY AND ETHICS 9

Concept of Social Responsibility – Importance of Social Responsibility – Business Ethics.Decision making process, individual influences, group decision process.

UNIT V WORK ETHICS 9

Professional Values and Ethics – Need – Issues – Challenges – Ethical Leadership.Leadership vs Management, Leadership Theories, Emerging issues in Leadership.Value crisis in Contemporary Indian Society – Aesthetic Values, Moral and Ethical Values – Values in the Work place.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand the importance of industrial psychological problems and issues
- develop the organizational structures and assessing cultural values
- learning to use interpersonal skills to minimize wastage of human power
- optimize the integration of social responsibility and ethics so as to improve the work rate and accuracy
- reveal the value of work ethics and leadership qualities

TEXT BOOKS

1. Vikram Bisen and Priya, "Industrial Psychology", New Age International (P) Ltd., Publishers, 2010.
2. Murthy C.S.V., "Business Ethics", Himalaya Publishing House, 2007.

REFERENCES

1. Luthans, Fred, Organizational Behavior, McGraw Hill, 2008.
2. Tripathi. A. N., "Human Values", New Age International Pvt. Ltd., New Delhi, 2002.
3. Maynard, H., "Industrial Engineering Hand Book", McGraw Hill Book Co., New York, l999.
4. Ronald E. Riggio, "Introduction to Industrial and Organizational Psychology", Pearson Education, Inc.New York, 2008.
5. Joel Lefkowitz, "Ethics and Values in Industrial-Organizational Psychology, Taylor and Francis", e-library, 2009.

WEB LINKS

1. http://www.ergonomics.org.uk/learning/what-ergonomics/
2. http:// www.iea.cc/whats/
3. https://books.google.co.in/books?isbn=1111839972

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

ME15701 **MECHATRONICS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the structural and functional principles of sensors and transducers used for various physical and nonelectric quantities and how to use them to measure these quantities.
- describe the constructional and functional aspects of mechanical actuators and stepper and servo motors
- get a precise idea about the system structural models and working of controllers
- learn structure and processing of PLC
- gain knowledge about the elements and techniques involved in Mechatronic systems which are very much essential to understand the emerging field of automation.

UNIT I MECHATRONICS, SENSORS AND TRANSDUCERS 9

Introduction to Mechatronics Systems – Measurement Systems – Control Systems. Sensors and Transducers - Performance Terminology – Potentiometer displacement sensor - Inductive displacement sensor - Hall effect sensor- Photoelectric sensor - Eddy current Proximity sensor. Tacho - generator-Strain gauge load cell, Orifice meter, Differential pressure liquid level detector, Resistant temperature detector, Photodiode and Photo transistor light sensors. Selection of Sensors.

UNIT II ACTUATION SYSTEMS 9

Pneumatic and Hydraulic Systems – Rotary Actuators. Mechanical Actuation Systems - Cams- Ratchet and pawl- Belt and Chain Drives. Stepper Motors - switching circuitries for stepper motor – AC & DC Servo motors. Mechanical Switches-Solid State Switches-Diode-SCR-TRIAC.

UNIT III SYSTEM MODELS AND CONTROLLERS 9

Building blocks of Mechanical, Fluid and Thermal Systems, Rotational – Electromechanical Systems- Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode – Two – Step mode - Proportional Mode – Derivative Mode – Integral Mode – PID Controllers- Digital Controllers – Velocity Control – Adaptive Control - Architecture of 8085 and 8051.

UNIT IV PROGRAMMING LOGIC CONTROLLERS 9

Programmable Logic Controllers – Basic Structure – Input / Output Processing –Programming – Mnemonics – Internal relays and counters – Shift Registers –Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC.

UNIT V DESIGN OF MECHATRONICS SYSTEM 9

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design – Possible Design Solutions. Case studies of Mechatronics systems- Pick and place Robot- Wireless surveillance balloon - Engine Management system- Automatic car park barrier.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- design components and systems to integrate computers, sensors and transducers in mechanical system to meet desired needs.
- have a strong foundation in actuators and fundamental operations of stepper and servo motors in the field of engineering and technology.
- design experiments to evaluate system performance with respect to specifications.
- integrate PLC with Mechanical, Electronic and computer engineering components in the design of mechatronics system.
- develop mechatronics systems for various engineering applications.

TEXT BOOKS

1. Bolton,W, "Mechatronics" , Pearson education, Sixth edition, 2015
2. Smaili.A and Mrad.F, "Mechatronics integrated technologies for intelligent machines", Oxford University Press, 2008.

REFERENCES

1. Rajput. R.K, "A Textbook of Mechatronics", S. Chand & Co, Fourth edition, 2014
2. Michael B. Histand and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, Third Edition, 2006.
3. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall,1993.
4. Dan Necsulesu, "Mechatronics", Pearson Education Asia, 2002 (Indian Reprint).
5. Devadas Shetty and Richard A.Kolk, "Mechatronics systems design", PWS Publishing company, 2007.

WEB LINKS

1. http://nptel.ac.in/downloads/112103174/
2. https://www.youtube.com/watch?v=qalDDp5V3ek
3. https://www.youtube.com/watch?v=PLYosK87D8E

CO-PO Mapping

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

ME15702 COMPUTER INTEGRATED MANUFACTURING SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the integration concept of CAD/CAM, Production planning and control under CIM.
- familiarize the principles of computer aided process planning, Inventory control, MRP and ERP.
- gain knowledge on the design of a manufacturing cell and the elements of cellular manufacturing system.
- learn about the components of Flexible Manufacturing System and AGVs.
- understand the basic concepts of robots, robot anatomy and its industrial applications.

UNIT I INTRODUCTION 10

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerized elements of CIM system –Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance – Manufacturing Control – 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).

UNIT III CELLULAR MANUFACTURING 9

Group Technologies(GT), Part families - Parts Classification and coding - 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 I V 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 - 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.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- describe the importance and scope of CIM in fabrication/ manufacturing industries.
- prepare CAPP (Computer Aided Process Planning) for manufacturing processes.
- demonstrate implementation of cellular manufacturing system in industries.
- explain about FMS, AGVs and its applications.
- develop robots and its components for different applications.

TEXT BOOKS

1. Mikell.P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2016.
2. Radhakrishnan P, Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P)Ltd, New Delhi, 2008.

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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", Londo
3. Rao. P. N Tewari & T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.
4. James A. Rehg, "Introduction to Robotics in CIM Systems", Prentice Hall, 5th edition, 2002.
5. Singh. N, "Systems Approach to Computer-Integrated Design and Manufacturing", Wiley India Pvt Ltd., 2011.

WEB LINKS

1. http://www.me.nchu.edu.tw/lab/CIM/www/courses/Computer%20Integrated%20Manufacturing/Chapter2%20-CIM-introduction.pdf.
2. https://www.slideshare.net/suraj_21/computer-integrated-manufacturing.
3. ieeexplore.ieee.org/document/718241.

CO-PO Mapping

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

ME15703 AUTOMOBILE ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the construction and working principles of various parts of an automobile
- have clear understanding of different auxiliary systems.
- gain knowledge about different types of transmission systems
- learn the concepts and working principles of steering, brakes and suspension systems
- acquire knowledge on alternate energy sources in automobiles.

UNIT I VEHICLE STRUCTURE AND ENGINES 10

Types of Automobiles, Vehicle Construction and different layouts, Chassis, Frame and Body, Vehicle Aerodynamics (various resistances and moments involved), IC engines – components - functions and materials, variable valve timing (VVT)

UNIT II ENGINE AUXILIARY SYSTEMS 10

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and CRDI system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine Emission control by 3- Way catalytic convertor system, Emission norms (Euro and BS).

UNIT III TRANSMISSION SYSTEMS 10

Clutch – Types and Construction, Gear Boxes - Manual and Automatic, Gear Shift Mechanisms – Over Drive, Transfer Box, Fluid flywheel, Torque converter, Propeller shaft, Slip Joints, universal joints, Differential and Rear Axle, Hotchkiss Drive and Torque Tube Drive.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS 8

Steering Geometry and Types of steering gear box – Power Steering, Types of Front Axle, Types of Suspension systems, pneumatic and hydraulic braking systems, Antilock braking system (ABS), Electronic brake force distribution (EBD) and traction control.

UNIT V ALTERNATIVE ENERGY SOURCES 7

Use of Natural Gas, Liquefied petroleum gas (LPG), Bio-diesel, Bio-ethanol, Gasohol and hydrogen in Automobiles – Engine modification required – performance, Combustion and Emission characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid vehicles, Fuel Cell.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- demonstrate knowledge on vehicle construction and IC Engine components

- describe the principle and working of CRDI, MPFI, electronic fuel injection system, ignition system and 3-way catalytic converter system.
- differentiate between clutch, gear box, rear axle drives, fluid flywheel, and torque converter.
- demonstrate knowledge on parts like the wheels, tyres, steering gear box, suspension system-telescopic, and leaf spring.
- appraise the recent trends in automobile like alternate fuels in automobiles.

TEXT BOOKS

1. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 2014.
2. Jain K.K. and Asthana.R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2014.

REFERENCES

1. Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers, 2007.
2. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 2004.
3. Martin W, Stockel and Martin T Stockle, "Automotive Mechanics Fundamentals," The Good heart –Will Cox Company Inc, USA,2008.
4. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
5. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.

WEB LINKS

1. nptel.ac.in/syllabus/125106002/
2. bookdha.com/ME6602%20Automobile%20Engineering.html
3. www.uptu.ac.in/academics/automobilesyllabus.pdf.

