

COURSE OBJECTIVES

- To describe the concept of metrology.
- To explain about metrology instruments and application for various measurements.
- To discuss the concept of computer applications in metrology.
- To acquire the principles of various Inspection, Instruments and Methodology.
- To develop the knowledge in the area of non-contact inspection.

UNIT I BASIC CONCEPTS AND COMPARATORS 9

Basic concept – Legal metrology – Precision – Accuracy – Types of errors – standards of measurement – principle traceability – interchangeability and selective assembly, gauge blocks, limit gauges – fits and tolerances – tailor's of gauge design. Comparators: Mechanical, Electronic, optical and Pneumatic – Automatic gauging.

UNIT II ANGULAR MEASUREMENT AND SURFACE FINISH MEASUREMENT 9

Angular measurement: sine bar – Autocollimator, optical projectors: profile projectors – toolmakers microscope, measurement of surface finish: Terminology – roughness – waviness – analysis of surface finish – stylus probe instrument – Talysurf.

UNIT III SCREW THREAD AND GEAR METROLOGY 9

Screw thread metrology: errors in thread – pitch error – drunkenness – measurement of various elements thread – two and three wire method – best wire size – Thread gauges – floating carriage micrometer. Measurement of gears – Terminology – measurement of various elements of gear – tooth thickness – constant chord and base tangent method – Parkinson Gear Tester.

UNIT IV OPTICAL METROLOGY 9

Laser Metrology: LASER interferometer – constructional features, sources of error, measurement of positional error, straightness and flatness of machine tools – LASER Alignment Telescope – LASER Micrometer – LASER Triangulation technique – in process and on line measurement – white light interferometer.

UNIT V ADVANCES IN METROLOGY 9

Coordinate measuring machine (CMM): Constructional features – types and applications. Computer Aided Inspection: Machine Vision system – Image processing.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- demonstrate different measurement technologies and to make use of them in Industrial Components.
- compute angular measurement and surface finish measurement.
- improve knowledge on screw thread metrology.
- describe the concept of laser metrology.
- illustrate Coordinate measuring machine.

TEXT BOOKS

1. Jain R.K. "Engineering Metrology", Khanna Publishers, 2005.
2. Gupta. I.C., "Engineering Metrology", Dhanpatrai Publications, 2005.

REFERENCES

1. Connie Dotson, et al., “Fundamentals of Dimensional Metrology”, Thomas Asia, Singapore, First print, 2003.
2. Doebelin E.O., “Measurement System Applications and Design” First Edition, 1990.
3. Groover M.P., “Automation, Production System and Computer Integrated Manufacturing “, Prentice – Hall, New Delhi, 2003.

WEB LINKS

1. [http://nptel.ac.in/courses/112102103//Module%20G/Module%20G\(2\)/p2.htm](http://nptel.ac.in/courses/112102103//Module%20G/Module%20G(2)/p2.htm)
2. https://en.wikipedia.org/wiki/Computer-aided_inspection



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

COURSE OBJECTIVES

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

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 8

Units and dimensions-Classification of fluids-Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.

UNIT II FLOW THROUGH CIRCULAR CONDUITS 8

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

UNIT III DIMENSIONAL ANALYSIS 9

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

UNIT IV HYDRAULIC PUMPS 10

Impact of jets - Euler's equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle -work done by the impeller - performance curves - Reciprocating pump- working principle – Rotary pumps –classification.

UNIT V HYDRAULIC TURBINES 10

Classification of turbines –heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities –performance curves for turbines –governing of turbines.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- list the fundamentals of fluid mechanics, including the basics of hydraulics, types of fluids- water, oils and its uses along with fluid properties.
- investigate the fluid flow phenomena with the application of momentum and energy equation.
- improve dimensional analysis and to learn the several non-dimensional numbers with real time applications.
- acquire knowledge about the working principle of turbo machinery.
- distinguish the different types of pumps, fluid machineries and its working principles.

TEXT BOOKS

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", Laxmi publications, New Delhi, (2010)
2. Modi P.N and Seth S.M, "Hydraulics and Fluid Mechanics", Standard Book House, New Delhi (2004).

REFERENCES

1. Som, S.K. and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw-Hill, New Delhi, 2nd Edition, (2007).
2. Kumar. K.L., "Engineering Fluid Mechanics", (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, (1995).
3. Graebel.W.P, "Engineering Fluid Mechanics", Taylor Francis, Indian Reprint, (2011).
4. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 2010
5. Rathakrishnan. E, "Fluid Mechanics", Prentice Hall of India (II Ed.), (2007)

WEB LINKS

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



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

COURSE OBJECTIVES

- To describe the fundamentals of digital logic and minimization technique
- To illustrate the students with various number systems and codes
- To formulate the methods for simplifying boolean expressions
- To justify the formal procedures for the analysis and design of combinational and sequential circuits
- To discuss the concept of memories and programmable logic devices.

UNIT I NUMBER SYSTEM, BOOLEAN LOGIC AND MINIMIZATION TECHNIQUES 15

Introduction to Number systems- Binary, Octal, Hexadecimal, BCD, Grey code, Excess 3 code - Binary Arithmetic, 1's complements, 2's complements, and Code conversions. Boolean theorems, Boolean algebra – AND, OR, NOT, NAND AND NOR operation. Minimization – K- Map, Don't care conditions - Five Variable K maps, Tabular Minimization Procedures.

UNIT II COMBINATIONAL CIRCUITS 15

Half and Full Adders - Half and Full Subtractors - Code Converters- Encoder – Decoder - Multiplexer- Demultiplexer - Binary/ BCD adders, Subtractors - Magnitude Comparator.

UNIT III SEQUENTIAL CIRCUITS 15

General model of sequential circuits – Latch, Flip Flops– SR, D, JK and T, Level triggering, Edge triggering, Master slave configuration. Realization of one flip flop using other flip flop. counters - Binary counters, Modulo-n counter- Ring counter, Johnson counter.

UNIT IV DESIGN OF SEQUENTIAL CIRCUITS 15

Classification of sequential circuits – Moore and Mealy - Design of Asynchronous counters- state diagram- State table –State minimization –State assignment- Register – shift registers - Universal shift register. Hazards: Static – Dynamic.

UNIT V MEMORY AND PROGRAMMABLE LOGIC DEVICES 15

Memories - ROM, PROM, EPROM, Programmable Array Logic (PAL), Programmable Array Logic (PAL) - Implementation of combinational logic using PROM and PLA, PAL.

TOTAL PERIODS 75**COURSE OUTCOMES**

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

- solve the fundamentals of digital logic with various number systems and codes.
- explain the concept of how to designing various combinational and sequential circuits
- elaborate the complex arithmetic and logic circuit and to evaluate its function realization using gates.
- discuss the basics about synchronous and asynchronous circuits
- propose the complex logic memories, programmable logic devices and test its functionality and timing.

TEXT BOOKS

1. Morris Mano M., "Digital Circuits and Logic Design", Prentice Hall of India, II Edition, 1996.
2. Ronald J. Tocci Neal S. Widmer and Gregory L. Moss, Digital Systems: Principles and Applications, Prentice Hall of India, New Delhi, 2010.

3. ZainalabedinNavabhi, VHDL Analysis and Modeling of Digital Systems, McGraw-Hill, 1998.

REFERENCES

1. W.H. Gothmann, "Digital Electronics – Introduction Theory and Practice", PHI, 1992.
2. S. Salivahanan and S. Arivazhagan, "Digital Circuits and Design", 2nd Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2004.
3. W.H. Gothmann, "Digital Electronics – Introduction Theory and Practice", Prentice Hall of India Pvt. Ltd New Delhi, 1992.
4. R.R. Jain, "Modern digital electronics", Third edition, Tata McGraw – Hill, 3rd edition 2003.
5. Leach and Malvino, "Digital Principles of Electronics & Applications", Tata McGraw – Hill, 5th Edition, 2003.

WEB LINKS

1. https://en.wikipedia.org/wiki/Digital_electronics
2. <http://www.electrical4u.com/digital-electronics/>
3. <http://www.asic-world.com/digital/tutorial.html>



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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	-

COURSE OBJECTIVES

- To inculcate knowledge about the basics of mechanisms and understand the geometry of motion at any point in a link of a mechanism.
- To examine students to understand the types of cam and follower, motion and profile drawing of cam.
- To construct students on the phenomenon of direction of rotation, speed and torque determination for simple, compound and planetary gear systems.
- To propose the effects of friction in motion transmission and in machine components.
- To the motion resulting from a specified set of linkages in a mechanism.

UNIT I BASICS OF MECHANISMS 15

Introduction to Mechanisms – Degree of Freedom – Kutzbach criterion – Grashoff's law – Kinematic Inversions of Four bar chain, Slider, Double crank chains – Description of common Mechanisms– Single, double and offset slider mechanisms – Quick return mechanisms Ratchets and escapements – Indexing Mechanisms – Design of Crank and Rocker Mechanisms.

UNIT II KINEMATICS OF LINKAGES 15

Displacement, velocity and acceleration and analysis in simple mechanisms – Graphical Method velocity and acceleration polygons – Vector Approach, Computer applications in the kinematic analysis of simple mechanisms – Coriolis Components of Acceleration.

UNIT III KINEMATICS OF CAM 15

Classifications – Displacement diagrams – Parabolic, Simple harmonic, UAAR and Cycloidal motions – Layout of plate cam profiles – Derivatives of Follower motion – High speed cams – circular arc and tangent cams– Pressure angle and undercutting.

UNIT IV GEARS AND GEAR TRAINS 15

Spur gear Terminology and definitions – Fundamental Law of toothed gearing and involute gearing – Inter changeable gears – gear tooth action - Contact ratio – Terminology – Helical, Bevel, Worm, Rack and Pinion Gears (Basics only) – Gear trains – Parallel axis gear trains – Epicyclic gear trains.

UNIT V FRICTION 15

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Friction clutches – Belt and rope drives, Friction aspects in Brakes.

TOTAL PERIODS 75**COURSE OUTCOMES**

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

- improve the basics of mechanisms and the geometry of motion at any point in a link of a mechanism.
- construct the profile of cam for any given combination and condition.
- determination the speed and torque for simple, compound and planetary gear systems.
- identify the effects of friction in motion transmission and in machine components.
- prioritize the sliding and rolling friction.

1. Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2009.
2. Rattan S.S., "Theory of Machines", Tata McGraw – Hill Publishing Company Ltd., New Delhi, 2010.

1. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 2001.
2. Ghosh A and A.K.Mallick, “Theory of Mechanisms and Machines”, Affiliated East – West Pvt. Ltd., New Delhi, 2005.
3. Rao J.S and Dukkupati R.V, “Mechanism and Machine Theory”, Wiley – Eastern Ltd., New Delhi, 2007.
4. John Hannah and Stephens R.C, “Mechanics of Machines”, Viva Low – Prices Student Edition, 2008.
5. Shigley J.E and Uicker J.J, “Theory of Machines and Mechanisms”, McGraw – Hill, Inc. 2008

1. www.asic-world.com/digital/tutorial.html
2. <https://www.britannica.com/science/friction>

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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 give awareness to concept of starting methods and speed control of electrical machines.
- To analyse 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 curves. 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 DC 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 AC 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, the students will be able to

- select and utilize various dc machines.
- employ effective control techniques to electrical motors.
- demonstrate the concept applied in electric drives.
- apply solid state speed control of D.C. drives.
- select appropriate electrical drive for engineering applications.

TEXT BOOKS

1. Nagrath .I.J. & Kothari .D.P, “Electrical Machines”, Tata McGraw-Hill, 2004.
2. VedamSubrahmaniam, “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.

WEB LINKS

1. https://en.wikipedia.org/wiki/DC_motor
2. https://en.wikipedia.org/wiki/AC_motor
3. <http://www.electrical4u.com/control-of-electrical-drives/>



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COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO3	3	3	-	-	-	-	3	-	3	-	-	-	3	-
CO4	3	3	-	-	3	-	-	-	-	-	-	-	3	2
CO5	3	3	-	-	3	-	3	-	3	-	-	-	3	2

COURSE OBJECTIVES

- To design the understanding of the fundamentals of fluid mechanics and hydraulic machines
- To improve the classical experimental and diagnostic techniques, and the principles behind these techniques
- To invent the practice in making engineering judgments, estimates and assessing the reliability of the measurements and skills which are very important in all engineering disciplines.

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. Study of Bernoulli's Theorem apparatus.
4. Study of Losses in Pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump.
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear oil 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 30**COURSE OUTCOMES**

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

- list the fundamentals of fluid mechanics and hydraulic machines.
- apply experimental knowledge on classical, experimental and diagnostic techniques.
- estimate and assess the reliability of measurements which are very important in all engineering disciplines.
- test venturi meter and orifice meter to determine the fluid flow parameters.

REFERENCES

1. P. N. Modi and S. M. Seth, "Hydraulics and Fluid Mechanics", Standard Book House, Delhi, (1991).
2. S. S. Rattan, "A Text Book of Fluid Mechanics", Khanna Publishers, Delhi, (1994)
3. Som, S.K. and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", Second Edition, Tata McGraw-Hill, New Delhi, 2nd Edition, (2007).



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COURSE OBJECTIVES

- To make the students conduct various experiments on D.C. machines and transformers and analyze their performance for practical exposure.
- To conduct relevant experiments for determining the performance characteristics of AC machines.
- To analyze about the speed control in DC drive using various techniques.
- To Familiar with AC drive techniques.

LIST OF EXPERIMENTS

1. Load test on DC shunt motor.
2. Load test on DC Series motor
3. Open circuit and load characteristics of DC generator.
4. Speed Control of DC Shunt Motor (Armature and Field control)
5. Swinburne's test.
6. Load test on three phase alternator.
7. Load test on three phase squirrel cage induction motor.
8. Speed control of three phase squirrel cage induction motor.
9. Load test on single phase induction motor.
10. Study of DC and AC Starters.

TOTAL PERIODS 60**COURSE OUTCOMES**

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

- examine the characteristics of DC motors under loaded and unloaded conditions.
- demonstrate the various starting methods in AC motors.
- employ practically the speed control in DC shunt motor.
- analyse the performance characteristics of AC motors practically.



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

COURSE OBJECTIVES

- To design the specifications and symbols of standard machine components used in machine drawing.
- To formulate the concept of various tolerances and fits used for component design.
- To recommended and practice the drawing of machine components and simple assemblies using standard CAD packages.
- To improve and create drawings manually or using any one CAD packages for standard machine components and assemblies with tolerance.

LIST OF EXPERIMENTS

1. Introduction to Machine Drawing - Dimensioning, Sectional views, Welding symbols, surface finish Symbols.
2. Study of Limits, Fits and tolerances.
3. Free hand sketching of Machine Elements - Keys, Hexagonal and Square Head Bolts and Nuts, Conventional representation of Threads.
4. Converting given isometric view into orthographic views
5. Part and Assemble drawing of Universal coupling and Flange Coupling
6. Part and Assemble drawing of Bearings.
7. Part and Assemble drawing of Valves.
8. Part and Assemble drawing of Machine Elements – Tail Stock, Screw Jack and Connecting Rod Assembly.

TOTAL PERIODS 30**COURSE OUTCOMES**

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

- decide the dimensioning, sectional views, welding symbols.
- construct the various part and assemble drawing of bearings.
- examine the various part and assemble drawing of couplings.
- predict the various part and assemble drawing of valves.



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

	SEMESTER IV	
	NUMERICAL METHODS	
MA16404	(COMMON TO AERO, CIVIL, EEE, MECH & MCT)	
		3 2 0 4

COURSE OBJECTIVES

- To analyse different methods to find solution for a large system of linear equations
- To find the intermediate values for a series of given data
- To develop efficient algorithms for solving problems in science, engineering and technology
- To solve the nonlinear differential equations that cannot be solved by regular conventional method.
- To apply finite element method to increase the accuracy of second order differential equations

UNIT I SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 15

Solution of equation –Iteration method : **Newton Raphson method** – Solution of linear system by Gauss-Jordan method and Gauss - Jordan method – Iterative method – Gauss-Seidel method – Inverse of a matrix by Gauss-Jordan method – **Eigenvalue of a matrix by power method.**

UNIT II INTERPOLATION AND APPROXIMATION 15

Lagrangian Polynomials – **Divided differences** – Newton's Divided Difference, Hermite Interpolation Polynomial and Interpolating with a cubic spline – Newton's forward and backward difference formulas.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 15

Differentiation using interpolation formulae – Numerical integration by trapezoidal and Simpson's 1/3– Romberg's method – **Two- and Three-point Gaussian quadrature formulas** – Double integrals using trapezoidal and Simpson's rule.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 15

Single step methods: **Taylor series method** – Modified Euler method for first order equation – Fourth order Runge – **Kutta method for solving first and second order equations** – Multistep methods: Milne's and Adam's predictor and corrector methods.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 15

Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – **One dimensional wave equation and two-dimensional Laplace and Poisson equations.**

TOTAL PERIODS 75

COURSE OUTCOMES

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

- comprehend the basics of linear equations.
- apply the interpolation methods for constructing approximate polynomials
- demonstrate the knowledge of numerical differential equations in computational and simulation process
- utilize the concept of initial value problems in the field of science and engineering
- describe the computational procedure of the amount of heat emitted or transferred from an object

TEXT BOOKS

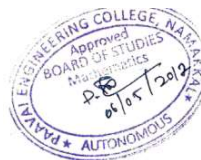
1. Erwin Kreyszig., “Advanced Engineering Mathematics” 10th edition, Wiley Publications, 2010.
2. T. Veerarajan. and T .Ramachandran, “Numerical Methods with programming in C”, 2nd ed., Tata McGraw-Hill, 2006.
3. Sankar Rao K “ Numerical Methods For Scientists And Engineers –3rd Edition Princtice Hall of India Private, New Delhi, 2007.

