KUMARAGURU COLLEGE OF TECHNOLOGY

(Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE – 641049

CURRICULUM AND SYLLABUS

(REGULATIONS 2013)

3rd - 8th Semesters

B.E. MECHATRONICS ENGINEERING

KUMARAGURU COLLEGE OF TECHNOLOGY, COIMBATORE 641 049
(An Autonomous Institution to Anna University, Chennai)

Regulations - 2013

B.E. MECHATRONICS ENGINEERING

CURRICULUM AND SYLLABI

SEMESTER – III

Code No.	Course Title	L	T	P	C
THEORY					
U13MA*T* 301	Numerical Methods	3	1	0	4
U13MC*T* 301	Sensors and Data Acquisition	3	0	0	3
U13MC*T* 302	Kinematics of Machinery	3	1	0	4
U13MC*T* 303	Electrical Machines and Drives	3	0	0	3
U13MC*T* 304	Mechanics of Fluids for Mechatronics	3	1	0	4
U13MC*T* 306	Manufacturing Technology	3	0	0	3
PRACTICAL					
U13CE*P* 312	Fluid Mechanics and Machinery Laboratory	0	0	3	1
U13EE*P* 312	Electrical Machines Laboratory	0	0	3	1
U13MCP301	Sensors and Data Acquisition Laboratory	0	0	3	1
U13GH*P* 301	Human Excellence - Family Values	1	0	1	1

Total periods – 32 **Total credits – 25**

SEMESTER – IV

Code No.	Course Title	L	T	P	C
THEORY					
U13MAT402	Signals and systems	3	1	0	4
U13GS*T* 001	Environmental Science and Engineering	3	0	0	3
U13MC*T* 401	Industrial Electronics	3	0	0	3
U13 MC*T* 402	Mechanics of Solids for Mechatronics	3	1	0	4
U13 MCT 403	Dynamics of Machinery	3	1	0	4
U13MC*T* 405	Digital Electronics	3	1	0	4
PRACTICAL					
U13ME*P* 404	Machine Dynamics Laboratory	0	0	3	1
U13EE*P* 411	Industrial Electronics Laboratory	0	0	3	1
U13MEP403	Manufacturing Technology Laboratory	0	0	3	1
U13GH*P* 401	Human Excellence - Professional Value	1	0	1	1

Total periods – 33 **Totalcredits - 26**

SEMESTER – V

Code No.	Course Title	L	T	P	C
THEORY					
U13EC*T*512	Digital Signal Processing	3	1	0	4
U13MC*T* 501	MicroprocessorandMicrocontroller	3	0	0	3
U13MC*T* 502	ControlEngineering	3	1	0	4
U13MC*T* 503	CNCTechnology	3	0	0	3
U13MC*T* 504	Process Control and Instrumentation	3	0	0	3
U13MC*T* 505	DesignofMachineElements	3	1	0	4
PRACTICAL					
U13MC*P* 501	Instrumentation Laboratory	0	0	3	1
U13MC*P* 502	CAD/CAMLaboratory	0	0	3	1
U13MC*P* 503	Microprocessor&Microcontroller Laboratory	0	0	3	1
U13GH*P* 501	HumanExcellence-SocialValues	1	0	1	1

Total periods – 32 **Total credits - 25**

SEMESTER–VI

Code No.	Course Title	L	T	P	C
THEORY					
U13MC*T* 601	Design of Mechatronics System	3	0	0	3
U13MC*T* 602	AppliedHydraulicsand Pneumatics	3	0	0	3
U13MC*T* 603	ProgrammableLogicController	3	0	0	3
U13ME*T* 604	ThermodynamicsandHeatTransfer	3	1	0	4
U13MC*T* 604	Embedded System Design	3	0	0	3
E1*	Elective–I	3	0	0	3
PRACTICAL					
U13MC*P* 601	HydraulicsandPneumaticsLaboratory	0	0	3	1
U13MC*P* 602	Embedded System Design Laboratory	0	0	3	1
U13EN*P*601	CommunicationSkillLaboratory	0	0	3	1
U13MC*P* 603	MiniProject 1	0	0	0	1
U13GH*P* 601	HumanExcellence-National Values	1	0	1	1

Total periods – 30 **Total credits - 24**

SEMESTER–VII

Code No.	Course Title	L	T	P	C
THEORY					
U13MC*T* 701	RoboticsandMachineVision System	3	0	0	3
U13MC*T* 702	Automotive Electronics	3	0	0	3
U13MC*T* 703	Micro Electro Mechanical systems	3	0	0	3
U13GS*T* 008	Professional Ethics	3	0	0	3
E2**	Elective–II	3	0	0	3
E3***	Elective–III	3	0	0	3
PRACTICAL					
U13MC*P* 701	RoboticsLaboratory	0	0	3	1
U13MC*P* 702	ProcessControlandSimulationLaboratory	0	0	3	1
U13MC*P* 704	MiniProject 2	0	0	4	2
U13GH*P* 701	HumanExcellence-GlobalValues	1	0	1	1

Total periods – 30 **Total credits - 23**

SEMESTER–VIII

Code No.	Course Title	L	T	P	C
THEORY					
E4****	Elective–IV	3	0	0	3
E5*****	Elective–V	3	0	0	3
E6******	Elective–VI	3	0	0	3
PRACTICAL					
U13MCP801	ProjectWork	0	0	18	6

Total periods – 27 **Total credits - 15**

LIST OF ELECTIVES

ELECTIVES FOR SEMSTER VI

*ELECTIVE I

Code No	Course Title	L	T	P	C
U13GS*T* 004	Operations Research	3	0	0	3
U13MC*E* 101	Finite Element Analysis (FEA)	3	0	0	3
U13GS*T* 005	Engineering Economics and Financial Management	3	0	0	3
U13MC*E* 102	Plant Layout and Material Handling	3	0	0	3

ELECTIVES FOR SEMSTER VII

**ELECTIVE II & ***ELECTIVE III

Code No	Course Title	L	T	P	C
U13MC*E* 201	Modeling and Simulation	3	0	0	3
U13MC*E* 202	Production Planning Control	3	0	0	3
U13GS*T* 006	Product Design and Development	3	0	0	3
U13MC*E* 203	Digital Image Processing	3	0	0	3
U13MC*E* 204	Statistical Quality Control	3	0	0	3
U13MC*E* 205	Virtual Instrumentation	3	0	0	3
U13MA*E* 702	Probability and Applied Statistics	3	0	0	3
U13MC*E* 206	Computational Fluid Dynamics (CFDs)	3	0	0	3
U13MC*E* 207	Computer Networks	3	0	0	3
U13MC*E* 208	Maintenance Engineering	3	0	0	3
U13MC*E* 209	Sensors for Engineering Applications	3	0	0	3
U13MC*E* 210	Concepts of Engineering Design	3	0	0	3

ELECTIVES FOR SEMSTER VIII
ELECTIVES FOR IV, V&VI

Code No	Course Title	L	T	P	C
U13MC*E* 301	Rapid Prototyping	3	0	0	3
U13MC*E* 302	Renewable Energy Sources	3	0	0	3
U13MC*E* 303	Medical Mechatronics	3	0	0	3
U13MC*E* 304	Intellectual Property Rights (IPR)	3	0	0	3
U13MC*E* 305	Artificial Intelligence	3	0	0	3
U13MC*E* 306	Automation System Design	3	0	0	3
U13MC*E* 307	Nano Science	3	0	0	3
U13MC*E* 308	Introduction to Aircraft Engineering	3	0	0	3
U13MC*E* 309	Vehicle Dynamics and control	3	0	0	3
U13MC*E* 310	Non destructive Evaluation	3	0	0	3
U13MC*E* 311	Engineering Metrology	3	0	0	3
U13G*ST* 002	Total Quality Management	3	0	0	3

SEMESTER III

U13MA*T*301NUMERICAL METHODS FOR ENGINEERS

	L	T	P	C
Course Outcomes	**3**	**1**	**0**	**4**

After successful completion of this course, the students should be able to

- Solve a set of algebraic equations representing steady state models formed in engineering problems.
- Fit smooth curves for the discrete data connected to each other or to use interpolation methods over these data tables.
- Find the trend information from discrete data set through numerical differentiation and summarize information through numerical integration.
- Predict the system dynamic behaviour through solution of ODEs modeling the system.
- Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.
- Use MATLAB for obtaining the above solutions.

Course Content

INTRODUCTION **5+3 Hours**

Simple mathematical modeling and engineering problem solving – Algorithm Design – Flow charting and pseudocode - Accuracy and precision – round off errors

NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS **5+3 Hours**

Solution of nonlinear equations - False position method – Fixed point iteration – Newton Raphson method for a single equation and a set of non- linear equations
Solution of linear system of equations by Gaussian elimination, Gauss Jordan method - Gauss Seidel method.

CURVE FITTING AND INTERPOLATION **5+3 Hours**

Curve fitting – Method of least squares - Newton's forward and backward difference formulas – Divided differences – Newton's divided difference formula - Lagrange's interpolation – Inverse interpolation.

NUMERICAL DIFFERENTIATION AND INTEGRATION **5+3 Hours**

Numerical differentiation by using Newton's forward, backward and divided differences – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Numerical double integration.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS
10+3 Hours

Initial value problems - Single step methods: Taylor's series method – Truncation error – Euler and Improved Euler methods – Fourth order Runge – Kutta method – Multistep methods: Milne's predictor - corrector method.

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS (PDEs)
15+3 Hours

PDEs and Engineering Practice – Laplace Equation derivation for steady heat conduction – Numerical solution of the above problem by finite difference schemes – Parabolic Equations from Fourier`s Law of Transient Heat Conduction and their solution through implicit schemes – Method of Lines – Wave propagation through hyperbolic equations and solution by explicit method.
Use of MATLAB Programs to workout solutions for all the problems of interest in the above topics.

Theory:45Hr **Tutorial:15Hr** **Total Hours: 60**

REFERENCES:

1. Steven C.Chapra and Raymond P. Canale, " Numerical Methods for Engineers with Programming and Software Applications", SixthEdition, WCB/McGraw-Hill, 1998.
2. John H. Mathews and Kurtis D. Fink, "Numerical Methods using Matlab", FourthEdition, Prentice Hall of India, 2004.
3. Gerald C. F. and Wheatley P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
4. Sastry S.S, "Introductory Methods of Numerical Analysis", Third Edition, Prentice – Hall of India Pvt Ltd, New Delhi, 2003.
5. Kandasamy P., Thilagavathy K. and Gunavathy K., "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2007.

U13MC*T* 301 SENSORS AND DATA ACQUISITION L T P C

3 0 0 3

Course Objectives

- To know about the types of transducers available.
- To understand the function of signal generators and analyzers.
- To gain information about data acquisition, data logging and application of sensors in condition based monitoring.

Course Outcomes

After successful completion of this course, the students should be able to

- Summarize the working and construction of sensors measuring various physical parameters.
- Design suitable signal conditioning and filter circuits for sensors.
- Outline operations of various data acquisition and transmission systems.
- Distinguish smart sensors from normal sensors by their operation and construction.
- Classify various sensing methods used in condition monitoring.

Course Content

SENSORS AND TRANSDUCERS 9 Hours

Sensors and classifications – Characteristics environmental parameters – Selection and specification of sensors – Introduction to Acoustics and acoustic sensors- Ultrasonic sensor- Types and working of Microphones and Hydrophones – Sound level meter, Humidity sensor, and Nuclear radiation sensor – Stress- Strain measurements Strain gauges (resistive and Optical) types Uniaxial and Multiaxial strain gauges with signal conditioning circuits (half, quarter, and full bridges)

SMART SENSORS 9Hours

Introduction - primary sensors, characteristic, Information coding / processing, Data communication - Recent trends in sensors and Technology - Film sensor, MEMS and Nano Sensors.

SIGNAL CONDITIONING 9 Hours

Amplification, Filtering – Level conversion – Linearization - Buffering – Sample and Hold circuit – Quantization – Multiplexer / Demultiplexer – Analog to Digital converter – Digital to Analog converter- I/P and P/I converter - Instrumentation Amplifier-V/F and F/V converter.

DATA ACQUISITION 9 Hours

Data Acquisition conversion-General configuration-single channel and multichannel data acquisition – Digital filtering – Data Logging – Data conversion – Introduction to Digital Transmission system.

SENSORS FOR CONDITION MONITORING 9 Hours

Introduction to condition monitoring - Non destructive testing (vs) condition monitoring- Intelligent fault detection- Accelerometers- Acoustic Emission sensors- Thermal imaging cameras- Vibration Signature based monitoring techniques - Acoustic emission holography - oil Analysis- Ultrasound based Non Destructive Evaluation techniques.

Total Hours: 45

REFERENCES:

1. Patranabis. D, "Sensors and Transducers", PHI, New Delhi, 2nd Edition , 2003.
2. Ernest O. Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009.
3. David G. Alciatore and Michael B. Histand, "Introduction to Mechatronics and Measurement systems", Tata McGraw-Hill, 2nd Edition, 2008.
4. John Turner and Martyn Hill, Instrumentation for Engineers and Scientists, Oxford Science Publications, 1999.
5. Cornelius Scheffer and PareshGirdhar "Practical Machinery Vibration Analysis and Predictive Maintenance" Elsevier, 2004.
6. A.K. Sawney and PuneetSawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, DhanpatRai& Co, New Delhi, 2001.
7. Mohamed Gad-el-Hak, "The MEMS handbook", Interpharm/CRC. 2001
8. Dr.Ing.B.V.A. RAO, "Monograph on Acoustics & Noise control", NDRF, The Institution of Engineers (India), 2013.

U13MC*T*302 KINEMATICSOFMACHINERY

L	T	P	C
3	1	0	4

Course Objectives

- To understand the basic mechanism and to know the layout of linkages in the assembly of a system.
- To understand the principles in displacement, velocity and acceleration at a point in a link of a mechanism
- To understand the Friction concept and its aspects.

Course Outcomes

After successful completion of this course, the students will be able to

- Design and analyze linkages, cams, gears and other mechanisms
- Apply and solve the kinematics quantities in both graphical and analytical methods.
- Distinguish various friction drives and can able to design standard frictional drives.

Course Content

BASICSOFMECHANISMS 7+3Hours

Terminology and Definitions - Degree of Freedom Mobility –Kutzbachcriterion - Grashoff'slaw-KinematicInversions of4-barchainandslidercrank chains - Mechanical Advantage-Transmissionangle - Description of common Mechanisms - Single, double and offset slider mechanisms - Quick return mechanisms - Ratchets and escapements – IndexingMechanisms –RockingMechanisms-Straightlinegenerators – DesignofCrank - rocker Mechanisms.

KINEMATICS 12+3Hours

Displacement,velocityandaccelerationandanalysisinsimplemechanisms -Graphical Method velocity and acceleration polygons - Kinematic analysis - VectorApproach,Computerapplicationsinthekinematicanalysisofsimple mechanisms – Coincidentpoints –CoriolisAcceleration.

KINEMATICSOFCAM 8+3Hours

Classifications-Displacementdiagrams-parabolicSimpleharmonicandCycloidalmotions-Layoutofplatecamprofiles-DerivativesofFollowermotion-Highspeedcams-circulararcandtangentcams-Standardcammotion-Pressureangleand undercutting.

GEARS 10+3Hours

Spur gear Terminology and definitions-Fundamental Law of toothedgearingandinvolutegearing-Interchangeablegears-geartoothaction- Terminology-Interferenceand undercutting Nonstandardgearteeth-Helical,Bevel,Worm,RackandPiniongears(Basicsonly) - Geartrains -Parallelaxisgeartrains - Epicyclicgeartrains - Differentials.

FRICTION 8 +3 Hours

Surfacecontacts-Sliding and Rolling friction - Friction drives – Frictionin screwthreads-Frictionclutches-Beltandropedrives,Frictionaspects inBrakes-Frictioninvehiclepropulsion andbraking

CASE STUDIES: Application of kinematics in the field of sports, forward and inverse kinematics in robotics

Theory:45Hr Tutorial:15Hr Total Hours: 60

REFERENCES:

1. RattanS.S,'TheoryofMachines',TataMcGraw-HillPublishing CompanyLtd.,NewDelhi,2009.
2. J. J. Uicker, G. R. Pennock and J. E. Shigley,'TheoryofMachinesand Mechanisms',Oxford University Press, 2003.
3. ThomasBevan,'TheoryofMachines',CBSPublishersandDistributors,2010.
4. GhoshAandA. K. Mallick,'TheoryofMechanismsandMachines', AffiliatedEast-WestPvt.Ltd.,NewDelhi,2000.
5. J.S. Raoand R.V. Dukkipati,'MechanismandMachineTheory',Wiley-Eastern Ltd.,NewDelhi,2006.
6. J.HannahandR.C. Stephens,'MechanicsofMachines',VivaLow-PricesStudentEdition,1999.

U13 MC*T*303 ELECTRICAL MACHINES AND DRIVES

L	T	P	C
3	0	0	3

Course Objectives

- To understand the basic concepts of different types of electrical machines and their performance.
- To study the different methods of starting and controlling of D.C. motors and induction motors.

Course Outcomes

After successful completion of this course, the students should be able to

- Use passive elements and basic theorems to solve the electric circuits.
- Relate the basic semiconductor physics to the characteristics and biasing of low powered electronic devices.
- Design regulators and rectifiers using diodes.
- Design amplifiers for oscillators using transistors.
- Use operational amplifiers to solve simple mathematical operations and build conventional vibrators.

Course Content

DCANDACMACHINES **9 Hours**

Introduction to Magnetic Circuits - Magnetic flux - Magnetic intensity,density-Inductance : self andMutual –FaradaysLaw-LenzLaw-Thumbrule–FlemingsRule-Constructionaldetailsandoperatingprinciplesof DCmotors - Back emf - Types of motors - Speed - torque equation-LoadcharacteristicsofDCmotors-Constructional detailsandprincipleofoperationofthreephaseinduction motors – Emfequation – Torque – slipcharacteristics-Constructionandprincipleofoperationofsinglephaseinductionmotors.

STARTINGANDBREAKINGMETHODS **9 Hours**

TypesofDCstarters – TypeofACmotorstarters,starting methods – Breakingofelectricalmotors-DCmotors-singlephaseandthreephaseinductionmotors.

ELECTRICALDRIVES **9 Hours**

Basicelements – Typesofelectricaldrives-Factors influencingthechoiceofelectricaldrives – Heatingandcoolingcurves – Loadingconditionsandclasseofduty – Selectionofpowerratingfordrivemotorswithregardtothermaloverloadingand loadvariationfactors.

CONVENTIONALANDSOLID-STATESPEED CONTROL OFDCMACHINES **9 Hours**

SpeedcontrolofDCseries and Shunt motors - Armature and Field control,WardLeonardcontrolsystem-Controlledrectifiers andDCchoppers based controland their applications.

CONVENTIONALAND SOLID-STATE SPEED CONTROL OF AC

MACHINES AND INVERTER 9 Hours

Speed control of three phase induction motor - Voltage control,Voltage/frequencycontrol,slippowerrecoveryscheme – InvertersandACvoltageregulators: applications.

CASE STUDIES: Pump vibration at an electrical utility. Inverter case studies for solar panel.

Total Hours: 45

REFERENCES:

1. VedamSubramaniam,"ElectricDrives(conceptsandapplications)", TataMcGraw-Hill,NewDelhi,2nd Edition, 2010.
2. Nagrath,I.J.,&Kothari,D.P.,"ElectricalMachines",TataMcGraw-Hill, New Delhi, 3rd Edition, 2006.
3. Pillai,S.K.,"AfirstcourseonElectricdrives",WileyEasternLimited, 1998.
4. Singh,M.D. andKhanchandani,K.B.,"PowerElectronics",TataMcGraw-Hill,NewDelhi,1998.
5. Partab,H.,"ArtandScienceandUtilizationofelectricalenergy",DhanpatRai andSons,NewDelhi,1994.

U13MCT 304 MECHANICS OF FLUIDS FOR MECHATRONICS

L	T	P	C
3	1	0	4

Course Objectives

- To understand the structure and the properties of the fluid.
- To understand and appreciate the complexities involved in solving the fluid flow problems.
- To understand the mathematical techniques already in vogue and apply them to the solutions of practical flow problems.
- To understand the energy exchange process in fluid mechanics handling incompressible fluids.

Course Outcomes

After successful completion of this course, the students should be able to

- Define and differentiate the various properties of fluids and flow.
- Determine the velocity, acceleration, flow rate and the frictional losses of incompressible fluids flowing through pipes.
- Identify the different types of pressure measuring devices and apply the concept of fluid statics in pressure measurements.
- Define and classify the different types of hydraulic machines and select them based on performance for real time applications.

Course Content

BASIC CONCEPTS AND PROPERTIES **6+3Hours**

Fluid - definition, distinction between solid and fluid - Units and dimensions – Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

FLIUD KINEMATICS AND FLUID DYNAMICS **12+3Hours**

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation – flow net – fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube.

INCOMPRESSIBLE FLUID FLOW **12+3Hours**

Viscous flow - Navier - Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen Poiseuille equation)- Hydraulic and energy gradient - flow through pipes - Darcy -weisbach equation - pipe roughness -friction factor - Moody's diagram minor losses - flow through pipes in series and in parallel.

HYDRAULIC TURBINES 8+3 Hours

Fluid machines: definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagram's - head and specific work - components of energy transfer - degree of reaction. Hydro turbines: definition and classifications - Pelton turbine - Francis turbine – propeller turbine - Kaplan turbine - working principles - velocity triangles - work done – specific speed - efficiencies - performance curve for turbines.

HYDRAULIC PUMPS 7+3Hours

Pumps: definition and classifications - Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principles, indicator diagram, and work saved by air vessels and performance curves - cavitations in pumps.

CASE STUDIES

Real time problems related to Bernouli's equation, flow between parallel plates, Pressure measurement, Flow measurement.

Theroy: 45Hr Tuturial: 15Hr TotalHours: 60

REFERENCES:

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", (5th Edition), Laxmi publications (P) Ltd., New Delhi, 2007.
2. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House, New Delhi, 7th Edition, 2008.
3. 3. White, F.M., "Fluid Mechanics", Tata McGraw-Hill, 5th Edition, New Delhi, 2007.
4. Ramamirtham, S., "Fluid Mechanics and Hydraulics and Fluid Machines", DhanpatRai and Sons, Delhi, 2006.
5. 5. Som, S.K., and Biswas, G., "Introduction to fluid mechanics and fluid machines", Tata McGraw-Hill, 2nd Edition, 2007.

U13 MC*T 3*06 MANUFACTURING TECHNOLOGY

L	T	P	C
3	0	0	3

Course Objectives

- To impart the knowledge on various production processes :Metal Casting. Metal Forming, Metal Machining and Metal Joining Processes.

Course Outcomes

After successful completion of this course, the students should be able to

- Identify and select proper manufacturing process.
- Estimate manufacturing process time, forces and other parameters involved in various manufacturing process.
- Select appropriate joining process and parameters for different kind of materials and dimensions.
- Summaries the causes and remedies for defects occurred in manufacturing process.

Course Content

FOUNDRY TECHNOLOGY **9 Hours**

Pattern and Core making – Moulding sand – Melting furnaces: Cupola and Induction furnaces – Special casting processes – Shell, Investment, Die casting – Defects in casting.

FORMING PROCESSES **9 Hours**

Hot and Cold Working Rolling - Introduction – Rolling Mills – Rolling Operations – Forging - Introduction – Related Forging Operations – Drop forging- Extrusion and Drawing - Extrusion Practice – Hot, Cold, Impact and Hydrostatic extrusion. Drawing Process – Defects and Residual Stresses – Drawing Equipment.Sheet metal operations – Blanking, Punching and Piercing. (Treatment is to be given only on operations)

CONVENTIONAL MACHINING PROCESS **9 Hours**

Lathes and Lathe Operations, Drilling and Drilling Machines, Reaming and Reamers, Tapping and Taps – Tool nomenclature, cutting speed, feed, machining Time calculations. (No Treatment on mechanisms)

SPECIALIZED MACHINING AND SUPER FINISHING PROCESS **9 Hours**

Milling Machines and Operations, Planning and Shaping, Broaching, Gear Hobbing and Shaping.Grinding Process – Abrasives – Finishing Operations – Lapping, Honing Burnishing. (No Treatment on mechanisms)

PRINCIPLES & APPLICATIONS OF JOINING PROCESSES **9 Hours**

Gas welding, Basic Arc Welding Processes, Thermit Welding, Electron – Beam Welding, Laser – Beam Welding. Solid State Welding: Cold Welding, Ultrasonic Welding, Friction Welding, Resistance Welding and Explosive Welding. Principles and applications of Brazing and Soldering.