CO-PO Mapping

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

ME15704 **MECHATRONICS LABORATORY** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- acquire practical knowledge on working principles of hydraulic, electro pneumatic kit with Programmable Logic Controller (PLC)
- learn interfacing of servo controller for open and closed loop circuits
- know interfacing of Proportional, Integral and Derivative (PID) controller and stepper motor
- provide practical hands on experience with Assembly Language Programming using 8085 microprocessor

LIST OF EXPERIMENTS

1. Design of basic pneumatic circuits using Electro pneumatic trainer kits.
2. Simulation of Hydraulic and Pneumatic circuits using simulation software
3. Simulation of Electro Pneumatic and electro hydraulic circuits using simulation software
4. Circuits with multiple cylinder sequences in Electro pneumatic using PLC
5. Servo controller interfacing for open loop
6. Servo controller interfacing for closed loop
7. PID controller interfacing
8. Stepper motor interfacing with 8051 Micro controller(i) Full step resolution (ii) Half step resolution
9. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division
10. Speed control circuit using basic hydraulic kit

TOTAL PERIODS 30

COURSE OUTCOMES

Upon completion of the course, students will be able to

- simulate Hydraulic, Pneumatic and Electric circuits using software tool
- conduct experiments using servo controller
- apply speed control of stepper motor using PID
- understand and apply the fundamentals of assembly level programming of microprocessors and microcontroller

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

ME15705 COMPUTER AIDED MANUFACTURING LABORATORY 0 0 2 1

COURSE OBJECTIVES

To enable the students to

- understand the basic concepts of computer numerical control (CNC) machine tool and CNC Programming.
- learn the different types of CNC Machine - Basic working principle, Axis movements, G & M code development programing and test run of programmed part.
- get practical knowledge on different cycles like canned cycle drilling, peck drilling, boring
- demonstrate CL Data and Post process generation using CAM packages

The Lab has Production model CNC lathe and CNC milling machines with CAM simulation Software (Edge CAM)

Exercises

Manual Part Programming

Part Programming - CNC Turning Centre

a. Simple Facing
b. Straight Turning
c. Contouring
d. Facing Cycle
    (i) Box Facing
    (ii) Taper Facing
    (iii) Multiple Facing
e. Turning Cycle
    (i) Box turning
    (ii) Taper turning
    (iii) Multiple turning
f. Pattern Repeating
g. Grooving cycle
h. Thread Cutting.
    (i) External Box threading
    (ii) Multiple Threading cycle
i. End face Peck Drilling Cycle.
j. Boring cycle
k. Parting off

(i) Part Programming - CNC Machining Centre

a. Linear and circular interpolation
b. Contouring
    (i) Cutter diameter compensation
    (ii) subprogram
c. Mirroring
d. Drilling
e. Pocketing
f. Rotation

g. Scaling
h. Canned Cycle - Drilling
i. Canned Cycle -Peck drilling
j. Canned Cycle -Boring
k. Tapping cycle
l. CL Data and Post process generation using CAM packages.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- understand and use G and M codes and manual part programming.
- get exposure to modern control systems (Fanuc, Siemens etc).
- know the working principles and application of various CNC machines.
- apply CL Data and Post process generation using CAM packages

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

ME15706 **PROJECT WORK (PHASE I)** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- develop ability to identify problems to solve through project works.
- get exposure to literature review related to project problem and how to find the gap.
- get exposure to required design procedure, experimental setup, analysis package to solve the identified problem.
- Prepare project reports, practice to face viva- voce examination.

GUIDELINES

- The students are expected to get formed into a team of convenient groups of not more than 4 members for a project.
- Every project team shall have a guide who is the member of the faculty of the institution. Identification of student group and their faculty guide need to be completed within the first two Weaks from the day of the beginning of 7thsemester.
- The group has to identify and select the problem to be addressed as their project work; work through literature survey and finalize a comprehensive aim and scope of their work.
- 30% of the total work of the project work has to be completed by end of 7th semester.
- A mini project report (of the phase-I) to this effect has to be submitted by each student group.
- Three reviews and end semester review of the progress of the project work have to be conducted by a team of faculty (minimum 3 and a maximum of 5) along with their faculty guide as a member the review team.
- The same team of faculty will evaluate the project phase-I report. This evaluation will form 50% of the internal assessment mark. The remaining 50% of the internal assessment mark will be given at the end of the 8th semester, at the time of completing the full project work.

TOTAL PERIODS 60

COURSE OUTCOME

On Completion of the project work, students will be able to

- identify feasible problems to solve through project works
- Collect literature through research journals and identify the gap in selected area
- Devise the methodology to find solution through gathering complete knowledge on materials/design procedure/analysis and optimisation techniques/ availability of experimental setup/ company permission and other documentation procedures to execute the project
- Prepare project report as per format and confidently face viva voce with proper PPT for presentation

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

PROGRAMME ELECTIVE – III

ME15351 MAINTENANCE ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the principles of maintenance and planning activities required for maintenance.
- explore the fundamentals of maintenance policies and classification of maintenance.
- gain knowledge on condition monitoring.
- get in-depth knowledge of repair methods of machine elements and its maintenance.
- gain in-sight into repair methods for material handling equipment.

UNIT I PRINCIPLE AND PRACTICES OF MAINTENANCE PLANNING 10

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

UNIT II MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE 9

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

UNIT III CONDITION MONITORING 9

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

UNIT IV REPAIR METHODS FOR BASIC MACHINE ELEMENTS 9

Repair methods for beds, slideways, 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 PERIODS 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- have a comprehensive understanding of the basic principles of maintenance, planning principles of maintenance activity, importance of maintenance planning, factors availability of maintenance planning.
- have good grounding on different types of maintenance- comparison of merits of different types of maintenance and also gain knowledge on preventive maintenance, maintenance schedules and repair cycle.

- acquire knowledge on monitoring techniques, cost of condition monitoring, wear debris analysis.
- demonstrate knowledge on material condition and methods used to repair the elements, sequential fault location.
- discuss technically the elements of computer maintenance, job order systems, and methods of material handling equipment.

TEXT BOOKS

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

REFERENCES

1. White E.N., "Maintenance Planning", I Documentation, Gower Press, 2005.
2. Garg M.R., "Industrial Maintenance", S. Chand & Co., 2010.
3. Higgins L.R., "Maintenance Engineering Hand book", McGraw Hill, 5th Edition, 1988
4. Armstrong, "Condition Monitoring", BSIRSA, 1988
5. Davies, "Handbook of Condition Monitoring", Chapman &Hall, 1998.

WEB LINKS

1. http://accessengineeringlibrary.com/browse/maintenance-engineering-handbook-seventh-edition
2. https://www.youtube.com/watch?v=f58SW0Hwcf0
3. https://www.accessengineeringlibrary.com/browse/maintenance-engineering-handbook-eighth-edition

CO-PO Mapping

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

ME15352 NON DESTRUCTIVE EVALUATION TECHNIQUES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the basic concepts on non - destructive testing and its limitations**.**
- gain knowledge of NDT methods like liquid penetrant and magnetic particle testing
- know the basic principles of eddy current and thermography testing.
- understand the principles of ultrasonic testing.
- familiarize the concepts involved in radiography techniques.

UNIT I INTRODUCTION TO NON-DESTRUCTIVE TESTING 7

Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects as well as material characterization; Comparison of advantages and limitations of different NDT methods; Visual inspection.

UNIT II SURFACE NDT, LIQUID PENETRANT (PT), MAGNETIC PARTICLE TESTING (MT) 8

PT: Physical Principles – procedure - testing methods - Applications and limitations; MT: Magnetization, principles - methods - Equipment's - evaluation of results.

UNIT III THERMOGRAPHY AND EDDY CURRENT TESTING (ET) 10

Thermography – principles - contact and non-contact methods - Active and Passive Thermography - Application in flaw detection; ET: Principles - permeability and conductivity-Testing for defects- material characterization and Sorting.

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

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.

UNIT V RADIOGRAPHY (RT) 10

Principle - interaction of X-Ray with matter-imaging - film and film less techniques - Computed Radiography - Computed Tomography.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- describe knowledge on various NDT techniques to carry out inspections in accordance with the established procedures.
- evaluate concepts involved in the liquid penetrant and magnetic testing methods.
- demonstrate knowledge on thermography and eddy current testing and its behavior.
- employ the functions of transducer and principle of ultrasonic testing at appropriate places.
- illustrate knowledge on radiography techniques and its elements.

TEXT BOOKS

1. Prakash Ravi., "Nondestructive Testing Techniques", New Age International Publishers. 1st Rev Edition., 2017.
2. Paul E Mix, "Introduction to Non-destructive Testing: a training guide, Wiley", 2nd edition New Jersey

REFERENCES

1. Baldev Raj., B. Venkataraman., O. J.Varde., Nerulikar., "Practical Magnetic Particle Testing", Narosa Publishing House.,2007.
2. Charles., J. Hellier., "Handbook of Non-destructive evaluation", 2nd edition McGraw Hill., New York, 2013.
3. J. Prasad and C. G. K. Nair., "Non-Destructive Test and Evaluation of Materials", Tata McGraw-Hill Education, 2nd edition 2011.
4. B. Raj., T. Jayakumar and M. Thavasimuthu., "Practical Non-Destructive Testing", Alpha Science International Limited, 3rd edition, 2002.
5. B.P.C. Rao., "Practical Eddy Current Testing", Alpha Science International Limited, 2006.

WEB LINKS

1. https://engineering.purdue.edu/AAE/Academics/Courses/Descriptions/AAE552
2. http://www.monash.edu.au/pubs/2014handbooks/units/MEC4801.html
3. http://nptel.ac.in/courses/113106070

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

ME15353 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- study the functions of Jigs and Fixtures.
- gain proficiency in design and development of jigs.
- understand the principles, functions and design practices of Fixtures.
- gain the knowledge of press working terminologies and operations.
- become familiar with the design of dies for bending, forming and drawing operations.

(Use of approved design data book is permitted)

UNIT I PURPOSE TYPES AND FUNCTIONS OF JIGS AND FIXTURES 8

Tool design objectives - Production devices - Inspection devices - Materials used in Jigs and Fixtures -Types of jigs - Types of Fixtures - Mechanical actuation - pneumatic and hydraulic actuation - Analysis of clamping force – Tolerance anderror analysis.

UNIT II JIGS 9

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

UNIT III FIXTURES 9

General principles of boring, lathe, milling and broaching fixtures - grinding, planning and shaping fixtures, assembly, inspection and welding fixtures - Modular fixtures. Design and development of fixtures for given component**.**

UNIT IV PRESS WORKING TERMINOLOGIES AND ELEMENTS OF DIES AND STRIP LAY OUT 10

Press working terminology - Presses and press accessories - Computation of capacities and tonnage requirements. Elements of progressive combination and compound dies: Die block - die shoe. Bolster Plate - punch plate – punch holder - guide pins and bushes - strippers - knockouts - stops - pilots - Selection of standard die sets strip lay out – strip lay out calculations.

UNIT V DESIGN AND DEVELOPMENT OF DIES 9

Design and development of progressive and compound dies for blanking and piercing operations. Bending dies - Development of bending dies - forming and drawing dies - Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- describe the selection of jigs and fixtures and design suitable actuation for fixtures.

- become proficient in different types of jigs for various products.
- implement in practice the principles of design and development of fixtures for different components
- internalize press working terminologies and operations.
- design the dies for bending, forming and drawing operations.

TEXT BOOKS

1. Edward G Hoffman, "Jigs & Fixture Design", Thomson – Delmar Learning, Singapore 2004.
2. Donaldson. C, "Tool Design", Tata McGraw-Hill, 2003.