REFERENCES

1. P. Kandasamy, K. Thilagavathy and K. Gunavathy, “Numerical Methods”, S.Chand Co. Ltd., New Delhi, 2003
2. Gerald C.F. and Wheatley, P.O., “Applied Numerical Analysis” 6th Edition, Pearson Education Asia, New Delhi, 2002.
3. M.K.Jain , S.R.K. Iyengar , R.K.Jain , “Numerical Methods For Scientific & Engineering Computation” New Age International (P) Ltd , New Delhi , 2005.
4. M.B.K. Moorthy and P.Geetha, “Numerical Methods”, Tata McGraw Hill Publications company, New Delhi. 2011.

WEB LINKS

1. <https://www.youtube.com/watch?v=QTQ8bO1F-Dg>
2. <https://www.youtube.com/watch?v=AT7Olelic8U>
3. <https://www.youtube.com/watch?v=TH06N7Q7FJw>
4. <https://www.youtube.com/watch?v=DnBJLpdVHCY>
5. <https://www.youtube.com/watch?v=5TccPEz2nB8>



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

COURSE OBJECTIVES

- To invent the knowledge about the static and dynamic force analysis on various parts of reciprocating engine, the function of flywheel and to construct the various turning moment diagram.
- To propose the knowledge about balancing of various parts for different engine.
- To predict the causes of free vibration through analysis.
- To elaborate the analysis and causes of forced vibration.
- To advertise the effects of vibration in various beams under different load conditions and the basic concepts of governor and gyroscopes.

UNIT I FORCE ANALYSIS 15

Rigid Body dynamics in general plane motion – Equations of motion- Dynamic force analysis – Inertia force and Inertia torque – D. Alembert's principle – The principle of superposition –Dynamic Analysis in Reciprocating Engines – Turning moment diagrams – Fly wheels.

UNIT II BALANCING 15

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder Engine Balancing Multi – Cylinder Engines – Partial balancing in locomotive Engines – Balancing linkages.

UNIT III FREE VIBRATION 15

Basic features of vibratory systems – Degrees of freedom – Free vibration – Equations of motion – Types of Damping – Damped vibration critical speeds of simple shaft – Torsional systems; Natural frequency of two and three rotor systems

UNIT IV FORCED VIBRATION 15

Response to periodic forcing – Harmonic Forcing – Forcing caused by unbalance – Support motion – Force Transmissibility and amplitude transmissibility vibration isolation.

UNIT V MECHANISM FOR CONTROL 15

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Controlling Force - Other governor mechanisms. Gyroscope – Gyroscopic couple – Gyroscopic Stabilization - Gyroscopic effects in Automobiles, ships and airplanes.

TOTAL PERIODS 75**COURSE OUTCOMES**

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

- formulate static and dynamic force analysis on various parts of reciprocating engine and construct turning moment diagram of flywheel.
- judge the balancing of various parts for different engine.
- improve knowledge on analysis of free vibration.
- improve knowledge on analyze of forced vibration.
- design the basic concepts of Mechanism for Control of Centrifugal governors and gyroscopes.

TEXT BOOKS

1. Khurmi, R.S., “Theory of Machines”, 14th Edition, S Chand Publications, 2009.
2. Rattan. S. S, “Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2011.

REFERENCES

1. Thomas Bevan, “Theory of Machines”, CBS Publishers and distributors, 2010.
2. Ghosh A. and Mallick A.K., “Theory of Mechanisms and Machines”, Affiliated East- West Press Pvt.Ltd., New Delhi, 2010.
3. Shigley J.E. and Uicker J.J., “Theory of Machines and Mechanisms “, McGraw – Hill, Inc., 2009.
4. Rao J.S. and Duggipati R.V., “Mechanism of Machine Theory”, Wiley – Eastern Limited, New Delhi, 2008.
5. John Hannah and Stephens R.C., “Mechanics of Machines”, Viva low – Priced Student Edition, 2007.

WEB LINKS

1. <http://nptel.ac.in/courses/112104114/>
2. <http://freevideolectures.com/Course/2364/Dynamics-of-Machines>

[illegible]

COURSE OBJECTIVES

- To describe the feedback control and basic components of control systems.
- To identify the various time domain and frequency domain tools for analysis and design of linear control systems.
- To discuss the methods to analyze the stability of systems using root locus technique.
- To describe the methods of designing compensators and applications of control systems.
- To compute knowledge in the basic concepts of linear control theory and design of Control system.

UNIT I BASIC CONCEPTS AND SYSTEM REPRESENTATION 9

Basic elements in control systems – Open and closed loop systems with example –Mathematical model of Translational, Rotational & Electrical systems – Transfer function – Block diagram reduction techniques – Signal flow graph.

UNIT II TIME RESPONSE ANALYSIS 9

Introduction – Time domain specifications – Types of test inputs I and II order system response– Steady state error – Error coefficients – Generalized error series – P, PI, PD, PID Controlled characteristics.

UNIT III FREQUENCY RESPONSE ANALYSIS AND DESIGN 9

Introduction – Frequency domain specifications – Bode plots and polar plots – Constant M and N circles and Nichols chart – Correlation between frequency domain and time domain specifications.

UNIT IV STABILITY OF CONTROL SYSTEMS 9

Characteristics equation – Location of roots in s-plane for stability – Routh Hurwitz criterion –Root locus Construction – Gain margin and phase margin – Nyquist stability criterion.

UNIT V COMPENSATION DESIGN & APPLICATIONS OF CONTROL SYSTEMS 9

Realization of basis compensation – Lag, Lead and Lag – lead networks – Compensator design using Bode plots. Stepper motors- AC & DC Servo Motor-Hydraulic Controller-Pneumatic Controller - Overview of Distributed Control system and PLC.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- construct the feedback control and basic components of control systems.
- explain the various time domain and frequency domain tools to analysis and design of linear control systems.
- conduct the analysis to stability of systems from transfer function and to define the methods of designing compensators.
- identify the application areas of control system.
- discover the compensation design processes.

TEXT BOOKS

1. J. Nagrath and M. Gopal, Control System Engineering, New Age International Publisher, New Delhi, 2011.

REFERENCES

1. Katsuhiko Ogata, “Modern Control Engineering”, 4th Edition, Pearson Education 2003.
2. I.J.Nagrath & M. Gopal, “Control Systems Engineering”, New Age International Publishers, 2003.
3. B.C.Kuo, “Automatic control systems”, Prentice Hall of India Ltd, New Delhi 1995.
4. Dorf R.C. and Bishop R.H., “Modern Control systems”, Addison – Wesley, 1995 (MATLAB reference).
5. Leonard N.E. and William Levine, “Using MATLAB to Analyze and Design Control Systems,”

WEB LINKS

1. <http://nptel.ac.in/courses/108101037/1>
2. https://en.wikipedia.org/wiki/Control_engineering



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

COURSE OBJECTIVES

- To construct the theoretical basis about the stress, strain and elastic modulus.
- To identify the concepts in various components with sound mathematical principles and to systematically solve engineering problems regardless of difficulty.
- To calculate the shear force, bending moment, deflection and slopes in various types of beams with different load conditions.
- To identify the concept of confidence and competence while solving problems related to the machine components like shafts, columns, springs and purposes.
- To explain the basic concept in torsion in shafts and springs.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 15

Properties of mild steel, cast iron, aluminum alloys, copper alloys and magnesium alloys - Mechanical properties of Materials - Stress and Strain - Stresses and strains due to axial force - Hooke's law - Factor of safety - Poisson's ratio - Elastic constants and their relationship Stress-Strain Curve for Ductile and Brittle Materials.

UNIT II ANALYSIS OF STRESSES IN TWO DIMENSIONS 15

State of stresses at a point - Normal and tangential stresses on inclined planes - Principal planes and stresses – Plane of maximum shear stress - Mohr's circle for biaxial stresses. Behavior of thick wall pressure vessels

UNIT III BEAMS 15

Types of beams: Supports and Loads - Theory of simple bending - Stresses in beams: bending and shear stress - Stress variation along the length and section of the beam, Slope and Deflection of beams: Double integration for Cantilever and simply supported beams Section modulus

UNIT IV COLUMNS 15

Columns - Buckling of long columns due to axial load - Equivalent length of a column - Euler's and Rankine's formulae for columns of different end conditions Deflection in overhanging beams

UNIT V SHAFTS 15

Analysis of torsion of circular bars - Shear stress distribution - Bars of Solid and hollow circular section – Compound shafts.

TOTAL PERIODS 75**COURSE OUTCOMES**

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

- examine the stress, strain and elastic moduli under given loading.
- construct the shear force and bending moment diagrams of standard beams.
- show the deflection and slopes in various types of beams with different load conditions.
- solve the problems related to the machine components like shafts, columns, springs and purposes.
- identify the application areas of springs.

TEXT BOOKS

1. R. K. Bansal, A text book of Strength of Materials, Laxmi Publications (P) Limited, New Delhi, 2010.
2. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India Learning. Ltd., New Delhi, 2010.

REFERENCES

1. R.K.Rajput, Engineering Materials, S. Chand and Company Ltd, New Delhi, 2007.
2. P. Purushothama Raj and V. Ramasamy, Strength of Materials, Pearson Education, India, 2013.
3. S. Rattan, Strength of Materials, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2011.
4. B. K. Sarkar, Strength of Materials, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
5. Irwing H. Shames and James M. Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India Learning. Ltd., New Delhi, 2009.
6. R. Subramaniam, Strength of Materials, Oxford University Press, New Delhi 2012.

WEB LINKS

1. www.engineersedge.com/strength_of_materials.html
2. www.me.mtu.edu/~mavable/MoM2nd.html



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

COURSE OBJECTIVES

- To understand the basics and working principle of various manufacturing processes.
- To distinguish conventional and non-conventional machining processes.
- To know the suitable metal removal processes for various application.
- To understand the principles of different metal finishing processes.
- To know the principles of different joining processes like welding, brazing, soldering and adhesive bonding.

UNIT I FOUNDRY TECHNOLOGY 9

Pattern and Core making: Pattern types, allowances, types of cores, core print - Moulding sand: types, properties, green sand moulding - **Melting furnaces**: Induction furnaces, CO₂ process, **Centrifugal Castings**, Shell Casing, Investment Casting, Die casting, Defects in casting.

UNIT II FORMING – PROCESSES 9

Hot Working and Cold Working. Rolling: Introduction – Rolling Mills – Rolling Operations – Production of Seamless Tubing and Pipe. Forging: Introduction – **Related Forging Operations** – Drop forging. Extrusion and Drawing: Extrusion Practice – Hot, Cold, Impact and Hydrostatic extrusion. **Sheet metal operations** – Blanking, Punching and Piercing.

UNIT III MATERIAL REMOVAL PROCESSES 9

Lathes and Lathe Operations, **Drilling and Drilling Machines**, Reaming and Reamers, Tapping and Taps- Tool nomenclature, cutting speed, feed, **machining Time calculations**.

UNIT IV SPECIAL MACHINES 9

Milling Machines and Operations, Planing and Shaping, Broaching, **Gear Hobbing and Shaping**. Grinding Process – Abrasives – Finishing operations –lapping, Honing Powder coating.

UNIT V PRINCIPLES AND APPLICATIONS OF JOINING PROCESSES 9

Gas welding, Basic Arc Welding Processes, Thermit Welding, Electron – Beam Welding, **Laser– Beam Welding**, **Ultrasonic Welding**, **Friction Welding**, Electro slag, Resistance welding, Principles and application of Brazing and Soldering.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- identify the basics and working principle of various casting processes.
- improve the knowledge on forming processes.
- explain the basic and working principle of conventional machining process.
- construct the basic and working principle of special machines.
- identify the basic application and principles of metal joining process.

TEXT BOOKS

1. Kalpakjian, S., “Manufacturing Engineering and Technology”, Pearson education India, 4th edition, 2001 (ISBN 81 78081 571)
2. Zainalabedin Navabhi, VHDL Analysis and Modeling of Digital Systems, McGraw-Hill, 1998. 2009.

REFERENCES

1. Hajra Choudhury, S.K., and Haqjra Choudhury, A.K., “Elements of Workshop Technology”, Volume I & II, Media Promoters and Publishers Private Limited, Mumbai, 1997.
2. Paul Degarma E, Black J.T. and Ronald A. Kosher, eighth edition, Materials and Processes in Manufacturing Prentice – Hall of India, 1997.
3. Sharma P.C. A Textbook of Production Technology, S. Chand and Co., Ltd., 1999.

WEB LINKS

1. <https://books.google.com/books?id=sT6jwN1LKTQC&printsec=frontcover&dq=Manufacturing+Technology&hl=en&sa=X&ei=NWUaVZfkNMyyogSG9YCACA&ved=0CDgQ6AEwAw#v=onepage&q=Manufacturing%20Technology&f=false>
2. <https://www.google.com/search?tbm=bks&hl=en&q=Manufacturing+Technology>

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



COURSE OBJECTIVES

- To study the architecture of 8085.
- To understand the addressing modes and instruction set of 8085.
- To impart knowledge of commonly used peripheral devices.
- To gain the knowledge of interrupt controller / interfacing ICs.
- To cognizant the applications of microprocessor.

UNIT I INTRODUCTION

9

Organization of Micro Computers – Organization of 8085: Architecture, Internal Register Organization and Pin Configuration – Instruction Set of 8085 – addressing modes – instruction and machine cycles with states and timing diagram.

UNIT II MEMORY AND I/O DEVICES

9

Need for Interfacing – Memory Interfacing: address space partitioning – address map – Address decoding – Bus contention. I/O Interfacing: Data transfer schemes – programmed Synchronous and asynchronous – Interrupt driven Transfer – Multiple devices and multiple interrupt levels – enabling disabling and masking of interrupts. DMA transfer: Cycle stealing – Burst mode – Multiple DMA devices – DMA transfer in 8085 systems – serial data transfer.

UNIT III INTERFACING DEVICES

9

Programmable peripheral device – programmable interval timer (8253) – Programmable communication interface (USART) – Programmable interrupt controller – Programmable DMA Controller (8257), programmable peripheral interface (8255).

UNIT IV DESIGN USING PERIPHERAL DEVICES

9

Interfacing A/D and D/A converters – Matrix Keyboard design using 8255 using 8085 programs. Designing real time clock, detecting power failure, detecting presence of objects using 8253 -Design of Keyboard and display interfacing using 8279.

UNIT V MICROPROCESSOR APPLICATIONS

9

Temperature monitoring system – Automotive applications – Closed loop process control – Stepper motor control.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- understand the architecture of 8085, instruction set and addressing modes of 8085 and illustrate with simple programs.
- get knowledge about commonly used peripheral / interfacing ics.
- analyse the concepts of i/o interfacing, execution.
- design microprocessor-based systems using peripheral devices.
- device selection and the applications of microprocessor.

TEXT BOOKS

1. Ramesh Goankar, "Microprocessor Architecture, Programming and Applications with 8085",
2. Umashankar B.S., Udaya Kumar K, "The 8085 Microprocessor: Architecture, Programming and Interfacing", Publisher: Pearson Education, 2008.
3. R.Theagarajan, S.Dhanasekaran, S.Dhanapal, "Microprocessors and its applications", New Age International, 2004

REFERENCES

1. V. Douglas Hall, "Microprocessors and Interfacing Programming and Hardware", Tata McGraw - Hill Publishing Company Ltd., 2002.
2. K. Ray and K. M. Bhurchandi, "Advanced Microprocessor and Peripherals – Architecture, Programming and Interfacing", Tata McGraw - Hill Publishing Company Ltd., 2006.
3. Aditya P. Mathur, "Introduction to Microprocessor", Tata McGraw-Hill Publishing Company Ltd., 2003.
4. Rafiquzzaman M., "Microprocessors Theory and Applications: Intel and Motorola", Prentice Hall, 2003.
5. Krishnakant "Microprocessors and Microcontrollers Architecture Programming and System Design", 8085-8086- 8051- 8096", PHI, 2007.

WEB LINKS

1. <https://en.wikipedia.org/wiki/Microcontroller>
2. <http://www.zseries.in/embedded%20lab/8085%20microprocessor/other%20applications>.
3. <http://www.zseries.in/embedded%20lab/8085%20microprocessor/other%20applications>.
4. <http://www.nptel.ac.in/courses/Webcourse->

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



COURSE OBJECTIVES

- To able to write program using arithmetic operations of microprocessors.
- To understand various IC interfacing with 8085.
- To experimentally understand the operation of Intel 8085 microprocessor.
- To know about the Sorting of number series and Code conversion.

LIST OF EXPERIMENTS**I. Programming**

1. Addition and subtraction of two 8 bit numbers.
2. Addition and subtraction of two 16 bit numbers.
3. Decimal addition and subtraction of two 8 bit numbers
4. To arrange a series of numbers in ascending order.
5. To arrange a series of numbers in descending order
6. To find the largest and smallest number in given array.
7. Multiplication and Division of 8 bit numbers
8. Decimal to hexadecimal conversion and hexadecimal number to decimal number conversion.