CASE STUDIES:

Study of production processes involved in car manufacturing: Stamping – Welding – Painting – Assembly - Inspection

Total Hours:45

REFERENCES:

1. Kalpakjian, S., "Manufacturing Engineering and Technology", Pearson education India, 4th Edition, 2009.
2. HajraChoudhury, S.K., and HajraChoudhury, A.K., "Elements of Workshop Technology", Volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 1997.
3. Paul Degarma E, Black J.T. and Ronald A. Kosher, Materials and Processes in Manufacturing – Hall of India, 8th Edition 2008.
4. Sharma P.C. A Textbook of Production Technology, S. Chand and Co., Ltd., 2009.

U13CE*P*312 FLUID MECHANICS AND MACHINERY LABORATORY

L	T	P	C
0	0	3	1

Course Objectives

- Operate fluid flow equipment and instrumentation
- To discuss and practice standard measurement techniques of fluid mechanics and their applications

Course Outcomes

After successful completion of this course, the students should be able to

- Use rotometer, venturimeter and orifice meter to determine the fluid flow parameters.
- Conduct experiments to assess the performances of various hydraulic machines.
- Analyze and present the findings of experimental observations in both written and oral format.

LIST OF EXPERIMENTS

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

Total Hours: 45

U13EE*P* 312 **ELECTRICAL MACHINES LABORATORY**

(**Common to III Semester ME & MCE)**

L	T	P	C
0	0	3	1

Course objectives

- To expose the students to the operation of DC machines, Transformers, synchronous machines and induction motors and give them experimental skills.

Course Outcomes

After successful completion of this course, the students should be able to

- Test and assess the performances of the DC motors and single phase AC motor for varying load.
- Control the speed of AC and DC motor.
- Analyze and present the findings of experimental observations in both written and oral format.

LIST OF EXPERIMENTS

1. Load test on DC Shunt motor
2. Load test on DC series motors
3. Speed control of DC shunt motor (Armature and Field Control)
4. Load Test on Three Phase Squirrel Cage Induction motor
5. Load Test on Single phase induction motor
6. Speed control of Three phase slip ring induction motor
7. Speed control of DC shunt motor using controlled rectifiers
8. Voltage / Frequency control of three phase induction motor using inverter.
9. Study of DC & AC starters

Total Hours: 45

U13MC*P*301	SENSORS AND DATA ACQUISTION LABORATORY	L	T	P	C
		0	0	3	1

Course Objectives

- To gain knowledgeon ,data acquisition, data logging and application of sensors in condition based monitoringby conducting experiments.

Course Outcomes

After successful completion of this course, the students should be able to

- Measure displacement and its derivatives by using contact and non- contact type positional sensors.
- Measure vibration and sound of various systems and can predict the causes of various frequency components from FFT.
- Design and realize various data conversion circuits and amplifiers used in data acquisition.
- Simulate simple micro systems.
- Analyze and present the findings of experimental observations in both written and oral format.

LIST OF EXPERIMENTS

1. Measurement of Position and velocity using encoders.
2. Measurement of Position using linear scales.
3. Measurement of speed using Inductive pickup / Proximity sensor.
4. Measurement of vibration for rotating machineries with FFT Analysis
5. Measurement of sound and estimation of noise of rotating machineries and environmental noise analysis in $1/n^{th}$ and FFT analysis.
6. Design of Flash type Analog to Digital Converters.
7. Design of Digital Comparator.
8. Design of Voltage to frequency converter.
9. Design of Frequency to Voltage Converter.
10. Design of multiplexer and demultiplexer using logic gates or IC's.
11. Design of sample and hold circuit.
12. Design of instrumentation amplifier using OP-AMP.
13. Design and simulation of Micro cantilever beam
14. Design and simulation of Micropump

Total Hours: 45

U13GHP 301 HUMAN EXCELLENCES - FAMILY VALUES

L	T	P	C
0	0	2	1

(Common to all branches of Engineering and Technology)

Course Objectives

- To inculcate the basic need for family life and peace in it.
- To lead spiritual development through good family life.
- To respect womanhood and live disease free life.
- To live with sound health.
- To reach Intuition.

Course Outcomes

After successful completion of this course, the students should be able to

- Develop skills in maintaining harmony among the family members.
- Acquire skills in traditional yogasanas leading to sound health.
- Behave as a family member and leading to a blissful family life.
- Use food as medicine.

Course Content

RESTRAINT IN FAMILY **4 Hours**

Definition - Greatness of life force & mind. Introduction - Kayakalpa yoga -aim - maintaining youthfulness – sex & spirituality – ten stage of mind – mental frequency-method of concentration – kayakalpa philosophy - physical body – sexual vital fluid – life force – bio-magnetism - mind –food transformation into seven minerals – postponing the ageing process – death – importance of kayakalpa training.

SPIRITUAL DEVELOPMENT THROUGH GOOD FAMILY LIFE **4 Hours**

Kayakalpa exercise – methods –aswinimudhra – ojus breathing – explanations – benefits – practices – Responsibility of men and women – introduction a good education – need of morality – spiritual development.Revision of previous physical exercises. Introduction – hints & caution – body massaging – accu-pressure –relaxation.

PEACE IN FAMILY **4 Hours**

Family value – meaning – Introduction – values – benefits of blessings – effect of vibrations – make blessings a daily habit – greatness of friendship – individual & family peace – reason for misunderstanding in the family – no comment – no command – no demand – no ego – peace of mind.

GREATNESS OF WOMANHOOD & FOOD IS MEDICINE **4 Hours**

Good–cultured behavioral patterns – love and compassion - Greatness of womanhood – Food is medicine (healthy food habits)

SIMPLIFIED PHYSICAL EXERCISES **7 Hours**

Simplified physical exercises – Kaya Kalpa Yoga (Benefits related to the Patient, Tolerance, Sacrifice)

MEDITATION & YOGASANAS **7 Hours**

Thuriya meditation – introduction – practice – benefits. Asanas– ashtanga yoga – pathanjali maharishi –hints & cautions – posture - movement – involvement – standing asanas: thadasana – ekapathasana – chakrasana(side) – uthkatasana – trikonasana. Sittingasanas: thandasana – padmasana – vajrasana – suhasana – siddhasana – parvathasana – yogamudhra.Downward lying asanas: makkarasana – bhujangasana – salabhasana – navukasana– dhanurasana. Upward lying asanas: savasana - arthapavanamukthasana– pavanamukthasana – utthanapathasana – navasana& Surya namaskara.

TotalHours: 30

REFERENCES:

1. VethathiriMaharishi,"Yoga for Modern Age".
2. Swami Vivekananda, "The Man making Messages".
3. Vethathiri Maharishi, "Manavalakalai Part- 1&2&3"
4. Vethathiriyam, "Value Education for Health & Happiness and Harmony"

SEMESTER IV

U13 MAT402 SIGNALS AND SYSTEMS

L	T	P	C
3	1	0	4

Course Objectives:

- To identify continuous time systems and signals that interact with them
- To apply laws of physics to derive simple models for real-life dynamic systems
- To obtain system behavior through model based simulation
- To represent periodic signals using Fourier series and understand the significance of frequency spectra
- To understand Fourier Transformation of aperiodic signals and the resulting continuous spectra
- To infer linear time invariant system behavior through state space as well as frequency domain models.

Course Outcomes

After successful completion of this course, the students should be able to

- Apply laws of Physics to model simple real life systems to predict its dynamic behavior
- Use Fourier analysis to identify the frequency characteristics of signals of interest
- Use time domain and frequency domain methods to understand the inherent behavior of LTI systems
- Take up advanced courses on system dynamics, digital signal processing and design of feedback control systems

Course Content

REPRESENTATION OF SIGNALS AND SYSTEMS 3Hours

Introduction to systems, signals and their interaction.Continuous time and discrete time signals, periodic and aperiodic signals, energy and power signals.

Representation of simple systems with examples. Linear and nonlinear systems, Systems with and without memory, Time varying and time- invariant systems

DYNAMIC SYSTEM MODELING & SIMULATION 12Hours

Lumped element modeling - Laws of Physics applied to Simple Mechanical Systems and RLC Electrical circuits

System State - State variables and forms of state equations. Matrix representation of state equations for linear dynamic systems – Free response and forced response

Time response from general system models through numerical integration. Use of Continuous System Simulation Tools (MATLAB)

PERIODIC SIGNALS AND FOURIER SERIES 7Hours

Obtaining trigonometric Fourier series – Exponential Fourier Series –Fourier Spectra – Parseval's Theorem- Linearity and time-shifting properties of Fourier series

FOURIER TRANSFORMS FOR APERIODIC SIGNALS 10Hours

Fourier Transform(FT) pair and equations relating them – Magnitude and phase spectra from Fourier Transforms – Linearity, time scaling , time shifting, time differentiation and integration properties of FTs - Parseval's Energy Theorem – Existence condition for FT

ANALYSIS OF LINEAR TIME INVARIANT (LTI) SYSTEMS USING TRANSFORMS 13Hours

Impulse Response of LTI system- Convolution integral – FT for convolved time signals - Transfer function of LTI system using Fourier Transform – System gain and phase responses in sinusoidal steady state – Bode plots – Applications in Communication and Control – Analog filters

Theroy : 45Hr **Lab: 15Hr** **Total Hours : 60**

REFERENCES:

1. MrinalMandal and AmritAsif, `Continuous and Discrete Time Signals and Systems', Cambridge University Press, 2007
2. P.D. Cha, J.J. Rosenberg & C.L. Dym, `Fundamentals of Modeling and Analyzing Engineering Systems', Cambridge University Press, 2000
3. W.Y. Yang et. al., `Signals and Systems with MATLAB', Springer, 2009
4. A.V. Oppenheim & A.S. Willsky, `Signals & Systems', PHI Learning Pvt.Ltd.,2011
5. V. Krishnaveni& A. Rajeshwari, `Signals &Systems',Wiley – India, 2012.

U13GS*T* 001	ENVIRONMENTAL SCIENCE AND ENGINEERING **(Common to all branches)**	L	T	P	C
		3	0	0	3

Course Objectives

At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve biodiversity.

Course Outcomes

Course Content

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES **10Hours**

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

ECOSYSTEMS AND BIODIVERSITY **14Hours**

Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION **8 Hours**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Solid waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT 7 Hours

From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – Wasteland reclamation – Consumerism and waste products – Environment Production Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness

HUMAN POPULATION AND THE ENVIRONMENT 6 Hours

Population growth, variation among nations – Population explosion – Family Welfare Programme – Environment and human health – Human Rights – Value Education – HIV / AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies.

Field Work

Visit to local area to document environmental assets- river / grassland / hill / mountain, visit to local polluted site- urban / rural / industrial / agricultural, study of common plants, insects, birds, study of simple ecosystems-pond, river, hill slopes etc.,

Total Hours:45

REFERENCES:

1. Deswal.S and Deswal.A, " A basic course in Environmental studies" DhanpatRai& Co, 2006.
2. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition, ISBN 81-297-0277-0, 2004.
3. Miller T.G. Jr., Environmental Science – Sustaining the earth, Wadsworth Publishing Co., 1993
4. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad India., 2002
5. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media. 1996
6. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, Jaico Publ., House, Mumbai, 2001.
7. Wager K.D., Environmental Management, W.B. Saunders Co., Philadelphia, USA, 1998.
8. Townsend C., Harper J and Michael Begon, "Essentials of Ecology", Blackwell science Publishing Co., 2003
9. Trivedi R.K and P.K.Goel "Introduction to Air pollution" Techno-science Pubications. 2003,
10. Yamuna R.T"Environmental Science" Inter Publications, 2008

U13MC*T*401	INDUSTRIAL ELECTRONICS	L	T	P	C
		3	0	0	3

Course Objectives

- The course is intended to familiarize the Mechatronics students with majoraspects of power electronics which has wide spread applications in today's industry suchas power supplies, variable speed drives, transportation, robotics etc.

Course outcomes

After successful completion of this course, the students should be able to

- Relate the basic semiconductor physics to the properties of real devices, and able to analyze the different EMI problem in switching.
- Describe the concepts of operation of dc-dc converters in steady state in continuous and discontinuous modes and be able to analyze basic converter topologies.
- Identify the proper gating sequence and control circuit in operating the single phase and three phase inverter circuits.
- Analyze the performance parameter, various techniques for analysis and design of AC voltage controller and also list the various control schemes in cycloconverter.

Course Content

POWER SEMICONDUCTOR DEVICES **9 Hours**

Classification of Power semiconductor devices, characteristics, construction, application and theory of operation of power diode, power transistor, thyristors.Device specifications and ratings, working of Diac, Triac, IGBT, GTO and other power semi conductor devices. EMI-Types of EMI problems – di/dt protection and dv/dt protection - snubbers – shielding - grounding-filtering – twisted shielding wires-soft switching and methods of solving in industrial electronics.

PHASE CONTROLLED CONVERTERS **9 Hours**

Single phase full converters, 3 phase half converter and 3 phase full converter – inverter operation – input power factor – effect of source inductance- use of flywheel diode in controlled rectifier configurations– Thyristor triggering circuits.

INVERTERS AND CHOPPERS **9 Hours**

Classification of inverters, Thyristor inverters, Voltage and Current Communicated inverters, PWM inverters, Principle of Chopper, Chopper classification – step up and step down Chopper - Types of regulators.

A. C. VOLTAGE CONTROLLERS AND CYCLO-CONVERTERS **9 Hours**

Single phase AC voltage controller – multistage sequence control – step up and step down cycloconverters – three phase to single phase and three phase cycloconverters

INDUSTRIAL APPLICATIONS **9 Hours**

Solid-state switching circuits, Relays, Electronic Timer, Saw tooth generator, applications in Industrial process control, Motor drive applications, Electronic regulators, etc., Induction heating, Dielectric Heating.

Total Hours:45

CASE STUDIES: Usage of Power Electronics in Thermal power Management, Converters modeling and control.

REFERENCES:

1. P S Bimbhra , "Power Electronics" Tata McGraw Hill, 2006
2. Rashid, M.H., "Power Electronics – Circuits Devices and Application" Prentice Hall International, New Delhi, 3rd Edition, 2004.
3. Dubey, G.K., Doradia, S.R., Joshi, A. and Singh, R.M., "Thyristorised Power Controllers", Wiley Eastern Limited, 2008.
4. Joseph Vithayathil, "Power Electronics – Principle and Applications", Tata McGraw-Hill Inc, New Delhi, 2010.
5. D. R. Patrick, S. W. Fardo, Industrial Electronics, Devices and Systems, Marcel Dekker, October 2000.
6. S. Bhattacharys , S. Chatterjee, "Industrial Electronics And Control " Tata McGraw Hill, 2004

U13 MCT 402	MECHANICS OF SOLIDS FOR MECHATRONICS	L	T	P	C
		3	1	0	4

Course Objectives

- The subject of Mechanics of solids cuts broadly across all branches of engineering profession. At the end of this course, the student will have knowledge about behaviour of members subjected to various types of forces. The subject can be mastered best by solving numerous problems.

Course Outcomes

After successful completion of this course, the students should be able to

- Apply and solve the concepts of stress, strain and deformation in various components
- Develop the shear force, bending moment diagram and calculate the slope and deflection for various types of beams and end conditions
- Determine the power transmitting, torque carrying capacities of the shafts with various cross sections
- Comprehend the energy absorption, deflection concepts of springs and solve the stiffness of helical springs by using appropriate guidelines and formulae.
- Learn the concepts of Finite Element Analysis and formulating FEA governing equations for simple structures

Course Content

STRESS,STRAINANDDEFORMATIONOFSOLIDS 9+3Hours

Rigidand Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Strain – Poisson's ratio – lateralstress–Deformationofsimpleand compoundbarsunderaxialload– Thermalstress–Elasticconstants– Strainenergyandunitstrainenergy –Strainenergyinuniaxial loads.

BEAMS–LOADSANDSTRESSES 9+3 Hours

TypesofbeamsSupportsandLoads–Shearforceand BendingMomentinbeams– Cantilever,SimplysupportedandOverhangingbeams –Stressesinbeams– Theoryofsimplebending–Stressvariation longthelengthandinthebeamsection– Effectofshapeofbeamsectiononstressinduced–Shearstressesin beams–Shearflow.

TORSION 9+3Hours

Analysisoftorsionofcircularbars–Shearstressdistribution– BarsofSolidandhollowcircularsection–Twistandtorsion stiffness–Compoundshafts– Fixedandsimplysupportedshafts–Applicationtoclosecoiledhelicalsprings– MaximumshearstressinspringsectionincludingWahlFactor–Designof helicalcoilsprings.

BEAMDEFLECTION 9+3Hours

Elastic curve of Neutral axis of the beam under normal loads – Evaluationofbeamdeflectionandslope:Doubleintegrationmethod,MacaulayMethod,– Columns–Endconditions– Equivalentlengthofacolumn– Eulerequation–Slenderness ratio– Rankineformulaforcolumns.

FINITE ELEMENT ANALYSIS FOR STRUCTURES 9+3 Hours

Introduction to FEA, General procedure for finite element analysis, governing equation for finite element analysis for 2D & 3D Structures, Application of FEA for Bars, Stepped bar and Beams.

Theory:45HrTutorial:15Hr Total Hours: 60

REFERENCES:

1. Popov,E.P,"EngineeringMechanicsofSolids",Prentice-HallofIndia, NewDelhi,2007.
2. Beer, F. P. and Johnston, R., "Mechanics of Materials", 3rd edition, McGraw-Hill, 2008.
3. Rajput, R. K, "A textbook of Strength of Materials", S. Chand, 2007.
4. Nash, W.A, "Theory of problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1998.
5. Kazimi, S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co, NewDelhi, 2001.
6. Ryder, G.H., "Strength of Materials", Macmillan India Ltd., 2002.\
7. Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2004.
8. Bansal, R.K., "A Text Book of Strength of Materials", Laxmi Publications, 2009.
9. Ramamrutham, S., "Strength of Materials", DhanpalRai, Publishing Company (P) Ltd., 2005

U13MC*T* 403 DYNAMICSOFMACHINERY

L	T	P	C
3	1	0	4

Course Objectives

- Tounderstandtheforce-motionrelationshipincomponentssubjected toExternalForces.
- Tounderstandtheforce-motionanalysisofstandard mechanisms.
- Tounderstandtheundesirableeffectsofunbalances resulting from prescribedmotionsinmechanism.
- TounderstandtheeffectofDynamicsofUndesirable Vibrations.
- Tounderstandtheprinciplesof variousmechanismsusedinmachines.

CourseOutcomes:

After successful completion of this course, the students should be able to

- Calculate the force analysis of dynamic systems.
- Identify and analyze the static and dynamic balancing of rotating masses and reciprocating masses.
- Measure the effect of free and forced vibration.
- Summarise the concepts of governors and gyroscopes.

Course Content

FORCEANALYSIS **10+3Hours**

Rigid Body dynamics in general plane motion – Equations of motion.- Dynamicforceanalysis – InertiaforceandInertia torque –D'Alembertsprinciple – Theprincipleofsuperposition – DynamicAnalysisinReciprocating Engines – Gas Forces- Equivalent masses-Bearing loads - CrankshaftTorque- Turningmomentdiagrams– Flywheels– EngineshakingForces – Camdynamics-Unbalance,SpringSurgeandWindup.

BALANCING **9+3Hours**

Static and dynamic balancing - Balancing of rotating masses -Balancing a single cylinder Engine - Balancing Multi- cylinder Engines – PartialbalancinginlocomotiveEngines-Balancing linkages – balancingmachines

FREEVIBRATION **10+3Hours**

Basicfeatures of vibratory systems - idealized models, Basic elements andlumpingofparameters-Degreesoffreedom-Singledegreeoffreedom-Freevibration- Equationsofmotion-naturalfrequency-Typesof Damping-Dampedvibration- criticalspeedsofsimpleshaft-Torsional systems:Naturalfrequencyoftwoandthreerotorsystems.

FORCEDVIBRATION **6+3Hours**

Responsetoperiodicforcing-HarmonicForcing-Forcing causedbyunbalance- Supportmotion–Forcetransmissibilityandamplitudetransmissibility-Vibrationisolation.

MECHANISMFORCONTROL **10+3Hours**

Governors- Types - Centrifugal governors - Gravity controlled andspring controlledcentrifugalgovernors– Characteristics – Effectoffriction – ControllingForce- otherGovernormechanisms. Gyroscopes- Gyroscopic forces and Torques – Gyroscopicstabilization- GyroscopiceffectsinAutomobiles,shipsand airplanes.

CASE STUDY: Isolation of vibrations in Automobiles-Engine - Suspensions.

Thory:45HrTutorial:15Hr **Total Hours: 60**

REFERENCES:

1. RattanS.S.,"TheoryofMachines",TataMcGraw-HillPublishing CompanyLtd.,NewDelhi,2nd Edition,2007.
2. R.S. Khurmi,J.K. Gupta"Theoryofmachines",S.Chand& Company Ltd, New Delhi, 2003.
3. ThomasBevan,"TheoryofMachines",CBSPublishersandDistributors,2003.
4. GhoshA.andMallickA.K.,"TheoryofMechanismsandMachines",AffiliatedEast-WestPress, Pvt.Ltd.,NewDelhi,2000.
5. ShigleyJ.E.andUickerJ.J.,"TheoryofMachinesandMechanisms",McGraw -Hill,Inc.,2003.
6. RaoJ.S.andDukkipatiR.V.,"MechanismandMachineTheory",Wiley-Eastern Limited,NewDelhi,2006.
7. JohnHannahandStephensR.C.,"MechanicsofMachines",Vivalow-PricedStudentEdition,1999.
8. SadhuSingh"TheoryofMachines",PearsonEducation,2nd Edition, 2008.

U13MC*T* 405 DIGITAL ELECTRONICS

L	T	P	C
3	1	0	4

Course Objectives

- To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions
- To introduce the methods for simplifying Boolean expressions
- To outline the formal procedures for the analysis and design of combinational circuits and sequential circuits
- To introduce the concept of memories and programmable logic devices.
- To illustrate the concept of synchronous and asynchronous sequential circuits

Course Outcomes

After successful completion of this course, the students should be able to

- State the theorem and understand the different logic families of integrated circuits to use the various methods for simplification of gates.
- Design complex arithmetic and logic circuit and to evaluate its function realization using gates.
- Describe the timing problem in sequential circuits and internal structure of various flip - flops.
- Analyze and design various flip flop based state machines for asynchronous, synchronous sequential circuits and counters.
- Design the complex logic memories, programmable logic devices and test its functionality and timing.

Course content

NUMBER SYSTEMS, DIGITAL LOGIC FAMILIES AND BOOLEAN LOGIC **9+3Hours**

Introduction to Number systems- Binary, Octal, Hexadecimal, BCD, Gray code, Excess 3 code - Binary arithmetic, 1's complements, 2's complements, and Code conversions Digital Logic Families:

TTL, CMOS, NMOS, ECL. Comparison of performance of various logic families. Boolean algebra: Basic Postulates and theorems, Switching functions, Canonical forms, Logic gates. Simplification using K-maps &QuineMcCluskey method, Implementation using logic gates.

COMBINATIONALCIRCUITS **9+3Hours**

Problem formulation and design of combinational circuits, adder , subtractor, Serial adder and Subtractor - Parallel adder and Subtractor- Carry look ahead adder- BCD adder- Magnitude Comparator , parity checker Encoder , decoder, Multiplexer/ Demultiplexer , code converters, Function realization using gates and multiplexers. Implementation of Combinational circuits using Multiplexers and Demultiplexers.

SEQUENTIALCIRCUIT **9+3Hours**

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

DESIGNOFSEQUENTIALCIRCUITS 9+3Hours

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 – Ring counters. Hazards: Static - Dynamic

DIGITAL MEMORIESAND PROGRAMMABLE LOGIC DEVICES 9+3Hours

Memories – ROM, PROM, EEPROM, RAM and Flash memories.– Programmable Logic Devices: Programmable Logic Array (PLA)- Programmable Array Logic (PAL)- Implementation of combinational logic using PROM and PLA,PAL. Introduction to FPGA.