REFERENCES

1. Kempster, "Jigs & Fixtures Design", The English Language Book Society", 1978.
2. Joshi, P.H., "Jigs & Fixtures", Second Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi 2004.
3. Hiram E Grant, "Jigs and Fixture" Tata McGraw-Hill, New Delhi, 2003.
4. "Fundamentals of Tool Design", CEEE Edition, ASTME, 1983.
5. Design Data Handbook PSG College of Technology, Coimbatore.

WEB LINKS

1. https://smartech.gatech.edu/bitstream/handle/1853/14178/bli.pdf
2. https://www.quora.com/in/What-is-the-difference-between-a-jig-and-a-fixture
3. http://nptel.ac.in/courses/112107144/Metal%20Forming%20&%20Powder%20metallurgy/lecture6/lecture6.htm

CO-PO Mapping

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

ME15354 MICRO ELECTRO MECHANICAL SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- gain knowledge on lithography techniques for Micro/Nano systems.
- understand different sensor packaging technologies.
- study the various types of techniques of mechanical transduction.
- familiarize with pressure sensors techniques and types.
- learn about various electronic devices of MEMS.

UNIT I INTRODUCTION 8

Introduction, Materials-substrates, Additive materials. Introduction to Micro fabrication - Silicon based MEMS processes – Fabrication techniques - Deposition, Lithography etching, Surface micro machining, Thick film screen-Printing and electroplating.

UNIT II MECHANICAL SENSOR PACKAGING 8

Introduction, Standard IC packages - ceramic, plastic and metal packages. Packaging process - Electrical Interconnects, Methods of die attachment, sealing techniques. MEMS mechanical sensor packaging.

UNIT III MECHANICAL TRANSDUCTION TECHNIQUES 9

Piezo resistivity, Piezoresistive sensor materials, Piezoelectricity, Capacitive Techniques, Optical techniques, Resonant techniques. Actuation techniques, Smart Sensors. MEMS Simulation and Design Tools - Behavioral modelling Simulation tools and Finite element simulation tools.

UNIT IV PRESSURE SENSORS 12

Introduction. Techniques for sensing. Physics of pressure sensing-Pressure sensor specifications. Dynamic Pressure sensing. Pressure sensor types. MEMS technology pressure sensors-Micro Machined Silicon diaphragms.

UNIT V FORCE, TORQUE AND INERTIAL SENSORS 8

Introduction - Silicon based devices - Optical devises - capacitive devices-Magnetic devices - Atomic force microscope and scanning probes - micro machined accelerometer - Micro Machined Gyroscope - Future inertial micro machined sensors

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- describe the fundamental working principles of micro fabrication techniques.
- get strong understanding of mechanical sensor packaging in MEMS.
- apply their knowledge about transduction techniques and MEMS simulation.

- become conversant with the working principles of sensing techniques.
- demonstrate knowledge on various electronic devices involved in MEMS.

TEXT BOOKS

1. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002
2. Nadim Maluf and Kirt Williams,' An introduction to Micro electro mechanical System Engineering, Artech House, Inc. Boston 1991

REFERENCES

1. Stephen Beeby, Graham Ensell, Michael Kraft and Neil White,' MEMS Mechanical sensors' Artech House, Inc. Boston 2003
2. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, "Micro Sensors MEMS and Smart Devices", JohnWiley & Son LTD,2002
3. James J.Allen, "Micro Electro Mechanical System Design", CRC Press Publisher, 2010
4. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer 2012
5. Chang Liu, "Foundations of MEMS", Pearson Education Inc., 2006

WEB LINKS

1. https://ocw.mit.edu
2. http://nptel.ac.in/courses/117105082/
3. https://lecturenotes.in/subject/134/micro-electro-mechanical-systems-mems

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

ME15355 INTRODUCTION TO AIRCRAFT SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn the basic concepts and principles of hydraulic and pneumatic systems of aircrafts.
- study the control systems of an aircraft.
- acquire knowledge on aircraft engine systems.
- understand the working principles of air-conditioning and pressurizing system of aircrafts.
- familiarize with various instruments used in aircraft.

UNIT I AIRCRAFT SYSTEMS 9

Hydraulic systems - Study of typical workable system - components - Hydraulic system controllers – Modes of operation - Pneumatic systems - Advantages - Working principles - Typical Air pressure system – Brake system - Typical Pneumatic power system - Components, Landing Gear systems - Classification – Shock absorbers - Retractive mechanism

UNIT II AIRPLANE CONTROL SYSTEMS 9

Conventional Systems - Power assisted and fully powered flight controls - Power actuated systems –Engine control systems - Push pull rod system, flexible push full rod system - Components - Modern control systems - Digital fly by wire systems - Auto pilot system active control Technology, Communication and Navigation systems Instrument Landing systems, VOR - CCV case studies.

UNIT III ENGINE SYSTEMS 9

Fuel systems - For Piston and jet engines - Components of multi engines, lubricating systems for piston and Jet Engines - Starting and Ignition systems - Typical examples for piston and Jet engines.

UNIT IV AIR-CONDITIONING AND PRESSURIZING SYSTEM 9

Basic Air cycle systems - Vapour Cycle systems, Boost-Strap air cycle system - Evaporative vapour cycle systems- Evaporative air cycle systems - Oxygen systems - Fire protection systems, Deicing and anti-icing systems

UNIT V AIRCRAFT INSTRUMENTS 9

Flight Instruments and Navigation Instruments - Accelerometers, Air speed Indicators - Mach Meters -Altimeters- Principles and operation - Study of various types of engine instruments - Tachometers – Temperature gauges - Pressure gauges - Operation and Principles

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- apply principles of hydraulic and pneumatic systems used in aircraft.
- be conversant with the control systems of aircrafts.
- have in-depth knowledge about engines and its components used in aircrafts.

- distinguish between the principle of operation of air-conditioning and pressurizing system used for aircraft systems.
- have greater understanding of different types of aircraft instruments, their operations and control.

TEXT BOOKS

1. Michael J. Kroes, Thomas W. Wild, Aircraft Power plants, Seventh Edition, Tata McGraw Hill education pvt Ltd, New Delhi, 2010
2. "General Hand Books of Airframe and Power Plant Mechanics ", U.S. Dept. of Transportation, Federal Aviation Administration, The English Book Store, New Delhi, 2005.

REFERENCES

1. Mekinley, J.L. and Bent, R.D., "Aircraft Power Plants ", McGraw Hill, 2010.
2. Pallet, E.H.J., "Aircraft Instruments & Principles ", Pitman & Co., 2003.
3. Treager, S., "Aircraft Gas Turbine Engine Technology ", McGraw Hill, 2010.
4. McKinley, J.L., and Bent, R.D., "Aircraft Maintenance & Repair ", McGraw Hill, 2013.
5. Aircraft Maintenance and Repair, Seventh Edition by Michael J Kroes, 2013.

WEB LINKS

1. http://ocw.mit.edu/courses/aeronautics-and-astronautics/16-885j-aircraft-systems-engineering-fall-2004/lecture-notes/
2. http://nptel.ac.in/courses/101108056/module7/lecture13.pdf
3. http://www.srmuniv.ac.in/downloads/Aircraft_ctrl_Systems.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	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

PROGRAMME ELECTIVE - IV

ME15451 PLANT LAYOUT AND MATERIAL HANDLING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- study the basics of plant layout, physical facilities and the requirements.
- understand and apply the techniques needed to plan, analyze and design new or modify existing production/service facilities.
- familiarize with material handling principles and storage systems.
- gain knowledge on packaging techniques and the significance of packaging and ergonomics.
- learn to analyze the material handling and surveying techniques.

UNIT I INTRODUCTION 9

Plant location - factors to be considered - influence of location on plant layout - selection of plant site. Comparative study of rural and urban sites. Consideration in facilities planning and layout. Equipment required for plant Operation. Capacity, serviceability and flexibility and analysis in selection of equipment space, requirements, man power requirements. Selection site - Case study.

UNIT II PLANT LAYOUT 9

Plant layout - need for layout, types of layout, factors influencing product- process, fixed and combination layout- Comparison of layouts: tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models - machine data. Layout planning procedure. Visualization of layout revision and improving existing layout, assembly line balancing-Methods.

UNIT III MATERIAL HANDLING 9

Material handling - Importance and scope. Principles of material handling. Storage system performances. Planning operation and costing principles - types of material handling systems, factors influencing their choice. Design of AGVs.

UNIT IV PACKAGING 9

Industrial buildings and utilities - centralized electrical pneumatic water line systems. Types of building, lighting heating, air-conditioning and ventilation utilities. Planning and maintenance, waste handling statutory requirements. Packing and storage of materials - Importance of packaging layout for packaging - packaging machinery – Ergonomics.

UNIT V ANALYSIS 9

Analysis of material handling - Factors involved, motion analysis, flow analysis, graphic analysis, Network diagram. Number of AGVs determination, safety analysis, equipment cost analysis, analysis of operation material handling surveys.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- demonstrate knowledge on site selection criteria and equipment selection.
- gather thorough knowledge on all the types of plant layout and development.
- describe knowledgeably the principle and operations of material handling systems.
- gain strong grounding on the concepts of packaging.
- analyze the concepts involved in the material handling processes.

TEXT BOOKS

1. K.R Govindan "Plant layout and material handling" Anuradha.2010
2. James, M. Apple., 'Plant Layout and Material Handling', John Wiley & Sons, INC, 3rd Ed., 1977.

REFERENCES

1. James, M. Moore, 'Plant Layout and Design', Macmillan Company, NY, 1963
2. Muther, R., 'Practical Plant Layout', Mc Graw Hill Book Company, NY, 1955
3. Norman Gaither, G. Frazier, "Operations management" Thomson learning 9th edition, 2007
4. Martand Telsang, "Industrial Engineering and Production Management", S. Chand and Company, 2000
5. Kanishka Bedi, "Production and Operations management", Oxford university press, 2nd Edition 2007.

WEB LINKS

1. web.mst.edu/gosavia/EMGT256_13.docx
2. www.uom.ac.mu/faculties/foe/mped/students/notes/lecture7.pdf
3. www.smatzworld.com/PLMHnotes.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	2	2	2	2	2	2	-	-	-	-	-	2	2	2
CO2	2	2	2	2	2	-	-	-	-	-	-	2	2	2
CO3	2	2	2	2	2	-	-	-	-	-	-	2	2	2
CO4	2	3	2	3	2	-	-	-	-	-	-	2	2	2
CO5	2	3	2	3	2	-	-	-	-	-	-	2	2	2

ME15452 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of productivity improvement techniques.
- learn the systems used for productivity measurement and evaluation process.
- know about how the planning and implementation of innovative concepts are carried out.
- familiarize modern practices in Re-engineering process
- acquire ideas of new tools like process improvement models along with BPR and IT

UNIT I INTRODUCTION 3

Basic concept and meaning of Productivity – Significance of Productivity – Factors affecting Productivity - Productivity cycle, Scope of Productivity, Engineering and Management.