II. Interfacing

1. Analog to digital conversion.
2. Digital to analog conversion.
3. Stepper motor controller.
4. Temperature controller.

**TOTAL PERIODS 30****COURSE OUTCOMES**

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

- execute programs for various arithmetic operations in 8085.
- transfer data to corresponding memory locations.
- convert analog and digital data for interfacing applications.
- implement programming for stepper motor and temperature control applications.

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

COURSE OBJECTIVES

- To impart knowledge and skill in the field of conventional machine tools used in the industries.
- To supplement the theory, course on machining processes.
- To demonstrate and to study of the following machines.
- To understand the machine capabilities and processes completely.

LIST OF EXPERIMENTS**UNIT I LATHE PRACTICE**

- a. Step Turning
- b. Taper Turning
- c. Thread Cutting

UNIT II DRILLING PRACTICE

- a. Drilling
- b. Tapping
- c. Reaming

UNIT III MILLING PRACTICE

- a. Surface Milling
- b. Gear Cutting
- c. Contour Milling

UNIT IV SHAPING PRACTICE

- a. Cutting Key Ways
- b. V-Block machining
- c. Round to Square shape

**TOTAL PERIODS 30****COURSE OUTCOMES**

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

- operate the lathe and make parts by performing step turning, taper turning and thread cutting operations.
- perform the drilling, tapping and reaming.
- ability to operate milling make parts by performing milling and cutting process.
- imagine the shaping and machining process.

REFERENCES

1. Central Machine Tool Institute (CMTI), Machine Tool Design Handbook, Tata McGraw-Hill Publishing Company Ltd, Bangalore, 2008
2. Geoffrey Boothroyd and Winston A. Knight, Fundamental of Machining and Machine Tools, CRC Press, Taylor and Francis Group, Indian Edition, 2006
3. Heinrich Gerling and Karl H. Heller, All About Machine Tools, New Age International (P) Limited Publishers, Noida, 2008
4. Steve F. Krar, Arthur R. Gill and Peter Smid, Technology of Machine Tools, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.

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

COURSE OBJECTIVES

- To list the various practical aspects of instrumentation with emphasis on mechanical domain.
- To explain the various types of governor, cam, balancing of rotating masses and to determine the M.I. of various systems.
- To discuss the concept of mechanical measurement and various methods used for measuring the
- To formulate the concept of vibrating system spring mass.

LIST OF EXPERIMENTS

1. Governor – Determination of sensitivity, effort, etc. for Watt, Porter, Proell, Hartnell Governors.
2. Cam – Study of jump phenomenon and drawing profile of the cam.
3. Motorized Gyroscope – Verification of law's – Determination of gyroscopic couple.
4. Whirling of shaft – Determination of critical speed of shaft with concentrated loads.
5. Balancing of reciprocating masses.
6. Balancing of rotating masses.
7. Determination of Moment of inertia by oscillation method for connecting rod and flywheel.
8. Vibrating system spring mass – system – Determination of damping co – efficient of single degree of Freedom system.
9. Determination of influence co – efficient for multi degree freedom suspension system.
10. Determination of transmissibility ratio – vibrating table.
11. Determination of torsional natural frequency of single and Double Rotor systems. - Undamped and Damped Natural frequencies.
12. Transverse vibration of Free and Fixed beam with and without concentrated masses.

TOTAL PERIODS 30**COURSE OUTCOMES**

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

- relate the different characteristics of governors and verify with gyroscopic relation.
- draw the cam profile with different followers and study of jump phenomenon.
- identify the system response, natural frequency and resonance for free, forced, torsional.
- know experimental verification of dynamic balancing of rotating masses, reciprocating masses.



[illegible]

COURSE OBJECTIVES

- To improve the skills to formulate a technical project.
- To explain the various tasks of the project and standard procedures.
- To Teach the use of new tools, algorithms and techniques required to carry out the projects.
- To analyze the various procedures for validation of the product and analyze the cost effectiveness.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The Device/system/component to Be fabricated may be decided in consultation with the supervisor. A project report to be submitted by the group and the fabricated model, which will be reviewed and Evaluated for internal assessment by a Committee Constituted by the Head of the Department. At the end of the semester examination the project work is evaluated based on oral presentation and the Project report jointly by external and internal examiners constituted by the Head of the Department. It is highly desirable to publish their project in state/ national level conferences or Symposiums.

TOTAL PERIODS 30**COURSE OUTCOMES**

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

- formulate the real-world problem, identify the requirement and develop the design solutions.
- identify the technical ideas, strategies and methodologies and use the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- analyze and validate through conformance of the developed prototype and analysis the cost effectiveness.
- explain the acquired knowledge through preparation of report and oral presentations.

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



SEMESTER V

DESIGN OF MACHINE ELEMENT

MT15501

(Use of PSG Design Data Book is permitted)

3 2 0 4

COURSE OBJECTIVES

To enable students to

- describe the various steps involved in the design process.
- identify the principles involved in evaluating the shape and dimensions of a component and to satisfy functional and strength requirements.
- propose the standard practices and standard data.
- extend the uses of catalogues and standard machine components.
- design the simple machine elements shaft, coupling, joint, lever, spring, flywheel and bearing.

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 15

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties - Direct, Bending and Torsional stress equations - Impact loading - Calculation of principle stresses for various load combinations- Design of curved Beams - Crane hook and C frame - Factor of safety - The theories of Failure.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 15

Design of solid and hollow shafts based on strength, rigidity and critical speed - Design of keys and key ways - Design of rigid and flexible couplings - Muff, Clamp, Rigid Flange, Bushed-pin flexible couplings

UNIT III DESIGN OF JOINTS 15

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints, Riveted joints for structures - theory of bonded joints.

UNIT IV DESIGN OF SPRINGS AND FLYWHEEL 15

Design of helical, multi- leaf and torsional springs under constant loads and varying loads - End conditions and length of springs - Stresses in Helical springs of circular wire - Wahl stress factor - Design of flywheels involving Stresses in rim and arm.

UNIT V DESIGN OF BEARINGS 15

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings - Sommerfeld Number - Raimondi and Boyd graphs - Selection of Rolling Contact bearings.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- acquire knowledge about design process and the factors influencing it and design the simple components for static loading.
- categorize the knowledge of life of the components subjected to varying loads.
- encompass grasped the concept the welded joints, threaded joints and springs subjected to static loads.
- formulate the design procedure for springs and flywheel.
- understand the rolling contact bearings for static and cyclic loads, select the lubricants and bearing dimensions for hydrodynamic lubrication.

TEXT BOOKS

1. Bhandari V, “Design of Machine Elements”, 3rd Edition, Tata McGraw-Hill Book Co, (2010).
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill, (2008).

REFERENCES

1. Sundararajamoorthy T. V. Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, (2003).
2. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 4th Edition, Wiley, (2005).
3. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-Hill Book Co (2011).
4. Bernard Hamrock, Steven Schmid, Bo Jacobson, “Fundamentals of Machine Elements”, 2nd Edition, Tata McGraw-Hill Book Co., (2006).
5. Orthwein W, “Machine Component Design”, Jaico Publishing Co, (2003).

WEB LINKS

1. <https://mech.iitm.ac.in/meiitm/course/design-of-machine-elements/>
2. http://www.readorrefer.in/article/Design-of-Shafts-and-Couplings_5901/
3. <https://www.rroij.com/open-access/design-and-development-of-dual-mass-flywheel-system.php?aid=54289>.

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



COURSE OBJECTIVES

To enable students to

- access knowledge on different types of power semi-conductor devices and their switching characteristics.
- identify with the operation of converter and their firing circuits and different commutation techniques of power converters.
- identify with the operation of various chopper conversion techniques and basics of resonance converter.
- propose the mode of inverters and different modulation techniques.
- propose the types of ac voltage controllers and basics of matrix converters.

UNIT I POWER SEMICONDUCTOR DEVICES 9

Study of switching devices, Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT-Static and Dynamic Characteristics - Commutation: Natural Commutation, Forced commutation, self-commutation. snubber circuit.

UNIT II PHASE-CONTROLLED CONVERTERS 9

2-pulse, 3-pulse and 6-pulse converters—performance parameters —Effect of source inductance— Gate Circuit Schemes for Phase Control—Dual converters.

UNIT III CHOPPER 9

Step-down and step-up chopper - control strategy—Forced commutated chopper—Voltage commutated, Current Commutated, switched mode regulators - Buck, boost, buck-boost converter. Introduction to Resonant Converters.

UNIT IV INVERTERS 9

Single phase and three phase voltage source inverters (both 120° mode and 180° mode) —PWM techniques: Current Sinusoidal PWM, modified sinusoidal PWM - multiple PWM — Introduction to space vector modulation — Source inverter - Introduction to multilevel inverter.

UNIT V AC VOLTAGE CONTROLLERS 9

Single phase and Three phase AC voltage controllers — Control strategy - Power Factor Control — Multistage Sequence control - single phase and three phase cyclo converters — Introduction to Matrix converters.

TOTAL PERIODS 45

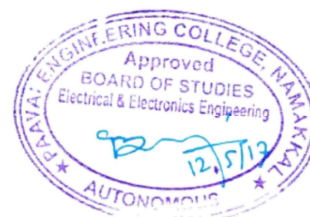
Upon the completion of the course, students will be able to

- ## TEXT BOOKS

- ## REFERENCES

1. L.Umanand, Power Electronics Essentials and Applications, Wiley India Pvt Ltd,Reprint,2010.
2. G.K. Dubey, S.R. Doradla, A. Joshi and R.M.K. Sinha, Thyristorised Power Controllers, New Age International Publishers, 2012.
3. Ned Mohan,Tore M. Undeland and William P.Robins, Power Electronics – Converters, Applications and Design Third Edition, John Wiley and Sons, 2008.
4. R.S. Ananda Murthy and V. Nattarasu, Power Electronics: A Simplified Approach, Pearson/Sanguine Technical Publishers,2009
5. Daniel W.Hart, Power Electronics, McGraw-Hill Publishing Company Ltd, 2011.

1. <http://www.completepowerelectronics.com/>
2. <http://www.irf.com/>

[illegible]

COURSE OBJECTIVES

To enable students to

- achieve a knowledge of the basics of scientific measurement techniques.
- discuss about units, standards, error analysis and characteristics of measurement systems.
- understand the process of electrical measurement.
- learn a signal conditioning circuit and data acquisition system.
- plan and purpose of this course is to make the students to get adequate knowledge about virtual instrumentation.

UNIT I SCIENCE OF MEASUREMENT

9

Units and Standards - Calibration techniques - Errors in Measurements - Generalized Measurement System - Static and dynamic characteristics of transducers - Generalized Performance of Zero Order and First Order Systems - Response of transducers to different Time varying inputs. Classification of transducers.

UNIT II MECHANICAL MEASUREMENTS

9

Temperature measurement: Filled thermometer - bimetallic thermometer - Pressure measurement: manometers - elastic transducers - Bourdon gauge – bellows – diaphragm - Vacuum measurement: McLeod gauge - thermal conductivity gauge - Ionization gauge - Flow Measurement: orifice – venturi – nozzle - pilot tube - turbine flow Meter -hot wire Anemometer.

UNIT III ELECTRICAL MEASUREMENTS

9

Potentiometer - RTD - Thermistor - Thermocouple - Strain gauges - LVDT - RVDT – Capacitive transducers - Piezo electric transducer - Pyrometers - load cell - Hall effect Transducers – Photoelectric transducers - Fiber Optic transducers -Electromagnetic Transducers - Anemometers – hygrometer.

UNIT IV SIGNAL CONDITIONING AND DATA ACQUISITION

9

Amplification, Filtering – Level conversion – Linearization - Buffering – Sample and Hold circuit - Multiplexer / Demultiplexer – Analog to Digital converter – Digital to Analog converter- Data Acquisition -Data Logging – Data conversion – Introduction to Digital Transmission system.

UNIT V VIRTUAL INSTRUMENTATION

9

Introduction to Lab VIEW - Graphical user interfaces - Data types - Data flow programming - Graphical programming - Palettes and tools Front panel objects - Functions and libraries - FOR Loops - WHILE Loops - Arrays and Clusters - Attribute modes Local and Global Variables - Data acquisition using DAQ card.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify the units and standards, their conversions, characteristics and error analysis of systems.
- describe the different devices available in mechanical measurements.
- classify and describe resistive, inductive and capacitive transducers which are used for measuring various parameters like displacement, temperature, humidity etc.
- design a signal conditioning circuit and data acquisition system.
- construct the lab view program for various applications and to know the use of lab view and daq card.

TEXT BOOKS

1. A.K.Sawhney and P.Sawhney, A Course on Mechanical Measurement Instrumentation and Control, Dhanpat Rai and Co, New Delhi, 2011.
2. Garry M. Johnson, Labview Graphical Programming, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.

REFERENCES

1. D. Patranabis, “Sensors and Transducers”, PHI, New Delhi, 2nd Edition, 2010.
2. Ernest O. Doebelin, “Measurement Systems – Applications and Design”, Tata McGrawHill, 2009
3. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011

WEB LINKS

1. <http://www.mfg.mtu.edu/cyberman/machtool/machtool/sensors/fundamental.html>
2. <http://sensorsandinstrumentation.co.uk/>



Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	1	-	2	2	1	-	3	2	1	-	2	3
CO2	2	1	-	-	-	3	2	1	3	2	1	-	-	-
CO3	-	3	2	1	2	-	-	3	2	-	2	2	-	1
CO4	2	3	2	-	1	2	2	1	-	3	2	1	-	2
CO5	-	2	2	1	2	-	-	3	2	-	2	2	-	1

COURSE OBJECTIVES

To enable students to

- identify the evolution and principle of CNC machine tools.
- describe the constructional features of CNC machine tools.
- construct the simple programs for CNC turning and machining centers.
- describe the tooling and work holding devices for CNC machine tools.
- explain the CNC programs for popular CNC controllers.

UNIT I INTRODUCTION TO CNC MACHINE TOOLS 9

Evolution of CNC Technology, principles, features, advantages, applications - CNC and DNC concept, systems- classification of CNC Machines turning centre, machining centre, grinding machine, EDM - Types of control CNC controllers, characteristics, interpolators - Computer Aided Inspection.

UNIT II STRUCTURE OF CNC MACHINE TOOL 9

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

UNIT III DRIVES AND CONTROLS 9

Spindle drives - DC shunt motor, 3 phase - AC induction motor - Feed drives - Stepper motor – Servo principle - DC and AC servomotors - Open loop and closed loop control - Axis measuring system - synchro, synchro- Resolver, gratings, moiré fringe gratings, encoders.

UNIT IV CNC PROGRAMMING 9

Coordinate system - Structure of a part program - G & M Codes - Tool length compensation – Cutter radius and tool nose radius compensation - Do loops, subroutines, canned cycles, mirror image, parametric programming.

UNIT V TOOLING AND WORK HOLDING DEVICES 9

Introduction to cutting tool materials: Carbides, Ceramics, CBN, PCD inserts classification - PMK, NSH, holding qualified, semi qualified and preset tooling - Tooling system for machining centre and turning centre - Work Devices for rotating and fixed work parts - Economics of CNC - maintenance of CNC machines.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify the evolution, principles, classification and applications of cnc machine tools.
- define the basic structure, construction, working and control of cnc machines.
- identify the fundamentals of drive system and control modules of cnc technology.
- expand the program for cnc machines.
- propose the knowledge about different tooling and working holding devices of cnc.

TEXT BOOKS

1. P. Radhakrishnan, Computer Numerical Control Machine & Computer Aided Manufacturing, New Academic Science Limited.
2. Tilak Raj, CNC Technology & Programming, Dhanpat Rai publishing company(p) ltd., New Delhi

REFERENCES

1. P. N. Rao and N. K. Tiwari, Numerical Control and Computer Aided Manufacturing, Tata McGraw-Hill Publishing company, New Delhi
2. M. Adithan & B. S. Pabla, CNC Machines, New Age International Publishers , New Delhi
3. HMT Limited, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.

WEB LINKS

1. <http://www.brighthubengineering.com/manufacturing-technology>
2. <https://www.scribd.com/doc/29051586/Introduction-of-CNC-Machine>.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	1	1	2	2	-	3	2	1	-	2	3
CO2	2	1	1	1	-	2	2	1	3	2	1	-	1	1
CO3	1	3	2	1	2	1	-	3	2	-	2	2	-	1
CO4	3	2	2	-	1	2	2	2	-	3	2	1	1	2
CO5	1	2	2	1	2	-	1	2	2	-	2	2	-	1



COURSE OBJECTIVES

To enable students to

- understand performance and applications of various power semi converter devices.
- know the various phase controlled rectifiers with different loads.
- study the chopper circuit using MOSFET and IGBT.
- analyze the various PWM inverters, know the performance of AC voltage converters.

LIST OF EXPERIMENTS

1. Characteristics of SCR and TRIAC.
2. Characteristics of MOSFET and IGBT.
3. Gate Pulse Generation using R, RC and UJT.
4. Voltage commutation.
5. Current commutation.
6. AC to DC half controlled converter.
7. AC to DC fully controlled converter.
8. Step down and step up MOSFET based choppers.
9. IGBT based single phase PWM inverter.
10. IGBT based three phase PWM inverter.
11. AC Voltage controller.
12. Cyclo converter.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- compare and contrast the performance and applications of various power semi converter devices.
- design the various phase controlled rectifiers with different loads.
- analyze the chopper circuit using MOSFET and IGBT.
- design and analyze the various PWM inverters, evaluate the performance of AC voltage converters.