CASE STUDIES : Simple Logic Design: Seven Segment Display

Theory:45Hr Tutorial:15HrTotalHours: 60

REFERENCES:

1. M. Morris Mano, 'Digital Design', Prentice Hall of India Pvt. Ltd., New Delhi, 4th Edition, 2007
2. John .M Yarbrough, 'Digital Logic Applications and Design', Thomson- Vikas Publishing House, New Delhi, 2002.
3. S. Salivahanan and S. Arivazhagan, 'Digital Circuits and Design', Second Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2004
4. Charles H.Roth.'Fundamentals of Logic Design', Thomson Publication Company, 2003.
5. Donald P.Leach and Albert Paul Malvino, 'Digital Principles and Applications', Tata McGraw Hill Publishing Company Limited, New Delhi, 5th Edition, 2003.
6. R.P.Jain, 'Modern Digital Electronics', Tata McGraw – Hill publishing company limited, New Delhi, 3rd Edition, 2003.
7. Thomas L. Floyd, 'Digital Fundamentals', Pearson Education, Inc, New Delhi,2003
8. Donald D.Givone, 'Digital Principles and Design', Tata McGraw - Hill Publishing company limited, New Delhi, 2003.

U13ME*P*404 MACHINEDYNAMICS LABORATORY L T P C
0 0 3 1

Course objectives

- To study thecharectersitics of governors.
- To do experiment on dynamic balancing of rotating massesand reciprocating masses.

Course Outcomes

After successful completion of this course, the students should be able to

- Relate the different characteristics of governors and verify 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 vibrations and whirling of shaft.
- Experimental verification of dynamic balancing of rotating masses, reciprocating masses.
- Analyze and present the findings of experimental observations in both written and oral format.

LIST OF EXPERIMENTS

1. Governors - 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-Determination of Gyroscopic couple Verification of Laws.
4. Bifilar Suspension and Compound Pendulum – Determination of Moment of Inertia of Rod.
5. Turn Table – Determination of Moment of Inertia of Disc and Ring.
6. Epicyclic Gear Train Apparatus – Gear Ratio and Torques.
7. Balancing of rotating masses (Static and Dynamic Balancing)
8. Balancing of reciprocating masses.
9. A) Helical Spring – Natural Frequency of Longitudinal Vibrations
   B) Transverse Vibrations Verification of Dunkerley's Rule.
10. Rotor Systems – Natural Frequency of Torsional Vibrations.
11. A) Whirling of Shaft – Determination of Critical Speed
    B) Vibrating Table – Determination of Transmissibility Ratio.

Total Hours: 45

U13EE*P*411	INDUSTRIAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	3	1

Course Objectives

- To understand solid state devices and power converter circuits by conducting experiments.

Course Outcomes

After successful completion of this course, the students should be able to

- realize solid state switches and its biasing circuits
- Choose proper power converter circuit with respect to load.
- Test the various solid state speed controller circuit for induction motor
- Analyze and present the findings of experimental observations in both written and oral format.

LIST OF EXPERIMENTS

1. Study of SCR, MOSFET & IGBT characteristics
2. UJT, R, RC firing circuits for SCR
3. Voltage & current commutated chopper
4. SCR / TRIAC phase control circuits
5. Study of half controlled & fully controller converters
6. Speed control of DC shunts motor using three phase fully controlled converter.
7. SCR single-phase cycloconverters
8. SCR series and parallel inverters
9. IGBT Chopper
10. IGBT based PWM inverter (single phase)

Total Hours: 45

.

U13ME*P*403 MANUFACTURING TECHNOLOGY LABORATORY

L	T	P	C
0	0	3	1

CourseObjectives

- To do experiments in different manufacturing machines by abiding to safety norms.

Course Outcomes

After successful completion of this course, the students should be able to

- Machine a part by selecting appropriate manufacturing process and abiding to safety norms.
- Use various measurement tools and techniques to confirm the production drawing.
- Analyze and present the findings of experimental observations in both written and oral format.

LIST OF EXPERIMENTS

UNIT 1 LATHE PRACTICE

a. Plain Turning
b. Taper Turning
c. Thread Cutting

Estimation of machining time for the above turning processes.

I DRILLING PRACTICE

a. Drilling
b. Tapping
c. Reaming

II MILLING

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

V PLANNING AND SHAPING

a. Cutting Key Ways
b. Dove tail machining.

Total Hours: 45

U13GH*P* 401 HUMAN EXCELLENCES - PROFESSIONAL VALUES

L	T	P	C
0	0	2	1

(Common to all branches of Engineering and Technology)

Course Objectives

- To know the 5 Cs (Clarity, courage, confidence, commitment, compassion)
- To Know the 5 Es(Energy, Enthusiasm, Efficiency, Enterprise, Excellence)
- To Practice the IQ Questions and given to the result
- To Learn about Professional Ethics
- To know the examples for Self Control

Course Outcomes

After successful completion of this course, the students should be able to

- Acquire knowledge on the Clarity, courage, confidence, commitment, compassion for a good Professionalize
- Demonstrate Skills of IQ test
- Contribute to the better Management of Time
- Behave a good Professionalism from Quality Enhancement.

Course Content

PERSONALITY CONCEPTS - 5C'S & 5E'S **5 Hours**

Personality-concepts, definition,-types of personality-personality development activities- how to develop a good personality factors affecting personality development tools of improve personality-steps to a dynamic personality-5 C's and 5 E's

TIME MANAGEMENT **5Hours**

Self-development – importance of self development – how to develop oneself – continuous learning – laser focus +persistence – working a plan – sound mind follows sound body –complete responsibility – practice – those who make it, made it – never give-up – meditation – ten commandments of self development – self control technique for teenagers.

LEADERSHIP TRAITS **5Hours**

Leadership traits – style – factors of leadership – principles of leadership - time management – importance of time management – benefits – top five time sucks of the average Human –time management for college students. Passion for excellence – what is passion? – Why passion? – Value of life – index of life – fuel for fulfillment – secret of physical & spiritual fitness – improves learning ability.

EMPOWERMENT OF MIND **5Hours**

IQ, - Factors affecting the intelligence quotient – IQ and the brain – sex – race – age – relationship between IQ & intelligence – how to develop good intelligence quotient power – exercise can improve IQ – food plan to increase IQ – meditation – reading – playing – try right with opposite hands – learn new things - the IQ tests. EQ – emotional Intelligence – list positive & negative emotions. SQ – spiritual quotients – definition – basic science of spiritual quotient – how to build SQ? – Relationship between IQ, EQ, SQ.

MEDITATION **3 Hours**

Panchendhriya meditation – Introduction – practice – benefits.

SIMPLIFIED PHYSICAL EXERCISE& YOGASANAS **7 Hours**

Asanas – revision of previous asanas–standing asanas: natarasana –virabhadrasana – pathangusthasana– ardhachandrasana–utthithatrikonasana–parsvakonasana.

Total Hours: 30

REFERENCES:

1. ICFAI University,"Personality & Self Development"
2. Dr.A Chandra Mohan,"Leadership".
3. Swami Vivekananda,"Intelligence".
4. Robert W. Bly ,"Ways to make every second valuable".
5. Vethathiri Maharishi,"Manavalkkalai Part-II".
6. D.R Kiran&S.Bhaskar,"Professional Ethics& Human Values".
7. Keith Ward& Cliff Bowman ,"Extraordinary performance from ordinary people".
8. Vethathiri Maharishi ,"Mind".
9. Vethathiri Maharishi, "Manavalkkalai Part-I".
10. Russell Kelfer ,"Self Cotrol".

SEMESTER V

U13EC*T*512 DIGITAL SIGNAL PROCESSING L T P C
(Common to EEE / CSE / IT / EIE / MCE) 3 1 0 4

Course Objectives

- Understand and analyze the characteristics of discrete signals and systems
- Apply mathematical tools for signal / system analysis
- Design digital filters.
- Learn the architecture and features of P-DSPs

Course Outcomes

After successful completion of this course, the students should be able to

- Understand the characteristics of discrete-time signals and discrete systems
- Analyze signal / system properties using mathematical tools
- Apply and develop algorithms for digital systems
- Illustrate efficient computation of DFT
- Discuss advanced features and architecture of generic P-DSP

Course Content

DISCRETE TIME SIGNALS AND SYSTEMS **12 Hours**

Representation of a CT signal by samples – Sampling theorem – Reconstruction of a signal from its samples – Aliasing – DT Signals – Impulse, Step, Pulse, Sine, Exponential – Properties of DT signals - Transformation of independent variable – Shifting, scaling, folding - Discrete Time LTI systems – Properties – Impulse response – Convolution sum – Properties of Convolution

Z-TRANSFORM AND SYSTEM ANALYSIS **12 Hours**

DTFT – Properties - Z transform – Forward Transform - Inverse Transform using Partial Fractions - Properties – Pole-Zero plot– Difference Equations - Transfer function - Analysis of Discrete Time systems using DTFT and Z Transform.

DISCRETE FOURIER TRANSFORM **12 Hours**

IntroductiontoDFT–PropertiesofDFT –EfficientcomputationofDFT –FFTalgorithms– Introduction to Radix-n algorithms – Radix – 2FFT –Decimation-in-Time andDecimation–in-Frequencyalgorithms – Butterfly diagram.

DESIGN OF DIGITAL FILTERS **12 Hours**

FIR filter design: Linear phase characteristics - Windowing Technique –Rectangular, Hamming, Hanning, Blackmann windows – IIR filter design: Analog filter design - Butterworth and Chebyshev approximations – Impulse invariance and Bilinear transformations - FIR and IIR filter structures – Direct form I and II - cascade and parallel forms – Finite Precision effects.

ADVANCED TOPICS AND PROGRAMMABLE DSP CHIPS **12 Hours**

Concepts of multi-rate signal processing – Decimation and interpolation by integer factor – Sampling rate conversion – Introduction to DSP architecture - Von Neumann, Harvard, Modified Harvard architectures - MACunit–MultipleALUsModified Bus structures and memory access schemes in P-DSP – Multiple access memory – Multi-ported memory – VLIW architecture –Pipelining – Special addressing modes

Theory:45Hr **Tutorial :15HrTotal Hours: 60**

REFERENCES

1. Mrinal Mandel and Amir Asif, "Continuous and Discrete Time Signals and Systems", Cambridge International Student Edition, Cambridge University Press, 2007.
2. JohnG.ProakisandDimitrisG.Manolakis, "DigitalSignalProcessing,Principles, AlgorithmsandApplications",PHI, 3rd Edition.2000.
3. B. Venkataramani, M. Bhaskar, "Digital Signal Processors, Architecture, Programming and Applications", Tata McGraw Hill, New Delhi, 2003. (Unit V)
4. JohnyR.Johnson,"IntroductiontoDigitalSignalProcessing",PHI, 2009.
5. Won Y. Yang et. Al., "Signals and Systems with MATLAB", Springer International Edition, 2009
6. Steven W. Smith, "The Scientists and Engineer's Guide to Digital Signal Processing", California Technical Publishing, 1997.
7. James H. McClellan, Ronald W. Schafer, Mark A. Yoder, "Signal Processing First", 2nd Edition.

U13MC*T*501 MICROPROCESSOR AND MICROCONTROLLER

L	T	P	C
3	0	0	3

Course Objectives:

- To study about the 8085 Microprocessor
- To study about data transfer methods
- To study about the peripheral devices
- To emphasize the basics of 8086 Microprocessor.
- Explains about the application of 8051

Course Outcomes

After successful completion of this course, the students should be able to

- Describe and differentiate the architectures of Microprocessor and microcontroller.
- Write assembly language programs for 8085 microprocessor and 8051 microcontroller.
- Effectively use interrupts and data transfer schemes for application development.
- Design interface circuits to interact with memory devices, I/O devices and develop real time applications.

Course Content

8085 MICROPROCESSOR 9Hours

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 - 8085 assembly language programming.

INTERFACING AND I/O DEVICES 9Hours

Need for Interfacing – Memory Interfacing: address space partitioning – address map – Address decoding – Designing decoder circuit for the given address map .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 –serial data transfer.

DESIGN USING PERIPHERAL DEVICES 9Hours

Interfacing A/D and D/A converters – Matrix Keyboard design using 8255 using 8085 programs – Design of Keyboard and display interfacing using 8279 – Design of digital transmission with modems and telephone lines using 8251 A.

8051 ARCHITECTURE 9 Hours

Microcontroller Hardware – I/O Pins, Ports – External memory – Counters and Timers – Serial data I/O – Interrupts – 8051 Assembly Language Programming: Instruction set of 8051, Addressing modes, Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions, interrupts and returns interrupts and returns interrupt handling.

APPLICATIONS 9Hours

Applications of 8051 Microcontroller: Interfacing of Keyboards – Interfacing of Display Devices– Analog to Digital and Digital to Analog Converter – Interfacing Hardware Circuit – Multiple interrupts – Serial Data Communication – Network Configuration.

CASE STUDIES: Interfacing of Display Devices.

Total Hours : 45

REFERENCES:

1. Ramesh Goankar, "Microprocessor Architecture. Programming and Applications with the 8085", Printice hall India, - 2002.
2. Kennath J. Ayala, "The 8051 Microcontroller Architecture, Programming and Applications", Penram International (India), Mumbai, 3rd edition 2004
3. Aditya P Mathur, "Introduction to Microprocessor", Tata McGraw Hill, 3rd edition, New Delhi 2003
4. B.P. Singh, "Microprocessors and Microcontrollers", 1st Edition, Galgotia, New Delhi, 1997.
5. Embedded Controller Hand book, Intel Corporation, USA.
6. Microcontroller Hand Book, INTEL, 1984.

U13MC*T* 502 CONTROL ENGINEERING

L	T	P	C
3	1	0	4

Course Objectives

- To study the open loop and closed loop systems.
- To study time response of first and second order systems and basic state variable analysis and to do simple problems.
- To study the concept of stability and criteria for stability and to do simple problems.
- To study the frequency response through polar plots and Bode plots and Nyquist stability criteria and to do simple problems.
- To study the compensation technique that can be used to stabilize control systems.

Course Outcomes

After successful completion of this course, the students should be able to

- Define the open loop and closed loop systems.
- Design time response of first and second order systems and basic state variable analysis.
- Sketch the Frequency response of second order system using polar plots ,Bode plots and Nyquist stability criteria and to do simple problems.
- Design a compensator to make a unstable system an stable system.

Course Contenet

INTRODUCTION **9+3Hours**

Open loop and closed loop systems - Examples - Elements of closed loop systems - Transfer function of elements - Modeling of physical systems - Mechanical systems - Translational and Rotational systems - Electrical networks - Block diagram – Signal flow graph - Mason's gain formula. Transfer function - Transfer function of DC servomotor, AC servomotor - Transfer function of potentiometer, Synchro. STEPPER MOTOR

T I M E DOMAIN ANALYSIS **9+3Hours**

Standard Test signals – Time response of second order system - Time domain response Performance criteria - Types of systems - Steady state error constants - Generalised error series - P , PI, PID controllers And different types of tuning methods.

FREQUENCY RESPONSE OF SYSTEMS **9+3Hours**

Frequency domain specifications - correlation between time and frequency response for second order systems-Bode plots- Assessment of stability - Gain Margin and phase Margin Assessment – Lead, lag and Lead lag compensation using Bode Plot - Polar plots

Use MATLAB for bode plot and Compensation design.

STABILITY OF CONTROL SYSTEMS **9+3Hours**

Characteristic equation - Routh Hurwitz criterion of stability - - Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin. Root Locus concept - Root Locus procedure - Root Locus construction - Root contours. Use MATLAB for stability analysis of higher order systems.

STATE SPACE ANALYSIS 9+3 Hours

Introduction to state space analysis - Phase variable and canonical forms - State transition matrix - Solutions to state space equation - Discretisation of state space equation - Controllability and Observability of systems.

CASE STUDIES: Temperature control system

Theory:45Hr Tutorial:15Hr Total Hours: 60

REFERENCES

1. Nagrath I J, and Gopal, M, 'Control Systems Engineering" Prentice Hall of India, New Delhi, 5th edition, 2009.
2. Katsuhiko Ogata, "Modern Control Engineering", Pearson Education, 4th Edition, 2002
3. Chesmond C.J. "Basic Control System Technology", Viva Low Priced Student Edition, 1998.
4. Datton K., Banaclough W. and Thompson S., "The Art of Control Engineering", Addison Wesley, 2000.
5. Dorf R.C. and Bishop R.H., "Modern Control systems", Addison – Wesley, 1995
6. Leonard N.E. and William Levine, "Using MATLAB to Analyze and Design Control Systems", Addison Wesley, 1995.
7. Ogata K, "Modern Control Engineering", Pearson Education, New Delhi, 4th Edition 2006.
8. Kuo B C, "Automatic Control Systems", Prentice-Hall Of India Pvt. Ltd, New Delhi, 8th edition, 2004.
9. Norman C. Nise S, "Control system Engineering', John Wiley & Sons, Singapore 4th Edition

U13 MC*T* 503 **CNC TECHNOLOGY** **L T P C**

3 0 0 3

Course Objectives

- CNC machining is one of the widely accepted machining methods in industries
- To study the fundamentals of CNC machines
- To study the features of CNC Machines and Retrofitting
- To study about types of measuring systems in CNC machines
- To study about the maintenance features of CNC Machines

Course Outcomes

After successful completion of this course, the students should be able to

- Explain the fundamentals of CNC machines , differentiate the advantages and disadvantages of different types of CNC machines
- Describe the constructional features of CNC machines
- Develop a CNC Part programming for the basic milling and turning operations
- Summarise various maintenance procedures practiced in industry for CNC Machines

Course Content

FUNDAMENTALS OF CNC MACHINES **9 Hours**

Introduction to Computer Numerical Control: CNC Systems – An Overview of Fundamental aspects of machine control, Different types of CNC machines – Advantages and disadvantages of CNC machines- DNC and Adaptive control

CONSTRUCTIONAL FEATURES OF CNC MACHINES AND RETROFITTING **9Hours**

Features of CNC Machines: Structure, Drive Mechanism, gearbox, Main drive, feed drive, Spindle Motors, Axes motors. Spindle bearing – Arrangement and installation. Slide ways. Recirculating ball screws – Backlash measurement and compensation, linear motion guide ways. Tool magazines, ATC, APC, Chip conveyors.Retrofitting of Conventional Machine Tools.

CONTROL SYSTEMS, FEED BACK DEVICES AND TOOLING **9Hours**

Description of a simple CNC control system.Interpolation systems. Features available in a CNC system – introduction to some widely used CNC control systems.

Types of measuring systems in CNC machines – Incremental and absolute rotary encoders, linear scale – resolver – Linear inductosyn – Magnetic Sensors for Spindle Orientation. Qualified and pre-set tooling – Principles of location – Principles of clamping – Work holding devices.

CNC PART PROGRAMMING **9Hours**

Part Program Terminology- G and M Codes – Types of interpolation Methods of CNC part programming – Manual part programming: Fixed cycle, canned cycle – Computer Assisted part programming – APT language – CNC part programming using CAD/CAM-Introduction to Computer Automated Part Programming.

ECONOMICS AND MAINTENANCE **9Hours**

Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines

CASE STUDIES: Case study on Preventive Maintenance, Intelligent systems such as automated handling and CMMs

Total Hours: 45

REFERENCES:

1. Radhakrishnan P., Computer Numerical Control Machines, New Central Book Agency, 2011.
2. Groover, M.P., Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall, 2007.
3. YoremKoren, "Computer Control of Manufacturing Systems", Pitman, London, 1987.
4. Berry Leatham – Jones, "Computer Numerical Control", Pitman, London, 1987.
5. SteaveKrar and Arthur Gill, "CNC Technology and Programming", McGraw Hill, 1990.
6. Hans B. Kief and T. Fredrick Waters, "Computer Numerical Control", Macmillan/McGraw-Hill, 2000.
7. Thyer, G.E., "Computer Numerical Control of Machine Tools", 2nd edition, B/H NEWNES, 1993.
8. Mike Mattson, "CNC Programming", Thomson Learning, 2003.

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U13MC*T*504	PROCESS CONTROL AND INSTRUMENTATION	L	T	P	C
		3	0	0	3

Course Objectives

- To study the basic characteristics of first order and higher order processes.
- To study about temperature, displacement, force and torque measurement.
- To study pressure, flow and level measurements.
- To get adequate knowledge about the characteristics of various controller modes and methods of tuning of controller.
- To study about the construction, characteristics and application of control valves.

Course Outcomes:.

After successful completion of this course, the students should be able to

- Classify and test for various characteristics, orders of measurement, calibrations, standards and errors in measurement.
- Setup, calibrate and configure control loops of different process stations.
- Develop a suitable algorithm using different controller method.
- Use various tuning methods related to control system

Course content

GENERAL CONCEPTS OF MEASUREMENT **9 Hours**

Generalized Measurement System – Performance Characteristics – Static and Dynamic Characteristics – Errors in Measurements – Calibration and Standards – Generalized Performance of Zero Order, First Order and Second Order Systems – Classifications of Transducers.

TEMPERATURE, DISPLACEM.ENT,FORCE,TORQUEMEASUREMENT **9 Hours**

Filled Thermometers – RTD – Thermistor, Thermocouple, Non Contact Total Radiation Pyrometer – Optical Pyrometer. Load Cells – Different Types -Strain Gauges Resistive and Semiconductor – Different Forms – Measurement Circuit- LVDT Characteristics- Piezo Electric Transducer – Different Types – Characteristics.

PRESSURE, FLOW AND LEVEL MEASUREMENTS **9 Hours**

Pressure Measurement: Manometers – Elastic Transducers – Bourdon Gauge – bellows – diaphragm – Calibration of Pressure Gauge using Dead Weight Testers. Vacuum Measurement: McLeod Gauge, Thermal Conductivity Gauge – Ionization Gauge. Flow Measurement: Orifice, Venturimeter, Turbine Flow meter, Hot wire Anemometer. Level Measurement: Float Level, surge type, Differential Pressure Type, Electrical Type-Resistance and Capacitance.

PROCESS CONTROL 9 Hours

Need for process control-process variables-dynamics of simple pressure, flow, level & temperature processes - basic control actions - characteristics of on off , proportional, integral and derivative control modes - PI, PD and PID control modes - feed forward control - ratio control - cascade control - inferential control - selective control - split range control - adaptive control - Process control instrumentation symbols and diagrams.

CONTROLLERS AND TUNING 9 Hours

Pneumatic and Electronic PID Controllers – Reaction curve tuning (Zeigler- Nichols)- Zeigler- Nichols Open Loop method- Loop time Constant method- Continous Cycling method (Ziegler-Nichols)- Damped cycle tuning method

CASE STUDY: Measurement Application – Control Application in Industries,Designof Fuzzy-Logic based controller,Design of Neural Network based controller.

Total Hours: 45

REFERENCES:

1. Ernest O. Doebelin, "Measurement Systems Application and Design", McGraw-Hill, 5th Edition, 2004.
2. Beckwith, T.G. and Buck, N.L. "Mechanical Measurements" Addition Wesley Publishing Company Limited, 1995.
3. Sawney, A.K. and PuneetSawney, "A course in Mechanical Measurements and Instrumentation and Control," DhanpatRai& Co, New Delhi, 12thedition , 2001.
4. Wolfgang Altmann, "Practical Process Control for Engineers and Technicians", Newnes, An Imprint of Elsiver, 2005.
5. Jain R.K. "Mechanical and Industrial Measurements" Khanna, Delhi, 1984.
6. Liptak .B.G, 'Process control instrument engineers' Handbook, , Butterworth and Heinemann, 3rd edition 1995.
7. DVS Murthy "Transducers and Instrumentation Printing Hall of India", New Delhi, 2003
8. Stephanopoulos.G, "Chemical process control", Prentice Hall of India, New Delhi, 8th Edition 2009.

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U13 MC*T* 505 DESIGNOFMACHINE ELEMENTS

L	T	P	C
3	1	0	4

(Use of approved design data book is permitted)

Course Objectives

- Tounderstandthedifferentdesign concepts.
- Toenablethestudentstounderstandtheconsiderationsin designsuchthatthefunctionalandstrengthrequirements aresatisfied.
- TolearntheevaluationanddesignofSimpleMachineComponents.
- Tounderstanddifferenttypesofwelded joints.
- To understand the concept of friction, contact types in designingbearing

Course Outcomes

After successful completion of this course, the students should be able to

- Demonstrate various basic machine elements used in machine design.
- Analyze the stress on machine members and identify failure modes of mechanical parts.
- Develop and analyze bolted joints, shafts, couplings and welded joints.
- Solve problems related to springs, levers, bearings and flywheels.