UNIT II PRODUCTIVITY MEASUREMENT AND EVALUATION 9

Productivity measurement in International, National and Industrial level – Total Productivity Model –Productivity measurement in Manufacturing and Service sectors – Performance Objective Productivity(PO) model – Need for Productivity Evaluation – Evaluation Methodology.

UNIT III PRODUCTIVITY PLANNING AND IMPLEMENTATION 9

Need for Productivity Planning – Short term and long term productivity planning – Productivity Material improvement approaches, Principles - Productivity Improvement techniques – Technology based, Employee based, Product based techniques – Managerial aspects of Productivity Implementation. Schedule, Productivity audit and control.

UNIT IV RE-ENGINEERING PROCESS 15

Definition, Fundamentals of process reengineering – Principles, Methodology and guidelines for Organization Transformation, DSMCQ and PMP organization Transformation models – Process Improvement Models like PMI, Edosomwan, LMICIP and NPRDC Models.

UNIT V BPR TOOLS AND IMPLEMENTATION 9

Analytical and Process Tools and Techniques - Role of Information and Communication Technology in BPR – Requirements and steps in BPR Implementation – Case studies.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- internalize concepts of productivity management.
- describe the differences among small, medium and large measurements of productivity and evaluation process.
- aggregate the salient characteristics of productivity measurement models.

- design new concepts on Business Process and Re-engineering.
- develop ability to improve productivity with new tools using latest techniques like IT.

TEXT BOOKS

1. Gopalakrishnan, P. and Banerji, A.K., "Maintenance and Spare Parts, Management", Prentice – Hall of India Pvt. Ltd., 2002.
2. Seiichi Nakajima, "Introduction to TPM", Productivity Press, Chennai, 2004.

REFERENCES

1. Sumanth, D.J."Productivity Engineering and Management", TMH, New Delhi, 2000.
2. Edosomwan, J.A. "Organizational Transformation and Process re- Engineering", British Cataloging in publications, 2006.
3. Premvrat, Sardana, G.D. and Sahay, B.S. "Productivity Management - A systems approach", Narosa Publications, New Delhi, 2002.
4. Prokopenko. J, "Productivity Management, A Practical Handbook", International Labour Organisation, 2000
5. Phusavat. K, Fankham-ai K, Haapasalo. H, & Lin. B, "Productivity Management in an Organization", 2011

WEB LINKS

1. https://onlinecourses.nptel.ac.in/noc18_mg03/preview
2. http://nptel.ac.in/courses/112107143/6
3. www.itil-officialsite.com/home/home.asp

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

ME15453 **TOOL DESIGN** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- study various types of cutting tools.
- understand the functions and design principles of cutting tools.
- gain proficiency in the development of die design for different types of dies.
- understand the functions and design principles of Jigs, fixtures.
- gain the knowledge on numerically controlled machine tools.

UNIT I TOOLING MATERIALS **9**

Broad Classification of Tools - Cutting tools, Dies, Holding and Measuring tools Introduction – Properties of Materials – Ferrous Tooling Materials – Tool steels – Cast Iron – Mild, or low-carbon Steel – Non-metallic Tooling Materials – Nonferrous Tooling Materials – Metal cutting Tools – Single-point cutting tools – Milling cutters – Drillsand Drilling– Reamer classification – Taps – Tap classification- the selection of carbide cutting tools – Determining the insert thickness for carbide tools.

UNIT II DESIGN OF CUTTING TOOLS **9**

Single Point and multi-pint cutting tools. Classification, Nomenclature, geometry, design of single point tools for lathes, shapers, planers etc. Chip breakers and their design. **Tools**: Classification and Specification, nomenclature, Design of drills, milling cutters, broaches, taps etc.

Design of Form Tools: Flat and circular form tools, their design and application.

UNIT III DESIGN OF DIES **9**

Classification of dies, Design of Dies for Bulk metal Deformation-Wire Drawing, Extrusion, Forging and Rolling; Design of Dies for Sheet metal: Blanking and Piercing, Bending and Deep-drawing; Design of Dies used for Casting and Molding, microstructure injection molding for MEMs, multi-color injection molding, Powder Metallurgy die design.

UNIT IV DESIGN OF JIGS AND FIXTURES **9**

Classification of Jigs and Fixtures, Fundamental Principles of design of Jigs and Fixtures, Location and Clamping in Jigs and fixtures, Simple design for drilling Jigs, Milling fixtures etc. Indexing Jigs and fixtures. Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

UNIT V TOOL DESIGN FOR NUMERICALLY CONTROLLED MACHINE TOOLS **9**

Introduction – The need for numerical control – A basic explanation of numeric control – Numerical control systems in use today – Fixture design for numerically controlled machine tools – Cutting tools for numerical control – Tool holding methods for numerical control – Automatic tool changers and tool positioners – Tool pre-setting – Introduction – General explanation of the Brown and sharp machine – tooling for Automatic screw machines.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- describe knowledge on tools used for different processes, materials used for tool-making and their specific advantages
- gain good grounding on single-point, multi-point cutting tools and design of form-tools along with specifications, nomenclature and designing aspects
- have knowledge for designing of dies for various processes like wire-drawing, forging, rolling, sheet metal, blanking, piercing, casting, moulding and powder metallurgy
- possess knowledge to design Jigs and Fixtures for various processes like drilling, milling and indexing
- demonstrate knowledge for tool design for Numerically controlled machine tools involving tool holding, tool changing and tool setting methods

TEXT BOOKS

1. Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000.
2. Pollack, H.W. Tool Design, Reston Publishing Company, Inc. 1966

REFERENCES

1. Donaldson. C, "Tool Design", Tata McGraw-Hill, 1986
2. "Fundamentals of Tool Design", CEEE Edition, ASTME, 1983.
3. Kempster, M.H.A. "Principles of Jig and Tool Design", English University Press Ltd
4. Prakash Hiralal Joshi, "Tooling data", Wheeler Publishing, 2000
5. Nicholas Lisitsyn, "Machine Tool Design", 2000

WEB LINKS

1. http://nptel.ac.in/courses/112106137/
2. https://lecturenotes.in/subject/251/metal-cutting-and-tool-design-mctd
3. https://www.docsity.com/en/lecture-notes/engineering/principles-of-machine-tool-design/

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

ME15454 **WELDING TECHNOLOGY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand welding techniques and principles of gas and arc welding
- learn the concepts of resistance welding and various resistance welding processes.
- gain knowledge of solid state welding process for engineering applications
- acquire knowledge on special welding processes.
- understand the standards and codes for design and testing of weldments.

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 Electro slag welding processes – safety aspects in welding – advantages, limitations and applications.

UNIT II RESISTANCE WELDING PROCESSES 9

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussionwelding 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 – brief introduction to welding codes & standards (ASME / ASTM / AWS)

TOTAL PERIODS 45

COURSE OUTCOMES

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

- gain knowledge on gas and arc welding processes
- describe knowledge on resistance welding processes
- identify solid state welding processes and their correct usage.
- demonstrate sound theoretical knowledge on various welding processes.
- design weldments with proper welding codes and standards

TEXT BOOKS

1. Parmer R.S., "Welding Engineering and Technology", 1st edition, Khanna Publishers, New Delhi, 2008.
2. Little R.L., "Welding and welding Technology", Tata McGraw Hill Publishing Co., Ltd., New Delhi, 34th reprint, 2008.

REFERENCES

1. K.S.Yadav. "Advanced Welding Technology", Standard Book Huse Publishers, 2017
2. Martin Thaddeus. "Welding: A Practical guide to joining metal", The Crowood Press Ltd, 2010.
3. AWS- Welding Hand Book. "Welding Process" 8th Edition. Vol- 2.
4. Nadkarni S.V. "Modern Arc Welding Technology", 1st edition, Oxford IBH Publishers, 2005.
5. O.P.Khanna, "Welding Technology", Dhanpat Rai and sons,2008

WEB LINKS

1. http://nptel.ac.in/courses/112107089/
2. https://ocw.mit.edu/courses/materials-science-and-engineering/3-37-welding-and-joining-processes-fall-2002/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-Weak**													
	Programme Outcomes(POs)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	-	1	-	-	-	-	-	-	-	-	2	2	2
CO2	2	-	1	-	-	-	-	-	-	-	-	2	2	2
CO3	2	-	1	-	-	-	-	-	-	-	-	2	2	2
CO4	2	-	1	-	-	-	-	-	-	-	-	2	2	2
CO5	2	-	1	-	-	-	-	-	-	-	-	2	2	2

ME15455 QUALITY CONTROL AND RELIABILITY ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the concepts of quality assurance, quality control, SQC, six sigma and control charts usage.
- study the basic use of p and np charts, C and U charts in quality control and to analyze and understand process variables.
- learn the process of lot sampling and probability of acceptance techniques and sampling plans with AQL, LTPD, AOQL concepts.
- acquaint with the concepts of life testing and reliability test.
- understand reliability improvements and its techniques and product analysis.

UNIT I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES 10

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

UNIT II PROCESS CONTROL FOR ATTRIBUTES 8

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

UNIT III ACCEPTANCE SAMPLING 9

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

UNIT IV LIFE TESTING 9

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

UNIT V QUALITY AND RELIABLITY 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply the concept of SQC in process control for reliable component production.
- analyze p chart, np chart, and other control chart attributes
- have thorough understanding of standing sampling techniques like AWL, LTPD, AOQL concepts and knowledge to apply them
- get good grounding on reliability, failure rate, hazard rate, maintainability, availability and reliability testing.
- employ optimization in reliability, product design and product life cycle analysis.

TEXT BOOKS

1. Douglas. C. Montgomery, "Introduction to Statistical quality control", 4th edition, John Wiley 2001.
2. Srinath. L.S., "Reliability Engineering", Affiliated East west press, 1991.

REFERENCES

1. John.S. Oakland. "Statistical process control", 5th edition, Elsevier, 2005.
2. Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993.
3. Grant, Eugene.L "Statistical Quality Control", McGraw-Hill, 1996.
4. Monohar Mahajan, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.
5. Gupta. R.C, "Statistical Quality control", Khanna Publishers, 1997.