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

	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO2	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	3	-	3	3



COURSE OBJECTIVES

To enable students to

- develop the analysis and design skills needed in PC based acquisition and control systems.
- measure voltage, current, temperature, displacement, power and torque.
- provide hands on experience on measuring instruments.
- understand the concept of controlling the parameters based on measurement.

LIST OF EXPERIMENTS

1. Measurement of temperature using thermistor and RTD
2. Measurement of temperature using thermocouple
3. Measurement of displacement using POT & Capacitive transducer
4. Measurement of displacement using LVDT
5. Strain Measurement using strain gauge
6. Servomotor position control using photo electric pickup
7. Load Cell Measurement
8. Torque measurement using torque measuring devices
9. Digital Comparator
10. Analog to Digital Converters
11. Position and velocity measurement using encoders
12. Study on the application of data acquisition system for industrial purposes.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- choose the sensors for the measurement of different signals.
- analyze the servomotor position control using photo electric pickup.
- create the appropriate design procedure to obtain a required measurement data.
- identify the signal processing techniques to convert them to useful signal.

TEXT BOOKS

1. A. K. Sawhney and P. Sawhney, A Course on Mechanical Measurement Instrumentation and Control, Dhanpat Rai and Co, New Delhi, 2011
2. LabVIEW: Basics I & II Manual, National Instruments, Bangalore, 2011

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

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



COURSE OBJECTIVES

To enable students to

- design problems in a systematic manner.
- instruct the manual and computer assisted part programming, tool path generation operation and control of CNC machines tools.
- use the CNC machines efficiently for manufacturing desired products and knowledge of programming and use of CNC tooling.
- implement CNC programs for milling and turning machining operations.

LIST OF EXPERIMENTS

1. Study of G codes and M codes for machining centre and turning centre.
2. Manual part programming using G and M codes for Turning, step turning, Taper turning, thread cutting and radius turning on cylindrical components.
3. Given a component drawing to write the manual part programming and execute on CNC Lathe and Milling Machine.
4. Programming and Simulation of machining using the following features.
 - (i) Linear and Circular interpolation
 - (ii) Pocket milling, slotting, peck drilling and other fixed canned cycles.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- program in the cnc machines to generate any contour/ profile.
- generate the part programs for cnc lathe.
- sketch the drawings of standard machine components using any modelling software.
- develop the cnc program for pocket milling, slotting, peck drilling and other fixed canned cycles.

REFERENCES

1. T1. William W. Lugges, CNC A First Look Primer, Delmar Publishers, New York, (1997)
2. Alan Overby, CNC Machining Handbooks: Building, Programming and Implementation, McGraw-Hill Publishing Company Ltd, New York, (2011).

WEB LINKS

1. <http://www.sosmath.com/matrix/matrix.html>

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

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



COURSE OBJECTIVES

To enable the students to

- to understand their capabilities and enhance their grooming and showcasing his/her capabilities to a prospective employer.
- to provide opportunity for the students to become acquainted with corporate opportunities relevant to their academic learning.
- to articulate their thoughts on a given topic - in English and also to make decent write ups in English on any given topic.
- to practice and score well in Aptitude tests conducted by corporate / prospective employers.
- to become a knowledgeable person on the various evaluation processes leading to employment.

UNIT I PERSONALITY DEVELOPMENT 1 6

Introduction – Self Explorations – Character Building – Self Esteem- Self Confidence- Positive Thinking - Leadership Qualities- Time Management.

UNIT II PERSONALITY DEVELOPMENT 2 6

Grooming- Role Play – Good Etiquettes - Extempore - Writing Skills: Email, Paragraph – Team Building- Body Language - Non-Verbal Communication.

UNIT III QUANTITATIVE APTITUDE (QA) 1 6

Time, Speed & Distance -- Simple Interest & Compound Interest – Percentage – Height & Distance – Time & Work – Number Systems – L.C.M & Hcf – Ratio Proportion- Area – Directions.

UNIT IV LOGICAL REASONING (LR) 1 6

Analogies - Letter & Symbol Series – Number Series – Cause & Effect – Essential Part – Verbal Reasoning.

UNIT V VERBAL REASONING (VR) 1 6

Blood Relation – Venn Diagrams – Analogy – Character Puzzles – Logical Sequence – Classification – Verification of Truth – Seating Arrangement.

TOTAL PERIODS 30

COURSE OUTCOMES

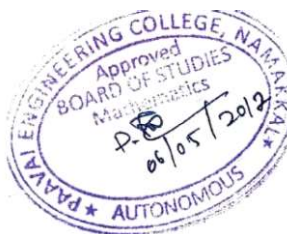
Upon the completion of the course, students will be able to

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

REFERENCES

1. Agarwal, R.S.” A Modern Approach To Verbal & Non Verbal Reasoning”, S.Chand & Co Ltd, New Delhi.
2. Abhijit Guha, “Quantitative Aptitude “, Tata-Mcgraw Hill.
3. Word Power Made Easy By Norman Lewis, Wr.Goyal Publications.
4. Johnson, D.W. Reaching Out – Interpersonal Effectiveness and Self Actualization. Boston: Allyn and Bacon.
5. Agarwal, R.S. “Objective General English” S.Chand & Co.
6. Infosys Campus Connect Program – Students’ Guide for Soft Skills.

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
CO5	3	-	2	-	-	-	-	-	3	3	3	2	2	2



COURSE OBJECTIVES

To enable students to

- provide a clear view on programmable logic controllers (PLC).
- propose the various methods involved in automatic control and monitoring.
- develop the plc program for various applications.
- know the basic features of micro controllers.
- understand programs and applications of micro controllers.

UNIT I PROGRAMMABLE LOGIC CONTROLLERS 9

Introduction - Parts of PLC - Principles of operation - PLC sizes - PLC hardware components - I/O section- Analog I/O modules - digital I/O modules CPU processor memory module – PLC programming Simple instructions - Output control devices - Latching relays PLC ladder Diagram, Converting simple relay ladder Diagram in to PLC relay ladder diagram.

UNIT II INSTRUCTIONS 9

Timer instructions ON Delay, OFF Delay and Retentive Timers-UP Counter, DOWN Counter and UP down Counters, program control instructions - Data manipulating instructions-math Instructions.

UNIT III APPLICATION OF PLC 9

Simple materials handling applications, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control, Automatic car washing machine, Bottle Label detection and process control application.

UNIT IV INTRODUCTION TO MICROCONTROLLER 9

8051 Architecture: Memory map - Addressing modes, I/O Ports –Counters and Timers – Serial data - I/O – Interrupts –Instruction set, Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions, Assembly Language Programming tools.

UNIT V MICROCONTROLLER PROGRAMMING AND ITS APPLICATIONS 9

8051 Assembly Language Programming- arithmetic operations-Interfacing of Keyboards – Interfacing of Display Devices – Pulse measurement – Interfacing Hardware Circuit – Serial Data Communication – Network Configuration.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify the different parts of plc and its functions.
- analyze the use of timers and counters in plc.
- develop the plc program for various applications.
- know about the architecture of microcontroller.
- learn the theory, programming and application of microcontroller.

TEXT BOOKS

1. Petruzella Frank D, Programmable Logic Controllers, Tata McGraw-Hill Publishing (p) Ltd., New Delhi, 2010.
2. Muhammad Ali Mazdi ,J.G.Mazdi & R.D.McKinlay "The 8051 Microcontroller& Embedded systems Using assembly & C "2nd Edition Pearson Education , Inc ,2006.

REFERENCES

1. Parr, "Programmable Controllers: An Engineers Guide", 3rd Edition, Elsevier, Indian Reprint, 2013.
2. Bolton , "Programmable Logic Controllers 5th Edition Newnes,2009.
3. Singh. B.P., "Microprocessors and Microcontrollers", Galcotia Publications (P) Ltd, First Edition, New Delhi, 1997.

WEB LINKS

1. <http://electrical-engineering-portal.com/basic-steps-in-plc-programming>
2. <http://www.plcmanual.com/>

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



COURSE OBJECTIVES

To enable students to

- identify the concepts of fluid power.
- examine the fundamental knowledge of hydraulic and pneumatic system.
- design and operation of hydraulic and pneumatic components and systems.
- use application in manufacturing and mechanical systems.
- identify the design of hydraulic and pneumatic circuits applied in industries.

UNIT I FLUID POWER SYSTEMS 9

Introduction to Fluid power- Advantages and Applications- Fluid Power ANSI Symbols- Types of fluids- Properties of fluids – Pascal's law and Applications-Basics of Hydraulics – Principles of flow – Pump Classification- Pump characteristics- Construction, Working, Performance, Selection criteria of pumps, Advantages, Disadvantages.

UNIT II HYDRAULIC ACTUATORS AND VALVES 9

Hydraulic Actuators: Cylinders– Types and construction, Application, Hydraulic cushioning – Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation- Servo and Proportional valves – Applications.

UNIT III HYDRAULIC SYSTEMS 9

Intensifiers, Industrial hydraulic circuits- Regenerative, Pump Unloading, Double-pump, Pressure Intensifier, Air- over oil, Reciprocation, Synchronization, Sequencing, Fail-safe, Speed Control, Hydrostatic transmission, Electro Hydraulic circuits.

UNIT IV PNEUMATIC SYSTEMS 9

Properties of air– Perfect Gas Laws- Filter, Regulator, Lubricator-Pneumatic actuators, Design of pneumatic Circuit cascade method-Electro pneumatic circuits. Accumulators: types and applications.

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic Systems-Case studies and Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift Applications. Design of Pneumatic circuits for a Pick and Place application - Case studies.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- illustrate symbols used in hydraulic and pneumatic systems.
- identify the appropriate components for hydraulic and pneumatic circuits.

- operate and maintain various pneumatic and hydraulic systems in industrial environments.
- design the hydraulic and pneumatic circuits for simple application.
- construct the fluid power circuits applied in industries.

TEXT BOOKS

1. Anthony Esposito, “Fluid Power with Applications”, Pearson, (2009).
2. S. R. Majumdar, “Pneumatic systems - Principles and maintenance”, Tata McGraw Hill, (2014).

REFERENCES

1. James L. Johnson, “Introduction to Fluid Power”, Delmar Thomson Learning, (2013).
2. Andrew Parr, “Hydraulics and Pneumatics”, Jaico Publishing House, (2015).
3. Illangov Soundararajan, “Introduction to Hydraulics and Pneumatics, Prentice hall of India, New Delhi, (2015)
4. S. R. Majumdar, “Oil Hydraulics”, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, (2014).
5. Pinches, “Industrial Fluid Power”, Prentice hall, New Delhi, (2008).

WEB LINKS

1. <http://www.jmpeng.com/wp-content/uploads/2014/03/PickFlex-CaseStudy.pdf>
2. <http://www.arozone.com/en/products/diaphragm-pumps.html>
3. <http://hydraulicspneumatics.com/datasheet/bluetooth-and-smartphones-configure-hard-reach-hydraulic-valves-pdf-download>.

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



COURSE OBJECTIVES

To enable students to

- access the knowledge on laws of thermodynamics concepts, principles and mechanism for physical systems.
- identify the applications of air standard cycles.
- familiar the application of various experimental heat transfer correlations in engineering calculations.
- apply empirical correlations for both forced and free convection to determine values for the convection heat transfer coefficient.
- understand the basic concepts of radiation heat transfer to include both black body radiation and gray body radiation.

UNIT I LAWS OF THERMODYNAMICS 15

Systems-**closed and open systems** - properties, processes and cycles- equilibrium- work and heat transfers-first Law for a closed system and flow processes - enthalpy - **second law -entropy- entropy change.**

UNIT II AIR STANDARD CYCLES 15

Air standard cycles: Carnot cycle - Otto cycle - Diesel cycle - Brayton cycle - Rankine cycle- cycle efficiency – IC Engine: two stroke and four stroke engines.

UNIT III HEAT TRANSFER: CONDUCTION 15

Basic Concepts- Mechanism of Heat Transfer - Conduction, Convection and Radiation - Fourier Law of Conduction - **General Differential equation of Heat Conduction** -Cartesian and Cylindrical Coordinates - **One Dimensional Steady State Heat Conduction**

UNIT IV CONVECTION 15

Convection: Basic Concepts -**Heat Transfer Coefficients** - Boundary Layer Concept - Types of Convection - Forced Convection - External Flow and Internal Flow - **Flow over Plates**, Cylinders and Spheres.

UNIT V RADIATION 15

Basic Concepts, Laws of Radiation - **Stefan Boltzmann Law**, Kirchhoff's Law -Black Body Radiation and Radiation Between different surfaces.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- examine the laws and basic concept of thermodynamics.
- draw pv diagram and obtain the performance of air standard cycles.
- examine the one dimensional heat transfer through conduction for a given system.
- explain the types of convection and determine heat transfer coefficient.
- justify the radiation effect among different surfaces.

TEXT BOOKS

1. P. K. Nag, Engineering Thermodynamics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.

2. C. P. Kothandaraman , Fundamentals of Heat and Mass Transfer, 3rd edition, New Age International publishers, New Delhi, 2006.

Using assembly & C “ 2nd Edition Pearson Education , Inc ,2006.

REFERENCES

1. Yunus A. Cengel and Michael A. Boles, Thermodynamics - An Engineering Approach in SI Units, Tata McGraw Hill Publishing Company, New Delhi, 2010.

2. T. D. Eastop and McConkey, Applied Thermodynamics for Engineering Technologists, Pearson, New Delhi, 2004

3. C. P. Kothandaraman and S. Subramanya, 8th Edition Heat and Mass Transfer Data Book, New Age International publishers, New Delhi, 2014.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak)														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	1	2	2	1	3	-	1	3	2	3
CO2	2	2	1	2	-	3	2	1	3	1	1	2	1	1
CO3	2	3	3	1	2	1	-	3	2	-	3	2	-	2
CO4	3	2	2	-	1	2	3	2	-	1	2	1	1	2
CO5	2	2	1	1	2	2	1	2	2	-	2	2	2	1



COURSE OBJECTIVES

To enable students to

- learn the basic concepts of Object-Oriented Programming.
- learn the basics of C++ language.
- know about C++ data types, access modifiers, classes and objects.
- work on identifying the relationship between classes.
- know about master of Object-Oriented Programming using C++.

UNIT I INTRODUCTION TO C++ 9

Object oriented programming concepts - **Introduction to C++** - Tokens – Keywords – Identifiers and constants– Basic data types– User defined data types – Derived data types – Symbolic constants – Declaration of variables – Dynamic initialization of variables – Reference variables – **Operators in C++** – Scope resolution operator – Manipulators – Expressions and their types – Control structures - The main function – Function prototyping – Call by reference – Return by reference – Inline functions – Default arguments –Function overloading.

UNIT II CLASSES AND OBJECTS 9

Specifying a class – **Defining member functions** – Private member functions –Arrays within a class – Memory allocation for objects – Static data members – Static member functions – Arrays of objects – Objects as function arguments –Friendly functions – **Returning objects**. Constructors: Parameterized constructors – Multiple constructors in a class – Constructors with default arguments – Dynamic initialization of objects – Copy constructor – Dynamic constructors – Destructors.

UNIT III OPERATOR OVERLOADING AND INHERITANCE 9

Defining operator overloading: Overloading unary, binary operators. Manipulation of strings using operators – Rules for overloading operators – **Type Conversions** - Defining derived classes – Single inheritance – Multilevel Inheritance – Multiple inheritance –Hierarchical inheritance – **Hybrid inheritance** – Virtual base classes – Abstract classes.

UNIT IV POLYMORPHISM AND TEMPLATES 9

Introduction to pointers to objects: This pointer – **Pointers to derived classes** – Virtual functions – Pure virtual functions. Function templates, user defined template arguments, class templates.

UNIT V EXCEPTION HANDLING AND GENERIC PROGRAMMING 9

Exception Handling: **Exception handling mechanism**, multiple catch, nested try, rethrowing the exception – Namespaces – std namespace- Standard Template Library.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify and apply object-oriented concepts like abstraction, encapsulation, modularity, hierarchy, typing, concurrency and persistence.
- relate real world object into entity.
- create reusable system components.
- estimate various metrics specific to object-oriented development.
- predict runtime error using exception handling technology.

TEXT BOOKS

1. E.Balagurusamy, “Object Oriented Programming with C++”, Tata McGraw Hill, Sixth Edition, 2013.

REFERENCES

1. Ira Pohl, “Object Oriented Programming using C++”, Pearson Education, Second Edition Reprint 2004.
2. S. B. Lippman, JoseeLajoie, Barbara E. Moo, “C++ Primer”, Fourth Edition, Pearson Education, 2005.
3. B. Stroustrup, “The C++ Programming language”, Third edition, Pearson Education, 2004.

WEB LINKS

1. <http://nptel.ac.in/courses/106105151/>
2. https://www.tutorialspoint.com/cplusplus/cpp_object_oriented.htm
3. <http://www.studytonight.com/cpp/cpp-and-oops-concepts.php>

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	1	-	2	-	-	-	1	1	1	-
CO2	-	1	3	-	1	-	2	-	-	-	-	-	-	1
CO3	-	1	3	2	-	-	-	-	-	-	-	-	1	-
CO4	-	2	2	-	1	-	-	-	-	-	-	1	-	1
CO5	1	2	2	1	-	-	1	-	-	-	-	-	-	-



COURSE OBJECTIVES

To enable students to

- provide a clear view on programmable logic controllers
- learn the various methods involved in automatic control and monitoring.
- describe the uses of microcontroller.
- impart knowledge on configure microcontroller with stepper motor.