Course content

STEADYSTRESSES AND VARIABLE STRESSES IN MACHINEMEMBERS

11+3 Hours

Introduction - factor influencing machine design, selection of materialsbasedonmechanicalproperties–Direct,Bending and torsionalstressequations– Impactandshockloading–calculationofprincipalstresses forvariousloadcombinations, eccentric oading–Designofcurvedbeams –cranehookand'C' frame – Factorofsafety – theoriesoffailure– stressconcentration–designforvariableloading–Soderberg,GoodmanandGerberrelations.

SHAFTSANDCOUPLINGS **7+3 Hours**

Design of solidandhollowshafts based on strength, rigidity- critical speed– keysandkeyways–designofmuffleandknucklejoints-Design ofrigidandflexiblecouplings– shockabsorbing couplings

FASTNERSANDWELDEDJOINTS **9+3Hours**

Threaded fasteners - Design of bolted joints including eccentric loading –Design of welded joints for pressure vessels and structures –theoryofbondedjoints.

SPRINGSANDLEVERS **9+3 Hours**

Design of helical, leaf, disc and torsional springs under constant loadsand varying loads – Concentric torsion springs - Belleville springs – DesignofLevers.

BEARINGSANDFLYWHEELS **9+3 Hours**

Selection of bearings and – sliding contact and rolling contact -types.– Cubicmeanload– Design of journal bearings– Mckeesequation– Lubrication in journal bearings – calculation of bearing dimensions – Designofflywheels involvingstressesinrimandarm.

CASE STUDIES:Case study on wear of gear trains- Case study on Deep Groove ball bearing test rig.

Thory:45HrTutorial:15Hr Total Hours: 60

Note:(UseofPSGDesignDataBookispermittedin theUniversityexamination)

REFERENCES:

1. Joseph Edward Shigley and Charles R.Mischke, "Mechanical EngineeringDesign", McGraw-Hill International, 7th Edition,2003.
2. Sundarajamoorthy.T.V,Shanmugam.N, "Machine Design", Khanna Publishers 7th Edition 2004.
3. Prabhu.T.J, "Fundamentals of Machine Design" Bharat Institute of Science and Technology.
4. Juvinall, R.C. and Marshek, K.M, "Fundamentals of Machine ComponentDesign", John Wiley & Sons, 3rd edition,
5. Bhandari, V.B, "Design of Machine Elements", Tata McGraw-Hill
6. Norton, R.L, "Design of Machinery", Tata McGraw-Hill
7. Orthwein, W., "Machine Component Design", Jaico
8. Ugural, A.C., "Mechanical Design – An Integral Approach", McGraw-Hill
9. Patil, R.B, "Design of Machine Elements", Tech-Max

U13MC*P*501 INSTRUMENTATION LABORATORY

L	T	P	C
0	0	3	1

Course Objectives

- To correlate the concepts studied in the instrumentation and control subject for the real world applications.
- To understand the concept of controlling the parameters based on measurement.

Course Outcomes.

After successful completion of this course, the students should be able to

- Measure and log various physical quantities.
- Perform calibration of measuring instruments.
- Analyze and present the findings of experimental observations in both written and oral format.

LIST OF EXPERIMENTS

1. Calibration of pressure gauge using dead weight pressure gauge tester
2. Calibration of vacuum sensor using vacuum measurement set-up
3. Measurement of temperature using thermocouple, RTD and thermistor
4. Speed Measurement using Stroboscope and tachometer
5. Force measurement using proving ring and load cell
6. Torque measurement using strain gauge
7. Power measurement using Prony-brake dynamometer
8. Strain measurement using strain gauge
9. Displacement measurement using LVDT
10. Speed measurement and control of DC servo motor using PI controller
11. Noise measurement using sound-level meter

LIST OF EQUIPMENTS

1. Vacuum measurement set-up
2. Prony-brake dynamometer with motor and accessories
3. Temperature measuring devices – thermocouple, RTD and thermistor.
4. Speed measurement system with accessories
5. DC-servo motor with PI controller interface
6. Digital sound-level meter
7. Dead weight pressure gauge tester
8. Displacement measurement set-up – LVDT
9. Strain measurement set-up
10. Torque measurement set-up
11. Force measurement set-up with load cell and proving ring

Total Hours: 45

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U13 MC*P*502 CAD/CAM LABORATORY

L	T	P	C
0	0	3	1

Objectives

- To study the various commands used in PRO E software.
- To study drafting and assembly through PRO E software for various machine components

Course Outcomes

After successful completion of this course, the students should be able to

- Model and assemble a given three dimensional engineering components.
- Perform various analyses on simple structures for the application of different loads.
- Generate CNC programs for a given components to work with CNC machines (Turning and Milling).
- Analyze and present the findings of experimental observations in both written and oral format.

COMPUTER AIDED DESIGN AND ANALYSIS LAB

LIST OF EXPERIMENTS

1. Solid modeling using SOLIDWORKS / ProE / CATIA / IDEAS software of given components / product assemblies (at least 2 components/product assemblies)
2. Analysis of engineering problems using FEA package (any 2 components)

LIST OF EQUIPMENTS

1. Any CAD software
2. Any FEA software

COMPUTER AIDED MANUFACTURING LAB

LIST OF EXPERIMENTS

1. Manual part programming using G and M codes for turning, step turning, taper turning and thread cutting and radius turning on cylindrical components.
2. Given a component drawing to write the manual part programming and execute on CNC Milling Machine.
3. Generation of NC codes and simulation of tool path using Master CAM software.
4. Post processing of NC code file for various controllers(FANUC, SINUMERIC)

LIST OF EQUIPMENTS

1. CNC Lathe
2. CNC Milling Machine
3. Master CAM software EDGECAM software
4. Computer nodes

Total Hours: 45

U13MC*P*503 MICROPROCESSORAND MICROCONTROLLERLABORATORY	L	T	P	C
	0	0	3	1

Course Objectives

- To experimentally understand the operation of Intel 8085 microprocessor and 8051 microcontroller.
- To realize theinterfacing conceptswith 8255, 8279.

Course Outcomes

After successful completion of this course, the students should be able to

- Develop assembly language programs to solve simple mathematical and logical problems.
- Debug and test the I/O interfacing circuits and programmes.
- Integrate real time systems with microcontroller.
- Analyze and present the findings of experimental observations in both written and oral format.

LIST OF EXPERIMENTS

I.PROGRAMMING **30 Hours**

1. Addition and subtraction of two 8-bit numbers in 8085 & 8051.
2. Addition of 16 bits numbers in 8085 & 8051.
3. To arrange a series of numbers in Ascending order and Descending order in 8085.
4. 8-bit Multiplication in 8085 & 8051.
5. 8-bit Division in 8085 & 8051.
6. Decimal to hexadecimal conversion and hexadecimal number to decimal number conversion in 8085.

Ⅱ.INTERFACING **15Hours**

1. Analog to digital conversion in 8085.
2. Digital to analog conversion in 8085.
3. Stepper motor controller in 8051.
4. DC motor controller interface using 8051.

Total Hours: 45

U13GHP501 HUMAN EXCELLENCE SOCIAL VALUES

L	T	P	C
1	0	1	1

(Common to all branches of Engineering and Technology)

Course Objectives

- To produce responsible citizens to family and society
- To uplift society by pure politics and need education
- To realize the value of unity, service
- To immunize the body
- To get Divine peace through inward travel

Course Outcomes

After successful completion of this course, the students should be able to

- Understand the Duties and responsibilities of a human being.
- Demonstrate skills required for the Disparity among human being.
- Behave as a responsible citizen
- Analyze Impact of Science in Society.

Course Content

RESPONSIBLE CITIZENS TO FAMILY AND SOCIETY **5 Hours**

Evolution of man - evolution of universe – creating theory – evolution theory – theory permanence theory – mithya – maya or illusion – evolution of living being –

POLITICS AND NEED EDUCATION **5 Hours**

Human being & group – unity of man in society – relationship between individual – society.

DEVELOPMENT OF SCIENCE, EDUCATION & ECONOMICS **5 Hours**

Duties and Responsibilities- Duty to self, family, society and world – politics & society – education & society – case study and live example – impact of science, economic & society.

DISPARITY AMONG HUMAN BEINGS **5 Hours**

Disparity among human beings – seven values – bodily structure – character of personality – advancement of knowledge or intellectual clarity – fame of service – physical strength –health – financial status. sixteen factors heredity – food – historical age – place of living – education – work – government – art – effort – physical age – friendship – opportunity – research – practice – accepted sentiments of society – morality.

SERVICE AND SACRIFICE **3Hours**

Social welfare – need – pure & pure society.

YOGASANAS & MEDITATION **7Hours**

Pancha bhootha navagraha meditation – Introduction – practice – benefits.

Sitting asanas: mahamudhra – ustrasana– gomukhasana– matsyasana – ArdhaMatsyendrasana.Upward lying asanas: setubhandasana–viparitakaranai – sarvangasana – halasana. Downward lying asanas: arthasarvangasana – adhomukhasvanasana–padmamayura

TotalHours :30

REFERENCES:

1. World peace plane ---- Vethathiri Maharishi
2. Prosperous India ---- Swami Vivekananda
3. SamudhayachikkalukkananalaAaivugal ---- Vethathiri Maharishi
4. World Community Life ---- Vethathiriyam

SEMESTER VI

U13MC*T*601 DESIGN OF MECHATRONICS SYSTEMS

L	T	P	C
3	0	0	3

Course Objectives

- To study aboutMechatronics Design process.
- To study the data acquisition and control case studies
- To study about the application of Mechatronics system

Course Outcomes:.

After successful completion of this course, the students should be able to

- Differentiate mechatronic design process from conventional design.
- Select appropriate communication module for system design.
- Apply Mechatronics design process for new product development.
- Summarize working of advanced controllers and Microsystems

Course Content

MECHATRONICS SYSTEM DESIGN **9Hours**

Mechatronics Design process – Types of Design – Traditional and Mechatronics designs, Advanced approaches in Mechatronics - industrial design and ergonomics, safety.

SYSTEM INTERFACING **9Hours**

Introduction-selection of interface cards-DAQ card-single channel-multichannal-RS232/422/485 communication- IEEE 488 standard interface-GUI card-GPIB-Ethernet switch - Man machine interface.

DATA ACQUISITION SYSTEM **9 Hours**

Introduction – Cantilever Beam Force Measurement system–Testing of Transportation bridge surface materials – Transducer calibration system for Automotive applications – Strain gauge weighing system – Solenoid Force-Displacement calibration system – Rotary optical encoder

DATA ACQUISITION AND CONTROL SYSTEM **9Hours**

Introduction – Thermal cycle fatigue of a ceramic plate – pH control system – De-Icing Temperature Control system – Controlling temperature of a hot/cold reservoir – Skip control of a CD player– Autofocus Camera, exposure control – Pick and place robot.

ADVANCED APPLICATIONS IN MECHATRONICS **9 Hours**

Sensors for condition Monitoring – Mechatronic Control in Automated Manufacturing – Artificial intelligence, Fuzzy Logic Applications, Micro actuation – Micro robot – Micro pump – Applications of micro Mechatronics components.

Total Hours: 45

REFERENCES:

1. Devdas Shetty and Richard A. Kolk, “Mechatronics System Design”, Thomson Asia Pte. Ltd., Singapore, 2nd edition 2010.
2. W.Bolton, “Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering”, 5rd Edition, Pearson Education Ltd., 5th Edition 2013.
3. Brian Morriss, “Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics”, McGraw Hill International, 1995.
4. Bradley, D.Dawson, N.C. Burd and A.J. Loader, “Mechatronics: Electronics in Products and Processes”, Chapman and Hall, London, 1993.
5. Georg pelz, Mechatronic Systems: Modeling and simulation with HDL’s, John wiley and sons Ltd, 2003
6. HMT “Mechatronics”, Tata McGraw Hill, 1998.

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U13MC*T* 602 **APPLIED HYDRAULICS AND PNEUMATICS**

L	T	P	C
3	0	0	3

Course Objectives

- This course aims to provide basic concepts and various components in fluid power systems.
- It deals about the application and low cost automation in industries.

Course Outcomes

After successful completion of this course, the students should be able to

- Describe the concept of fluid power and use symbols of various components used in fluid power.
- Design fluid power circuits by selecting appropriate control valves and actuators.
- Summarize the common faults and troubleshooting methods for fluid power circuits.

Course Content

FLUID POWER SYSTEMS AND FUNDAMENTALS 6Hours

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids. Fluid power symbols.

HYDRAULIC SYSTEMANDCOMPONENTS(PUMPSAND ACTUATORS) 9 Hours

Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps.

Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tandem, Rodless, Telescopic - Construction and application. Cushioning mechanism, Rotary actuators - Gear, Vane and Piston motors.

HYDRAULIC VALVES, ACCUMULATORS AND CIRCUITS 10 Hours

Directional control valve – 3/2 way valve – 4/2, 4/3 way valve – Shuttle valve – check valve. Pressure control valves, Flow control valve – Fixed and adjustable, electrical control solenoid valves.

Types of accumulators, Accumulators circuits, Intensifier – Circuit and Application, Speed control circuits, synchronizing circuit and industrial application circuits – copying circuit and press circuit.

PNEUMATIC SYSTEMS, COMPONENTS AND CIRCUITS 10Hours

Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves and pneumatic actuators.Pneumo-hydraulic circuit, Sequential circuit design for simple applications using cascade and step counter method.

FLUID LOGIC CONTROL SYSTEMS AND MAINTENANCE 10 Hours

Hydro Mechanical servo systems, Electro-hydraulic and Electro-pneumatic systems and proportional valves. Logic and switching controls - PLC applications in fluid power control, Maintenance - Failure and trouble shooting in fluid power systems.

CASE STUDIES

Designing of Hydraulic and Pneumatic circuits for applications like Rough terrain forklift, Plastic Injection molding, Paint Spray system, Clamping, Loading and Assembly lines.

Total Hours :45

REFERENCES:

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education Inc., 7th Edition 2009.
2. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw-Hill, 2009.
3. Michael J. Pinches and John G. Ashby, "Power Hydraulics", Prentice-Hall, 1989.
4. Andrew Parr, "Hydraulics and Pneumatics (HB)", Jaico Publishing House, 2005.
5. James A. Sullivan, "Fluid Power: Theory and Applications",C.H.I.P.S, 4th edition, 2007.

U13MC*T*603	PROGRAMMABLELOGIC CONTROLLER	L	T	P	C
		3	0	0	3

Course Objectives

- To explain the operation of relays, pushbuttons, limit switches, and other basic control devices.
- Using ladder diagrams, design basic motor control circuits.
- Describe the hardware of a PLC, identifying the functions of the main components.
- To explain the PLC programs to perform specified discrete sequential control operations.
- Configure a PLC, including choosing appropriate addressing for I/O for a specified application.

Course Outcomes

After successful completion of this course, the students should be able to

- Explain and use relays, pushbuttons, limit switches, and other basic control devices for automation.
- Describe the hardware and architecture of PLCs and also identify the analogy of relay logic components.
- Write PLC programes using ladder diagrams for complex applications.
- Summarise various maintenance procedures practiced in industry for PLC based control systems.

Course Content

INTRODUCTION **9 Hours**

Programmable controller – need for PLC – modular PLC and fixed PLC – block diagram of PLC – input and output modules – power supply – types of PLC system.

HARDWARE MODULES **9 Hours**

CPU – processor's function – processor's operating system – processor ports – interfacing PC to PLC – processor operating modes – PLC system memory and application memory – input modules – output modules – module selection – PLC internal operation and signal processing – input and output processing – timing consideration.

PROGRAMMING OF PLC SYSTEM **9 Hours**

Introduction to IEC 61131 - System functions – sequence control – ladder logic – programming sequences – limitation of ladder programming – logic instruction sets – standard PLC functions – special function relays – data handling instructions – arithmetic instructions – data manipulation – program subroutines – programming examples.

PLC COMMUNICATION AND DCS **9 Hours**

PLC communication ports – serial communications – RS232 – standard requirements – communication between several PLCs – PLC field bus - Manufacturing

Automation Protocol (MAP) – Technical Office Protocol (TOP) - Distributed control system (DCS) – building blocks – descriptions and functions of field controlled units – operator stations – data highways – redundancy concepts – DCS system integration with PLC and computers – communication in DCS.

PLC MAINTENANCE AND CASE STUDIES **9 Hours**

PLC maintenance – internal PLC faults – faults external to PLC – programmed error – watch dogs – safety – hardware safety circuits – troubleshooting.

Case Studies: PLC as robot controller and FMS – PLC to factory automation – PLC in process control

Total Hours: 45

REFERENCES:

1. Frank D. Petruzella, "Programmable Logic Controllers", McGraw-Hill Companies, 3rd Edition, March 2013.
2. Lukcas M.P., "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986.
3. Ian G.Warnock, "Programmable Controllers Operation and Application", Prentice Hall International, UK, 1992.
4. John W. Webb and Ronald A.Reis, "Programmable Logic Controllers – Principles and Applications", Prentice Hall Inc., New Jersey, 3rd Edition, 1995.
5. Krishnakant , "Computer Based Industrial Control", Prentice Hall of India, 1997.

U13ME*T*604	THERMODYNAMICS AND HEAT TRANSFER	L	T	P	C
		3	1	0	4

Use of approved steam tables and charts are permitted.
Use of approved heat and mass transfer data book is permitted

Course Objectives

- Will be introduced to the laws of thermodynamics with their applications related to I.C engines, heat and mass transfer.

Course Outcomes

After successful completion of this course, the students should be able to

- Define the laws of thermodynamics and describe the properties of the system
- Explain the various air standard cycles and describe the working of I.C engines
- Distinguish various nodes of heat transfer and eliminate the rate of heat transfer for various applications
- Discuss the concepts of mass transfer and derive their correlations.

Course Content

LAWS OF THERMODYNAMICS **9+3 Hours**

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- reversibility.

AIR-STANDARD CYCLES **9+3 Hours**

Air standard cycles: Carnot cycle - Otto cycle - Diesel cycle - Brayton cycle - - cycle efficiency - two stroke and four stroke engines- SI, and CI engines. **Case Studies –** Application of stand air cycles in Engines.

HEAT TRANSFER : CONDUCTION **9+3 Hours**

Basic Concepts- Mechanism of Heat Transfer - Conduction, Convection and Radiation - Fourier Law of Conduction - General Differential equation of Heat Conduction -Cartesian and Cylindrical Coordinates - One Dimensional Steady State Heat Conduction - Conduction through Plane Wall, Cylinders and Spherical systems.

CONVECTION AND RADIATION **9+3 Hours**

Convection: Basic Concepts –Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – External Flow and Internal Flow – Flow over Plates and Cylinders

Radiation: Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoffs Law – Black Body Radiation –Grey body radiation -Shape Factor Algebra – Electrical Analogy

MASS TRANSFER **9+3 Hours**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations

Theory:45Hr Tutorial:15Hr **Total Hours: 60**

R**EFERENCES**

1. Yunus A. Cengel and Michael A Boles, "Thermodynamics – An EngineeringApproach, in SI Units", , Tata McGraw Hill, 5th edition New Delhi, 2006.
2. CP.Kothandaraman, S.Subramanya, " Fundamentals of Heat and MassTransfer" New Age International Publishers, New Delhi, 3rd edition, 2008.
3. Nag P. K, 'Engineering Thermodynamics' Tata McGraw-Hill, 4th edition 2008.
4. EastopT.D. andMcConkey,"Applied Thermodynamics for EngineeringTechnologists", Pearson, New Delhi, 5th Edition, 2004.
5. C. P. Kothandaraman, S. Domkundwar and A.V.Domkundwar, "A course in Thermal Engineering" Dhanpatrai& Co, 5th edition, 2000.
6. Frank P. Incropera and David P. DeWitt, "Fundamentals of Heat and Mass Transfer" John Wiley, Singapore, 5th edition, 2006.

U13MC*T* 604 EMBEDDED SYSTEM DESIGN L T P C
3 0 0 3

Course Objectives

- Introduce to features that build an embedded system.
- To study the Embedded Software Architecture.
- To study Techniques of inter facing between processors & peripheral device related to embedded processing.
- To explain real time operating systems, inter-task communication.
- To present in lucid manner the basic concepts of systems programming like operating system, assembler compliers etc and to understand the management task needed for developing embedded system.

Course Outcomes

After successful completion of this course, the students should be able to

- Summarize the embedded system design process and their challenges.
- Describe and analyze various Embedded Software Architectures.
- Design an embedded system using real time operating system and distinguish various debugging techniques.
- Explain about embedding the software into the target system.

Course Content

INTRODUCTION TO EMBEDDED SYSTEMS 9 Hours

Overview of embedded systems, embedded system design process, challenges– common design metrics and optimizing them. Shared data problem, Interrupt Latency.

PIC MICROCONTROLLER 9 Hours

Introduction – CPU architecture – Instruction set – Addressing modes – Loop timing – Timers – Interrupt logic – I/O expansion – IIC bus operation– A/D converter.

EMBEDDED SOFTWARE ARCHITECTURE 9 Hours

Round robin - Round robin with interrupts - Function Queue scheduling Architecture - Real time operating systems Architecture - Selecting architecture.

REAL TIME OPERATING SYSTEM 9 Hours

Tasks and Task states - Tasks and Data - Semaphore and shared data -Message queues, mail boxes and pipes - Encapsulating semaphores and queues - Timer functions - Events - Memory management - Interrupt routines in an RTOS Environment - **Case study: Design of an embedded system (Underground tank monitoring System).**

EMBEDDED SOFTWARE DEVELOPMENT TOOLS AND DEBUGGING 9 Hours

Linker/Locators for embedded software - embedded software in to the target system - Testing on host machine: Basic techniques - more Advanced techniques - Limitations and shortcomings - Instruction set simulators – The assert macro - Testing using laboratory tools.

Total Hours: 45

REFERENCES :

1. David E. Simon, "An embedded software primer", Addison – Wesley, Indian Edition Reprint (2009).
2. Vahid, Tony Givargis, Embedded System Design: A Unified Hardware/SoftwareIntroduction - Frank John Wiley & Sons, Inc.2002
3. John B. Peatman, "Design with PIC Microcontrollers" Prentice Hall, 2003.
4. Steve Heath, 'Embedded System Design', II edition, Elsevier, 2003.
5. Rajkamal, 'Embedded System – Architecture, Programming, Design', Tata McGraw Hill, 2008
6. K.V.K.K.Prasad "Embedded /Real-Time Systems: Concepts, Design and Programming" Dream tech Press, reprint 2009

U13MC*P*601 HYDRAULICS AND PNEUMATIC LABORATORY

L	T	P	C
0	0	3	1

Course Objectives

- Expose the students to technology of generation, control and transmission of power using pressurized fluids, with hands on training.

Course Outcomes

After successful completion of this course, the students should be able to

- Select the actuators and valves for the design of fluid power circuits.
- Design and simulate the fluid power circuits using software tool.
- Test the simulated output by constructing the fluid power circuits using suitable actuators and valves.
- Analyze and present the findings of experimental observations in both written and oral format.

LIST OF EXPERIMENTS

1. Design and testing of the following hydraulic circuits:
   i) Pressure control
   ii) Flow control
   iii) Sequential circuit using an Electro hydraulic Trainer kit.
2. Design and testing of the following pneumatic circuits:
   i) Pressure control
   ii) Flow control
   iii) Circuits with logic controls
   iv) Circuits for multiple cylinder sequencing in Pneumatic, Electro pneumatic Trainer kits.
3. Simulation of basic hydraulic, pneumatic and electrical circuits using Automation Studio software.