WEB LINKS

1. http://en.wikipedia.org/wiki/Quality_control
2. https://en.wikipedia.org/wiki/Accelerated_life_testing
3. http://www.businessmanagementideas.com/production-2/control-charts-for-variables-and-attributes-quality-control/7044

CO-PO Mapping

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

BA15253 TOTAL QUALITY MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- describe the basic concepts in Quality Management, Customer orientation and retention.
- facilitate the understanding of Quality Management principles and process.
- discuss the techniques in Six Sigma, Bench marking and FMEA.
- understand the basic concepts in Quality Function Development and TPM.
- become familiar with Quality System, Quality Auditing and HR practices.

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, Benchmarking 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. Return on Investment - Personnel management. Recruitment, selection and training - Technology in Agri sectors.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of the course, students will be able to

- discuss the basic concepts in Quality Management, Customer orientation and retention.
- describe the principles and process of Quality Management.
- implement the quality control techniques in Six Sigma, Bench marking and FMEA..

- explain the basic concepts of Quality Function Development and TPM.
- understand the elements in Quality System, Quality Auditing and HR practices.

TEXT BOOKS

1. Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2006.
2. D.R Kiran, "Total quality Management", Butterworth-Heinemann, 2016.

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.
4. Dennis Aubuchon, "Understanding the Concept of Quality", Pronoun, 2017.
5. Donna C. S. Summers, "Quality", Pearson, 5th Edition, 2009.

WEB LINKS

1. www.inderscience.com/ijpqm
2. http://nptel.ac.in/courses/110105031/1

CO-PO Mapping

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

ME15801 **PROJECT WORK (PHASE II)** **0 0 12 6**

COURSE OBJECTIVES

To enable the students to

- get trained in preparing project reports and how to face reviews and viva voce examinations.
- develop ability to identify problems to solve through project works.
- acquire knowledge on literature review related to project problem and how to find the gap.
- gain exposure to required design procedure, experimental setup, analysis package to solve the identified problem.

GUIDELINES

1. The students are expected to get formed into a team of convenient groups of not more than 4 members on a project.
2. Two mid semester review and another end semester review for the progress of the project work have to be conducted by a team of faculty along with their faculty guide as a member the review team.
3. Progress of project work has to be monitored by the project guide and committee periodically.
4. Attendance for review is mandatory. If a student fails to attend review for some valid reasons, one more chance may be given.
5. The project report should be submitted by the students around the first Weak of April.

TOTAL PERIODS 180

COURSE OUTCOMES

On Completion of the project work, the students will be able to

- to take up any challenging practical problems and find solution by formulating proper
- collect literature through research journals and identify the gap in selected area
- devise the methodology to find solution through gathering complete knowledge on materials/design procedure/analysis and optimisation techniques/ availability of experimental setup/ company permission and other documentation procedures to execute the project.
- prepare project report as per format and confidently face viva voce with proper PPT for presentation

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

PROGRAMME ELECTIVE - V

ME15551 COMPUTATIONAL FLUID DYNAMICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- study the concept of finite difference method
- gain knowledge on conduction and convection heat transfer problems
- understand the incompressible fluid flow.
- understand the convective heat transfer
- integrate the concepts of different types of turbulence models

UNIT I GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD 10

Classification, Initial and Boundary conditions – Governing equations of fluid dynamics -Initial and Boundary Value problems – Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids Numerical Errors, Grid Independence Test.

UNIT II CONDUCTION HEAT TRANSFER 10

Steady one-dimensional conduction, Two and three-dimensional steady state problems, Transient One-Dimensional problem, Two-dimensional Transient Problems.

UNIT III INCOMPRESSIBLE FLUID FLOW 10

Governing Equations, Stream Function – Vorticity method, Determination of pressure for viscous flow, SIMPLE Procedure of Patankar and Spalding, Computation of Boundary layer flow, finite difference approach.

UNIT IV CONVECTION HEAT TRANSFER AND FEM 10

Steady One - Dimensional and Two-Dimensional Convection – diffusion, unsteady one – dimensional convection – diffusion, unsteady two- dimensional convection – Diffusion – Introduction to finite element method – solution of steady heat conduction by FEM – Incompressible flow – simulation by FEM.

UNIT V TURBULENCE MODELS 5

Algebraic Models – One equation model, K – ϵ Models, Standard and High and Low Reynolds number Models, Prediction of fluid flow and heat transfer using standard codes.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon completion of this course, students will be able to

- become conversant with the governing equations used in computational fluid mechanics.
- solve heat transfer problems
- demonstrate knowledge on incompressible fluid flow concepts
- solve problems of convection heat transfer using finite element methods.
- develop different types of turbulence models

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., 2012.

REFERENCES

1. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer", Narosa Publishing House, New Delhi, 2003.
2. Taylor, C and Hughes, J.B. "Finite Element Programming of the Navier-Stokes Equation", Pineridge Press Limited, U.K., 2001.
3. Anderson, D.A., Tannehill, J.I., and Pletcher, R.H., "Computational fluid Mechanics and Heat Transfer", Hemisphere Publishing Corporation, New York, USA, 2001.
4. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere Publishing Corporation, 2004.
5. Ghoshdasdidar, P.S, "Computer Simulation of flow and heat transfer" Tata McGraw-Hill Publishing Company Ltd., 1998.

WEB LINKS

1. http://ocw.mit.edu/courses/mechanical-engineering/2-29-numerical-fluid-mechanics-fall 2011/lecture-notes/
2. www.engr.uky.edu/~acfd/me691-lctr-nts.pdf
3. www.nptel.ac.in/courses/112107080/

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

CO-PO Mapping

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

ME15552 **PRODUCTION PLANNING AND CONTROL** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the concepts of production planning, product development and design and break-even analysis
- become familiar with basic procedure, selection, work measurement involved in work study
- gain knowledge on value analysis, product planning, routing, batch production and balancing analysis of process capabilities of product planning and process planning.
- Learn methods of scheduling, material requirement planning, kanban, dispatching process and techniques for aligning completion time of Production scheduling
- study concepts like inventory control, bin system, ABC analysis, Just in Time system and other recent trends in production planning and control

UNIT I INTRODUCTION **9**

Objectives and benefits of planning and control - Functions of production control - steps in production planning and control - Types of production – job - batch and continuous - Product development and design - Marketing aspect - Functional aspect -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 - Steps - 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 PRODUCTION PLANNING AND CONTROL **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 PERIODS 45

COURSE OUTCOMES

Upon completion of this course, students will be able to

- internalize the concepts of production control, product development, break even analysis and economics of new design.
- thoroughly understand production components like selection, recording procedure, work measurement, time study and predetermined motion time standards.
- demonstrate knowledge on product planning, value analysis, planning and routing, batch production and balancing, analysis of multi product system
- be conversant with production control, scheduling, product sequencing, material requirement planning, kanban, dispatching and manufacturing lead time and techniques of scheduling
- implement techniques of inventory control, ordering procedure, two bin system, ABC analysis and elements of Just in Time systems.

TEXT BOOKS

1. Martand Telsang, "Industrial Engineering and Production Management", S. Chand and Company, First edition, 2000.
2. James.B.Dilworth, "Operations management – Design, Planning and Control for manufacturing and services" Mcgraw Hill International edition 2005

REFERENCES

1. Samson Eilon, "Elements of production planning and control", Universal Book Corpn.2001.
2. Elwood S.Buffa, and Rakesh K. Sarin, "Modern Production / Operations Management", 8th Ed. John Wiley and Sons, 2000.
3. Kanishka Bedi, "Production and Operations management", Oxford university press, 2nd Edition 2007.
4. Norman Gaither, G. Frazier, "operations management" Thomson learning 9th edition, 2007.
5. Jain. K.C & L.N. Aggarwal, "Production Planning Control and Industrial Management", Khanna Publishers, 2002.

WEB LINKS

1. http://mech.at.ua/PPC-NOTES.pdf
2. http://nptel.ac.in/courses/112107143/1
3. https://www.youtube.com/watch?v=yYIVumq6sVM

CO-PO Mapping

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

ME15553 **REFRIGERATION AND AIR CONDITIONING** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- get familiar with the basic principles and concepts of refrigeration applied in the engineering practice.
- understand the fundamentals of refrigeration system components, properties of refrigerants and applications of refrigeration systems.
- learn about Psychrometric processes and its properties.
- gain knowledge on different air conditioning systems.
- study the cooling load calculations in various systems.

UNIT I REFRIGERATION CYCLE **9**

Review of thermodynamic principles of refrigeration. Air cycle refrigeration system. Vapour compression refrigeration cycle - use of P-H charts - multistage and multiple evaporator systems - cascade system - COP comparison. Vapor absorption refrigeration system. Ammonia water and Lithium - Bromide water systems. Steam jet refrigeration system.

UNIT II REFRIGERATION SYSTEM COMPONENTS AND REFRIGERANTS **9**

Compressors: Types – based on operation and based on arrangement. Condensers: Types-air cooled, water cooled and evaporative condensers. Evaporators: Flooded and dry expansion types. Expansion devices: Capillary tube, Automatic expansion valve, Thermostatic expansion valve. Refrigerants: Properties and Selection. Eco friendly refrigerants: Ozone Depletion Potential (ODP) and Global Warming Potential (GWP).

UNIT III PSYCHROMETRIC PROCESSES **9**

Review of fundamental properties of psychrometry, Psychrometric chart, Psychrometry properties calculation, Psychrometric processes, Bypass factor, Apparatus Dew Point (ADP) temperature, numerical problems.

UNIT IV AIR CONDITIONING SYSTEMS **9**

Air conditioning – definition, standards of temperature, humidity and air motion, components of air conditioning system. Summer, winter and year-round air conditioners, Window, Split air conditioners, Central air conditioner systems. Air distribution system. Thermal insulation of air conditioning systems- applications

UNIT V COOLING LOAD CALCULATIONS **9**

Types of load - design of space cooling load - heat transmission through building. Solar radiation -infiltration - internal heat sources (sensible and latent) - outside air and fresh air load - estimation of total load - Domestic, commercial and industrial systems - central air conditioning systems.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- use with understanding the basic concepts and terms involved in refrigeration and Air-Conditioning systems like refrigerants, refrigeration cycle, compressor, COP etc.
- describe knowledge on different types of compressors and different types of refrigerants
- demonstrate thorough understanding of Psychrometric chart and its usage
- be conversant with Air-conditioning systems for car, stores and public buildings
- learn Cooling load calculations for different types of Air-Conditioning requirements like domestic, commercial and industrial systems

TEXT BOOKS

1. R.K.Rajput, "Refrigeration and Air-Conditioning" , S.K. Kataria & Sons, 3rd Edition:2015
2. R.S. Khurmi ,"Refrigeration and Air-conditioning" S.Chand, Dec 2006

REFERENCES

1. Manohar Prasad, "Refrigeration and Air Conditioning", Wiley Eastern Ltd., 2010.
2. Domkundwar, Arrora and Domkundwar, "Refrigeration and Air Conditioning", Dhanpat Rai and co,2009
3. Ramesh Arora," Refrigeration and Air-conditioning", Prentice Hall of India, 2010.
4. Arora. C.P., "Refrigeration and Air Conditioning", Tata McGraw-Hill New Delhi, 2008.
5. W.F.Stocker and J.W.Jones, "Refrigeration and Air Conditioning", McGraw-Hill, 2009.