LIST OF EXPERIMENTS

1. Study of Programmable Logic Controllers
2. Linear actuation of hydraulic cylinder with counter and speed control.
3. Hydraulic rotation with timer and speed control.
4. Sequential operation of pneumatic cylinders
5. Traffic light controller
6. Linear actuation of hydraulic cylinder with counter and speed control.
7. Automate the tank water level and flow control using PLC
8. Bottle filling process using PLC
9. Study of Microcontroller Kits.
10. 8051 / 8031 Programming (Addition and subtraction)
11. 8051 / 8031 Programming (Multiplication and Division)
12. Stepper Motor interface



TOTAL PERIODS 30

COURSE OUTCOMES

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

- compose the plc program for various applications like bottle filling, cylinder actuation and elevator control.
- choose plc to control different motor/equipment.
- choose microcontroller for interfacing.
- compose the microcontroller programming.

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	PSO 2
CO1	3	1	2	1	3	2	-	1	3	-	1	3	2	2
CO2	2	-	2	2	2	1	2	1	2	-	2	2	2	1
CO3	2	-	2	1	3	1	-	3	2	-	-	2	1	2
CO4	3	1	2	-	2	2	3	2	-	-	2	-	1	2

COURSE OBJECTIVES

To enable students to

- know fundamental knowledge of object-oriented programming.
- demonstrate C++ syntax and semantics.
- solve simple engineering problems.
- know the development of solution for complex problems in the real world.

LIST OF EXPERIMENTS

1. Write C++ Programs using Classes and Objects.
2. Design C++ Classes with static members, methods with default arguments, friend functions.
3. Develop C++ Programs using Operator Overloading.
4. Develop C++ Programs using constructor, destructor, and copy constructor.
5. Develop C++ Programs Overload the new and delete operators.
6. Develop C++ Programs using Inheritance, Polymorphism and its types.
7. Develop C++ Programs using Arrays and Pointers.
8. Develop C++ Programs using Dynamic memory allocation.
9. Develop C++ Programs using Function Templates.
10. Develop C++ Programs using Exceptions Handling.
11. Write C++ Programs using Classes and Objects.
12. Design C++ Classes with static members, methods with default arguments, friend functions.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- understand object-oriented concepts and how they are supported by C++.
- demonstrate the ability to analyze, use, and create functions, classes, to overload operators.
- create and initialize real world entities using constructors.
- apply the concepts of data encapsulation, inheritance, and polymorphism to develop large scale software.

RECOMMENDED SYSTEM/SOFTWARE REQUIREMENTS

Software: Turbo C++.

Hardware: Flavor of any WINDOWS or LINUX and Standalone desktops 30 Nos.

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

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



COURSE OBJECTIVES

To enable students to

- invent and provide hand on experience to students to design and test hydraulic circuit to control press, flow.
- gain to design and test hydraulic, pneumatic circuits.
- design and test the pneumatic circuit to perform basic operations.
- invent and provide hand on experience to students to design and test hydraulic circuit to control press.

LIST OF EXPERIMENTS

1. Fluid power standards.
2. Study of Hydraulics systems components.
3. Study of Pneumatic systems components.
4. Design of pressure control of Pneumatic circuit
5. Design of Meter in Circuit.
6. Design of Meter out Circuit.
7. Design of Speed control circuit for double acting Pneumatic cylinder.
8. Design of Hydraulic press Circuit.
9. Design of Hand operated Pneumatic Double Acting Cylinder using fluid power simulation software
10. Design of Hydraulic cylinder reciprocating system using fluid power simulation software
11. Design and Testing of two Pneumatic Double Acting Cylinder Sequencing circuit (A+ B+ B- A-) using fluid
12. Design and Testing of Pneumatic two Double Acting Cylinder Synchronization circuits. (Cylinders connected in Series and Parallel) using fluid power simulation software.

TOTAL PERIODS 30

COURSE OUTCOMES

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

- find the experience of common hydraulics & pneumatic machine used in the industries.
- construct the fluid system for various applications.
- know the use of automation studio software for simulation of hydraulic circuits.
- know the use of automation studio software for simulation of pneumatic circuits.



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

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

COURSE OBJECTIVES

To enable the students to

- to understand their capabilities and enhance their grooming and showcasing his/her capabilities to a prospective employer.
- to provide opportunity for the students to become acquainted with corporate opportunities relevant to their academic learning.
- to articulate their thoughts on a given topic - in English and also to make decent write ups in English on any given topic.
- to practice and score well in Aptitude tests conducted by corporate / prospective employers.
- to become a knowledgeable person on the various evaluation processes leading to employment.

UNIT I CORPORATE READINESS

Business Communication – Inter & Intra Personal Skills – Business Etiquettes – Corporate Ethics – Communication Media Etiquette.

UNIT II INTERVIEW SKILLS

Resume Building – Group Discussions – Presentation Skills – Entrepreneur Skills – Psychometric Assessment – Mock Interview.

UNIT III QUANTITATIVE APTITUDE (QA) 2

Profit & Loss – Clock – Power & Square Roots – Train – Boats & Streams – Probability – Calendars – Permutations & Combinations - Partnership – Simplification – Pipes & Cisterns – Puzzles.

UNIT IV LOGICAL REASONING (LR) 2

Statements & Assumptions – Matching Definitions – Logical Games – Making Judgements – Statements & Conclusions – Verbal Classifications.

UNIT V VERBAL REASONING (VR) 2

Syllogisms – Data Sufficiency – Dice – Series Completion – Character Puzzles – Cube & Cuboids – Arithmetic Reasoning.

TOTAL PERIODS 30

COURSE OUTCOMES

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

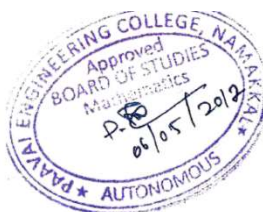
- demonstrate aptitude and reasoning skills.
- enhance verbal and written ability.
- improve his/her grooming and presentation skills.
- interact effectively on any recent event / happenings / current affairs

- be a knowledgeable person on the various evaluation processes leading to employment and face the same with confidence.

REFERENCE

1. Agarwal, R.S.” A Modern Approach To Verbal & Non Verbal Reasoning”, S.Chand & Co Ltd, New Delhi.
2. Abhijit Guha, “Quantitative Aptitude “, Tata-Mcgraw Hill.
3. Word Power Made Easy By Norman Lewis ,Wr.Goyal Publications.
4. Johnson, D.W. Reaching Out – Interpersonal Effectiveness And SelfActualization.Boston: Allyn And Bacon.
5. Agarwal, R.S. “ Objective General English” S.Chand&Co.
6. Infosys Campus Connect Program – Students’ Guide For Soft Skills.

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
CO5	3	-	2	-	-	-	-	-	3	3	3	2	2	2



COURSE OBJECTIVES

To enable students to

- identify the several non-traditional machining process in micro and precision manufacturing field.
- select the suitable machining process for materials considering their merits and demerits.
- strengthen the graduates' ability to work productively in a global manufacturing environment.
- know the various laser material processing.
- understand the different special processing techniques.

UNIT I ADVANCED MACHINING PROCESSES 9

Introduction - Classification - process economy - Mechanical machining - Types - Ultrasonic machining (USM) - Abrasive Jet Machining (AJM) - Abrasive Flow Machining (AFM) - Water Jet Machining (WJM) - Operating principle - Process parameters - Applications - Limitations.

UNIT II ELECTRO CHEMICAL MACHINING 9

Electro chemical machining - Chemical material removal - Types - Electro chemical machining (ECM) - Electro chemical drilling (ECD) - Electro chemical grinding (ECG) - Electro chemical honing (ECH) - Shaped tube electrolytic machining - Operating principle - Process parameters - Applications - Limitations.

UNIT III THERMO ELECTRICAL MACHINING 9

Thermo electrical machining - Types – Electrical discharge machining (EDM) - Electrical discharge wire cutting (EDWC) - Electron beam machining (EBM) - Ion Beam Machining (IBM) - Plasma Arc Machining (PAM) - Operating principle - Process parameters - Applications - Limitations

UNIT IV LASER MATERIALS PROCESSING 9

Laser materials processing - Laser types - Processes - Laser beam machining (LBM) – Laser cutting (LC) – Laser drilling (LD) - Laser marking and engraving (LM) - Laser micromachining (LMM) - Laser engineered net shaping (LENS) - Applications - Limitations.

UNIT V SPECIAL PROCESSING TECHNOLOGIES 9

Special processing technologies - Rapid Prototyping - Methods - Fused Deposition Modeling (FDM) - Laminated Object Manufacturing (LOM) - Selective laser sintering (SLA) - Solid Ground curing (SGC) - 3D printing (3DP) - Processing of integrated circuits - Micro and nano fabrication technologies.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify the contribution of non-traditional machining process in micro and precision manufacturing.
- select the most appropriate process for a given product design, application requirements and cost constraint..
- summarize the merits and demerits of the non-traditional manufacturing process.

- identify the principles of non-traditional manufacturing system.
- invent subtractive and additive (3d-printing) manufacturing for rapid prototyping.

TEXT BOOKS

1. Abdel, H. and El-Hofy, G. “Advanced Machining Processes”, McGraw-Hill, USA, 2005.
2. Wellar, E.J. "Non-Traditional Machining Processes", Society of Manufacturing Engineers Publications, 2nd Edition, Michigan, 1984.

REFERENCES

1. Steen, W.M. and Watkins, K. “Laser Materials Processing”, Springer London Ltd, 2003.
2. Groover, M.P. “Fundamentals of modern manufacturing processes - Materials, Processes and Systems”, 3rd

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



COURSE OBJECTIVES

To enable students to

- introduce discrete fourier transform and its applications.
- list signal processing concepts in systems having more than one sampling frequency.
- define structure and techniques of iir filter.
- define structure and techniques of fir filter.
- teach the design of infinite and finite impulse response filters for filtering undesired signals.

UNIT I SIGNALS AND SYSTEMS 9

Basic elements of DSP – concepts of frequency in Analog and Digital Signals – sampling theorem – Discrete – Time signals, systems – Analysis of discrete time LTI systems – Z transform – Convolution–Correlation.

UNIT II FREQUENCY TRANSFORMATIONS 9

Introduction to DFT – Properties of DFT – Circular Convolution - Filtering methods based on DFT – FFT Algorithms – Decimation – in – time Algorithms, Decimation – in – frequency Algorithms – Use of FFT in Linear Filtering – DCT – Use and Application of DCT.

UNIT III IIR FILTER DESIGN 9

Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF, BRF) filter design using Frequency translation.

UNIT IV FIR FILTER DESIGN 9

Structures of FIR – Linear phase FIR filter – Fourier Series - Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanging Window), Frequency sampling techniques

UNIT V FINITE WORD LENGTH EFFECTS IN DIGITAL FILTERS 9

Binary fixed point and floating point number representations – Comparison - Quantization noise –truncation and rounding – quantization noise power- input quantization error- coefficient Quantization error – limit cycle Oscillations-dead band- Overflow error-signal Scaling.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- know the discrete Fourier transform and its applications.
- perform frequency transforms for the signals.
- design IIR filters.
- design FIR filters.
- construct finite word length effects in digital filters.

TEXT BOOK(S)

1. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education, Prentice Hall, (2015).

REFERENCES

1. Emmanuel C. Ifeachor, and Barrie W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education, Prentice Hall, (2012).
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Third Edition, Tata McGraw Hill, (2012).
3. A.V. Oppenheim, R.W. Schaffer and J.R. Buck, Discrete-Time Signal Processing, 8th Indian Reprint, Pearson, (2014).
4. Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, (2015).

WEB LINKS

1. <http://www.signalsandsystems.html>
2. <http://www.filterdesign.html>
3. <http://www.digitalfilters.html>
4. <http://www.signalprocessing.html>

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO3	2	2	3	2	2	-	-	-	-	-	-	-	3	-
CO4	2	2	3	2	2	-	-	-	-	-	-	-	3	-
CO5	1	-	2	-	-	-	-	-	-	-	-	-	2	1



COURSE OBJECTIVES

To enable students to

- identify with various types of maintenance, their procedure and defects analysis commonly adopted in manufacturing industries.
- discriminate preventive, predictive and failure maintenance.
- distinguish about usage of computers for maintenance management and various condition monitoring techniques.
- distinguish about usage of computers for maintenance management.
- understand how condition monitoring techniques can be used to detect and analyse some common machinery problems.

UNIT I INTRODUCTION TO MAINTENANCE**9**

Introduction - Fundamentals of Maintenance Engineering- **Scope of industrial preventive/predictive maintenance programs** - Definition of terminology- Overview of condition-based maintenance technologies- Maintenance planning, management and designing an effective maintenance organization- Information systems organization and asset management - Evaluating maintenance performance

UNIT II MAINTENANCE SYSTEMS**9**

Planned and un-planned maintenance - **Breakdown maintenance** - Corrective maintenance - Opportunistic Maintenance - Routine maintenance - Preventive maintenance, Predictive maintenance - Condition based Maintenance system selection of maintenance system-TPM.

UNIT III SYSTEMATIC MAINTENANCE**9**

Codification and Cataloguing-**Instruction manual and operating manual**-Maintenance manual and Departmental manual-Maintenance time standard-Maintenance work order and work permit - **Feedback and control**- Maintenance records and documentation

UNIT IV DEFECTS AND FAILURE ANALYSIS**9**

Defect generation-types of failures-**Defects reporting and recording**-Defect analysis-Failure analysis- Equipment Down time analysis-Breakdown analysis- Root cause analysis- FTA, FMEA.

UNIT V CONDITION MONITORING**9**

Condition monitoring techniques-Visual monitoring-**Temperature monitoring**-vibration monitoring- Lubricant Monitoring-Cracks monitoring-Thickness monitoring-Noise and sound Monitoring- **condition monitoring of Hydraulic system**. Machine diagnostics-Objectives- Monitoring strategies-Online monitoring.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- classify the maintenance system and select suitable one based on requirement.
- identify the documentation and record updating involved in maintenance systems.
- prepare the maintenance plan and explain the cost benefit analysis.
- analyze the defects and failures encountered in manufacturing system.

- establish the monitoring strategies according to system characteristics.

TEXT BOOKS

1. Keith Mobley, Lindley Higgins and Darrin Wikoff, "Maintenance Engineering Handbook", McGraw-hill, 2008.
2. Sushil Kumar Srivastava, Industrial Maintenance Management, S. Chand and Company Ltd, New Delhi, 2006.

REFERENCES

1. R. Keith Mobley, Maintenance Fundamentals, Butterworth Heinmann Publications, USA, 2004
2. Don Nyman and Joel Levitt, Maintenance Planning, Scheduling and Coordination, Industrial Press Inc., New York, 2010.
3. Manfred Weck and H. Bibring, Handbook of Machine Tools, John Wiley and Sons, New York, 1984.

WEB LINKS

1. <https://www.lce.com/Whats-the-role-of-the-Reliability-Engineer-1227.html>
2. [http://www. defects and failure analysis.html](http://www.defects and failure analysis.html)

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	-	-	-	-	-	-	-	-	-	-	1	-
CO2	2	2	1	1	2	-	-	-	-	-	-	-	2	1
CO3	2	2	3	2	2	-	-	-	-	-	-	-	3	-
CO4	2	2	3	2	2	-	-	-	-	-	-	-	3	-
CO5	1	-	2	-	-	-	-	-	-	-	-	-	2	1



COURSE OBJECTIVES

To enable students to

- define the basics of simulation modeling and replicating the practical situations in organizations.
- generate random numbers and random variates using different techniques.
- develop simulation model using heuristic methods.
- analysis of simulation models using input analyzer, and output analyzer.
- get elaborate knowledge on system identification and decision making.

UNIT I SYSTEM AND SYSTEM ENVIRONMENT

9

Component of a System – Continuous and discrete systems– Types of model; Steps in Simulation study; Simulation of an event occurrence using random number table – Single server queue –two Server queues – Inventory system.

UNIT II RANDOM NUMBER GENERATION

9

Properties of random numbers – Generation of Pseudo – random numbers – techniques of generating pseudo random numbers; Test for random numbers: the Chisquare test-the kolmogrov Smirnov test – Runs test – Gap Test – poker test.

UNIT III RANDOM – VARIATE GENERATION

9

Inverse transform technique for Exponential, Uniform, triangular, weibull, empirical, uniform and discrete distribution, Acceptance rejection method for Poisson and gamma distribution; Direct Transformation For Normal distribution.

UNIT IV ANALYSIS OF DATA

9

Analysis of simulated Data – Data collection, identifying the distribution, Parameter estimation, Goodness of fit Tests, verification and validation of simulation models.

UNIT V SYSTEM IDENTIFICATION

9

Concepts of System Identification – Identification using normal operating records (Integration method) – Identifiability conditions – System order determination.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- describe the simulation and its importance in creation of models for real time systems.
- describe the different types of systems.
- simulate the real time systems by generating the random numbers and variables.
- design and analyze the model using simulation software packages.
- describe identify system using integration method.

TEXT BOOKS

1. Banks J., Carson J.S. and Nelson B.L., “Discrete – Event System Simulation”, 3rd Edition, Pearson Education, Inc 2004 (ISBN 81-7808-505-4).