EQUIPMENTS	QUANTITY
Hydraulic equipments	
1 Pressure relief valve	2
2 Flow control valves	2
3 Limit switches	2
4 Linear actuator	4
5 Rotary actuator	2
6 Double solenoid actuated DCV	3
7 Single solenoid actuated DCV	2
8 Hydraulic power pack with pump and pressure relief valve	1
Pneumatics equipments	
1 Pneumatic trainer kit with FRL Unit, Single acting cylinder, push button actuated DCV and manually	1

	actuated DCV	1
2	Pneumatic training kit with FRL unit, Double acting cylinder, pilot actuated DCV	1
3	Pneumatic trainer kit with FRL unit, Double acting cylinder, Double solenoid actuated DCV with sensors/ magnetic reed switches	1
4	Pneumatic trainer kit with FRL unit with PLC with Interface card	10 licenses
5	Automation studio software	

Total Hours: 45

U13MCP602	EMBEDDED SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	3	1

Course Objectives

- To provide a clear understanding on the basic concepts of embedded system design
- To understand the basic scheme for interfacing IO devices

Course Outcomes

After successful completion of this course, the students should be able to

- Design and debug embedded system hardware.
- Experiment the basic schemes for interfacing IO devices.
- Design real time embedded system using RTOS

LIST OF EXPERIMENTS

8051 MICRO CONTROLLER -IO PROGRAMMING

1. Read data from port P2 and P3. Add data and display result on port P0. Glow LED connected at port pinP1.1 if carry flag set after addition.
2. Write program to read switch connected at port pin P1.0, toggle it and send to port pin P1.1
3. Write a program to generate square wave of 50% duty cycle having frequency 5 KHz at port pin P1.0 using timer 1 in mode 2. Modify program to generate pulse waveform of 70% duty cycle using timer on the same pin.

INTERRUPTS AND TIMER APPLICATION

4. Generate external interrupt INT0 and INT1 by connecting push button switch. Glow LEDs connected at port 1 one by one when interrupt INT0 occurs. LEDs should flash when interrupt INT1 occurs.

INTERFACING EXPERIMENTS

5. Interface LCD with the microcontroller. Display your name on the LCD.
6. Interface ADC0808 with 89C51 microcontroller. Write program to read analog voltage applied at the input of ADC. Display it on LCD.

PIC MICRO CONTROLLER - IO PROGRAMMING

7. Introduction to Software Tools MPLAB, PROTEUS.
8. Delay Loops Applications Flasher & Counter

INTERRUPTS AND TIMER APPLICATION

9. TMR0 Application Counter Using TMR0
10. Interrupt Application Controlling flashing speed of a flasher

INTERFACING EXPERIMENTS

11. Application for Keypad and LCD
12. Analog Digital Conversion

Total Hours: 45

U13EN*P*601	COMMUNICATION SKILLS LABORATORY	L	T	P	C
		0	0	3	1

(Common to all branches of Engineering and Technology)

(Method of End Semester Evaluation : Practical : 60 marks, Online Exam : 40 marks)

Course Objectives

- To impart communicative ability to exhibit the individual's subject knowledge
- To achieve the desirable communicative competence by the students to meet the expectation of corporate
- To show the need for a comprehensive link language to share subject expertise
- To offer adequate exposure to soft skills needed for the corporate.
- To sensitize towards corporate culture.

Course Outcomes

After successful completion of this course, the students should be able to

- Present the individual, academic curricular and career profiles.
- Speak to prove the industry-ready communication competency in GDs & interviews.
- Project desirable soft skills to interface the corporate.

Course Content

GRAMMAR IN COMMUNICATION **9 Hours**

Grammar and Usage – Building Blocks, Homonyms, Subject and Verb Agreement, Error Correction - Grammar Application, Framing Questions – Question words, Verbal Questions, Tags, Giving Replies –Types of Sentences, Listening Comprehension – Listening and Ear training.

ASSERTIVE COMMUNICATION **9 Hours**

Listening Comprehension in Cross–Cultural Ambience, Telephonic Conversations/Etiquette, Role Play Activities, Dramatizing Situations- Extempore – Idioms and Phrases.

CORPORATE COMMUNICATION **9 Hours**

Video Sensitizing, Communicative Courtesy – Interactions – Situational Conversations, Time Management, Stress Management Techniques, Verbal Reasoning, Current Affairs – E Mail Communication / Etiquette.

PUBLIC SPEAKING **9 Hours**

Giving Seminars and Presentations, Nuances of Addressing a Gathering - one to one/ one to a few/ one to many, Communication Process, Visual Aids & their Preparation, Accent Neutralization, Analyzing the Audience, Nonverbal Communication.

INTERVIEW & GD TECHNIQUES **9 Hours**

Importance of Body Language –Gestures & Postures and Proxemics, Extempore, Facing the Interview Panel, Interview FAQs, Psychometric Tests and Stress Interviews, Introduction to GD, Mock GD Practices.

Total Hours: 45

REFERENCES:

1. Bhatnagar R.P. & Rahul Bhargava, "English for Competitive Examinations", Macmillian Publishers, India, 1989, ISBN: 9780333925591
2. Devadoss K. & Malathy P., "Career Skills for Engineers", National Book Publishers, Chennai, 2013.
3. Aggarwal R.S., "A Modern Approach to Verbal & Non–Verbal Reasoning", S.Chand Publishers, India, 2012, ISBN : 8121905516

U13MC*P*604 **MINIPROJECT1** **L T P C**
0 0 0 1

Course Objectives

- Students in the form of group not exceeding 3 members in a group to carry out their mini project. It can be a measurement project, mechatronic project or computer based simulation work. The interdisciplinary projects will carry more weightage. It is highly desirable to publish their project in state/ national level conferences or symposiums.

Course Outcomes

After successful completion of this course, the students should be able to

- Design, and realize a simple mechanical/electrical/electronic/mechatronic system.
- Use various sensors, actuators and controllers.
- Work in a team with a confined time duration.
- Disseminate his work both in oral and written format.

MARK SPLIT UP FOR MINI PROJECT 1

S.NO.	PARAMETER	% OF MARKS
1.	Interdisciplinary work	10
2.	Publication	10
3	Working model/ simulation result	40
4	Innovation	30
5	Report with good referencing	10

U13GHP601HUMAN EXCELLENCE NATIONAL VALUES

L	T	P	C
1	0	1	1

(Common to all branches of Engineering and Technology)

Course Objectives

- To produce responsible citizens.
- To uphold our culture and spiritual life.
- To realize the value of unity, service.
- To immunize the body.
- To get Divine peace through inward travel.

Course Outcomes

After successful completion of this course, the students should be able to

- Acquire knowledge on the Enlightened Citizenship.
- Demonstrate skills required for the Indian Culture and it's greatness.
- Behave as responsible Great spiritual Leaders.
- Analyze National Values identification and practice.

Course Content

RIGHTS AND RESPONSIBLE CITIZENSHIP **5 Hours**

Citizenship- its significance-Enlightened citizenship - what are the rights to citizenship Emerging India-its glory today- Global perspective

GREATNESS OF INDIAN CULTURE **5 Hours**

Outsiders view about India – about yoga - culture – joint family – morality – service - food–behavior – attitude – work.
Indian culture and it's greatness – dress coding - festivals – food is medicine – games – traditional medicines

INDIA AND PEACE **5 Hours**

India and Peace – who are the person to participate world peace - India and Spirituality- Great spiritual leaders – Shankarar – Ramanujar – mathvar – budha – mahaveerar – vallalar – Ramakrishna paramahamsar –mathaamirthananthamaayi – ramanar – aravindhar – annai.

INDIA'S MESSAGE TO THE WORLD **5 Hours**

India's message to the world – thiruvalluvar – thirukural – manivasagar – tiruvasagam – aravindhar – B.K.S Iyengar – yoga asanas – Sir C.V.Raman – Physics –ramanujam – maths – rabinthranathtagore – literature – A.P.J Abdulkalam.

GLOBAL PEACE **3 Hours**

It's role in global peace - – vethathiri maharishi – world peace –Thiruvalluvar – vallalar - Service and sacrifice-Unity in diversity – case studies-live examples - National values identification and practice.

MEDITATION & YOGASANAS **7 Hours**

Nine Centre Meditations – Introduction – practice – benefits.
Yogasanas - II

TotalHours :30

REFERENCES:

1. Vethathiri Maharishi,"World peace plane"
2. Swami Vivekananda, "Prosperous India"
3. Vethathiri Maharishi, "SamudhayachikkalukkananalaAaivugal"
4. Vethathiriyam, "World Community Life"

SEMESTER VII

U13MC*T*701 ROBOTICSAND MACHINE VISION SYSTEMS **L T P C 3 0 0 3**

Course Objectives

- To understand the basics of drives and power transmission system.
- To learn about the kinematics of robot
- To understand the basics of sensors and the different types of robotic End Effectors
- To learn about the machine vision systems and its application
- To gain information about the different types of robot programming methods.

Course Outcomes:

After successful completion of this course, the students should be able to

- Explain the basics of robots , drives and power transmission system.
- Solve and analyse kinematics of robotic manipulator.
- Illustrate different sensors and robotic end effectors
- Explain the basics of machine vision and their operation.
- Program robots using different programming methods.

Course Content

INTRODUCTION **5Hours**

Basic Structure, Classification of robot and Robotic systems, laws of robotics, work space and precision of movement. Drives and control systems - Robot drive mechanisms- hydraulic – electric – servomotor- stepper motor - pneumatic drives. Control systems for robot.

KINEMATICS OF ROBOT MANIPULATOR: **10Hours**

Introduction to manipulator kinematics, homogeneous transformations and robot kinematics, Denavit-Hartenberg (D-H) representation, concept of forward and inverse kinematics.

SENSORS AND ROBOT END EFFECTORS **10Hours**

Sensors in robotics -Position sensors, Velocity sensors, Acceleration Sensors, Force/Torque sensor, Touch and Tactile sensors, Proximity, Range and sniff sensors, RCC and IRCC systems, VOICE recognition and synthesizers. Robot End Effectors - Types of end effectors, Mechanical grippers – Types of Gripper mechanisms – Grippers force analysis, other types of Grippers – Vacuum cups – Magnetic Grippers – Adhesive Grippers, Active and passive grippers, Robot end effector interface.

MACHINE VISION **10Hours**

Image Sensing and Digitizing - Image definition, Image acquisition devices – videcon camera and digital camera, specialized lighting techniques.Digital Images - Sampling, Quantization and Encoding. Image storage.Image Processing and Analysis - Data reduction – digital conversion and windowing. Segmentation – Thresholding, Edge detection and Region growing. Binary Morphology and grey morphology operations. Feature Extraction, Object recognition, Depth measurement. Application of Vision systems.

ROBOT PROGRAMMING **10Hours**

Robot programming: Introduction; On-line programming: Manual input, lead through programming, teach pendant programming; Off-line programming languages, Simulation.

Case studies: Material transfer, Machine loading, Assembly, inspection, processing operations and service robots, Mobile Robots, biologically inspired robotics, Medical applications, and Space applications.

TotalHours:45

REFERENCES:

1. S. R. Deb and S. Deb, 'Robotics Technology and Flexible Automation', Tata McGraw Hill Education Pvt. Ltd, 2010.
2. Saeed B. Niku, 'Introduction to Robotics',Prentice Hall of India, 2nd Edtion 201.
3. Mikell P. Groover, "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008.
4. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
5. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics : Control, Sensing, Vision and Intelligence", McGraw Hill, 1987
6. Ramesh Jam, Rangachari Kasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 1991.
7. Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1987.
8. P.A. Janaki Raman, Robotics and Image Processing, Tata McGraw-Hill, 1991.

U13MC*T*702 AUTOMOTIVE ELECTRONICS

L	T	P	C
3	0	0	3

Course Objectives

- To study the basics of electronics, emission controls and its importance in automobiles
- To study the various sensors and actuators used in automobiles for improving fuel economy and emissions
- To study the various blocks of control units used for control of fuel, ignition and exhaust systems.
- To study the chassis electrical systems, comfort and safety systems in the automobiles for the safety of vehicle users.

Course Outcomes:

After successful completion of this course, the students should be able to

- Describe the importance of emission standards and electronics in automobiles.
- Identify; select the sensors and actuators used in automobiles for improving fuel economy and also in reduction of emissions.
- Compare the different types of ignition systems, injection systems used in automobiles.
- Explain the different control modes of engine management, networking in vehicles, comfort and safety systems in automobiles

Course Content

INTRODUCTION 9 Hours

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Charging systems – working and design of charging circuit diagram – starter motors and starter circuits.

BASICS OF ENGINES 9 Hours

Operating principles of IC engine – major engine components – engine cylinder arrangements – the ignition systems – Electronic ignition, direct ignition, injection systems – working of the carburetor – throttle body injection – Multipoint fuel injection – sequential fuel injection.

SENSORS AND ACTUATORS 9 Hours

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.

ENGINE CONTROL SYSTEMS 9 Hours

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.

CHASSIS, COMFORT AND SAFETY SYSTEMS 9 Hours

Traction control system – Cruise control system– electronic control of automatictransmission antilock braking system – electronic suspension system –airbag systems – centralized door locking system – Navigation systems – climate control of cars.

CASE STUDIES: Design of the Passenger comfort and safety systems.

TotalHours :45

REFERENCES:

1. TOM DENTON, "Automobile Electrical and Electronics Systems", Edward Arnold Publishers,2004.
2. William B. Ribbens, "Understanding Automotive Electronics", Newnes Publishing, 5th edition, 2003.
3. "BOSCH Automotive Handbook –", Bentley publishers6th edition, 2005.
4. Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls",
5. Delmar Publishers, 2001.
6. "Fuel System and Emission controls", Check Chart Publication, 2000.
7. Ronald. K. Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 1999.

U13MC*T*703	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives

- To study about micro sensors and actuators.
- To study about fabrication process
- To design micro systems.

Course Outcomes:

After successful completion of this course, the students should be able to

- List the different scaling laws used in micro system design.
- Describe the various working principles of microsensor and microactuators.
- Summarizevarious micro system fabrication techniques.

Course Content

INTRODUCTION **9 Hours**

Overview-Microsystems and microelectronics -definition-MEMS materials-scaling laws scaling in geomentry-scaling in rigid body dynamics- scaling in electrostatic forces- scaling in electricity- scaling in fluid mechanics- scaling in heat transfer.

MICRO SENSORS AND ACTUATORS **9Hours**

Working principle of Microsystems - micro actuation techniques - micro sensors-types -Microactuators – types – micropump – micromotors – micro – valves – microgrippers –micro Accelerometers

FABRICATION PROCESS **9 Hours**

Substrates-single crystal silicon wafer formation-Photolithography-Ion implantation-Diffusion –Oxidation-CVD-Physical vapor deposition-Deposition by epitaxy-etching process

MICRO SYSTEM MANUFACTURING **9Hours**

Bulk Micro manufacturing- surface micro machining –LIGA-SLIGA-Micro systempackaging-materials-die level-device level-system level-packaging techniques-diepreparation-surface bonding-wire bonding-sealing

MICRO SYSTEM DESIGN **9Hours**

Design considerations-process design-mask layout design- mechanical design-applications of micro systems in automotive industry, bio medical, aero space and telecommunications.

TotalHours:45

REFERENCES:

1. Tai-Ran Hsu, “MEMS & Microsystems Design and Manufacture”, Tata McGraw-Hill,2006.
2. Mohamed Gad-el-Hak, “The MEMS Hand book”, CRC press 2005.
3. Julian W.Gardner,Vijay K.Varadan,Osama O.Awadel Karim, “Microsensors MEMSand Smart Devices”, John Wily & sons Ltd.,2001.

4. S.Fatikow,U.Rembold, “Microsystem Technology and Microrobotics”,Springer-Verlag Berlin Heidelberg ,1997.
5. Francis E.H Tay and W.O Choong, “Microfludics and BioMEMS Applications”, Springer, 2002.

U13GST008 PROFESSIONAL ETHICS L T P C
3 0 0 3

Course Objectives

- To create an awareness on Engineering Ethics and its use in ones profession
- To instill moral values, social values and loyalty
- To provide an insight into ones professional rights and a view of professional ethics in the global context

course Outcomes:

After successful completion of this course, the students should be able to

- Understand the ethical theories and concepts
- Understanding an engineer's work in the context of its impact on society
- Understand and analyze the concepts of safety and risk
- Understand the professional responsibilities and rights of Engineers
- Understand the concepts of ethics in the global context

Course Content

ENGINEERING ETHICS AND THEORIES 9Hours

Definition, Moral issues, Types of inquiry, Morality and issues of morality, Kohlberg and Gilligan's theories, consensus and controversy, Professional and professionalism, moral reasoning and ethical theories, virtues, professional responsibility, integrity, self respect, duty ethics, ethical rights, self interest, egos, moral obligations.

SOCIAL ETHICS AND ENGINEERING AS SOCIAL EXPERIMENTATION 9Hours

Engineering as social experimentation, codes of ethics, Legal aspects of social ethics, the challenger case study, Engineers duty to society and environment.

SAFETY 9Hours

Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – the Three Mile Island and Chernobyl case studies. Bhopal gas tragedy.

RESPONSIBILITIES AND RIGHTS OF ENGINEERS 9Hours

Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – Intellectual Property Rights (IPR) – discrimination.

GLOBAL ISSUES AND ENGINEERS AS MANAGERS, CONSULTANTS AND LEADERS 9Hours

Multinational Corporations – Environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership – Engineers as trend setters for global values.

Total Hours :45

REFERENCES:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering". (2005) McGraw-Hill, New York.
2. John R. Boatright, "Ethics and the Conduct of Business", (2003) Pearson Education, New Delhi.
3. Bhaskar S. "Professional Ethics and Human Values", (2005) Anuradha Agencies, Chennai.
4. Charles D. Fleddermann, "Engineering Ethics", 2004 (Indian Reprint) Pearson Education / Prentice Hall, New Jersey.
5. Charles E. Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and cases", 2000 (Indian Reprint now available) Wadsworth Thompson Learning, United States.

U13MC*P*701	ROBOTICS LABORATORY	L	T	P	C
		0	0	3	1

Course Objectives

- To study about the different types of robot
- To program the robot using different sensors
- To program an industrial robot using a machine vision system
- To simulate a robot using the robotics simulation software.

Course Outcomes:

After successful completion of this course, the students should be able to

- Work with different types of robots.
- Control mobile robots using different sensors and actuators.
- Manipulate an industrial robot using a machine vision system and HMIs.
- Handle a robot model using the robotics simulation software.
- Analyze and present the findings of experimental observations in both written and oral format.

Course Content

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. Modeling Forward and inverse kinematics for robotic arm using Mathematical Software
5. Offline programming of an Industrial robot using Robotics simulationSoftware
6. Setup and program a station with conveyor tracking using the Robotics simulation Software
7. Vision-Based Control On an Industrial Robot
8. Writing and verifying a Program for point to point operations for mobile robots
9. Obstacle Avoidance of a mobile robot with Ultrasonic Sensor
10. Tilt sensing for an autonomous mobile robot
11. Line following robot

Total Hours:45

U13MC*P* 702	PROCESS CONTROL AND SIMULATION LABORATORY	L	T	P	C
		0	0	3	1

Course Objectives

- To study about PLC ladder logic programming
- To Manipulate data using PLC instruction sets.
- To Write motion control programs
- To design and Configure graphical screens for HMI (Human Machine Interface) in LabVIEW

Course Outcomes:

After successful completion of this course, the students should be able to

1. Use different sensors and actuators to control various industrial parameters : temperature, pressure, level and flow.
2. Write program for PLCs and Labview to interface and control various actuators.
3. Simulate and create virtual instruments.
4. Analyze and present the findings of experimental observations in both written and oral format.

Course Content

I PROCESS CONTROL

1. Closed loop response of level control loop.
2. Closed loop response of flow control loop.
3. Closed loop response of temperature control loop.
4. Closed loop response of pressure control loop.

II PROGRAMMABLE LOGIC CONTROLLER

1. Simulation exercises.
2. Traffic light control.
3. Stepper motor control.
4. DC motor control.
5. Relay testing.

III LAB VIEW SIMULATIONS

1. Programming exercises using loops and charts.
2. Programming exercises using clusters and graphs
3. Programming exercises using case and sequence structures, file input/output, string operations.
4. Creating virtual instrumentation for simple applications.

TotalHours :45

		L	T	P	C
U13MC*P*704	**MINIPROJECT2**	**0**	**0**	**4**	**2**

Course Objectives

- Students in the form of group not exceeding 3 members in a group to carry out their mini project. It can be a measurement project, mechatronic project or computer based simulation work. The interdisciplinary projects will carry more weightage. It is highly desirable to publish their miniproject in state/ national level conferences or symposiums.

Course Outcomes

After successful completion of this course, the students should be able to

- Design, analyze, realize/simulate a physical system by using the technology they learnt during three years of the programme.
- Integrate various systems into one mechatronic product.
- Work in a team with a confined time duration.
- Disseminate his work both in oral and written format.

MARK SPLIT UP FOR MINI PROJECT 2

S.NO.	PARAMETER	% OF MARKS
1.	Interdisciplinary work	10
2.	Publication	15
3	Working model/ simulation result	35
4	Innovation	30
5	Report with good referencing	10

.

U13GHP701 HUMAN EXCELLENCE GLOBAL VALUES

L	T	P	C
1	0	1	1

(Common to all branches of Engineering and Technology)

Course Objectives

- To realize global brotherhood and protect global.
- To know the youths participation in politics.
- To know importance of retain of our culture and Maintain
- To know impact of global terrorism.
- To know the current economic status among the youths.

Course Outcomes

After successful completion of this course, the students should be able to

- Behave as responsible human beings respecting the global values.
- Acquire knowledge on the complex patterns involved in maintaining world's peace and ecological balance.
- Demonstrate skills required for the emergency of mono-culture at the global level.
- To learn about Man is the cause and Man is the solution.

Course Content

GLOBAL BROTHERHOOD AND PROTECT GLOBE 5 Hours

Global values – understanding and identification – its importance - Racial discrimination and solution

MAN IS THE CAUSE AND MAN IS THE SOLUTION 5 Hours

Ecological imbalance – global warming – rain fall – status – acid rain – plastic usage – control - Political upheavals – nowadays political status – basic rights to citizen – corruption – youths participate in politics –e.g: M.K.Stalin – Kanimozhi – ragul Gandhi.

GREATNESS OF CULTURE 5 Hours

Social inequality and solution– live case discussions and debate – black money – poverty people - Cultural degradation– live case discussions and debate – difference between Indian culture & western culture – impact of western culture in India – how to retain our culture and solution.

EMERGENCE OF MONOCULTURE 4 Hours

Emergence of monoculture – solution - Global terrorism – it's cause and effect – solution –

MARGINALIZATION OF GLOBAL ECONOMIC 4Hours

Economic marginalization and solution – it's impact in the globe – globalization in market – its effect in local market – merits – demerits of globalization - Man is the cause and man is the solution.

MEDITATION & YOGASANAS 7 Hours

Nithyananda Meditation& Divine Meditation – Introduction – practice – benefits.
Yogasanas - III

TotalHours :30

REFERENCES :

1. VethathiriMaharishi,"World peace plane"
2. Swami Vivekananda,"Prosperous India"
3. Vethathiri Maharishi,"SamudhayachikkalukkananalaAaivugal"
4. Vethathiri Maharishi, "World Community Life"

SEMESTER VIII

U13MCP801 PROJECT WORK

L	T	P	C
0	0	18	6

Course Objectives

- Students in the form of group, not exceeding 3 members in a group to carry out their main project. It should be a mechatronic project. However, special considerations can be given for interdisciplinary measurement and computer based simulation projects. This exception should be recorded and approved by thedepartment committee. Management related project projects will not be allowed. The interdisciplinary projects will carry more weightage. It is mandotry to publish their main project in national/international level conferences to appear in the viva-voce exam.

Course Outcomes

After successful completion of this course, the students should be able to

- Design, analyze, realize/simulate a physical system by using thetechnology they learnt during the programme.
- Integrate various systems into one mechatronic product.
- Work in a team with a confined time duration.
- Disseminate his work both in oral and written format.

MARK SPLIT UP FOR MAIN PROJECT

S.NO.	PARAMETER	% OF MARKS
1.	Interdisciplinary work	10
2.	Publication	25
3	Working model/ simulation result	25
4	Innovation	30
5	Report with good referencing	10

U13GST004	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

Course Objectives

- Apply knowledge of OR techniques to domain specific industrial situations to optimize the quality of decisions
- Conduct investigations by the use of OR techniques

Course Outcomes:

After successful completion of this course, the students should be able to

- Apply linear programming model and assignment model to domain specific situations
- Analyze the various methods under transportation model and apply the model for testing the closeness of their results to optimal results
- Apply the concepts of PERT and CPM for decision making and optimally managing projects
- Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions
- Analyze the inventory and queuing theories and apply them in domain specific situations

Course Content

LINEAR MODEL **9Hours**

The phases of OR study – formation of an L.P model – graphical solution – simplex algorithm – artificial variables technique (Big M method, two phase method), duality in simplex.