WEB LINKS

1. nptel.ac.in/courses/112105128/
2. nptel.ac.in/courses/112105129/35
3. nptel.ac.in/courses/112105129/pdf/R&AC%20Lecture%2027.pdf

CO-PO Mapping

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

ME15554 **INDUSTRIAL TRIBOLOGY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- acquire knowledge on various terminology involved in Tribology
- become familiar with the basic principles of Wear Mechanism
- learn about various properties and types of lubricants
- study the fundamental concepts of film lubrication theory
- familiarize with the concept of surface engineering and bearing materials

UNIT I SURFACES AND FRICTION **9**

Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction – Adhesion – Ploughing - Energy dissipation mechanisms Friction Characteristics of metals - Friction of non-metals. Friction of lamellar solids - friction of Ceramic materials and polymers - Rolling Friction - Source of Rolling Friction – Stick slip motion - Measurement of Friction.

UNIT II WEAR **9**

Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals – Abrasive wear – Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture - wear - Wear of Ceramics and Polymers - Wear Measurements.

UNIT III LUBRICANTS AND LUBRICATION TYPES **9**

Types and properties of Lubricants - Testing methods – Concepts of Hydrodynamic, Hydrostatic, Elasto - hydrodynamic, and Boundary Lubrication. Thin film and thick film lubrication – Methods of lubrication – Semi solid and Solid Lubrication.

UNIT IV FILM LUBRICATION THEORY **9**

Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation Reynolds Equation for film Lubrication - High speed unloaded journal bearings – Loaded journal bearings – Reaction torque on the bearings - Virtual Co-efficient of friction – The Sommerfeld diagram.

UNIT V SURFACE ENGINEERING AND MATERIALS FOR BEARINGS **9**

Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes – Surface coatings - Plating and anodizing - Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand the significance of tribology and how it affects the life of machine components

- identify different types of wear, wear behavior of different types of materials and perform wear measurements
- select suitable lubricants, know their properties and different methods of lubrication.
- describe technically film lubrication theory, bearings and the governing equations of lubrication
- use modification techniques to resist wear and design components with good tribological properties.

TEXT BOOKS

1. Basu S.K. et. Al., "Fundamentals of Tribology" PHI Learning Private Limited, 2009.
2. Sushil Kumar Srivatsava, "Tribology in Industry", S. Chand &Co,2010

REFERENCES

1. M.M. Khonsari & E.R.Booser, " Applied Tribology", John Willey & Sons, New York,2001
2. E.P. Bowden and Tabor D., " Friction and Lubrication ", Heinemann Educational Books Ltd., 1974.
3. A. Cameron, "Basic Lubrication theory ", Longman, U.K.., 1981.
4. M.J.Neale (Editor), "Tribology Handbook ", Newnes. Butter worth, Heinemann, U.K., 1995.
5. Applied Tribology: Bearing Design and Lubrication (Tribology in Practice Series)" by Michael M Khonsari and E Richard Booser

WEB LINKS

1. nptel.ac.in/courses/112102015/
2. www.stle.org.
3. https://ocw.mit.edu/courses/mechanical-engineering/2-800-tribology-fall-2004/lecture-notes/

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	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

ME15555 **VIBRATION AND NOISE CONTROL** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- become conversant with the fundamentals of vibration.
- develop analytical competency in solving vibration problems.
- understand the various techniques of measurement and control of vibration
- get familiar with the concepts of basic noise terms.
- acquire good grounding on industrial acoustics and control measures of noise

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 VIBRATION OF CONTINUOUS SYSTEMS **9**

Vibration of continuous systems: exact methods, boundary value problem, eigen value problem, axial vibration of rods, transverse vibration of beams, response of system by modal analysis, general elastic waves, approximate methods to analyse system, different methods like Rayleigh's energy method, Rayleigh-Ritz method, Dunkerleys method.

UNIT III VIBRATION MEASUREMENT AND CONTROL **9**

Measurement of vibration, FFT analyzer-Methods of vibration control-Vibration absorbers-tuned absorbers,tuned and damped absorber (qualitative treatment only), untuned viscous dampers, Vibration isolation, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT IV 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 and equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT V INDUSTRIAL NOISE AND CONTROL **9**

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, engine radiated noise, intake and exhaust noise, engine accessory contributed noise, transmission noise. Methods for control of engine noise, combustion noise, predictive analysis, palliative treatments and enclosures, automotive noisecontrol principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

TOTAL PERIODS 45

ME15651 SAFETY IN ENGINEERING INDUSTRY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- gain basic knowledge of modern safety concepts.
- understand the principles of industrial toxicology and their hazards.
- acquire knowledge on environmental hazards and control.
- familiarize the concept of system safety analysis techniques.
- get exposure to various types of safety regulation and case studies.

UNIT I INTRODUCTION 9

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, pressure vessels, Electrical Exposure.

UNIT II CHEMICAL HAZARDS 9

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation -Industrial Hygiene - Industrial Toxicology.

UNIT III ENVIRONMENTAL CONTROL 9

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring Instruments, Control of Noise, Vibration - Personal Protection.

UNIT IV HAZARD ANALYSIS 9

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT V SAFETY REGULATIONS 9

Explosions – Disaster management – catastrophe control, hazard control, Factories Act, Safety regulations; Product safety – case studies.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the modern safety concepts and mechanical hazards.
- discuss about the chemical exposure and industrial toxicology.
- explain the safety precaution required for environmental control.
- demonstrate knowledge of system safety analysis techniques.
- become well versed with disaster management, control measures and safety regulations.

TEXT BOOKS

1. John V. Grimaldi, "Safety Management", AITB S Publishers, 2003.
2. M. Deshmukh, "Industrial Safety management", Tata McGraw-Hill. 5th Edition, 2009.

REFERENCES

1. Raju.K.S.N, "Chemical process industry safety ", Tata McGraw-Hill,2014.
2. "Accident Prevention Manual" – NSC, Chicago, 2009.
3. "Occupational safety Manual" BHEL, Trichy, 2015.
4. David L. Goetsch, "Occupational Safety and Health for Technologists", Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
5. Indian Boiler acts and Regulations, Government of India, 2015.

WEB LINKS

1. https://www.abdn.ac.uk/study/.../safety-and-reliability-engineering-for-oil-and-gas
2. https://www.araiindia.com
3. www.hse.gov.uk/engineering

CO - PO Mapping

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

ME15652 ENERGY CONSERVATION AND MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic principles of energy consumption and know how energy auditing is applied in engineering practice.
- gain knowledge on the analysis of various power generation systems involved in electrical systems.
- know the fundamentals of boilers and the factors to improve their efficiency.
- acquire knowledge for conserving energy from pumps, fans, blowers, refrigeration and air conditioning systems.
- learn the concepts of Energy resource management and utilize the available resources in optimal ways.

UNIT I IMPORTANCE OF ENERGY CONSERVATION AND MANAGEMENT 8

World, national Energy consumption – environmental aspects – Energy prices, policies – Energy auditing: methodology, analysis, energy accounting – Measurements – Thermal and Electrical.

UNIT II ELECTRICAL SYSTEMS 12

AC / DC current systems, Demand control, power factor correction, load management, Motor drives: motorefficiency testing, energy efficient motors, motor speed control – Lighting: lighting levels, efficient options,daylighting, timers, Energy efficient windows – electrical distribution systems – Transformers – Power quality – harmonic distortion

UNIT III THERMAL SYSTEMS 10

Boiler – efficiency testing, excess air control, Steam distribution & use – steam traps, condensate recovery, flash steam utilization, Thermal Insulation. Heat exchanger networking – concept of pinch, Target settling, problem table approach.

UNIT IV ENERGY CONSERVATION 8

Energy conservation in Pumps, Fans (flow control) and blowers, Compressed Air Systems, Refrigeration and air conditioning systems – Waste heat recovery recuperators, heat sheets, heat pipes heat pumps.

UNIT V ENERGY MANAGEMENT, ECONOMICS 7

Energy resource management – Energy Management information systems – Computerized energy management – Energy economics – discount rate, payback period, internal rate of Return, life cycle costing – Financing energy conservation Project.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- carry out energy accounting and balancing.
- demonstrate knowledge on various motor drives and transformers.

- get strong grounding on basics of boilers and identify the various concepts/components/processes involved in thermal systems
- implement practices like cogeneration in industry and waste heat recovery techniques for energy conservation.
- apply the concepts of energy management and energy economics for energy savings in practical life.

TEXT BOOKS

1. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publications, Washington, 2002.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 2005.

REFERENCES

1. Albert Thumann, Handbook of Energy Audits, 6th Edition, The Fairmont Press,2007
2. W.C. turner, "Energy Management Hand book" Wiley, New York,2009
3. W.R. Murphy and G. Mc KAY "Energy Management" Butterworths, London,2007
4. Dale R Patrick, Stephen W Fardo, "Energy Conservation Guidebook" 2nd Edition, CRC Press,2005
5. I.G.C. Dryden, "The Efficient Use of Energy" Butterworths, London, 2003.

WEB LINKS

1. https://nptel.ac.in/courses/103104043/Lecture_pdf/Lecture19.pdf
2. www.gtuinfo.in/.../Syllabus/.../Energy+Conservation+And+Management.
3. http://www.valluriorg.com/blog/energy/energy-conservation-and-management

CO - PO Mapping

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

ME15653 INDUSTRIAL PSYCHOLOGY AND WORK ETHICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the industry needs, scope and major influences from psychological point of view
- familiarize the factors like cultures, values, cross-cultural issues that shape the structure of an organization.
- learn the significance of inter-personal relationship and managing emotions among industry personnel.
- Know about the modern concept of Corporate Social Responsibility.
- get clear understanding of work ethics, moral and ethical values, leadership styles and other ethics related concepts.