REFERENCES

1. Geoffrey Gordon, "System Simulation", Prentice Hall of India, 2003.
2. Narsingh Deo., "System Simulation with Digital Computer", Prentice Hall of India, 2003.
3. Birta, "Modelling and Simulation: Exploring Dynamic System Behaviour", Springer, Indian Reprint, 2010.

Mapping of Course Outcomes with Programme Outcomes: (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak)														
	Programme Outcomes (POs)													
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	-	2	-	2	-	-	-	-	-	-	1	-
CO2	2	2	-	1	2	-	-	-	-	-	-	-	2	1
CO3	3	2	-	-	2	1	-	-	-	-	-	-	3	-
CO4	-	-	2	3	1	2	-	-	-	-	-	-	3	-
CO5	3	2	1	2	-	-	-	-	-	-	-	-	2	1



COURSE OBJECTIVES

To enable students to

- identify the several aspects of the design process.
- study the concept of product costing, patenting and manufacturing economics in product design.
- identify with the relationship between customer desires.
- propose the functional requirements, product materials and product design.
- investigate the knowledge about manufacturing process selection.

UNIT I PRODUCT DESIGN AND PLANNING 9

Product Planning - Identifying Opportunities- Allocating Resources and Timing- Pre-Project Planning-Reflect on the Results and the Process-Identifying Customer Needs- Raw Data from Customers- Interpreting Raw Data in Terms of Customer Needs- Organizing the Needs into a Hierarchy-Establishing the Relative Importance of the Needs-Reflecting on the Results and the Process.

UNIT II PRODUCT SPECIFICATIONS AND CONCEPT GENERATION 9

Specifications - Specifications Established - Establishing Target Specifications-Setting the Final Specifications- Concept Generation-The Activity of Concept Generation-Clarify the Problem- External search – Internal search – Systematic exploration- Reflect on the Results and the Process.

UNIT III PRODUCT DEVELOPMENT ECONOMICS 9

Elements of economic analysis -Quantitative analysis, Qualitative analysis - Building a Base- Case Financial Model - Sensitivity analysis -Development cost and time with examples - Project tradeoffs - Six potential, Trade off rules, Limitations - Influence of qualitative factor on project success - Qualitative analysis

UNIT IV COST ESTIMATION 9

DFM Cross functional team-Estimate the manufacturing cost, Reduce the Cost of components, Reduce the cost of assembly, Rescue the cost of supporting production-Impact of DFM decisions- Development time, Development Cost, Product quality, External factors.

UNIT V PATENTS AND INTELLECTUAL PROPERTY 9

Overview of patents, Utility patents, preparing a disclosure - Formulate strategy plan- Study of Prior invention- Outline claims - Description of inventions - Refine claims - Pursue application- Reflect of result and process.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify the customer requirements to start new project and carryout product planning.
- generate and select suitable ideas to pursue successful design.
- quantify and access the manufacturing process and cost to make well defined component.
- express the process of patenting the intellectual property.

- apply the economic reasoning to analysis the contemporary problem for newly developed product.

TEXT BOOKS

1. Karl T. Ulrich and Stephen D. Eppinger, “Product Design and Development”, McGraw- Hill Book Company, New Delhi, (2009).
2. Benjamin W. Niebeland Alanb.Draper, “Product Design and Process Engineering”, Tata Publishing Company Ltd, New Delhi, (1976).

REFERENCES

1. George E. Dieter, “Engineering Design - Materials and Process Approach”, Tata McGraw- Hill Publishing Company Limited, New Delhi, (2008).
2. S. Dalela and MansoorAli, “Industrial Engineering and Management Systems”, Standard Publishers Distributors Pvt. Ltd., New Delhi, (2006).
3. Harry Nystrom, “Creativity and Innovation”, John Wiley and Sons Pvt. Ltd., Singapore, McGraw-Hill, (1988)
4. S. B. Srivastava, "Industrial Management", I. K. International Publishing House Pvt. Ltd., New Delhi, (2012).

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



COURSE OBJECTIVES

To enable students to

- identify the use of forecasting, control of inventory, process of routing and scheduling for improving productivity.
- construct and solve linear programming problem.
- investigate deterministic and probabilistic models of problems related to networks and queuing.
- understand the concepts of linear programming technique.
- know decision theory and game theory techniques.

UNIT I PRODUCTION PLANNING AND CONTROL 9

Productivity - Productivity index - **Productivity measurement** - Job design - Job standard - Work study - Method - study - Operation process chart - Motion study - Motion economy - SIMO chart – Work measurement - PMTS
Ergonomics - Industrial safety: losses due to accidents, causes, preventive measures Forecasting - Types - Accuracy of forecast - Sales forecasting techniques - **Time series method**: simple moving average, weighted Moving average, exponential smoothing.

UNIT II INVENTORY CONTROL 9

Inventory control - Purpose - **Inventory costs** - EOQ - Deterministic models - Shortage model - Classification: ABC analysis, FSN analysis - **Material Requirement Planning (MRP)**

UNIT III SCHEDULING AND QUEUING 9

Introduction - Rules - Factors affecting - Master schedule - Gantt chart - Sequencing problem: Models with n jobs with 2 machines Models with n jobs with 3 machines Queuing models - **Basic Queuing systems and models** - Notation - Parameter - Poisson arrival - Exponential service - Constant rate service - Infinite population

UNIT IV LINEAR PROGRAMMING 9

Introduction - Formulation - **Graphical method**, Simplex method Artificial Variable techniques: Big M and Two phase method - Transportation Problems: North West corner method, Least cost method, Vogel's approximation Method - MODI method - **Assignment problems with Hungarian algorithm**.

UNIT V NETWORK MODELS 9

Network models - Shortest route - **Minimal spanning tree** - Maximum flow models - **Project network** - CPM and PERT networks - Critical path scheduling

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the ways of improving productivity by job design, work study, ergonomics, forecasting techniques and following safety.
- explain the inventory control techniques and the need for material requirement planning.

- solve the sequencing of 'n' jobs with two and more machines and also compute the characteristics of single server queuing models.
- formulate the linear programming problems and find the optimum solution.
- construct the network model and identify the critical path of deterministic and probabilistic models.

TEXT BOOKS

1. Prem Kumar Gupta and D. S. Hira, "Operations Research", S. Chand and Co., New Delhi, 2014.
2. S. B. Srivastava, "Industrial Management", I. K. International Publishing House Pvt. Ltd., New Delhi, 2012
3. T. R. Banga, N. K. Agarwal and S. C. Sharma, "Industrial Engineering and Management Science", Khanna Publishers, Delhi.

REFERENCES

1. Hamdy A. Taha, "Operation Research: An introduction", Pearson Publications., New Delhi, (2010).
2. Frederick S. Hiller and Gerald J. Liberman, Operations Research: Concepts and cases, Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi, 2010.

WEB LINKS

1. <http://www.industrialmanagement.html>
2. <http://www.operationresearch.html>

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



COURSE OBJECTIVES

To enable students to

- access uses, application and design of different material handling techniques, equipment and machines used in common use and in industrial sector.
- identify the concept of material handling equipment.
- propose the idea for selection of proper material handling equipment.
- propose the evaluation and design of material handling equipment.
- access the knowledge on conveyors and elevators.

UNIT I INTRODUCTION

9

Objectives of material handling system - Principal groups of materials handling equipment and classification
 Scope of Material Handling - Criteria for selection of Material Handling Equipment's - **Basic kind of material Handling problems.**

UNIT II DESIGN OF HOISTS

9

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of forged hooks and eye Hooks – crane grabs -Systems, sprockets and drums, Load handling Attachments. lifting magnets - **Grabbing attachments.**

UNIT III DRIVES OF HOISTING GEAR

9

Hand and power drives - Traveling gear - **Rail traveling mechanism** - cantilever and monorail Cranes - slewing, jib and buffing gear - cogwheel drive - **selecting the motor ratings.**

UNIT IV CONVEYORS

9

Types - description - **design and applications of Belt conveyors**, apron conveyors and Escalators Pneumatic Conveyors, Screw conveyors and **vibratory conveyors.**

UNIT V ELEVATORS

9

Bucket elevators: design - **loading and bucket arrangements** - Cage elevators - shaft way, Guides, counter Weights, hoisting machine, safety devices - **Design of fork lift trucks.**

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- achieve the knowledge about material handling equipment.
- define the gained a well- found knowledge of hoists designing processes.
- predict the grasped the concept of drives of hoisting gear.
- plan the obtained capacity of conveyor design.
- state the knowledge on elevator designing processes.

TEXT BOOKS

1. Rudenko, N., "Materials handling equipment" ELNvee Publishers, (1970).
2. Spivakovsy, A.O. and Dyachkov, V.K., "Conveying Machines" Volumes I and II, MIR Publishers, (1985).

REFERENCES

1. Alexandrov, M., "Materials Handling Equipments" MIR Publishers, (1981).
2. Boltzharol, A., "Materials Handling Handbook" The Ronald Press Company, (1958).
3. P.S.G. Tech., "Design Data Book", Kalaikathir Achchagam, Coimbatore, (2003).
4. Lingaiah. K. and Narayana Iyengar, "Machine Design Data Hand Book", Vol. 1 & 2, Suma Publishers, Bangalore, (1983).

WEB LINKS

1. <http://www.thomasnet.com/articles/materials-handling/material-handling-equipment>
2. <http://www.mccue.com/content/types-of-material-handling-equipment>
3. <http://www.mechanicalengineeringblog.com/2342-classification-of-material-handling-equipment-types-of-material-handling-equipment-loads/>

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CO1	3	1	-	2	-	2	3	-	1	2	1	2	-	-
CO2	2	2	-	1	2	-	2	-	2	1	2	-	1	-
CO3	3	2	-	-	2	1	2	1	2	-	-	2	1	-
CO4	-	-	2	3	1	2	-	2	1	2	1	-	-	2
CO5	3	2	1	2	-	-	2	2	3	2	-	-	2	3



COURSE OBJECTIVES

To enable students to

- understand an embedded system and compare with general purpose system.
- identify the comprehensively processor and internal memory architecture.
- identify the the i/o devices and network protocols.
- identify the information about rtos.
- identify with comprehensively the technologies and techniques underlying in building an embedded solution to a wearable, mobile and portable system.

UNIT I INTRODUCTION TO EMBEDDED SYSTEM 9

System Design: Definitions - Classifications and brief overview of micro-controllers - Microprocessors and DSPs - Embedded processor architectural definitions - Typical Application - scenarios of embedded systems.

UNIT II PROCESSOR AND MEMORY ORGANIZATION 9

Bus Organization - Memory Devices and their Characteristics - Instruction Set Architecture [RISC, CISC] -Basic Embedded Processor/Microcontroller Architecture [8051, ARM, DSP,PIC] – Memory system architecture [cache, virtual, MMU and address translation] - DMA, Co-processor and Hardware Accelerators - Pipelining

UNIT III I/O DEVICES AND NETWORKS 9

I/O Devices[Timers, Counters, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Infrared devices] - Memory Interfacing - I/O Device Interfacing [GPIO, FIREWIRE, USB, IRDA] Networks for Embedded (CAN, I2C,SPI, USB, RS485, RS232)-Wireless Applications [Bluetooth, Zigbee].

UNIT IV OPERATING SYSTEMS 9

Basic Features of an Operating System - Kernel Features [polled loop system, interrupt driven system, multi rate system] -Processes and Threads - Context Switching - Scheduling[RMA, EDF, fault tolerant scheduling]- Inter-process Communication - Real Time memory management [process stack management, dynamic allocation] - I/O[synchronous and Asynchronous I/O, Interrupts Handling, Device drivers] - RTOS [Vx Works,RT-LINUX].

UNIT V EMBEDDED SYSTEM DEVELOPMENT 9

Design Methodologies[UML as Design tool, UML notation, Requirement Analysis and Use Modeling] - Design Examples [Telephone PBX, Inkjet Printer, PDA, Elevator Control System, ATM System] - Fault-tolerance Techniques - Reliability Evaluation Techniques

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify an embedded system and compare with general purpose system.
- identify the various embedded processor and internal memory architecture.

- identify the various input and output devices and network protocols.
- introduce rtos and related mechanisms.
- choose the design methodologies for the real time application.

TEXT BOOK(S)

1. Raj Kamal, “Embedded systems Architecture, Programming and design”, Second Edition, (2015)

REFERENCES

1. Jane W. S., Liu, “Real time systems”, Pearson Education, (2012).
2. Robert Ashby, “Designer's Guide”, Cypress PSoCNewnes,(2012)
3. Microblaze processor Reference guide, Xilinx(2013)
4. Wayne Wolf Computers as components “Principles of Embedded Computing System design”, The Morgan Kaufmann Series in Computer Architecture and Design, (2014).

WEB LINKS

1. <http://www.processorandmemory.html>
2. <http://www.operatingsystems.html>
3. <http://www.embeddedsystemdevelopment.html>

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



COURSE OBJECTIVES

To enable students to

- demonstrate an understanding of entrepreneurial concepts and processes.
- plan to know the entrepreneurship analysis and opportunities.
- identify with legal issues and government policies.
- describe with start-ups of new business.
- inculcate knowledge on small scale business.

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9

Concept of entrepreneur and entrepreneurship; **entrepreneurial and managerial characteristics**; Distinction between an entrepreneur and a Manager, Agri-entrepreneurship-concept, need and scope - Ethics in Entrepreneurship. Managing an enterprise; **motivation and entrepreneurship development**; importance of planning, budgeting, monitoring, evaluation and follow up in running an enterprise

UNIT II ENTREPRENEURSHIP ANALYSIS AND OPPORTUNITIES 9

Innovation - principles of innovation, SWOT analysis. **Sources of innovative opportunities** - the unexpected and success /failure, unsatisfied needs, process improvement, changes in industry structure, changes in demography perception, new knowledge. **Create a customer** - utility, pricing, adaptation to customer needs and deliver value to customer - Market research - customer needs, competitors

UNIT III FINANCING, ACCOUNTING, GST 9

Finance - government policies, **Government Schemes and Incentives for Promotion of Entrepreneurship** - Venture capital financing - concept, purpose and schemes, Role of financial institutions for funding enterprises, Capital markets - shares and securities Accounting - concepts and conventions of accounting, double entry system of book keeping, Problems in **Accounting Systems**, National agricultural policy, Government policies and regulations for agribusiness, Principles of taxation and tax structure in India, Legal issues in agribusiness, Role of regulations for agribusiness, GST, **Role of District Small Industry Association**.

UNIT IV BUSINESS 9

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

UNIT V SUPPORT TO ENTREPRENEURS 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify with the entrepreneurial concepts and processes.
- attain knowledge on entrepreneurship analysis and opportunities.
- identify with legal issues and government policies.
- start a New Business.
- plan to know the supports of entrepreneurs in starting small scale business.

TEXT BOOKS

1. Robert D Hisrich and Michael P Peters, Entrepreneurship, Irwin Mc Graw - Hill Inc. Boston, 4th edition, 1998.
2. Vasant Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, 3rd edition, 1997.

REFERENCES

1. Jeffry A. Timmons, New Venture Creation: Entrepreneurship for the 21st Century, Fifth Edition, Irwin McGraw-Hill Publishers, Boston, MA (ISBN 0-356-19756-3).
2. Poornima M. Charantimath. (2014). Entrepreneurship Development and Small Business Enterprises. Pearson publishers.
3. Sulakshan Mohan, Making of an Entrepreneur, how to set up your own enterprise and manage it successfully, Indian Publishers distributors, Delhi, 2000
4. P.Saravanel (1997). Entrepreneurial Development, Ess Pee kay Publishing House, Chennai.
5. Prasanna Chandra (1996). Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill.

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



COURSE OBJECTIVES

To enable students to

- explain the concept of non-destructive evaluation.
- access knowledge on various types of non-destructive evaluation methods.
- identify the principles and working of different NDT methods.
- compose knowledge on selection of such different methods for testing and evaluation of various components minimum values.
- identify the concept of ultrasonic testing methods.

UNIT I INTRODUCTION AND LIQUID PENETRANTS TESTING 9

Non-destructive testing (NDT) and its importance—NDT vs. Destructive Testing – Visual Examination – Basic Principles, optical aids used and applications. Liquid Penetrants— Principles, Procedure for penetrants testing, Penetrants testing methods, Post emulsification, properties of liquid penetrants, sensitivity, applications and Limitations – Standards.

UNIT II MAGNETIC PARTICLE TESTING 9

Magnetic Particle Testing –Principles, Magnetizing techniques, Procedures, Equipment's, Sensitivity, Applications and Limitations—Standards. Case studies.

UNIT III ULTRASONIC TESTING 9

Properties of sound beam, Transducers, inspection methods, Techniques for Normal and angle beam inspection, Flaw characterization—equipment's, and methods of display— A – Scan– B – Scan - C–Scan –Immersion testing—Application, advantages and limitations—standards.

UNIT IV RADIOGRAPHY 9

Electromagnetic radiation sources—X-ray production & gamma ray sources, properties, radiation—attenuation and effects in film, Exposure charts – radiographic imaging – inspection techniques—applications and limitations – Safety in industrial radiography—neutron radiography—Standards. Case studies.