TRANSPORTATION AND ASSIGNMENT MODELS **9Hours**

Transportation model – Initial solution by North West corner method – least cost method – VAM. Optimality test – MODI method and stepping stone method.

Assignment model – formulation – balanced and unbalanced assignment problems.

PROJECT MANAGEMENT BY PERT & CPM **9Hours**

Basic terminologies – Constructing a project network – Scheduling computations – PERT - CPM – Resource smoothening, Resource leveling, PERT cost.

REPLACEMENT AND SEQUENCING MODELS **9Hours**

Replacement policies - Replacement of items that deteriorate with time (value of money not changing with time) – Replacement of items that deteriorate with time (Value of money changing with time) – Replacement of items that fail suddenly (individual and group replacement policies).

Sequencing models- n job on 2 machines – n jobs on 3 machines – n jobs on m machines, Traveling salesman problem.

INVENTORY AND QUEUING THEORY **9Hours**

Variables in inventory problems, EOQ, deterministic inventory models, order quantity with price break, techniques in inventory management.

Queuing system and its structure – Kendall's notation – Common queuing models - M/M/1: FCFS/∞/∞ - M/M/1: FCFS/n/∞ - M/M/C: FCFS/∞/∞ - M/M/1: FCFS/n/m

Total Hours:45

REFERENCES:

1. Taha H.A., "Operation Research", Pearson Education
2. Hira and Gupta "Introduction to Operations Research", S.Chand and Co.2002
3. Hira and Gupta "Problems in Operations Research", S.Chand and Co.2008
4. Wagner, "Operations Research", Prentice Hall of India, 2000
5. S.Bhaskar, "Operations Research", Anuradha Agencies, Second Edition, 2004

U13MC*E* 101 FINITE ELEMENT ANALYSIS

L	T	P	C
3	0	0	3

Course Objectives

- To understand the principles involved in discretization and finite element approach
- To learn to form stiffness matrices and force vectors for simple elements

Course Outcomes

After successful completion of this course, the students should be able to

- Develop the governing equations for a continuum.
- Model and assemble the stiffness matrices for 1D, 2D elements.
- Choose the appropriate element type for a particular application.
- Apply the FEM for plate bending and thermal analysis.

Course Content

INTRODUCTION 9Hours

Historical background – Introduction to FEA – Review of Matrix Algebra and Gaussian elimination – Governing equations for continuum – Spring assemblage – Stiffness method & Potential Energy Approach – Galerkin's weighted residual method

ONE DIMENSIONAL ELEMENTS – BAR, PLANE TRUSS & BEAM 9Hours

Bar element - Stiffness Matrix in local and global coordinates, Computation of Stress – Potential Energy and Galerkin's residual method – Solution of Plane Truss – Beam element – Stiffness and assembly of stiffness matrices - Potential energy and Galerkin's approach

PLANE STRESS & PLANE STRAIN – CST & LST APPROACH 8Hours

Basic concepts of plane stress & plane strain – Constant Strain Triangle approach – Stiffness Matrix and Equations - Body & Surface Forces – FE solution for plane stress problem – Practical Considerations in Modeling (Qualitative treatment) – Linear Strain Triangle approach - Stiffness Matrix and Equations

AXISYMMETRIC ELEMENTS&ISOPARAMETRIC FORMULATION 10 Hours

Axisymmetric formulation – Stiffness Matrix – Pressure Vessel Analysis – Applications – Isoparametric formulation – Formulation for Bar and Plane Elements – Numerical Integration – Gaussian & Newton-Cotes Quadrature – Evaluation of Stiffness Matrix by Gaussian Quadrature

PLATE BENDING AND THERMAL ANALYSIS 9Hours

Basic Concepts of Plate Bending – Element Stiffness Matrix and Equations – Heat Transfer – Basic Differential Equation and Units – 1d and 2d formulation

CASE STUDIES: Finite Element Analysis on Bicycle Frame, Finite Element Analysis on V-belt pulley of a fodder crushing machine

Total Hours: 45

REFERENCES:

1. Daryl, L. Logan, "A First course in the Finite Element Method", Thomson Learning, 4th edition, 2007.
2. Chandrupatla T.R., and Belegundu A.D., Introduction toFinite Elements in Engineering, Pearson Education, 3rd Edition, 2002.
3. David V Hutton "Fundamentals of Finite Element Analysis", McGraw-Hill International Edition, 2004.
4. Rao S.S., The Finite Element Method in Engineering, Pergammon Press, 1989.
5. J. N. Reddy, "An Introduction to the Finite Element Method", , Tata McGraw Hill, 3rd Edition 2005.

U13GST005 ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT

L	T	P	C
3	0	0	3

Course Objectives

- Acquire knowledge of economics to facilitate the process of economic decision making
- Acquire knowledge on basic financial management aspects
- Develop the skills to analyze financial statements

Course Outcomes

After successful completion of this course, the students should be able to

- Evaluate the economic theories, cost concepts and pricing policies.
- Understand the market structures and integration concepts.
- Understand the measures of national income, the functions of banks and concepts of globalization.
- Apply the concepts of financial management for project appraisal
- Understand accounting systems and analyze financial statements using ratioanalysis.

Course Content

ECONOMICS, COST AND PRICING CONCEPTS **9Hours**

Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply – Actual cost and opportunity cost – Incremental cost and sunk cost – Fixed and variable cost – Marginal costing – Total cost – Elements of cost – Cost curves – Breakeven point and breakeven chart – Limitations of break even chart – Interpretation of break even chart – Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing policies – Pricing methods

CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES **9Hours**

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger – Horizontal integration

NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT **9Hours**

National income concepts – GNP – NNP – Methods of measuring national income – Inflation – Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization

CONCEPTS OF FINANCIAL MANAGEMENT **9Hours**

Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital

ACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS

9Hours

Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations

TotalHours:45

REFERENCES:

1. Prasanna Chandra, " Financial Management (Theory & Practice)".
2. Weston & Brigham, " Essentials of Managerial Finance".
3. Pandey, I. M., "Financial Management".
4. James C. Van Horne ,"Fundamentals of Financial Management".
5. James C. Van Horne ,"Financial Management & Policy".
6. M. Y. Khan & P. K. Jain ,"Management Accounting & Financial Management".
7. P. Saravanavel ,"Management Accounting Principles & Practice".

U13MC*E*102 PLANT LAYOUT AND MATERIAL HANDLING

L	T	P	C
3	0	0	3

Course Objectives

- To studyof location on plant layout, selection of plant site, consideration in facilities planning and layout.
- To studyabout thetool and techniques for developing layout.
- To study about the industrial buildings and utilities material handling
- To study designing of material handling systems

Course outcomes

After successful completion of this course, the students should be able to

- Identify the location for plant site and also prepare the requirements for the operation of plant.
- Plan and prepare layout for various process lines in the plant.
- Describe the importance of material handling systems and factors influencing in the selection of material handling systems.
- Design and analyze the material handling system.
- Suggest the material handling system in terms of economy and safety.

Course Content

PLANT LOCATION AND PHYSICAL FACILITIES **9Hours**

Factors to be considered – Influence of location on plant layout, selection of plant site, consideration in facilities planning and layout – Equipment required for plant operation, Capacity, Serviceability and flexibility and analysis in selection of equipments, space and man power requirements.

PLANT LAYOUT **9Hours**

Need for layout, types of layout, factors influencing product, process, fixed and combination layout, tool and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models – machine data. Layout planning procedure – visualization of layout, revision and improving existing layout, balancing of fabrication and assembly lines.

INDUSTRIAL BUILDINGS AND UTILITIES **9 Hours**

Centralized electrical, pneumatic, water line systems. Types of buildings, lighting, heating, air-conditioning and ventilation utilities – planning and maintenance, waste handling, statutory requirements, packing and storage of materials: Importance of packaging, layout for packaging – packaging machinery – wrapping and packing of materials, cushion materials.

MATERIAL HANDLING **9Hours**

Importance and Scopes – Principles of material handling – engineering and economic factors - planning, relationship to plant layout – types and selection of material handling systems, factors influencing their choice – concept of containerization and palletization.

ANALYSIS OF MATERIAL HANDLING 9Hours

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

CASE STUDIES:

Improvements in material handling in cement manufacturing industry, Design of a final assembly plant in an automobile industry, development of material tracking system for food packaging industry.

TotalHours: 45

REFERENCES:

1. Khanna, O. P., "Industrial Engineering and Management", Dhanpatrai and Sons, 2003.
2. Apple, James M. Plant Layout and Material Handling,. John Wiley and Sons, New York, 3rd, edition, 1977.
3. Fred E Meyers, "Plant Layout and Material Handling", Prentice Hall, 2nd edition, 1999.
4. James A. Tompkins , John A. White, Yavuz A. Bozer and J. M. A. Tanchoco "Facilities Planning", John Wiley & Sons, 3rd edition, 2003.
5. Govindan, K. R., "Plant Layout and Material Handling", Anuradha, Kumbakonam, 2001.

U13MC*E*201 MODELLING AND SIMULATION

L	T	P	C
3	0	0	3

Course Objectives

- To explain the basic concepts of building a model, study of simulation and systems
- To study about the generation of random numbers, testing of random numbers
- To study about the generation of random variables
- To study the concepts of analysis and evaluation of models
- To study about various simulation soft wares

Course Outcomes:

After successful completion of this course, the students should be able to

- Define 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.

SYSTEM AND SYSTEM ENVIRONMENT 9 Hours

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 queue – inventory system.

RANDOM NUMBER GENERATION 9 Hours

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.

RANDOM – VARIATE GENERATION 9 Hours

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.

ANALYSIS AND EVALUATION OF MODEL 9 Hours

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

SIMULATION SOFTWARE PACKAGES 9Hours

Comparison and selection of General Purpose Simulation System *(*GPSS) , SIMSCRIPT, SLAM, Arena simulation language, Modeling basic operations using Arena – An Electronic Assembly and testing system, Development of simulation models using Arena simulation package for queuing system, Production system, inventory system, Arena Integration and customization. Simulation Case Study of a Metal-Parts Manufacturing Facility

Total Hours: 45

REFERENCES :

1. Banks J., Carson J.S. and Nelson B.L., "Discrete – Event System Simulation", , Pearson Education, Inc 3rd Edition, 2005
2. David Kelton.W. and Randall P. Sowdowski, "Simulation with Arena", , McGraw Hill, 2nd Edition, 2002.
3. Geoffrey Gorden, "System Simulation", Prentice Hall of India, 2003.
4. Narsingh Deo., "System Simulation with Digital Computer", Prentice Hall of India, 2003.

U13MC*E*202	PRODUCTIONPLANNINGAND CONTROL	L	T	P	C
		3	0	0	3

(Common to Mechanical and Mechatroincs Engineering)

Course Objectives

- To understand thecomponentsandfunctionsofproductionplanningand control
- To understand Workstudy methodology
- To understand Productplanning,processplanningandprocess capabilities
- To understand Production scheduling
- To understand Inventory Control.

Course Outcomes:

After successful completion of this course, the students should be able to

- Define and summarize the production facilities along with proper systematic planning of production activities.
- Explain and apply various assessing method of working such as to achieve maximum output and efficiency.
- Compare and select the optimum process for the production, along with process steps and production capacity.
- Comprehend and solve basic problems that arise in scheduling and inventory in a production process.

Course Content

INTRODUCTION **9 Hours**

Objectivesand benefits of planning and control-Functions of production control-Typesofproduction – job – batchandcontinuous – Productdevelopmentand design-Marketing aspect - Functional aspects-Operational aspect- Durabilityanddependability aspect-aesthetic aspect. Profit consideration- Standardization, Simplification &specialization-Break even analysis – Economicsofanewdesign.

WORKSTUDY **9 Hours**

Method study, basic procedure-Selection-Recording of process – Criticalanalysis,Development – Implementation – Micromotionandmemomotionstudy – workmeasurement – Techniquesof workmeasurement-Timestudy-Productionstudy-Worksampling-Synthesisfromstandarddata-Predetermined motion time standards.

PRODUCTPLANNINGANDPROCESSPLANNING **9 Hours**

Product planning-Extending the original product information-Valueanalysis-Problems in lack of product planning-Process planning androuting-Prerequisiteinformation neededforprocesssplanning – Stepsinprocess planning-Quantity determination in batch production-Machine capacity,balancing.

PRODUCTIONSCHEDULING **9 Hours**

ProductionControl Systems-Loading and scheduling-Master Scheduling-Scheduling rules-Gantt charts-Perpetual loading-Basic scheduling problesms - Line of balance - Flow production scheduling-Batch production scheduling-Productsequencing-ProductionControlsystems-Periodicbatch control-Material requirement planning kanban

–Dispatching-Progress reportingandexpediting – Manufacturingleadtime – Techniquesforaligning completiontimesanddue dates.

INVENTORYCONTROLANDRECENT TRENDSINPPC 9Hours

Inventory control-Purpose of holding stock-Effect of demand on inventories-Orderingprocedures.Twobinsystem – Orderingcyclesystem – DeterminationofEconomicorder quantity and economic lot size-ABC analysis-Recorder procedure – Introductiontocomputerintegratedproductionplanningsystems-elements ofJUSTIN TIME SYSTEMS-Fundamentals of MRP II and ERP, Lean Manufacturing.

CASE STUDIES:Shop floor Management

Total Hours:45

REFERENCES:

1. Martand Telsang, "Industrial Engineering and Production Management", S.Chand andCompany,2nd Edition,2006.
2. SamsonEilon,"Elementsofproductionplanningandcontrol",UniversalBookCorpn .1984.
3. Elwood S.Buffa, and Rakesh K.Sarin, "Modern Production / OperationsManagement",8th Ed.JohnWileyandSons,2000.
4. K.C.Jain &L.N. Aggarwal, "Production Planning Control and IndustrialManagement",KhannaPublishers,(1990)reprint2002.
5. N.G.Nair,"ProductionandOperationsManagement",TataMcGraw-Hill,1996.
6. S.N.Chary,"TheoryandProblemsinProduction&OperationsManage ment",TataMcGrawHill,1995.
7. S.K.HajraChoudhury,NirjharRoyandA.K.HajraChoudhury, "ProductionManagement",MediaPromotersandPublishersPvt.Ltd.,1998.

U13GST006	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Objectives

- Acquire knowledge on the various stages of a product development process
- Develop skills for using the various tools and techniques for developing products
- Acquire knowledge on project management techniques

Course Outcomes

After successful completion of this course, the students should be able to

- Differentiate product design and process design.
- Develop ideas for creating new products by selecting the appropriate parts.
- Apply the different laws of appearance in the product design.
- Analyse the products in terms of cost, appearance and quality by applying the value engineering concept.

Course Content

INTRODUCTION -DEVELOPMENT PROCESSESAND RGANIZATIONS - PRODUCT PLANNING 9Hours

Characteristics of successful product development to Design and develop products, duration and cost of product development, the challenges of product development.

A generic development process, concept development: the front-end process, adapting the generic product development process, the AMF development process, product development organizations, the AMF organization.

The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.

IDENTIFYING CUSTOMER NEEDS - PRODUCT SPECIFICATION 9Hours

Gathering 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 and reflecting on the results and the process.

Specifications, establish specifications, establishing target specifications setting the final specifications.

CONCEPT GENERATION - CONCEPT SELECTION - CONCEPT TESTING 9Hours

The activity of concept generation clarify the problem search externally, search internally, explore systematically, reflect on the results and the process.

Overview of methodology, concept screening, concept scoring, caveats.

Purpose of concept test, choosing a survey population and a survey format, communicate the concept, measuring customer response, interpreting the result, reflecting on the results and the process.

PRODUCT ARCHITECTURE - INDUSTRIAL DESIGN - DESIGN FOR MANUFACTURING

9Hours

Meaning of product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.

Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, is assessing the quality of industrial design.

Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors.

PROTOTYPING - PRODUCT DEVELOPMENT ECONOMICS - MANAGING PROJECTS **9Hours**

Prototyping basics, principles of prototyping, technologies, planning for prototypes.

Elements of economic analysis, base case financial mode,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.

Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation.

Total Hours:45

REFERENCES:

1. Karl. T. Ulrich, Steven D Eppinger,. Irwin, “Product Design and Development” McGrawHill.
2. A C Chitale and R C Gupta, “Product Design and Manufacturing”, PHI.
3. Timjones. Butterworth Heinmann,”New Product Development” Oxford. UCI.
4. Geoffery Boothroyd, Peter Dewhurst and Winston Knight “Product Design for Manufacture and Assembly”.

U13MC*E*203 DIGITAL IMAGE PROCESSING

L	T	P	C
3	0	0	3

Course Objectives

- To study the image fundamentals and mathematical transforms necessary for image processing.
- Tostudytheimageenhancement techniques.
- Tostudytheimagecompression procedures.
- Tostudy aboutcolor image processing and wavelets.
- Tostudytheimagesegmentationandrepresentationtechniques.

Course Outcomes:

After successful completion of this course, the students should be able to

- Summarize acquisition and processing methods of digital image along with thier applications.
- Design filters for image enhancement.
- Compare image enhancement in spatial domain with frequency domain.
- Choose appropriate image compression and segmentation techniques for different applications.

Course Content

DIGITALIMAGEFUNDAMENTALS **9 Hours**

Introduction – Examples of fields that use Digital image processing,FundamentalstepsinDigitalImageProcessingsystems,Componentsofanimage processingsystems,LightandEMspectrum,Imagesensingand acquisition, Image sampling and quantization- Concepts, imagerepresentation, Spatial and gray level resolution, Aliasing and Moriepatterns, Somebasicrelationshipsbetweenpixels.

IMAGEENHANCEMENTINSPATIALDOMAIN **9 Hours**

Background, Gray level transformation- Image negatives, Logtransformations, Power law transformations, Piecewise – Lineartransformationfunctions,Histogramprocessing – Histogramequalization,Histogram matching(Specifications),EnhancementusingALU.

IMAGE ENHANCEMENT IN FREQUENCYDOMAIN **9 Hours**

IntroductiontotheFouriertransformandthefrequencydomain – 1-DFouriertransformanditsinverse,2-DFouriertransformanditsinverse,Smoothing frequency domain filters- Ideal, Butterworth, Gaussian lowpass filters, Sharpening frequency domain filters- Ideal, Butterworth,Gaussianhighpassfilters.

COLORIMAGEPROCESSINGANDWAVELETS **9 Hours**

Color fundamentals, Color models- RGB color model, CMY and CMYKcolormodel,HIScolormodel.Wavelets-Background-Imagepyramids,subbandcoding,Haartransform,Wavelettransformin1-D-Waveletseries expansion, discrete wavelet transform, Continuous wavelettransform.

IMAGECOMPRESSIONANDSEGMENTATION **9 Hours**

Fundamentals–Imagecompressionmodels,Error-free compression– Lossycompression-Lossypredictivecoding, Transformcoding,JPEG2000 – Detection of discontinuities – Edge linking and boundarydetection.

CASE STUDIES:Optimization of Image Processing Algorithms

Total Hours:45

REFERENCES:

1. Rafael C. Gonzalez andRichard E. Woods, "Digital ImageProcessing",PearsonEducation Asia/AddisonWesleypublishingcompany, 6thIndianReprint,2008.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Prentice-HallofIndia,NewDelhi,2001.
3. Maher A. Sid-Ahmed, "Image Processing Theory, Algorithms andarchitectures",McGraw-Hill,1995.
4. William K. Pratt, "Digital Image Processing", Wiley-Inter SciencePublication,2ndEdition,1991.
5. ArthurKWreeks,"FundamentalsofElectronicsImageProcessing",Prentice-HallofIndia,NewDelhi,2001.

U13MC*E*204 STATISTICAL QUALITY CONTROL L T P C

3 0 0 3

Course Objectives

- To Study on sampling procedures.
- To Study the application of control charts to measure.
- To Study the improvement of the quality of products and processes.

Course Outcomes:

After successful completion of this course, the students should be able to

- Define the concept of probability, and also the various sampling method to measure quality and the attributes of quality.
- Summarize the process behaviour based on various control charts.
- Select the appropriate samples for the study.
- Apply various techniques to improve the overall quality.

Course Content

INTRODUCTION 7Hours

Probability concepts, Review of distribution: Normal, Poison's, and Binomial, Problems, Measuring of quality and control, Value and quality, Quality costs, Quality assurance.

CONTROL CHARTS FOR VARIABLES 10 Hours

Chance and assignable causes of quality variation, Control charts for variables, X-bar, R, and σ-charts, Warning and modified control limits, Process capability study, Ranges, Moving Averages, and Six σ- limits, multivariate charts.

CONTROL CHARTS FOR ATTRIBUTES 8 Hours

Limitation of variable chart, p-chart, problems with variable sample size, np-chart, c- chart, u-chart, and ku-chart, Demerits per unit control chart.

ACCEPTANCE SAMPLING 10Hours

Economics of sampling, Lot formation, OC-Curve-Producer's and Consumer's risk, Single and double sampling plans, AOQ, AOQL, ATI, ASN, Sequential sampling plan, MIL – STD – 1050 tables, MIL – STD – 414 tables, IS 2500 Standard.

QUALITY IMPROVEMENT 10Hours

Zero defects program, Quality circle, Fishbone diagram, scatter diagram, Pareto Analysis, Deming cycle, Introduction to Reliability function, System reliability of series, parallel, and combined configurations, Reliability improvement techniques.

Total Hours :45

REFERENCES:

1. Grant E.L. and Leavensworth, "Statistical Quality Control", Tata McGraw-Hill Publishing Company, 5th edition 2002.
2. Douglas C. Montgomery, "Statistical Quality Control", John Wiley and Sons, 2001.

3. Fiegenbaum, A.V., “Total Quality Control”, McGraw-Hill Inc., 1991.
4. Sharma S.C., “Inspection Quality Control and Reliability”, Khanna Publishers, New Delhi, 1998.
5. Srinath L.S “Reliability Engineering”, Affiliated East west Press, 1998.

U13MC*E*205 VIRTUAL INSTRUMENTATION

L	T	P	C
3	0	0	3

Course Objectives

- To review background information required for studying virtual instrumentation.
- To study the basic building blocks of virtual instrumentation.
- To study the programming techniques.
- To study the data acquisition and instrument control in virtual instrumentation
- To study the various techniques of interfacing of external instruments of PC.
- To study a few applications in virtual instrumentation.

Course Outcomes

After successful completion of this course, the students should be able to

- Describe the basic building blocks of virtual instrumentation.
- Use various functions to effectively developprograms.
- Demonstrate the various componenets involved in interfacing of different hardwares to the PC.
- Develop simple applications related to process automation and biomedical engineering.

Course Content

INTRODUCTION **9 Hours**

Historical perspective of traditional benchtop instruments, Architecture of Virtual Instrumentation -Advantages of Virtual Instrumentation over conventional instruments -Sequencing - data flow- Graphical programming concept.

SOFTWARE ENVIRONMENT **9 Hours**

Introduction to VI software - Front panel - Block diagram - Icon and Connector – Palettes -Creating, editing, wiring, debugging and saving VIs - sub-VIs - creating sub-VIs - simple examples - Looping: For loop, while loop - Shift registers.

PROGRAMMING TECHNIQUES **9 Hours**

Case and sequence structures, formula nodes, Arrays-clusters, charts and graphs, local and global variables - property node, string and file I/O.

DATA ACQUISITION AND INSTRUMENT CONTROL **9 Hours**

DAQ - Components - Buffers: Buffered and non buffered I/O – Triggering - Analog I/O, Digital I/O-Counters and timers-Instrument control: VISA**,** GPIB, PXI.

APPLICATIONS OF VIRTUAL INSTRUMENTATION **9 Hours**

Process control- Physical- Biomedical- Image acquisition and processing.

Total Hours : 45

REFERENCES:

1. Sanjeev Gupta, "*Virtual Instrumentation using Labview"* Tata McGraw Hill, 2010.
2. Gary Johnson, "*Lab view graphical programming*", II Ed., McGraw Hill, 4th edition 2006.
3. Lisa K Wells & Jeffrey Travels, "*Lab view for everyone*", Prentice Hall, 2003.
4. Jovitha Jerome "*Virtual Instrumentation using Lab View*" PHI Learning Pvt. Ltd, 2009.

	L	T	P	C
U13MA*E*702 PROBABILITY AND APPLIED STATISTICS	**3**	**0**	**0**	**3**

Course Objectives

- will be introduced to various types of statistical analysis of data
- will be acquinted with construction of probabilistic model and control charts

Course Outcomes

After successful completion of this course, the students should be able to

- Compute measures of central tendencies, dispersions and correlate the variables.
- Analyze random or unpredictable experiments and investigate important features of random experiments.
- Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.
- Analyze sample data and interpret the same for population.
- Sketch the control charts and outline the process capability.