UNIT I INDUSTRIAL PSYCHOLOGY 9

Introduction to Industrial Psychology – Definitions & Scope Major influences on industrial Psychology - Scientific management and human relations schools Hawthorne Experiments. Individual behavior – Group behavior – Group Dynamics – Leadership Styles – Industrial Fatigue.

UNIT II ORGANIZATIONAL STRUCTURE 9

Key organizational design process, Structural differentiations, Forces reshaping organizations. Functions of organizational culture, Organizational Socialization, Assessing Cultural Values and Fit, Cross Cultural issues. Lewin's Change Model.

UNIT III INTERPERSONAL RELATIONSHIP 9

Managing emotions – Emotional Intelligence – Building Better interpersonal Relations – Managing the Boss – Dealing with Subordinates – Case Study. Basic Theories of Motivation – Importance of Perception – Need for Shaping Perception.

UNIT IV SOCIAL RESPONSIBILITY AND ETHICS 9

Concept of Social Responsibility – Importance of Social Responsibility – Business Ethics. Decision making process, individual influences, group decision process.

UNIT V WORK ETHICS 9

Professional Values & Ethics – Need – Issues – Challenges – Ethical Leadership, Leadership Vs Management, Leadership Theories, Emerging issues in Leadership. Value crisis in Contemporary Indian Society – Aesthetic Values, Moral and Ethical Values – Values in the Work place.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- discuss the importance of psychological problems and issues involved in running an industry.

- demonstrate knowledge on how organizational structure is shaped by issues like cultures, values and emotions involving different sections of people.
- apply knowledge gained on interpersonal relations to run a business smoothly.
- understand the social responsibility of a business concern and follow ethical ways to run a business.
- consciously follow work ethics, moral and ethical values, appropriate leadership style in running a business.

TEXT BOOKS

1. Vikram Bisen & Priya, "Industrial Psychology", New Age International (P) Ltd., Publishers, 2010.
2. Murthy C.S.V., "Business Ethics", Himalaya Publishing House, 2007.

REFERENCES

1. Luthans, Fred, "Organizational Behavior", McGraw Hill 2008
2. Tripathi. A. N., "Human Values", New Age International Pvt. Ltd., New Delhi, 2002.
3. Maynard, H., "Industrial Engineering Hand Book", McGraw Hill Book Co., New York, l999
4. Ronald E. Riggio, "Introduction to Industrial and Organizational Psychology", Pearson Education, Inc. New York, 2008
5. Joel Lefkowitz, "Ethics and Values in Industrial-Organizational Psychology", Taylor and Francis, e-library, 2009.

WEB LINKS

1. http://www.ergonomics.org.uk/learning/what-ergonomics/
2. http:// www.iea.cc/whats/
3. https://books.google.co.in/books?isbn=1111839972

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

ME15654 **ADVANCED I.C. ENGINES** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the underlying principles of operation of Spark Ignition Engines and its components.
- get educated about the principles and operation of Compression Ignition Engines and its components.
- gain knowledge on pollutant formation and control methods.
- acquire knowledge on various alternate fuels available to replace non-renewable energy.
- update knowledge on recent trends and developments in IC engines.

UNIT I SPARK IGNITION ENGINES **9**

Mixture requirements – Fuel injection systems – Mono point, 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.

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 PERIODS 45

COURSE OUTCOMES

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

- describe knowledge on the operations of Spark Ignition Engine and its components.
- discuss in detail the operations of Compression Ignition Engine and its components.
- understand about pollutants developed from various fuel sources and apply controlling techniques.
- demonstrate knowledge on alternate fuels and engine design modifications required to use them
- keep trend with the latest developments in I.C engines like rail direct injection systems, On-board diagnostics and hybrid vehicles.

TEXT BOOKS

1. Ganesan.V, "Internal Combustion Engines", II Edition, TMH, 2002.
2. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", Scitech Publications, 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.
4. Ed May, “Automotive Mechanics”, Tata McGraw-Hill,2003
5. Kirpal Singh “Automobile Engineering”, Standard Publishers, New Delhi, 2009.

WEB LINKS

1. http://nptel.ac.in/courses/112101004/
2. https://easyengineering.net/me6016-advanced-i-c-engines/
3. http://thebooksout.com/downloads/ic-engine-notes-for-gate.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	2	1	-	-	-	2	2	-	-	-	-	2	2	2
CO2	2	2	-	-	-	2	2	-	-	-	-	2	2	2
CO3	2	2	-	-	-	2	2	-	-	-	-	2	2	2
CO4	2	3	-	-	-	2	3	-	-	-	-	2	2	2
CO5	2	3	-	-	-	2	3	-	-	-	-	2	2	2

ME16951 **NON-DESTRUCTIVE TESTING (NDT)** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- to introduce the basic principles, techniques, equipment, applications and limitations of NDT methods.
- to enable selection of appropriate NDT methods.
- to identify advantages and limitations of nondestructive testing methods
- to make aware the developments and future trends in NDT.
- to identify various defects in the material

1. **LIQUID PENETRANT TESTING** **6**
   Introduction
   Equipment
   &Materials
   Inspection Methods
   Interpretation
   Discontinuities
2. **MAGNETIC PARTICLE TESTING** **6**
   Introduction
   Magnetization
   Methods Magnetization
   Equipment
   Interpretation
   Discontinuities
3. **ULTRASONIC TESTING** **6**
   Introduction
   Ultrasonic
   Principle
   Equipment
   Reference Block
   Testing Methods
   Inspection & Evaluation
4. **VISUAL TESTING** **6**
5. **RADIOGRAPHIC TESTING** **6**

Principles
Techniques
Applications
Limitations
Standards and Specifications related to Radiography

TOTAL PERIODS 30

COURSE OUTCOMES

Upon completion of the course students will be able to

- select an appropriate NDT technique as per requirement.
- inspect and evaluate the surface imperfections using penetrant testing method.
- inspect subsurface defects by magnetic particle.
- inspect subsurface defects by Ultrasonic, visual testing and radiographic testing.
- introduce environmental friendly solutions to achieve organizational sustainability.

ME16952 **CATIA** **0 0 2 1**

COURSE OBJECTIVE

To enable the students to

- gain strong ground on solid modeling techniques that would enhance the productivity in modeling and analysis of mechanical components.
- create the surface primitive by surface modelling.
- assemble the various parts of the machine components by using different commands.
- create different views of the machine components.
- make the bill of materials and specify dimension and its tolerance in the parts.

1. INTRODUCTION TO CATIA 6

Introduction to CATIA-History of CATIA-CATIA modeling process, Parametric design concept, feature based design etc-CATIA Features-SKETCHER-Creating a new part.

2. SKETCHER WORKBENCH 6

Basic sketch, Sketch in task environment, Selection tools-Profile, Predefined shapes, Circles, Spline, Conics, Line, Points-Operations, Corner, Chamfer, Relimitation tools-Projections, Transformations-Constraints, Sketch tools, Grid, Snap on grid, Construction-Geometrical constraints, Dimensional constraints., Sketch analysis-Visualization tools, View tool bar, Workbench

3. PART MODELING 6

Sketch based features-Pad, Multipad, Drafted filleted pad-Pocket, Multipocket, Drafted filleted pocket-Shafts, groove-Holes-Rib, Slots-Solid combine, Stiffner-Multi section solid, Multi section solid removal-Edit Geometry, Parent child relationship, -Drafts, Drafted reflected line, Variable angle draft-Shell feature, Affinity-Reference elements- Point, Axis, Planes,-Boolean operations- Assemble, Add, Remove, Intersect, Union trim, Remove lump

4. ASSEMBLY DESIGN 6

Introduction on assembly-Assembly approaches-Top down assembly, Bottom up assembly-Product structure tools-Component, Product, Part-Existing component, Existing component with positioning-Replace component, - Assembly constrains-Coincident, Contact constrain, Offset, Angular, parallel, Perpendicular, Fix-Fix together, Quick constrain, Change constrain, Reuse pattern-Assembly Features-Split, Hole, Pocket, Add, Remove-Symmetry in assembly

5. DRAFTING AND DETAILING 6

Introduction on drafting-Standards, -Creating the drawing-Views-Front view, Isometric view, -Detail view, Clipping view, Broken view, View creation wizard Dimensions-Dimensions, , Stacked dimensions, Geometric tolerance Annotations- Arrow-Geometry creation-Points, Lines, Circle and Ellipse, Profiles, Transformation tools, Constrains Generation-Generate dimensions, Generate balloons, Bill of material generation Saving and Formats.

TOTAL PERIODS 30

COURSE OUTCOMES

Upon completion of this course, the students would have

- create the different wireframe primitives using parametric representations.
- create surface primitives using parametric modeling.
- create the different solid primitives using the different representation schemes.
- apply geometric transformations on the created wireframe, surface and solid models
- ability to create 3D assemblies that represent static or dynamic Mechanical System

ME16953 **CNC MILLING** **0 0 2 1**

COURSE OBJECTIVE

To enable the students to

- evaluate manufacturing assignment based on critical thinking and problem solving skills.
- practice writing complex "G" code programs for CNC turning centers that meet the part specification
- interpret and demonstrate complex "G" code programs for CNC milling centers that meet the part specification
- prepare "G: code programs to perform secondary operations including tapping, countersinking, counter boring, and threading.

1.BLUE PRINT READING **7**

- Reading the machining sketches.
- Different Geometrical Tolerance symbols.
- Reading Dimensional Tolerances.
- Understanding the Views.
- Concept of First angle & Third angle projection

2.CONVENTIONAL MILLING AWARENESS **8**

- Introduction to milling machine & its parts.
- Different operations of milling.
- Plain milling-Step Milling-Slot Milling-Pocket Milling-Co-ordinate drilling- Job setting in vice bydialing-Job setting on bed with clamps
- Knowledge of different cutting tool materials used.
- Selecting speeds & feeds.

3.CNC MILLING – BASIC **7**

- Fundamentals of CNC milling.
- Familiarization of control panel.
- Fundamentals of CNC programming.
- Part programming techniques.
- Canned cycles.
- Simulation using MTAB.
- Machining practice on CNC Milling

4.CNC MILLING – ADVANCED **8**

- Work piece setting methods.
- Tool setting methods.
- Programming by using multiple tools.
- Advanced programming techniques.
- Practice on CNC Milling.
- Exercises on machine by using different cycles.