UNIT V EDDY CURRENT 9

Principles, Instrumentation, Techniques, Probe, Sensitivity, Advanced Test Methods, applications & Limitations Standards. Other Techniques: Acoustic Emission Testing Principle, Techniques, Instrumentations, Applications and Standards, Homograph Thermography –Principles, equipment's, Techniques, Applications and Standards, Leak testing-methods, detection and Standards. Selection of NDT Methods: Defects in material—Selection of NDT and Instrumentation—Some Case studies.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- access the knowledge about working liquid penetrants testing.
- identify the non-destructive evaluation methods for magnetic particle testing.
- identify the ultrasonic testing methods and working processes.
- relate the knowledge about the sources, process and safety precautions of x-ray radiography.
- locate the test performance on eddy current techniques.

TEXT BOOKS

1. Baldev Raj, T. Jayakumar and M. Thavsimuthu, "Practical Non-Destructive Testing" 3rd Edition, Narosa Publishing House, New Delhi, 2009.
2. Shull Peter J., —Non Destructive Evaluation: Theory-Techniques and Applications, Marcel Dekkar Inc., New York, USA, 2002.

REFERENCES

1. Baldev Raj and Venkatraman B., —Practical Radiology, Narosa Publishing House, New Delhi, 2004.
2. Hull Barry and John Vernon, —Non Destructive Testing, 1st Edition, Macmillan, London, 1988.
3. Brichan D., —Non Destructive Testing, Oxford Press, 1975.
4. ASM Handbook, —Non Destructive Evaluation and Quality Control, Vol.17, 9th Edition, 1989.

WEB LINKS

1. <http://www.asnt.org/MinorSiteSections/AboutASNT/Intro-to-NDT>
2. <http://www.trainingndt.com/what-is-nondestructive-testing>
3. <http://www.twi-global.com/capabilities/integrity-management/non-destructive-testing/ndt-techniques>

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



- v. Circuits with timers
- vi. Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.

Modeling and analysis of basic electrical, hydraulic, and pneumatic systems using

MATLAB/LABVIEW software.

- 3. Simulation of basic hydraulic, pneumatic and electrical circuits using Automation studio software.
- TOTAL : 45 PERIODS**

OUTCOMES:

- Ability to design and test hydraulic, pneumatic circuits
- Use of MATLAB/LABVIEW software for simulation of hydraulic, pneumatic and electrical circuits.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	NAME OF THE EQUIPMENT	Qty
Hydraulic equipment		
1	Pressure relief valve	4
2	Pressure reducing valves	2
3	Flow control valves	2
4	Pressure switch	1
5	Limit switches	2
6	Linear actuator	1
7	Rotary actuator	1
8	Double solenoid actuated DCV	2
9	Single solenoid actuated DCV	1
10	Hydraulic power pack with 2 pumps & 2 pressure relief valve	1
11	PLC	1
Pneumatics equipment		
1	Pneumatic trainer kit with FRL Unit, Single acting cylinder, push buttons	1
2	Pneumatic trainer kit with FRL unit, Double acting cylinder, manually actuated DCV	1
3	Pneumatic training kit with FRL unit, Double acting cylinder, pilot actuated DCV	1
4	Pneumatic trainer kit with FRL unit, Double acting cylinder, Double solenoid actuated DCV, DCV with sensors/ magnetic reed switches	1
5	PLC with Interface card	1
6	LABVIEW Software	1
7	Automation studio software	1

MT6701

MEDICAL MECHATRONICS

L T P C
3 0 0 3

OBJECTIVES:

- The students will be exposed to sensors and actuators used in biomedical system design

UNIT I INTRODUCTION

9

Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential – electrodes for their measurement, ECG, EEG, EMG – machine description – methods of measurement – three equipment failures and trouble shooting.

UNIT II TRANSDUCERS FOR BIO-MEDICAL INSTRUMENTATION 9

Basic transducer principles Types – **source of bioelectric potentials** – resistive, inductive, capacitive, fiber-optic, photoelectric and chemical transducers – their description and feature applicable for biomedical instrumentation – Bio & Nano sensors & application

UNIT III SIGNAL CONDITIONING, RECORDING AND DISPLAY 9

Input isolation, DC amplifier, power amplifier, and differential amplifier – feedback, op-Amp-electrometer amplifier, **carrier Amplifier** – instrument power supply. Oscillagrophic – galvanometric - X-Y, magnetic recorder, storage oscilloscopes – **electron microscope** – PMMC writing systems – Telemetry principles – Bio telemetry.

UNIT IV MEDICAL SUPPORT 10

Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – plethysonography – blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography. Heart lung machine – artificial ventilator – Anesthetic machine – **Basic ideas of CT scanner** – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC– defibrillator patient safety - electrical shock hazards. Centralized patient monitoring system.

UNIT V BIO-MEDICAL DIAGNOSTIC INSTRUMENTATION 8

Introduction – **computers in medicine** – basis of signal conversion and digital filtering data reduction technique – time and frequency domain technique – ECG Analysis.

TOTAL :45 PERIODS

OUTCOMES:

- The students will be able to design , use and maintain various medical equipments

TEXT BOOKS:

1. Siamak Najarian “ Mechatronics in Medicine – A Bio medical engg approach” , McGraw – Hill Education , 2011
2. Cromwell, Weibell and Pfeiffer, “Biomedical Instrumentation and Measurements”, 2nd Edition, Printice Hall of india , 1999
3. Arumugam M., “Bio Medical Instrumentation”, Anuradha agencies Pub., 2002

REFERENCES:

1. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, TMH, 1989.
2. Geddes L.A., and Baker, L.E., “Principles of Applied Bio-medical Instrumentation”, 3rd Edition, John Wiley and Sons, 1995.
3. Tompkins W.J., “Biomedical Digital Signal Processing”, Prentice Hall of India, 1998

MT6702

MODELING AND SIMULATION

L T P C
3 0 0 3

OBJECTIVES:

- To provide an exposure on how to simulate a system or a process or an activity for detailed analysis, optimization and decision making which is essential to reduce the product design and development cost and time.

UNIT I SYSTEM AND SYSTEM ENVIRONMENT 9

Component of a System – **Continuous and discrete systems**– Types of model; Steps in Simulation study; Simulation of an event occurrence using random number table – **Single server queue** –two server queues – inventory system.

9

Properties of random numbers – **Generation of Pseudo** – random numbers – techniques of generating pseudo random numbers; **Test for random numbers**: the Chisquare test-the kolmogrov Smirnov test – Runs test – Gap test – poker test.

9

Inverse transform technique for Exponential, Uniform, triangular, weibull, empirical, uniform and discrete distribution, Acceptance rejection method for Poisson and gamma distribution; Direct Transformation for normal distribution.

9

Analysis of simulated Data – Data collection, identifying the distribution, Parameter estimation, goodness of fit tests, verification and validation of simulation models.

9

Concepts of System Identification – Identification using normal operating records (Integration method)
– Identifiability conditions – System order determination

TOTAL : 45 PERIODS

OUTCOMES:

- The students will be able to design and develop products using simulation techniques.

TEXT BOOK:

1. Banks J., Carson J.S. and Nelson B.L., "Discrete – Event System Simulation", 3rd Edition, Pearson Education, Inc 2004 (ISBN 81-7808-505-4).

REFERENCES:

1. Geoffrey Gorden, "System Simulation", Prentice Hall of India, 2003.
2. Narsingh Deo., "System Simulation with Digital Computer", Prentice Hall of India, 2003.
3. Birta, "Modelling and Simulation: Exploring Dynamic System Behaviour", Springer, Indian Reprint, 2010

MT6703

ROBOTICS AND MACHINE VISION SYSTEM

L T P C
3 0 0 3

OBJECTIVES:

- Students will learn about basics of robots , programming and Machine vision applications in robots

9

Introduction- Basic components of robot-Laws of robotics- classification of robot-work space-accuracy-resolution –repeatability of robot. **Power transmission system:** Rotary to rotary motion, Rotary to linear motion, Harmonics drives

9

Robot End effectors: Introduction- types of End effectors- Mechanical gripper- types of gripper mechanism- gripper force analysis- other types of gripper- special purpose grippers.

10

Robot kinematics: Introduction- **Matrix representation**- rigid motion & homogeneous transformation- forward & inverse kinematics- trajectory planning. Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - **Euler formulation**- Newton - Euler formulation

UNIT IV MACHINE VISION FUNDAMENTALS**9**

Machine vision: image acquisition, digital images-sampling and quantization-levels of computation
Feature extraction-windowing technique- segmentation- Thresholding- edge detection- binary morphology - grey morphology

UNIT V ROBOT PROGRAMMING**8**

Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- application of robots.

TOTAL: 45 PERIODS**OUTCOMES:**

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

TEXT BOOKS:

1. M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited, 2008

REFERENCES:

1. Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Sixth edition, Tata McGraw-Hill Publication, 2003.
2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGraw-Hill Publication, 1987.
3. John.J.Craig, "Introduction to Robotics: Mechanics & control", Second edition, 2002.
4. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, Indian Reprint, 2010

ME6602**AUTOMOBILE ENGINEERING****L T P C
3 0 0 3****OBJECTIVES:**

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

UNIT I VEHICLE STRUCTURE AND ENGINES**9**

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**9**

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT III TRANSMISSION SYSTEMS**9**

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

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS

9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V ALTERNATIVE ENERGY SOURCES

9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell

Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students will be able to identify the different components in automobile engineering.
- Have clear understanding on different auxiliary and transmission systems usual.

TEXT BOOKS:

1. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Standard Publishers, Seventh Edition, New Delhi, 1997.
2. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002.

REFERENCES:

1. Newton, Steeds and Garet, "Motor Vehicles", Butterworth Publishers, 1989.
2. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999.
3. Martin W, Stockel and Martin T Stockle, "Automotive Mechanics Fundamentals," The Good heart –Will Cox Company Inc, USA, 1978.
4. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998.
5. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2007.

MT6711

COMPUTER AIDED DESIGN AND COMPUTER AIDED MANUFACTURING LABORATORY

**L T P C
0 0 3 2**

OBJECTIVES:

- To provide an overview of how computers are being used in design

LIST OF EXPERIMENTS:

1. Modelling of a part using Pro-E / CATIA / UNIGRAPHICS.
2. Modelling of a component using Pro-E / CATIA / UNIGRAPHICS.
3. Modelling and assembling of the mechanical assembly using Pro-E / CATIA / UNIGRAPHICS.
4. Structural analysis using FEA software – ANSYS / SOLIDWORKS / CATIA.
5. Beam deflection analysis using FEA software – ANSYS / SOLIDWORKS / CATIA.
6. Thermal analysis using FEA software – ANSYS / SOLIDWORKS / CATIA.
7. Vibration or modal analysis using FEA software – ANSYS / SOLIDWORKS / CATIA.
8. Modelling and tool path simulation using Master CAM (MILL) or any CAM package.
9. Modelling and tool path simulation using Master CAM (Lathe) or any CAM package.
10. NC code generation for milling using Master CAM (MILL) or any CAM package.
11. NC code generation for turning using Master CAM (Lathe) or any CAM package.

TOTAL : 45 PERIODS

EQUIPMENTS FOR A BATCH OF 30 STUDENTS

NOTE - Any solid modelling or suitable software packages can be used for exercise.

OUTCOMES:

- The students can able to apply the students can able to apply mathematical knowledge in modeling and assembly of parts

MT6712

ROBOTICS LABORATORY

L T P C
0 0 3 2

OBJECTIVES:

- To introduce different types of robotics and demonstrate them to identify different parts and components.
- To write programming for simple operations like pick and place, rotation etc.,

LIST OF EXPERIMENTS:

1. Study of different types of robots based on configuration and application.
2. Study of different type of links and joints used in robots
3. Study of components of robots with drive system and end effectors.
4. Determination of maximum and minimum position of links.
5. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
6. Estimation of accuracy, repeatability and resolution.
7. Robot programming exercises

TOTAL: 45 PERIODS

OUTCOMES:

- Use of AutoCAD software and MATLAB software to model the different types of robots and calculate work volume for different robots.

EQUIPMENTS FOR A BATCH OF 30 STUDENTS

AutoCAD software and MATLAB software packages are to be used to carry out the listed experiments

MT6713

DESIGN AND FABRICATION PROJECT

L T P C
0 0 4 2

OBJECTIVES:

- The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.

GUIDELINE FOR REVIEW AND EVALUATION

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

on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS

OUTCOMES:

- Use of design principles and develop conceptual and engineering design of any components.
- Ability to fabricate any components using different manufacturing tools.

MT6801

AUTOMOTIVE ELECTRONICS

L T P C
3 0 0 3

OBJECTIVES:

- Students will be exposed to application of electronics in automotives systems

UNIT I INTRODUCTION

8

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT II IGNITION AND INJECTION. SYSTEMS

10

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT III SENSOR AND ACTUATORS

7

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.

UNIT IV ENGINE CONTROL SYSTEMS

10

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

UNIT V CHASSIS AND SAFETY SYSTEMS

10

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars.

TOTAL : 45 PERIODS

OUTCOMES:

- The students will be able to use advanced sensors and actuators in the upgradation of automobiles.

TEXT BOOKS:

1. Ribbens, "Understanding Automotive Electronics", 7th Edition, Elsevier, Indian Reprint, 2013

REFERENCES:

1. Tom Denton, "Automobile Electrical and Electronics Systems", Edward Arnold Publishers, 2000.

2. Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls", Delmar Publishers, 2001.
3. Richard K. Dupuy "Fuel System and Emission controls", Check Chart Publication, 2000.
4. Ronald. K. Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 1999.

MT6811

PROJECT WORK

L T P C
0 0 12 6

OBJECTIVES:

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

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

TOTAL: 180 PERIODS

OUTCOMES:

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

MT6001

ADVANCED MANUFACTURING TECHNOLOGY

L T P C
3 0 0 3

OBJECTIVES:

- To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components.

UNIT I SHEET METAL WORKING OF METALS

8

Hot and Cold Working- rolling, forging, wire drawing, extrusion-types-forward, backward & tube extrusion. Blanking-blank size calculation, draw ratio, drawing force, piercing, punching, trimming, stretch forming, tube bending, tube forming -embossing & coining-explosive forming electro hydraulic forming-electromagnetic forming

UNIT II NON TRADITIONAL MACHINING

9

Ultrasonic machining (USM) – process and description of USM-applications and limitations- Electron Beam Machining (EBM)-Process principles of EBM-applications-process principles- Laser Beam Machining (LBM)-Laser beam production-applications-laser beam welding-Plasma Arc Machining (PAM)-Generation of plasma arc-process parameters-applications and limitations.

UNIT II CONCEPT GENERATION AND SELECTION**5**

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III PRODUCT ARCHITECTURE**10**

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV INDUSTRIAL DESIGN**10**

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT**15**

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

TOTAL: 45 PERIODS**OUTCOMES:**

- The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

TEXT BOOK:

1. Kari T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw-Hill International Edns. 1999.

REFERENCES:

1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates,26/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal,"Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY.

MT6002**DIAGNOSTIC TECHNIQUES****L T P C
3 0 0 3****OBJECTIVES:**

- The basics of various diagnostics techniques for proper maintance and monitoring the equipment are introduced.

- UNIT I DEFECTS AND FAILURE ANALYSIS 9**
Maintenance Concept, Maintenance objective, **Challenges in maintenance**. Defect generation - Types of failures - Defect reporting and recording - Defect analysis -Failure analysis -Equipment down time analysis - Breakdown analysis - FTA - FMEA - FMECA.
- UNIT II MAINTENANCE SYSTEMS 9**
Planned and unplanned maintenance - **Breakdown maintenance** - corrective maintenance- Opportunistic maintenance - Routine maintenance - Preventive maintenance – Predictive Maintenance - Condition based maintenance system - **Design out maintenance** – Maintenance by objectives – Selection of maintenance system
- UNIT III SYSTEMATIC MAINTENANCE 9**
Codification and Cataloguing - instruction manual and operating manual - Maintenance manual and departmental manual - **Maintenance time standard** - Maintenance work order and work permit - job monitoring – Feedback and control – Maintenance records and documentation. Introduction to Total Productive Maintenance (TPM).
- UNIT IV COMPUTER MANAGED MAINTENANCE SYSTEM 9**
Selection and scope of computerization – **Equipment classification** – Codification of breakdown,material and facilities - Job sequencing - Material management module – Captive engineering module. Decision making in maintenance.Economic aspects of maintenance.
- UNIT V CONDITION MONITORING 9**
Condition monitoring techniques – Visual monitoring – **Temperature monitoring** – Vibration monitoring – Lubricant monitoring – Cracks monitoring – Thickness monitoring - Noise and sound monitoring – Condition monitoring of hydraulic system. Machine diagnostics – Objectives - Monitoring strategies – Examples of monitoring and diagnostics - **Control structures for machine diagnosis**.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to analyze the defects and rectify the faults. Also they will be able to monitor and maintain the equipment..

TEXTBOOK:

1. Sushil Kumar Srivastava, "Industrial Maintenance Management", S.Chand & Company Ltd, New Delhi, 1998.

REFERENCES:

1. Manfred, H. "Bibring, Handbook of Machine Tools", Vol.3, John Wiley & Sons
2. Mishra R.C., Pathak K. "Maintenance Engineering and Management", Prentice Hall of India Private Ltd., New Delhi, 2002

MG6072

MARKETING MANAGEMENT

L T P C
3 0 0 3

OBJECTIVES:

- To enable students to deal with newer concepts of marketing concepts like strategic marketing segmentation, pricing, advertisement and strategic formulation. The course will enable a student to take up marketing as a professional career.