Course Contenet

STATISTICAL MEASURES **9 Hours**

Measures of central tendency: Mean, Median and Mode – Measures of variation – Range, standard deviation, Mean deviation and coefficient of variation. Correlation and Regression: Karl Pearson's coefficient of correlation –Rank Correlation – Regression lines (Definitions and simple numerical problems only).

PROBABILITY AND RANDOM VARIABLE **10 Hours**

Axioms of probability - Conditional probability - Total probability – Baye's theorem - Random variable - Probability mass function - Probability density function- moments –moment generating function- properties.

STANDARD DISTRIBUTIONS **8 Hours**

Binomial, Poisson and Normal distributions – properties- Fitting of Binomial, Poisson and normal distributions to data.

TESTING OF HYPOTHESIS **9 Hours**

Testing of hypothesis for large samples (single mean, difference of means, single proportion, difference of proportions) – Small samples tests based on t and F distributions (single mean, difference of means, paired *t*- test and variance ratio test) – Chi-square test for independence and goodness of fit - Simple numerical problems only.

DESIGN OF EXPERIMENTS AND QUALITY CONTROL **9 Hours**

Analysis of variance – One way classification - Two – way classification – CRD - RBD - Latin square – LSD Concept of process control - Control charts for variables – $\overline{X}$, R – charts – Control charts for attributes – p, np, c – charts – Tolerance limits.

Total Hours:45

REFERENCES

1. Veerarajan T., “Probability and Statistics”, Tata McGraw-Hill, New Delhi, 2007
2. Gupta S. P., “Statistical Methods”, Sultan Chand & Sons Publishers, 2004. (Unit - I)
3. Johnson R. A., “Miller & Freund’s Probability and Statistics for Engineers”, Pearson Education, Delhi, 6th Edition, 2000.
4. Gupta S.C. and Kapur J.N., “Fundamentals of Mathematical Statistics”, Sultan Chand, New Delhi, 9th Edition 1996.
5. Walpole R. E., Myers S.L. & Keying Ye, “Probability and Statistics for Engineers and Scientists”, Pearson Education Inc, 2002.
6. Arunachalam T., “Probability and Statistics”, Inder Publications, Coimbatore, 2008.

U13MC*E*206 COMPUTATIONAL FLUID DYNAMICS

L	T	P	C
3	0	0	3

Course Objectives

- To understand the fundamental concepts of computational fluid dynamics.
- To study the various techniques involved in discretization of fluid elements.
- To gain knowledge in solving the fluid dynamics problems using finite element and finite volume methods.

Course Outcomes

After successful completion of this course, the students should be able to

- Solve numericalequations related to fluid flow.
- Apply finite difference, finite volume andfinite element methods to fluid flow problems.
- Describe the important classes of numerical discretisation scheme, and explain the relationship between the discretisation process and the underlying fluid physics.

Course Contenet

FUNDAMENTAL CONCEPTS 10Hours

Introduction - Basic Equations of Fluid Dynamics - Incompressible In viscid flows: Source, vortex and doublet panel, methods - lifting flows over arbitrary bodies. Mathematical properties of Fluid Dynamics Equations -_ Elliptic, Parabolic and Hyperbolic equations - Well posed problems - discretization of partial Differential Equations -Transformations and grids - Explicit finite difference methods of subsonic, supersonic and viscous flows.

PANEL METHODS 7Hours

Introduction – Source panel method – Vortex panel method – Applications.

DISCRETIZATION 8Hours

Boundary layer Equations and methods of solution -Implicit time dependent methods for inviscid and viscous compressible flows - Concept of numerical dissipation -- Stability properties of explicit and implicit methods - Conservative upwind discretization for Hyperbolic systems - Further advantages of upwind differencing.

FINITE ELEMENT TECHNIQUES 10Hours

Finite Element Techniques in Computational Fluid Dynamics; introduction – Strong and Weak Formulations of a Boundary Value Problem - Strong formulation - Weighted Residual Formulation - Galerkin Formulation - Weak Formulation - Variational Formulation - Piecewise defined shape functions - Implementation of the FEM - The Solution Procedure.

FINITE VOLUME TECHNIQUES 10Hours

Finite Volume Techniques - Cell Centered Formulation - ~ Lax - Vendoroff Time Stepping - Runge - Kutta Time Stepping - Multi - stage Time Stepping - Accuracy

-. Cell Vertex Formulation - Multistage Time Stepping - FDM -like Finite Volume Techniques - Central and Up-wind Type Discretizations - Treatment of Derivatives.

TotalHours:45

REFERENCES

1. Fletcher, C.A.J., "Computational Techniques for Fluid Dynamics", Vols. I and II, Springer - Verlag, Berlin, 1991.
2. John F. Wendt (Editor), "Computational Fluid Dynamics - An Introduction", Springer – Verlag, Berlin, 1992
3. Charles Hirsch, "Numerical Computation of Internal and External Flows", Vols. I and II.John Wiley & Sons, New York, 1988.
4. Klaus A Hoffmann and Steve T. Chiang. "Computational Fluid Dynamics for Engineers", Vols. I & II, Engineering Education System, P.O. Box 20078, W. Wichita, K.S., 67208 - 1078 USA, 1993.

U13MC*E* 207 COMPUTER NETWORKS

L	T	P	C
3	0	0	3

Course Objectives

- To study the concepts of data communications.
- To study the functions of different layers.
- To introduce IEEE standards employed in computer networking.
- To make the students to get familiarized with different protocols and network components.

Course Outcomes

After successful completion of this course, the students should be able to

1. Identify different types of network topologies and protocols.
2. Differentiate and explain the various layers of the OSI model and TCP/IP.
3. Identify the different types of data communication concepts and their functions within a network
4. Understand and building the skills of TCP/IP and internetworking.
5. Explain the importance of broad band networks and connectivity.

Course Content

OPEN SYSTEM INTERCONNECTION MODEL 9 Hours

Network Goals – uses – network topologies – Network architecture - OSI Reference model services – Network standardization – ARPANET – SNA – USENET

DATA COMMUNICATIOM CONCEPTS 9 Hours

Guided and unguided Medias – Asynchronous and synchronous transmission – RS 485 Ethernet - Fast Ethernet RS232C Interface, X.21 interface switching technologies – Circuit, Message, packet and hybrid switching – Elementary data link protocols – sliding window – Automatic repeat request.

MEDIUM ACCESS SUB-LAYER AND NETWORK LAYER 9 Hours

Channel allocation methods – ALOHA protocols – Pure ALOHA – Slotted ALOHA – local area networks – IEEE standard 802 for LANS – Wireless LAN IEEE 802.11 FDD1 - Virtual circuits – datagram – comparison – Routing congestion control.

TCP/IP –AND INTERNETWORKING 9 Hours

TCP/IP – architecture and operation – IP layers and functions – addressing and routing – Internet user services – E-Mail – w.w.w. - Internetworking – Bridges – Gateways – Repeaters – Routers – Brouters.

BROAD BAND NETWORKS AND CONNECTIVITY 9 Hours

ISDN Evolution – structures – Limitation - Broadband - ISDN, Transfer modes – Asynchronous transfer mode (ATM) – ATM cell format – Traffic Management – SONET – Introduction to VSAT networks.

CASE STUDIES: OSI model in Controller area network (CAN) , TCP/IP Performance over Mobile Networks

TotalHours :45

REFERENCES:

1. Andrew S. Tanenbaum, "Computer Networks", Prentice Hall of India, 4th edition,2002
2. Behrouz A. Forouzan, "Data communication and Networking", Tata McGraw-Hill,2004.
3. Dimetri Bertsekas and Robert Gallager, "Data Networks", PH1, 1994.
4. Hughes.L. "Data Communication a Practical Approach", Narosa Publications 1997.
5. James F. Kurose and Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet", Pearson Education, 2003.
6. Larry L.Peterson and Peter S. Davie, "Computer Networks", Harcourt Asia Pvt. Ltd., Second Edition.

U13MC*E*208 MAINTENANCE ENGINEERING L T P C
3 0 0 3

Course Objectives

- To study the basics of maintenance and reliabilty engineering, maintenance management, cost analysis and the techniques used for predictive maintenance.
- Students learn the principles of various maintenance technologies as they are currently practiced by industry

Course Outcomes

After successful completion of this course, the students should be able to

- Summarize the siginificance of maintenance, schedulingand their limitations.
- Explain the procedures used to extract data from machinery measurements for predictive maintenance.
- Describe the various vibration measuring techniques and vibration signature analysis used in rotating machineries.
- Demonstrate theprinciples of lubrication oil analysis and its use in predictive maintenance.
- Explain the basics of failure models and apply life prediction techniques as part of an equipment diagnosis

Course Content

OVERVIEW OF MAINTENANCE AND RELIABILITY ENGINEERING
9 Hours

Scope of industrial preventive/predictive maintenance programs - Definition of terminology- An example of establishing equipment maintenance program- Overview of condition-based maintenance technologies- Maintenance planning, management and designing an effective maintenance organization- Information systems organization and asset management - Evaluating maintenance performance- Cost-benefit analysis.

DIGITAL SIGNAL PROCESSING (DSP) AND INFORMATION EXTRACTION FROM MACHINERY MEASUREMENTS
9Hours

Instrumentation systems and measurements- Data acquisition from machinery sensors, data sampling- Signal conditioning: digital filters and signal preprocessing- Time-domain and frequency-domain signatures- Monitoring transients such as machinery start-up and coast-down events- Demonstration of a typical data acquisition and analysis system- **Case studies** of machinery monitoring for predictive maintenance.

VIBRATION ANALYSIS AND ROTATING MACHINERY CONDITION MONITORING WITH CASE STUDIES **9Hours**

Vibration and its causes- Classification of frequency ranges- Imbalance, misalignment, looseness, bearing defects, and their characteristic frequencies- Understanding vibration of a second order system- Instrumentation for vibration monitoring- Description of a typical vibration monitoring system- Vibration signatures, data trending, and alarming techniques.

Case studies of vibration monitoring: turbine imbalance, pump misalignment, pump looseness, boiler feed water pump anti-friction bearing monitoring, pump journal bearing monitoring, rolling mill gearbox problem, transient vibration analysis.

LUBRICATION OIL ANALYSIS AND TRIBOLOGY 9Hours

Scope of lubrication oil analysis- Classification of lube oil test methods - Lube oil degradation monitoring; demonstration of equipment - Lube oil contamination analysis- Lube oil wear particle analysis- Case studies of industrial applications.

RELIABILITY ENGINEERING AND FAILURE MODELS 9 Hours

Reliability, availability and maintainability - Reliability models and failure distributions - Reliability function estimation - Residual life estimation as a prognosis activity- model development and forecasting

Case studies of applications to rotating machinery and heat exchangers.

TotalHours:45

REFERENCES

1. Cornelius Scheffer and Paresh GirdharPractical “Machinery Vibration Analysis and Predictive Maintenance” Elsevier, 2004.
2. Collacatt R.A., “Mechanical fault Diagnosis and Condition Monitoring”, Chapman andHall Ltd, 2004.
3. A.R. Crawford, "The Simplified Handbook of Vibration Analysis," Volumes1&2,
4. Computational Systems, Inc., Knoxville, 1992
5. Gupta A.K., “Reliability, maintenance and safety engineering”, University science press, NewDelhi, 1st edition, 2009.
6. J.D. Campbell and J. V. Reyes- Picknell “Up time Strategies for Excellence in Maintenance Management," 2nd Edition Productivity Press, Portland, OR, 2006
7. H.P. Bloch and F.K. Geitner, "An Introduction to Machinery Reliability Assessment," Gulf Publishing, Houston, 1994.
8. R.B. Northrop, "Introduction to Instrumentation and Measurements," CRC Press, Boca Raton, 1997.
9. "Maintenance Technology," The magazine of plant equipment reliability, maintenance, and asset management, Barrington, IL.
10. A.R. Crawford, "The Simplified Handbook of Vibration Analysis," Volumes1&2, Computational Systems, Inc., Knoxville, 1992.
11. E.A. Elsayed, "Reliability Engineering," Addison Wesley, Reading, MA, 1996.
12. T. Wireman, "Developing Performance Indicators for Managing Maintenance," Industrial Press, New York, 1998.
13. J. Moubray, "Reliability-Centered Maintenance," Industrial Press, New York, 1997.

U13MC*E* 209 SENSORS FOR ENGINEERING APPLICATIONS

L	T	P	C
3	0	0	3

Course Objectives

- To understand the basics of various types of sensors
- To study and compare the characteristics of different types of sensors
- To gain knowledge in selecting the suitable sensor for the engineering applications

Course Outcomes

After successful completion of this course, the students should be able to

- Describe the various types of strain gauges and their measurement techniques.
- Compare the characteristics of different types of sensors.
- Explain the working principles of various sensors used in physical parameter measurements.
- Apply the knowledge in selecting the suitable sensor for the engineering applications.

Course Content

STRAIN AND PRESSURE MEASUREMENT9 Hours

Resistance strain guage, piezoelectric pressure gauge, characteristics. Electronic circuits for strain gauge, load cells. Interferometer, Fibre-optic methods. Pressure gauges Aneroid capacitance pressure gauge, ionization gauge, Using the transducers for applications.

MOTION SENSORS 9 Hours

Capacitor plate sensor, Inductive sensors, LVDT Accelerometer systems, rotation sensors drag cup devices, piezoelectric devices. Rotary encoders.

LIGHT RADIATION 9 Hours

Color temperature, light flux, photo sensors, photomultiplier, photo resistor and photoconductors, photodiodes, phototransistors, photovoltaic devices, fiber-optic applications, light transducer, solid-state ,transducers liquid crystal devices.

HEAT AND TEMPERATURE 9 Hours

Bimetallic strip, Bourdon temperature gauge, thermocouples, Resistance thermometers, thermistors, PTC thermistors, bolometer, Pyroelectric detector.

ELECTRONIC SENSORS 9 Hours

Proximity detectors – Inductive and capacitive, ultrasonic, photo beam detectors Reed switch, magnet and Hall-effect units, Doppler detectors, liquid level detectors, flow sensors, smoke sensors

Total Hours :45

REFERENCES:

1. Doebelin, E O, “Measurement Systems, Application and Design” , McGraw Hill, 5th Edition, 2004
2. Jack P Holman, “Experimental Methods for Engineers”, McGraw Hill, USA, 7th Edition 2001.
3. Ian R Sinclair, “Sensors and Transducers”, Third Edition, Newnes publishers, 2001.
4. Robert G Seippel, “Transducers, Sensors and Detectors”, Reston Publishing Company, USA, 1983.

U13MC*E* 210	CONCEPTS OF ENGINEERING DESIGN	L	T	P	C
		3	0	0	3

Course Objectives

- To understand the basics of engineering design and its principles
- To study about stress- strain concepts and data acquisition methods.
- To incorporate environmental aspects in the engineering design

Course Outcomes

After successful completion of this course, the students should be able to

- Design a model by applying various engineering principles.
- Apply stress and strain principles to the systems in a logical and discerning manner.
- Use modeling, simulation and computing tools and techniques for new product development.
- Recognize environmental constraints and safety issues in engineering.

Course Content

INTRODUCTION **12 Hours**

Design Engineer- Aspirations, Competency, Engagement, Iceberg model of competency, Functional competency, Behavioral Competency, Traits & Motives of a Design Engineer, Personality Assessment.Visualization and freehand sketching - Understanding of form and functions, freehand sketching of a typical modern kitchen, plan of a house, an executive's modern office, domestic products like chair, water bottle Engineering Design - Engineering design process, Identification and analysis of needs, Organization of design concept, Modeling, Design Management, Information Gathering, Presentation Techniques.Review of Mechanics -Force, torque, power, moment of inertia, bending moment, eccentric loading, friction.

DESIGN PRINCIPLES **8 Hours**

Occam's Razor, Saint-Venant's Principle, Golden Rectangle, Abbe's Principle, Maxwell's Reciprocity Theorem, Self-Principles, Stability, Symmetry, Parallel Axis theorem, Accuracy, Repeatability, Resolution, Sensitivity direction, Fool Proofing, Form design principles, DFX-Typical application examples.

STRESS AND STRAIN **9 Hours**

Loading (elastic and plastic, buckling), stress, strain, Young's modulus, shear modulus, stress-strain curve (yield strength, ultimate tensile strength, proof strength, percentage elongation), tensile stress and shear stress computation, thermal stress, stress concentration factor, hoop stress, bending of beams, torsion of shafts, ductility, toughness, Hertzian contact stress, Fatigue (high-cycle, low-cycle), fracture mechanics(Initiation, Propagation, failure), springs-strain energy, bearings-an overview.

INNOVATION AND INVENTION SERIES **9 Hours**

Creativity-development concepts, examples, Concept Evaluation, Mind Maps, TRIZ, Intellectual Property Rights.Planned experimentation through Labview Graphical Programming -Introduction, the front panel, the block diagram, data acquisition, components of a DAQ system, DAQ hardware configuration, DAQ assistant, analog I/O, digital I/O, typical sensor interface examples.

GREEN DESIGN PROCESS **7 Hours**

Environment impact assessment, factors in material selection for green design, material properties, energy content, eco-indicators, calculation of the eco-indicator, manufacturing issues, environmental issues, Evaluation of alternative materials example.Introduction to lean concepts - Lean Concepts in Manufacturing, Lean design principles

Total Hours : 45

PROJECT BASED LAB SESSIONS:

1. Assembly and Dismantling of a Bicycle
2. Sensor Interface to monitor temperature by employing thermocouple using LabVIEW graphical programming
3. Study of automotive systems cut sections of automotive components.
4. Cut sectional view of six cylinder diesel engine showing cam operated valves, piston, connecting rod, cam shaft, timing gear, diaphragm clutch, synchromesh gear box, brake assembly, wheel assembly and differential gear box.

REFERENCES:

1 Michael Ashby, Hugh Shercliff and David Cebon, "Materials Engineering, Science,Processing and Design", Elsiever, 2008,
2 James Garrat, "Design and Technology", Cambridge University Press, 2004.
3 Allen Strickland Hall, Alfred R. Holowenko, Herman G. Laughlin, "Schaum's Outline of Machine Design", Tata McGraw-Hill Education Private Lmited,New Delhi, 2008.
4 LabVIEW: User Manual By National Instruments, 2000.
5 Mike Ashby and Kara Johnson, "Materials and Design – The Art and Science of Material Selection in Product Design", Elsiever, Second Edtion.
6 Faculty of Mechanical Engineering, "PSG Design Data Book", PSG College of Technology.
7 Myer Kutz, "Environmentally Conscious Mechanically Design", John Wiley & sons, 2007.
8 Jacob, Golden Berg, David Mazursky, "Creativity in Product Innovation", Cambridge University Press, 2002
9 Kalevi Rantanen, Ellen Domd,"Simplified TRIZ, New Problem Solving Application for Engineers and Manufacturing Professional", CRC Press, 2002
10 Ronald G. Askin, Jeffrey B. Goldberg, "Design and Analysis of Lean Production Systems", Wiley India,2007.
11 James P.Womack, Daniel T. Jones, "Lean Thinking: Banish Waste And Create Wealth In Your Corporation", Simon & Schuster, 2003.

U13MC*E* 301 RAPID PROTOTYPING

L	T	P	C
3	0	0	3

Course Objectives

- To study about learning Rapid Prototyping is to enhance the knowledge of students in the field of prototyping,
- The syllabus will also provide knowledge on the various RP Machines and their process capabilities.

Course Outcomes

After successful completion of this course, the students should be able to,

- Explain the principles and processes of rapid prototyping (RP), rapid tooling (RT), and reverse engineering (RE) technologies.
- Identify the limitations of RP, RT, and RE technologies for product development;
- Summarize the importance of RP, RT, and RE technologies in product development with case some studies

Course Content

OVERVIEW OF RAPID PROTOTYPING **9Hours**

Definitions, evolution, CAD for RPT, Product design and rapid product development, conceptual design, detail design, prototyping, Fundamentals of RP systems, 3D solid modeling software and their role in RPT, creation of STL file

LIQUID BASED RP PROCESSES **9Hours**

Liquid based RP systems: Stereo lithography (SLA)-principle-process parameters-process details-machine details- applications Solid Ground Curing - Principle- process parameters process details-machine details, Applications.

SOLID BASED RP PROCESSES **9 Hours**

Fusion Deposition Modeling - Principle- process parameters-process details-machine details, Applications. Laminated Object Manufacturing - Principle- process parameters-process details-machine details, Applications.

POWDER BASED RP PROCESSES **9Hours**

Powder based RP systems: Selective Laser Sintering (SLS)- Principle- process parameters process details-machine details- Applications. 3-Dimensional Printers - Principle- process parameters-process details-machine details, Applications, and other Concept Modelers like Thermo jet printers, Sander's model maker.

RAPID TOOLING **10Hours**

Principles and typical process for quick batch production of plastic and metal parts through quick tooling. Reverse Engineering – 3D scanning-3D digitizing and Data fitting- Vacuum Casting.

CASE STUDIES: RP in Aerospace Industry, Automotive Industry, Jewelry Industry, Arts and Architecture.

Total Hours :45

REFERENCES:

1. Pham D.T & Dimov.S.S, "Rapid manufacturing" , Springer-Verlag, London, 2011
2. Chua C.K. et al., "Rapid Prototyping: principles and applications" Wiley, 2003
3. Jacobs P.F., "Stereolithography and other Rapid Prototyping & Manufacturing

4. Technologies", McGraw Hill, New york, 1996
5. Hilton P.D., "Rapid Tooling" Marcel Dekkar, 2000
6. Zeid I., "CAD/CAM: Theory & Practice", McGraw Hill, Singapore, 1991.

U13MC*E*302 RENEWABLE ENERGYSOURCES L T P C
3 0 0 3

Course Objectives

- To know about different primary energy sources and renewable energysources
- To studythesolarenergymeasurementanddesigningof various solarenergyutilizedsystems
- Tostudythprinciplesofdifferentnon-conventionalenergysources andtheirutilization.
- Tounderstandtheapplicationsofenergyfromwasteand designing ofbiogasplant
- Togetanexposureinvariousdirectenergyconversion systems

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

1. Relate the effect of renewable and non renewable energy sources on climate change and other global contemporary issues.
2. Describe solar energy generation, measurement systems and calculate the performances of various solar energy systems.
3. Summarize other renewable energy resources and their usage in power generation.
4. Compute performance characteristics of direct energy conversion systems and explain their storage and transport phenomena.

Course Content

ENERGYANDENVIRONMENT **9 Hours**

Primaryenergysources – worldenergyresources – energycycleoftheearth– environmentalaspectsofenergyutilization,EmissionsandGlobalwarming– Renewableenergyresourcesandtheirimportance – Potentialimpactsofharnessingthe differentrenewableenergyresources.

SOLARENERGY **9 Hours**

Principles ofsolarenergycollection-.solarradiation- measurements- instruments- dataandestimation – typesofcollectors – characteristicsand designprinciplesofdifferenttype ofcollectors,performanceandtesting ofcollectors – Solarwaterandairheaters – performanceandapplications –solarcooling-solardrying – solarponds-solartowerconcept -solar furnace.

WIND,TIDALANDGEOTHERMALENERGY **9 Hours**

General theory of windmills - types of windmills - design aspects of horizontalaxiswindmills–applications-Energyfromtidesandwaves– workingprinciplesoftidalplantsandocean thermalenergyconversion plants – Geothermalpowerplants.

BIOENERGY **9 Hours**

Energy from bio mass and bio gas plant – types and design of biogasplants – applications - Energy from wastes - utilization of industrial,municipalandagriculturalwastes.

DIRECTENERGY CONVERSIONSYSTEM **9 Hours**

Magneto hydrodynamicsystems (MHD) - thermoelectric generators – thermionicgenerators – fuelcells-solarcells-types,Emfgenerated,poweroutput,lossesandefficiency applications.Hydrogenconversionandstoragesystems.