TOTAL PERIODS 30

COURSE OUTCOME

Upon completion of this course, the students able to

- understanding of manual and CNC milling practices as well gain knowledge in tooling, machining practices.
- prepare and understand line program for various profiles Identify and set parameters for various simulators.
- define and explain Modern CNC systems and explain its importance in manufacturing
- prepare programs, demonstrate, simulate and operate CNC milling machine with Canned cycle and for multiple tools.

ME16954 **SOLIDWORKS** **0 0 2 1**

COURSE OBJECTIVES

To enable the students to

- exposure to CAD tools for use in mechanical engineering design conceptualization, geometric modelling, communication, analysis and optimization, further use in CAD, CAM, CAE.
- use basic and advanced features of current CAD software.
- understand how CAD technology can be leveraged in the design process.
- Impart knowledge related to principles, methods and techniques of 3D modelling in parametric CAD software.
- assemble the various parts of the machine components by using different commands.
- understand the concept of various factor applied in design of sheet metal design.

1.INTRODUCTION TO CAD, CAE, PDM **5**

Features of solid works, various tools available in Solid works for product design – Solid Works GUI – feature manager, design tree, Callouts, Handles, Confirmation corner, mouse buttons. Keyboard shortcuts, Commandmanager–File management.

2.SKETCHING **5**

Sketching environment – Sketch entities – Inference line, Centerline line, Line, Circle, Arc, Ellipse, Rectangle, Slots, Polygon, Ellipse, Partial Ellipse, Spline, Spline tools, Points, Text, Construction geometry, Snap, grid –Sketch Relations– Blocks – Make block, Edit block, Insert block, Add/Remove Entities, Rebuild, Save, Explode.

3.INTRODUCTION TO PART MODELING **5**

Reference geometry – Co–ordinates, Plane, Axis and Points – Modeling features – Extrude, Revolve, Swept andLoft– Relations –Adding Sketch Relation, Automatic relations – Creating extrude features — Creating revolvefeatures–Creating helix and spiral – Creating loft features.

Fillets, Chamfers, Shell, Rib, Draft, Hole – Creating pattern – Linear pattern, Circular pattern, Sketch drivenpattern, Curve driven pattern, Table driven pattern, Fill pattern, Mirror – Other tools – Inserting library feature,Measuring geometries, Materials, Mass properties, Selection manager, Multiple body concepts.

4.ASSEMBLY MODELING **5**

Introduction to assembly modeling & approaches – Top down and bottom up approach – Applying standardmates–Coincident, Parallel, Perpendicular, Tangent, Concentric, Lock, Distance, Angle – Top down design –Layout sketch, Work part in the context of an assembly.

5.DRAWING ANNOTATION **5**

Dimensions – Smart, Horizontal, Vertical, Baseline, Ordinate, Horizontal ordinate, Vertical ordinate, Chamfer,Attach dimensions, Align collinear/radial, Align parallel/concentric, Model dimensions, Auto dimension, Dimxpert, Annotations, Geometric tolerance, Surface finish, – Conversion of Solid body to Sheet metal.

6.SHEET METAL DESIGN **5**

Concepts in Sheet metal design bend allowance bend deduction, K-factor – Inserting Base Flange, Sheet MetalTab, Edge Flange, Miter Flange, Hem, Jog, Creating Break Corner/Corner Trim, Closed Corners, Rip, Inserting Sketched Bend – Conversion of Solid body to Sheet metal

TOTAL PERIODS **30**

COURSEOUTCOMES

Upon completion of this course the student will

- demonstrate competency with multiple drawing and modification commands inSolidWorks.
- Create the dimensional tolerance and special features in the drawing.
- create three-dimensional solid models.
- create three-dimensional assemblies incorporating multiple solid models.
- apply industry standards in the preparation of mechanical drawings.
- apply the concepts in sheet metal design in fabrication work design.

ME16955 **INDUSTRIAL ROBOTICS** **0 0 2 1**

COURSE OBJECTIVE

To enable the students to

- gain knowledge and process expertise to apply the advanced robotic technology in innovative ways to solve customer's challenges.
- understand the basic concepts associated with the design, functioning and applications of robots.
- study about the drives and end of tooling in robots.
- Write a programme for controlling the elements of the robots.

1.INTRODUCTION **7**

Introduction to Robotics, Co-ordinate systems and their applications

2.MOTOSIM SOFTWARE **7**

Introduction to Motosim Software and basic position movement for six axis and using various interpolation.

3.MOTOMAN SOFTWARE **8**

Robot Motoman - Introduction and basic movements using various interpolation

4.PROGRAM DEVELOPMENT **8**

Basic Program development using manipulator-Motosim Program Development on Interpolation Types andProgramming on 2D and Programming for 3D Models - MultiRobot work station programming using Motosim - Programming using various interpolation Joints- Linear, Circular and Spline using manipulator – Application and development in manipulator Motoman

TOTAL PERIODS 30

COURSE OUTCOME

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

- develop programming principles and languages for a robot control system.
- explain the basic concepts associated with the design, functioning and applications of robots.
- use the Motosim software and write the programme.
- apply the software concept for various application.

ME16956 INDUSTRIAL AUTOMATION 0 0 2 1

COURSE OBJECTIVES

To enable the students to

- describe the basic concepts of automation in manufacturing systems
- control industrial processes locally or at from remote locations.
- directly interact with devices such as sensors, valves, pumps, motors and othercomponents through interfacing software.

1. INTRODUCTION OF AUTOMATION 10

Types of automation-Need of automation-Application of automation-History of automation-Tools of automation- Introduction of SCADA-Designing Methods

2. DEVELOPING CONCEPTS 10

Application Manager-Window Maker-Window Viewer-Basic Screen Development-Digital Tags-Analog Tags- Various Properties of an Object-Development of Industrial Designs-Creating Basic Animations-Location Property-Filling Property-Screen Jump-Numerical Data Display & Entry Operation.

3. INTERFACING CONCEPTS 10

Application -Problems based on Movements, Filling, Height & Width Properties-Alarm Creation in SCADA- Interfacing with PLC & Application Design Developments - Case Studies

TOTAL PERIODS 30

COURSE OUTCOME

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

- Illustrate the basic concepts of automation in machine tools.
- Analyze various automated flow lines, Explain assembly systems and line balancing methods.
- Interpret the importance of adaptive control systems, automated inspection systems

ME16957 **ANSYS FLUENT** **0 0 2 1**

COURSE OBJECTIVES

To enable students to

- know about the fundamentals and applications of CFD and Ansys Fluent.
- gain knowledge incoupled solver and transonic flow in Ansys Fluent.
- expand knowledge in the area of Fluent turbulence model.
- study the periodic heat flow modeling and turbulent flow in heat exchanger.
- understand radiation, convection and multiphase using Ansys Fluent.

1. INTRODUCTION TO CFD **6**

Introduction to CFD- CFD theory fundamentals and applications-ANSYS Fluent application-Fluent Simulation process - ANSYS Fluent GUI and Software preliminaries- Solver fundamentals-Boundary conditions-Flow mix and heat transfer (3D)-Geometry in design modeler-Meshing using ANSYS Meshing application-CFD Simulation setup-Models-Defining regions-Material definition-Cell zone conditions-Extracting preliminary results.

2. COUPLED SOLVER AND TRANSONIC FLOW **6**

Flow mix and heat transfer (3D) –Coupled solver – Mesh adaption – Transonic flow – Airfoil - CFD Simulation

setup – Models - Defining regions - Material definition – Solution – Post Processing.

3. TURBULENCE MODEL 6

Turbulence model in Fluent – Setting up model – Materials and operating conditions – Solution extraction –

Convergence modeling.

4. PERIODIC HEAT FLOWAND TURBULENT FLOW **6**

Modeling Periodic heat Flow – Creation of zones – Model setup – Material definition – Cell zone definitions –Periodicity definition – Boundary conditions – Solution extraction – Advanced post processing.

Turbulent flow in heat exchanger – Model setup – Boundary conditions – Solving – Post Processing.

5. RADIATION AND CONVECTION **6**

Radiation and Convection - Model setup – Thermal boundary conditions - Solution - Post Processing. Siphoning using Multiphse – Review, test and Project discussion.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- know the Ansys Fluent GUI and software preliminaries and solver fundamentals.
- learn about coupled solver, material definitions and post processing in Fluent.
- gain through knowledge in turbulence model and Convergence modeling of Fluent.
- enlarge their knowledge in cell zone definitions, solution extraction and advanced postmethods in

Fluent.

- understand how to solve problems under radiation and convection and multiphase fields.

ME16958 COMPUTER AIDED REVERSE ENGINEERING 0 0 2 1

COURSE OBJECTIVES

To enable the students to

- understand the Reverse Engineering (RE) Methodology
- disassemble products and specify the interactions between its subsystems and their functionality
- understand Computer-Aided RE and Rapid Prototyping Technology
- re-draw electrical schematics from available PCBs
- understand RE applications in software engineering

1. INTRODUCTION AND PROCESS IN CARE **6**

Introduction- CATIA- Reverse Engineering-Process- Hardware and software Requirements, Overview of CARE. Getting started with CARE-CARE Tool- GUI of CATIA. Sketcher and Part design Workbench. Processing the Point cloud data-GUI of DSE- importing, edition, activation, filtering, removing protecting.

2. MESH PROCESSING **6**

Creating mesh-offsetting a mesh, rough offset, flipping edges, smoothing meshes, Cleaning mesh, Filling holes on Meshes, creating triangles, Optimizing Meshes. Mesh Edition- Add point, move point, Delete Element, Collapse element.

3. CLOUD TRANSFORMATION **6**

Performing symmetry on the geometry-Translation, Rotating, Transforming by Scaling, Affinity, Transforming the elements from one Axis to another. Scans and Curves-Creating Scans-Projecting Curves -Creating Planar sections- Discretizing Curves-Editing scans

4. CREATION OF CURVES AND SURFACES **6**

Curve creation-Started with QSR-Creating curve from scans-Sketches from scans-Trimming on intersecting curves- Curve mesh. Creating Surfaces- Creating conical surfaces- creating a network-Wireframes- creating point, Planes, Polyline, Projection, Intersection, Circles, and Spline. Creating Surfaces-Blend, revolve, Multi- section surfaces

5. OPERATIONS **6**

Extracting Geometry- Join, Boundary, Healing, Trim, Split, Extra polate, Shape fillet. Variable Fillet.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- Understand the problem in the existing process.
- Collect the large number of data/ information for the product
- Depth analyze of the products and extraction of real time data

- Understand the principles behind the design of the product, ways to redesign and improve the performance of the system.
- Extract the geometry and made the various changes according the need.