UNIT I MARKETING PROCESS**9**

Definition, Marketing process, dynamics, needs, wants and demands, marketing concepts, environment, mix, types. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy.

UNIT II BUYING BEHAVIOUR AND MARKET SEGMENTATION**9**

Cultural, demographic factors, motives, types, buying decisions, segmentation factors - demographic - Psycho graphic and geographic segmentation, process, patterns.

UNIT III PRODUCT PRICING AND MARKETING RESEARCH**9**

Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.

UNIT IV MARKETING PLANNING AND STRATEGY FORMULATION**9**

Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.

UNIT V ADVERTISING, SALES PROMOTION AND DISTRIBUTION**9**

Characteristics, impact, goals, types, and sales promotions - point of purchase - unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing, Modern Trends, e-Marketing.

TOTAL: 45 PERIODS**OUTCOMES :**

- The learning skills of Marketing will enhance the knowledge about Marketer's Practices and create insights on Advertising, Branding, Retailing and Marketing Research.

TEXTBOOKS:

1. Philip Kotler & Keller, "Marketing Management", 14th edition, Prentice Hall of India, 2012.
2. Chandrasekar. K.S., "Marketing Management Text and Cases", 1st Edition, Tata McGraw Hill – Vijaynicole, 2010.

REFERENCES:

1. Ramasamy and Nama kumari, "Marketing Environment: Planning, implementation and control the Indian context", 1990.
2. Czinkota & Kotabe, "Marketing management", Thomson learning, Indian edition 2007
3. Adrain palmer, " Introduction to Marketing Theory and Practice", Oxford university press IE 2004.
4. Donald S. Tull and Hawkins, "Marketing Reasearch", Prentice Hall of Inida-1997.
5. Philip Kotler and Gary Armstrong "Principles of Marketing" Prentice Hall of India, 2000.
6. Steven J. Skinner, "Marketing", All India Publishers and Distributes Ltd. 1998.
7. Graeme Drummond and John Ensor, "Introduction to marketing concepts", Elsevier, Indian Reprint, 2007.

MT6003**ENGINEERING ECONOMICS AND COST ANALYSIS****L T P C
3 0 0 3****OBJECTIVES:**

- Basics of economic analysis and cost analysis are introduced. Method adopted For capital budgeting and depreciation estimation are introduced.

9

Nature and scope of engineering economics – definition and scope of study- importance of economic analysis in business. Demand and supply analysis – demand determinants- Law of demand – elasticity of demand – demand forecasting. Law of supply – elasticity of supply – market price

9

Types of cost - Fixed cost, variable cost, marginal cost. Cost output relationship in short and long run. Pricing decisions – situations demanding pricing decisions, **pricing techniques in practice** – full cost pricing, marginal cost pricing, going rate pricing, bid pricing, price fixing for a rate of return. Statutory requirements.

9

Value of money – inflation – deflation, banking- commercial bank and its functions, central bank and its functions. New economic environment – globalization, liberalization and privatization.

9

Need for capital budgeting – method of appraising project profitability – rate of return method, payback period method, present value comparisons method, cost benefit analysis. Preparation of feasibility report, appraisal process, economic and commercial feasibility, financial feasibility, technical feasibility.

9

Causes of depreciation, objectives, methods of computing depreciation, simple problems. Breakeven analysis, breakeven point – assumptions, breakeven chart, uses of breakeven analysis, simple problems. Financial statements – cash flow statement, profit and loss account, balance sheet and evaluation of projected financial statements.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will be able to carryout cost analysis for capital subjecting based on depreciation, money available , supply of material and demand of products.in their management profession.

TEXTBOOK:

1. James L Riggs, David D. Bedworth, "Engineering Economics", Tata McGraw Hill, 1998

REFERENCES:

1. Varshney R Lnd Maheswari K L, "Managerial Economics", S.Chand& Co, 1993
2. Samuelson P A and Nordhaus W D, "Economics", Tata McGraw Hill, 2001
3. Prasanna Chandra, "Projects", Tata McGraw Hill, 2003
4. Patel Bhavesh . M, "Project Management, Strategic Financial Planning Evaluation and Control". Vikas Publishing House. New Delhi. 2000

GE6084

HUMAN RIGHTS

L T P C
3 0 0 3

OBJECTIVES :

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

9

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

UNIT II	9
Evolution of the concept of Human Rights Magna carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.	
UNIT III	9
Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.	
UNIT IV	9
Human Rights in India – Constitutional Provisions / Guarantees.	
UNIT V	9
Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.	

TOTAL : 45 PERIODS

OUTCOME :

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

REFERENCES:

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

MT6004	INDUSTRIAL ELECTRONICS AND APPLICATIONS	L T P C
		3 0 0 3

OBJECTIVES:

- Students will be exposed to electronics devices and their controls used in industrial environment

UNIT I	INTRODUCTION	9
Industrial control classification- motion and process control- feed forward control-interfacing devices- Operational Amplifier-review of thyristor- SCR- TRIAC-Phototransistor		
UNIT II	CONVERTERS AND INVERTERS	9
Analysis of controlled and fully controlled converters-Dual converters-Analysis of voltage source and current source- current source and series converters		
UNIT III	INDUSTRIAL MOTOR CONTROL	9
Method of controlling speed- Basic control circuit-DC motor control- AC motor control- Servo motor control- Stepper motor control- micro controller based speed control – solid state motor control-PLL control of a DC motor control		
UNIT IV	RELAYS, HEATING & WELDING CONTROL	9
Introduction- principle of relays- electromechanical relay- solid state relays- Latching relays timing relays- Induction heating- dielectric heating- resistance welding.		

UNIT V PROCESS AND MOTION CONTROL**9**

Elements of process control- temperature control- Flow control- Level control- Methods of motion control- feedback control- Direct digital control

TOTAL :45 PERIODS**OUTCOMES:**

- The students will be able to design various electronic industrial controllers

TEXT BOOK:

1. Chitode .J.S “ Industrial Electronics “ Technical Publications ,2009

REFERENCES:

1. Terry Baltelt, "Industrial electronics, devices, systems and applications", Delmar publishers, 1997
2. Stephan L.Herman, Walter N.Alerich, "Industrial Motor Control", fourth edition, Delmar publishers, 1998
3. Biswanath Paul, "Industrial Electronics and Control" Prentice Hall India publisher-2004.
4. P.Harrott- "Process Control"- Tata McGraw Hill-1991

ME6501**COMPUTER AIDED DESIGN****L T P C
3 0 0 3****OBJECTIVES:**

- To provide an overview of how computers are being used in mechanical component design

UNIT I FUNDAMENTALS OF COMPUTER GRAPHICS**9**

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations- homogeneous coordinates - Line drawing -Clipping- viewing transformation

UNIT II GEOMETRIC MODELING**9**

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep

UNIT III VISUAL REALISM**9**

Hidden – Line-Surface-Solid removal algorithms – shading – colouring – computer animation.

UNIT IV ASSEMBLY OF PARTS**9**

Assembly modelling – interferences of positions and orientation – tolerance analysis-massproperty calculations – mechanism simulation and interference checking.

UNIT V CAD STANDARDS**9**

Standards for computer graphics- Graphical Kernel System (GKS) - standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALSetc. - communication standards.

TOTAL : 45 PERIODS**OUTCOMES:**

- Upon completion of this course, the students can able to use computer and CAD software's for modeling of mechanical components

- Discuss digital image fundamentals.
- Apply image enhancement and restoration techniques.
- Use image compression and segmentation Techniques.
- Represent features of images.

TEXT BOOK

1. Rafael C. Gonzales, Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2010.

REFERENCES:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using MATLAB", Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011.
2. Anil Jain K. "Fundamentals of Digital Image Processing", PHI Learning Pvt. Ltd., 2011.
3. William K Pratt, "Digital Image Processing", John Wiley, 2002.
4. Malay K. Pakhira, "Digital Image Processing and Pattern Recognition", First Edition, PHI Learning Pvt. Ltd., 2011.
5. <http://eeweb.poly.edu/~onur/lectures/lectures.html>.
6. <http://www.caen.uiowa.edu/~dip/LECTURE/lecture.html>

EE6007

MICRO ELECTRO MECHANICAL SYSTEMS

L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION

9

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

UNIT II SENSORS AND ACTUATORS-I

9

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

UNIT III SENSORS AND ACTUATORS-II

9

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

UNIT IV MICROMACHINING**9**

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

UNIT V POLYMER AND OPTICAL MEMS**9**

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

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to understand the operation of micro devices, micro systems and their applications.
- Ability to design the micro devices, micro systems using the MEMS fabrication process.

TEXT BOOKS:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. Nadim Maluf, "An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

MF6009**RAPID PROTOTYPING****L T P C
3 0 0 3****OBJECTIVES:**

- Generating a good understanding of RP history, its development and applications.. To expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.

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 - Case study.

TOTAL: 45 PERIODS

OUTCOMES:

- To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields

TEXT BOOKS:

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

REFERENCES:

1. Hopkinson N., 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 Prototyping", Wiley, 2006
3. Paul F.Jacobs, Rapid Prototyping and Manufacturing, "Fundamentals of Stereolithography", McGraw Hill 1993.
4. D.t.Pham and S.S. Dimov, "Rapid Manufacturing", Springer Verlag 2001.

MT6005

VIRTUAL INSTRUMENTATION

L T P C
3 0 0 3

OBJECTIVES:

- The principle and applications of virtual instruments are introduced in mechatronics systems.

UNIT I REVIEW OF VIRTUAL INSTRUMENTATION 9

Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data -flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II VI PROGRAMMING TECHNIQUES 9

VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

UNIT III DATA ACQUISITION BASICS**9**

AOC.OAC. 010. Counters & timers. PC Hardware structure, timing. Interrupts OMA, software and hardware installation.

UNIT IV COMMON INSTRUMENT INTERFACES**9**

Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office & Industrial applications, Visa and IVI, image acquisition and processing. Motion control.

UNIT V USE OF ANALYSIS TOOLS**9**

Fourier transforms, power spectrum correlation methods, windowing & filtering, VI application in various fields.

TOTAL : 45 PERIODS**OUTCOMES:**

- The students will be able to use virtual instruments to design various mechatronics systems

TEXT BOOK:

1. Gupta , " Virtual Instrumentation Using Lab view" 2nd Edition, Tata McGraw-Hill Education, 2010

REFERENCES:

- 1 Gary Jonson, "Labview Graphical Programming", Second Edition, McGraw Hill, New York, 1997
2. Sokoloff, "Basic concepts of Labview 4", Prentice Hall Inc., New Jersey 1998.
3. Gupta.S., Gupta.J.P., "PC interfacing for Data Acquisition & Process Control", Second Edition, Instrument Society of America, 1994.

ME6015**OPERATIONS RESEARCH****L T P C
3 0 0 3****OBJECTIVES:**

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

UNIT I LINEAR MODELS**15**

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

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS**8**

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

UNIT III INVENTORY MODELS**6**

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

UNIT IV QUEUEING MODELS**6**

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

UNIT V DECISION MODELS**10**

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

TOTAL: 45 PERIODS**OUTCOMES:**

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

TEXT BOOK:

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

REFERENCES:

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

MG6071**ENTREPRENEURSHIP DEVELOPMENT****L T P C
3 0 0 3****OBJECTIVES :**

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

UNIT I ENTREPRENEURSHIP**9**

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

UNIT II MOTIVATION**9**

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

UNIT III BUSINESS**9**

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

UNIT IV FINANCING AND ACCOUNTING**9**

UNIT II PROJECT LIFE CYCLE AND EFFORT ESTIMATION 9

Software process and Process Models – Choice of Process models - mental delivery – Rapid Application development – Agile methods – Extreme Programming – SCRUM – Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II A Parametric Productivity Model - Staffing Pattern.

UNIT III ACTIVITY PLANNING AND RISK MANAGEMENT 9

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules.

UNIT IV PROJECT MANAGEMENT AND CONTROL 9

Framework for Management and control – Collection of data Project termination – Visualizing progress – Cost monitoring – Earned Value Analysis- Project tracking – Change control- Software Configuration Management – Managing contracts – Contract Management.

UNIT V STAFFING IN SOFTWARE PROJECTS 9

Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham-Hackman job characteristic model – Ethical and Programmed concerns – Working in teams – Decision making – Team structures – Virtual teams – Communications genres – Communication plans.

TOTAL : 45 PERIODS

OUTCOMES:

- At the end of the course the students will be able to practice Project Management principles while developing a software.

TEXTBOOK:

1. Bob Hughes, Mike Cotterell and Rajib Mall: "Software Project Management", Fifth Edition, Tata McGraw Hill, New Delhi, 2012.

REFERENCES:

1. Robert K. Wysocki "Effective Software Project Management", Wiley Publication, 2011.
2. Walker Royce: "Software Project Management"- Addison-Wesley , 1998.
3. Gopalaswamy Ramesh, "Managing Global Software Projects", McGraw Hill Education (India), Fourteenth Reprint 2013.

CS6302

DATABASE MANAGEMENT SYSTEMS

L T P C
3 0 0 3

OBJECTIVES:

- To expose the students to the fundamentals of Database Management Systems.
- To make the students understand the relational model.
- To familiarize the students with ER diagrams.
- To expose the students to SQL.
- To make the students to understand the fundamentals of Transaction Processing and Query Processing.
- To familiarize the students with the different types of databases.
- To make the students understand the Security Issues in Databases.

UNIT I INTRODUCTION TO DBMS 10

File Systems Organization - Sequential, Pointer, Indexed, Direct - Purpose of Database System- Database System Terminologies-Database characteristics- Data models – Types of data models – Components of DBMS- Relational Algebra. LOGICAL DATABASE DESIGN: Relational DBMS - Codd's Rule - Entity-Relationship model - Extended ER Normalization – Functional Dependencies, Anomaly- 1NF to 5NF- Domain Key Normal Form – Denormalization

UNIT II SQL & QUERY OPTIMIZATION 8

SQL Standards - Data types - Database Objects- DDL-DML-DCL-TCL-Embedded SQL-Static Vs Dynamic SQL - QUERY OPTIMIZATION: Query Processing and Optimization - Heuristics and Cost Estimates in Query Optimization.

UNIT III TRANSACTION PROCESSING AND CONCURRENCY CONTROL 8

Introduction-Properties of Transaction- Serializability- Concurrency Control – Locking Mechanisms- Two Phase Commit Protocol-Dead lock.

UNIT IV TRENDS IN DATABASE TECHNOLOGY 10

Overview of Physical Storage Media – Magnetic Disks – RAID – Tertiary storage – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing - Introduction to Distributed Databases- Client server technology- Multidimensional and Parallel databases- Spatial and multimedia databases- Mobile and web databases- Data Warehouse-Mining- Data marts.

UNIT V ADVANCED TOPICS 9

DATABASE SECURITY: Data Classification-Threats and risks – Database access Control – Types of Privileges –Cryptography- Statistical Databases.- Distributed Databases-Architecture-Transaction Processing-Data Warehousing and Mining-Classification-Association rules-Clustering-Information Retrieval- Relevance ranking-Crawling and Indexing the Web- Object Oriented Databases-XML Databases.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Design Databases for applications.
- Use the Relational model, ER diagrams.
- Apply concurrency control and recovery mechanisms for practical problems.
- Design the Query Processor and Transaction Processor.
- Apply security concepts to databases.

TEXT BOOK:

1. Ramez Elmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Fifth Edition, Pearson Education, 2008.

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Sixth Edition, Tata Mc Graw Hill, 2011.
2. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
3. Atul Kahate, "Introduction to Database Management Systems", Pearson Education, New Delhi, 2006.

4. Alexis Leon and Mathews Leon, "Database Management Systems", Vikas Publishing House Private Limited, New Delhi, 2003.
5. Raghu Ramakrishnan, "Database Management Systems", Fourth Edition, Tata Mc Graw Hill, 2010.
6. G.K.Gupta, "Database Management Systems", Tata Mc Graw Hill, 2011.
7. Rob Cornell, "Database Systems Design and Implementation", Cengage Learning, 2011.

CS6551

COMPUTER NETWORKS

L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer
- Learn the flow control and congestion control algorithms

UNIT I FUNDAMENTALS & LINK LAYER

9

Building a network – Requirements - Layering and protocols - Internet Architecture – Network software – Performance ; Link layer Services - Framing - Error Detection - Flow control

UNIT II MEDIA ACCESS & INTERNETWORKING

9

Media access control - Ethernet (802.3) - Wireless LANs – 802.11 – Bluetooth - Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP, ICMP)

UNIT III ROUTING

9

Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM)

UNIT IV TRANSPORT LAYER

9

Overview of Transport layer - UDP - Reliable byte stream (TCP) - Connection management - Flow control - Retransmission – TCP Congestion control - Congestion avoidance (DECbit, RED) – QoS – Application requirements

UNIT V APPLICATION LAYER

9

Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS - SNMP

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Identify the components required to build different types of networks
- Choose the required functionality at each layer for given application
- Identify solution for each functionality at each layer
- Trace the flow of information from one node to another node in the network

TEXT BOOK:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.

REFERENCES:

1. James F. Kurose, Keith W. Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009.
2. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", Mc Graw Hill Publisher, 2011.
4. Behrouz A. Forouzan, "Data communication and Networking", Fourth Edition, Tata McGraw – Hill, 2011.

GE6083

DISASTER MANAGEMENT

L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO DISASTERS

9

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

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR)

9

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

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT

9

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

UNIT IV DISASTER RISK MANAGEMENT IN INDIA

9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.