CASE STUDIES:Effects of Nuclear power plant, Thermal power plants,Wind and tidal power plants

Total Hours : 45

REFERENCES:

1. Rai G.D, "Non conventional Energy sources" Khanna Publishers, New Delhi. 4th edition (24th Reprint), 2009
2. "Renewable Energy Sources and Emerging Technologies", Kothari, Eastern Economy Edition, 2009.
3. Sukhatme, S.P., "Solar Energy, Principles of Thermal Collection andStorage", 3rd Edition, TataMCGraw Hill, 2008.
4. B.H.Khan, "Non Convention Energy Resources", Tata McGraw Hill", 2nd Edition 2009.
5. S.RAo and Parulehar, "Energy Technology – Non conventional, Renewable and Conventiona"l, Khanna Publishers, 3rd Edition (6th Reprint), 2009.
6. Garg. H. P and Prakash. J., "Solar Energy - Fundamentals and applications", , Tata McGraw Hill, 1st revised edition 2000

U13MC*E* 303 MEDICAL MECHATRONICS

L	T	P	C
3	0	0	3

Course Objectives

- To study how to measure biochemical and various physiological information.
- To study the need and technique of electrical safety in Hospitals.
- To study the use of radiation for diagnostic and therapy.
- To study about recorders and advanced equipments in medicine

Course Outcomes:

After successful completion of this course, the students should be able to,

- Explain different measurement techniques used in physiological parameters measurement.
- Describe the sensors and signal conditioning circuits used in biomedical engineering.
- Comment on various measurement systems used in diagnostics.
- Differentiate the working of recorders and explain the advanced systems used in medicine.

Course Content

INTRODUCTION 9Hours

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

BIO-MEDICAL SENSORS AND TRANSDUCERS 9Hours

Basic transducer principles Types — resistive, inductive, capacitive, fiber-optic, photoelectric, chemical, active and passive transducers and their description and feature applicable for biomedical instrumentation – Bio, Nano sensors and application.

SIGNAL CONDITIONING AND DISPLAY 9 Hours

Input isolation, DC amplifier, instrumentation, charge amplifier, power amplifier, and differential amplifier – feedback, op-Amp-electrometer amplifier, carrier Amplifier – instrument power supply, basis of signal conversion and digital filtering, data reduction technique – time and frequency domain technique.

MEDICAL MEASUREMENT AND MONITORING SYSTEMS 9Hours

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 – cardiac pacemaker –defibrillator patient safety - electrical shock hazards - Centralized patient monitoring system.

RECORDERS AND ADVANCED SYSTEMS 9 Hours

Oscillagraphic – galvanometric - thermal array recorder, photographic recorder, storage oscilloscopes, electron microscope.Biotelemetry, Diathermy,Audiometers, Dialysers, Lithotripsy.

CASE STUDIES: Hot wire Anemometry for respiratory flow measurements.

Total Hours :45

REFERENCES:

1. Khandpur, R.S., "Handbook of Biomedical Instrumentation", TMH, 2009.
2. Cromwell, Weibell and Pfeiffer, "Biomedical Instrumentation and Measurements", Prentice Hall of India, 2nd Edition, 2007.
3. Geddes L.A., and Baker, L.E., "Principles of Applied Bio-medical Instrumentation", , John Wiley and Sons, 3rd Edition, 1995.
4. Tompkins W.J., "Biomedical Digital Signal Processing", Prentice Hall of India, 1998.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

U13MC*E* 304 INTELLECTUAL PROPERTY RIGHTS (IPR)

L	T	P	C
3	0	0	3

Course Objectives

- To study the legal concepts in Science, Engineering, Technology and Creative Design.
- To study new scenario, Intellectual Property Rights should occupy the central stage in the economic development.
- To study revision of national legislation on Intellectual Property Rights (IPR) as well as to the establishment or modernization of Government structures that administer such legislation

Course Outcomes:

After successful completion of this course, the students should be able to,

1. Distinguish variousproperty rights.
2. Describe the procedures to obtain Intellectual Property Rights.
3. Explain the effective usage of copyrights and international practices with some case studies

Course Contenet

INTRODUCTION **9 Hours**

Introduction - Invention and Creativity - Intellectual Property (IP) - Importance - Protection of IPR - Basic types of property (Movable Property , Immovable Property and Intellectual Property).

PATENTS, COPYRIGHTS AND TRADEMARKS **9 Hours**

IP - Patents - Copyrights and related rights - Trade Marks and rights arising from Trademark registration - Definitions - Industrial Designs and Integrated circuits - Protection of Geographical Indications at national and International levels - Application Procedures.

INTERNATIONAL CONVENTION RELATING TO INTELLECTUAL PROPERTY **9 Hours**

Introduction - Establishment of WIPO - Mission and Activities - History - General Agreement on Trade and Tariff (GATT).

IPR STRATEGIES **9 Hours**

Indian Position Vs WTO and Strategies - Indian IPR legislations - commitments to WTO-Patent Ordinance and the Bill - Draft of a national Intellectual Property Policy - Present against unfair competition.

CASE STUDIES **9 Hours**

Case Studies on - Patents (Basumati rice, turmeric, Neem, etc.) - Copyright and related rights - Trade Marks - Industrial design and Integrated circuits - Geographic indications - Protection against unfair competition.

Total Hours : 45

REFERENCES

1. Subbaram N.R., S. Viswanathan *"Handbook of Indian Patent Law and Practice"*, Printers and Publishers Pvt. Ltd., 1998.
2. Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1994.
3. Intellectual Property Today: Volume 8, No. 5, May 2001, [www.iptoday.com].
4. Using the Internet for non-patent prior art searches, Derwent IP Matters, July 2000.
5. [www.ipmatters.net/features/000707_gibbs.html.]

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U13MC*E* 305 ARTIFICIAL INTELLIGENCE L T P C
3 0 0 3

Course Objectives

- To acquire knowledge about different searching techniques and algorithms.
- To train the system in playing games.
- To Study the concept of representing knowledge and facts using reasoning and structures.

Course Outcomes

After successful completion of this course, the students should be able to

- Explain the characteristics of AI systems with different searching techniques and algorithms.
- Develop algorithms to train the system in playing games.
- Summarize the concepts of knowledge representation.
- Designa simple AI System.

Course Content

INTRODUCTION **10 Hours**

Definition – Pattern recognition – Criteria of success – Production Systems – Control Strategies – Heuristic Search – Problem Characteristics – Production System Characteristics – Forward and backward reasoning – Matching Indexing – Heuristic Functions, Search algorithms.

GAME PLAYING **8 Hours**

Overview – Minimax search procedure – Adding Alpha – Beta cutoffs – Waiting for Ouiescence – Secondary search – Using book moves.

KNOWLEDGE REPRESENTATION USING CONVENTIONAL LOGICS

10 Hours

Use of Predicate logic – Introduction to representation – representing simple facts in logic augmenting the representation – resolution – Conversion to clause from – The basis of resolution Unification of algorithm – Question answering – Natural Deduction.

KNOWLEDGE REPRESENTATION USING MODERN LOGICS 8Hours

Nonmonotonic reasoning – Statistical Probabilistic reasoning – Techniques for dealing with a random world and deterministic world – rule based system.

STRUCTURAL REPRESENTATIONS OF KNOWLEDGE **9 Hours**

Common knowledge structures – level of representation – Right structures – Declarative representations – Semantic nets – Conceptual dependency Frames Scripts – Procedural representation – Natural language understanding – Perception – learning – Implementation A.I. Systems.

Total Hours :45

REFERENCES:

1. Elaine Rich, “Artificial Intelligence”, McGraw-Hill Book Co., 2009.
2. M. W. Richaugh, “Artificial Intelligence, A. Knowledge Based Approach”, PWS Rent Publishing Boston, 1998.
3. Charniac. E and M.C.Dermott. “Introduction to Artificial Intelligence”, Addison Wesley Publishing Company, 2002.
4. Robert Goodell Brown, “Materials Management Systems – A Members Library”, John Wiley Publishers, 1977.
5. Westing Fine and Zone, “Purchasing Management Principles”, John Wiley Publishers, 1986

U13MC*E* 306 AUTOMATION SYSTEM DESIGN

L	T	P	C
3	0	0	3

Course Objectives

- To acquire knowledge about fundamental concepts of industrial automation.
- To study the detail about designs in assembly and pneumatics control.
- To understand and able to write programming for Robot and CNC automation.
- To Study the concept of representing knowledge and facts used to design various applications.

Course Outcomes

After successful completion of this course, the students should be able to

- Apply industrial automation concepts for a given problem.
- Choose transfer lines and automated assembly for a given system.
- Use and program various systems used in automation.
- Differentiate Mechatronics design process from conventional design.

Course Content

FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION 7 Hours

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation. Introduction to HMI systems – text display, touch panels and integrated displays.

TRANSFER LINES AND AUTOMATED ASSEMBLY 9 Hours

General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines.AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing.

PNEUMATIC CONTROL & SYSTEM DESIGN 12Hours

Components, constructional details, filter, lubricator, regulator, constructional features, types of cylinders, control valves for direction, pressure and flow, air motors, air hydraulic equipments. Pneumatic control system design: General approach to control system design, symbols and drawings, schematic layout, travel step diagram, circuit, control modes, program control, sequence control, cascade method, Karnaugh-Veitch mapping.

PROGRAMMABLE AUTOMATION & ROBOTIC SYSTEMS 11Hours

Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems.Robotic systems: Basic structure of a robot–robot end effectors. Classification of robots–accuracy, resolution and repeatability of a robot. Drives and control systems–mechanical components of robots–sensors and vision systems. Transducers and sensors-tactile sensors, proximity sensors and range sensors, vision systems. Robot motion control and robot programming.

DESIGN OF MECHATRONIC SYSTEMS **6Hours**

Stages in design, traditional and mechatronic design, possible design solutions.Case studies-pick and place robot, engine management system.

Total Hours :45

REFERENCES:

1. Mikell P Groover, "Automation Production Systems and Computer- Integrated Manufacturing" Pearson Education, New Delhi, 2008.
2. Wemer Depper ,Kemprath Reihe , Vogel Buch and Kurt Stoll, "Pneumatic Application", Verlag Wurzbutg, 1987.
3. Bolton W, "Mechatronics", Pearson Education, Second Edition, 1999.
4. Steve F Krar, "Computer Numerical Control Simplified", Industrial Press, 2001.
5. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications" , McGraw Hill , New York, USA. 2000.
6. Wemer Deppert and Kurt Stoll, "Pneumatic Application", Kemprath Reihe, Vovel Verlag , Wurzburg, 1976.
7. Festo K G, "Pneumatic Tips", Festo, Germany, 1987.
8. Nitaigour Premchand Mahadik, "Mechatronics", Tata Mc Graw-Hill, Publishing Company, Ltd., 2003.
9. Rolf Isermann, "Mechatronic Systems Fundamentals", Springer, 2003.
10. John W Webb and Ronald A Reis, "Programmable Logic Controllers", Prentice Hall, Inc., 1999.
11. Robert H Bishop, "Mechatronics: Introduction", Taylor and Franics, 2006.
12. Peter Smid, "CNC Programming Techniques: An Insider's Guide to Effective Methods and Applications", Industrial Press, 2006.
13. Wisama Khalil and Etienne Dombre, "Robot Mainpulators Modeling, Performance Analysis and Control", ISTE, 2007.
14. Mark W Spong and Seth Hutchinson, "Robot Modeling and Control", Wiley-India Pvt. Ltd.,2006.

U13MC*E* 307 **NANO SCIENCE** **L T P C**
3 0 0 3

Course Objectives

- To acquire knowledge on nanostructures and its effect.
- To study the basics of nanomaterials and its characterization.
- To Study the concept of nanodevices and its applications.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to,

- Classify nano structures and the effect on physical parameters of nano sizing.
- Describe nano systems, nano semiconductor fabrication process and the materials used in nano systems.
- Demonstrate nano system characterization techniques.
- Illustrate nano devices and thier applications.

Course Content

INTRODUCTIONANDCLASSIFICATION **10Hours**

Classification of nanostructures, nanoscale architecture – Effects of the nanometre length scale – Changes to the system total energy, changes to the system structures, vacancies in nanocrystals, dislocations in nanocrystals – Effect of nanoscale dimensions on various properties – Structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems.

NANOMATERIALS AND CHARACTERIZATION **10Hours**

Fabrication methods – Top down processes – Milling, lithographics, machining process – Bottom-up process – Vapour phase deposition methods, plasma-assisted deposition process, MBE and MOVPE, liquid phase methods, colloidal and solgel methods – Methods for templating the growth of nanomaterials – Ordering of nanosystems, self-assembly and self-organisation – Preparation, safety and storage issues

GENERIC METHODOLOGIES FOR NANOTECHNOLOGY **10Hours**

Characterisation: General classification of characterisation methods – Analytical and imaging techniques – Microscopy techniques - Electron microscopy, scanning electron microscopy, transmission electron microscopy, STM, field ion microscopy, scanning tunnelling microscopy, atomic force microscopy – Diffraction techniques – Spectroscopy techniques – Raman spectroscopy – Surface analysis and depth profiling – Mechanical properties, electron transport properties, magnetic and thermal properties.

INORGANIC SEMICONDUCTOR NANOSTRUCTURES **8Hours**

Quantum confinement in semiconductor nanostructures - Quantum wells, quantum wires, quantum dots, superlattices, band offsets and electronic density of states – Fabrication techniques – Requirements, epitaxial growth, lithography and etching, cleared edge overgrowth – Growth on vicinal substrates, strain-induced dots and wires, electrostatically induced dots and wires, quantum well width fluctuations, thermally annealed quantum wells and self-assembly techniques.

NANODEVICES AND THEIR VARIOUS APPLICATIONS 7Hours

Nanomagnetic materials – Particulate nanomagnets and geometrical nanomagnets – Magneto resistance – Probing nanomagnetic materials – Nanomagnetism in technology – Carbon nanotubes – fabrication- applications – Organic FET, organic LED's – Organic photovoltaics – Injection lasers, quantum cascade lasers, optical memories, electronic applications, colulomb blockade devices.

Total Hours : 45

REFERENCES:

1. Kelsall Robert W Ian Hamley, Mark Geoghegan, "Nanoscale Science and Technology", Wiley Eastern, 2005.
2. Michael Kohler, Wolfgang, Fritzsche, "Nanotechnology: Introduction to Nanostructuring Techniques", 2004.
3. William Goddard, Donald W Brenner, "Handbook of Nano Science Engineering and Technology", CRC Press, 2004.
4. Bharat Bhushan, "Springer Handbook of Nanotechnology", 2004.
5. Charles P Poole, Frank J Owens, "Introduction to Nanotechnology", John Wiley and Sons, 2003.
6. Mark Ratner, Danial Ratner, "Nanotechnology: A Gentle Introduction to the Next Big Idea", Pearson, 2003.
7. Gregory Timp, "Nanotechnology", Springer-Verlag, 1999.

L	T	P	C
3	0	0	3

U13MC*E*308 INTRODUCTION TO AIRCRAFT ENGINEERING

Course Objectives

- To acquire knowledge and overview about Aircraft industry.
- To study the basics of Aircrafts and its various principles in flights.
- To acquire knowledge about flight mechanics and its performance.
- To Study the concept of aircraft system in all disciplines such as electrical, electronics, mechanical and also environmental aspects.

COURSE OUTCOMES

After successful completion of this course, the students should be able to

- Explain the evolution of aircrafts systems, trends of aerospace industry and the materials used in aerospace applications.
- Demonstrate the components and subsystems used in aircrafts.
- Analyse various parameters affecting the flight.
- Compare and contrast various mechanisms used for flying.
- Outline various mechanical and electronic systems used for controlling and navigation of aircrafts

Course Content

AIRCRAFT INDUSTRY OVERVIEW **5 Hours**

Evolution and History of Flight, Types Of Aerospace Industry, Key Players in Aerospace Industry, Aerospace Manufacturing, Industry Supply Chain, Prime contractors, Tier 1 Suppliers, Key challenges in Industry Supply Chain, OEM Supply Chain Strategies, Mergers and Acquisitions, Aerospace Industry Trends, Advances in Engineering/CAD/CAM/CAE Tools and Materials technology, Global and Indian Aircraft Scenario

INTRODUCTION TO AIRCRAFTS **6 Hours**

Basic components of an Aircraft, Structural members, Aircraft Axis System, Aircraft Motions, Control surfaces and High lift Devices.Types of Aircrafts - Lighter than Air/Heavier than Air Aircrafts Conventional Design Configurations based on Power Plant Location, Wing vertical location, intake location, Tail Unit Arrangements, Landing Gear Arrangements. Unconventional Configurations-Biplane, Variable Sweep, Canard Layout, Twin Boom Layouts, Span loaders, Blended Body Wing Layout, STOL and STOVL Aircraft, Stealth Aircraft. Advantages and disadvantages of these Configurations.

BASIC PRINCIPLES OF FLIGHT **10 Hours**

Significance of speed of Sound, Air speed and Ground Speed, Properties of Atmosphere, Bernoulli's Equation, Forces on the airplane, Airflow over wing section, Pressure Distribution over a wing section, Generation of Lift.Drag, Pitching moments, Types of Drag, Lift curve, Drag Curve, Lift/Drag Ratio Curve, Factors affecting Lift and Drag, Center of Pressure and its effects.Aerofoil Nomenclature, Types of Aerofoil, Wing Section- Aerodynamic Center, Aspect Ratio, Effects of lift, Drag, speed, Air density on drag.Mach Waves, Mach Angles, Sonic and Supersonic Flight and its effects

MECHANICS OF FLIGHT **8 Hours**

Aircraft Performance- Taking-off,Climing,cruise,Landing,Power Curves, Manoeuvres- Pull out dives,The load Factor,Loads during a Turn, Correct and Incorrect Angles of Bank, Control and steep Banks, Inverted Maneuvers, Maneuverability", Stability and Control-Meaning of Stabillity and Control,Degree of Stability- Lateral, Longitudinal and Directional Stability ,Dihedral and Anhedral Angles,Control of an Aeroplane",Aircraft Performance and Maneuvers-Power Curves, Maximum and minimum speeds of horizontal flight, Effects of Changes of Engine Power, Effects of Altitude on Power Curves, Forces acting on a Aeroplane during a Turn, Loads during a Turn, Correct and incorrect Angles of Bank, Aerobatics, Inverted Maneuvers, Maneuverability

INTRODUCTION TO AIRCRAFT SYSTEMS **16 Hours**

Types of Aircraft Systems.Mechanical Systems.Electrical and Electronic Systems. Auxiliary systems.Mechanical Systems: Environmental control systems (ECS), Pneumatic systems, Hydraulic systems, Fuel systems, Landing gear systems, Engine Control Systems, Ice and rain protection systems, Cabin Pressurization and Air Conditioning Systems, Steering and Brakes Systems Auxiliary Power Unit, Electrical systems: Avionics, Flight controls, Autopilot and Flight Management Systems, Navigation Systems, Communication, Information systems, Radar System

Total Hours :45

REFERENCES :

1. A.C Kermode, “Flight without Formulae” , Pearson Education, 10th Edition, 2001.
2. A.C Kermode, “Mechanics of Fligh”t, Pearson Education, 5th Edition, 2007.
3. Shevell, “Fundamentals Of Flight”, , Pearson Education, 2nd Edition.
4. Dave Anderson,“Introduction to Flight”.
5. Ian moir, Allan Seabridge,“Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration”.

U13MC*E*309	VEHICLE DYNAMICS AND CONTROL	L	T	P	C
		3	0	0	3

Course Objectives

- To study about vehicle dynamics and how to control it under different loads, speed and road conditions in order to improve the comfort for the passengers and life of the various components of the vehicle.

COURSE OUTCOMES:

After successful completion of this course, the students should be able to,

- Demonstrate simple mechanical systems subjected to dynamic loads.
- Solve vehicle stability related problems.
- Design suspensions and characterise the forces acting on tyre, steering and braking.
- Summarise various methods of achieving vehicle stability and its control.
- Design and analyse simple suspension using simulations methods.

Course Content

INTRODUCTION 9Hours

Single degree of freedom, two degree of freedom, free, forced and damped vibrations modeling and simulation studies, model of an automobile, magnification factor, transmissibility, vibration absorber, Closed and coupled far system, orthogonality of mode shapes, modal analysis.

STABILITY OF VEHICLES 9Hours

Load distribution, stability on a curved track slope and a banked road, calculation of tractive effort and reactions for different drives. Lateral Vehicle Dynamics - Kinematic Models, Dynamic Bicycle Model, From Body Fixed to Global Coordinates. Longitudinal vehicle dynamics - Longitudinal Vehicle Model, Driveline Dynamics, Mean Value Engine Models.

SUSPENSION AND TYRE DYNAMICS 9Hours

Requirements, sprung mass frequency, wheel hop, wheel wobble, wheel shimmy, choice of suspension spring rate, calculation of effective spring rate, vehicle suspension in fore and aft, roll axis and vehicle under the action of sideforces, tyre dynamics, ride characteristics power consumed by a tyre. Oversteer, under steer, steady state cornering, effect of braking, driving torques on steering, effect of camber, transient effects in cornering.

LATERAL & LONGITUDINAL VEHICLE CONTROL 9Hours

Steady State Analysis: Understanding Steady State Cornering, Control System Architecture, Individual Vehicle Stability and String Stability, Controller for Transitional Maneuvers, Automated Highway Systems, Longitudinal Control for Vehicle Platoons, String Stability with Inter-Vehicle Communication, Adaptive Controller for Unknown Vehicle Parameters, Rollover Prevention Control.

CASE STUDIES **9 Hours**

Introduction to simulation packages for vehicle dynamics. Active Suspension design for passenger cars, CVs and two wheelers.Design and analysis of suspension using simulation and analysis packages.

Total Hours : 45

REFERENCES:

1. Rajesh Rajamani, "Vehicle Dynamics and Control", Springer Publications Ltd.2nd Edition 2012.
2. Gillespie T.D, "Fundamentals of Vehicle Dynamics", SAE USA 1992.
3. Giri N.K – Automotive Mechanics, Khanna Publishers, 2002.
4. Rao J.S and Gupta. K "Theory and Practice of Mechanical Vibrations", Wiley Eastern Ltd., New Delhi -2, 2002.
5. Heldt.P.M -"Automotive Chassis"- Chilton Co., New York- 1992
6. Ellis.J.R - "Vehicle Dynamics"- Business Books Ltd., London- 1991
7. Giles.J.G.Steering - "Suspension and Tyres", Illiffe Books Ltd., London- 1998
8. Ham B, Pacejka - Tyre and Vehicle Dynamics - SAE Publication - 2002.

U13MC*E*310 NON DESTRUCTIVE EVALUATION L T P C
3 0 0 3

Course Objectives

- To impart knowledge on various types of non destructive evaluation methods
- To understand the principles and working of different NDE methods
- To have knowledge on selection of such different methods for testing and evaluation of various components

Course Outcomes

After successful completion of this course, the students should be able to,

- Describe and select an appropriate non destructive evaluation methods from the basic four methods.
- Summarize the sources, process and safety precautions of X-Ray radiography.
- Describe the wave probagation in media.
- Differentiate various scan methods, probes and noises present in the ultrasonic testing systems.

Course Content

ULTRA SONIC HARDNESS TESTING **9 Hours**

Flaw Detection Using Dye Penetrants.Magnetic Particle Inspection introduction to electrical impedance, Principles of Eddy Current testing, Flaw detection using eddy currents.

INTRODUCTION TO X-RAY RADIOGRAPHY **9 Hours**

The Radiographic process, X-Ray and Gamma-ray sources, Geometric Principles, Factors Governing Exposure, Radio graphic screens, Scattered radiation, Arithmetic of exposure, Radiographic image quality and detail visibility, Industrial XRay films.

X-RAY RADIOGRAPHY PROCESSES **9 Hours**

Fundamentals of processing techniques, Process control, The processing Room, Special Processing techniques, Paper Radiography, Sensitometric characteristics of x-ray films, Film graininess signal to noise ratio in radiographs, The photographic latent image, Radiation Protection.

INTRODUCTION TO ULTRASONIC TESTING **9 Hours**

Generation of ultrasonic waves, horizontal and shear waves, near field and far field acoustic wave description, ultrasonic probes- straight beam, direct contact type, angle beam, transmission/reflection type, and delay line transducers, acoustic coupling and media.

ULTRASONIC TESTS **9 Hours**

Transmission and pulse echo methods, A-scan, B-scan, C-scan, F-scan and Pscan modes, Flaw sizing in ultrasonic inspection: AVG, Amplitude, Transmission, TOFD, Satellite pulse, Multi-modal transducer, Zonal method using focused beam. Flow location methods, Signal processing in Ultrasonic NDT; Mimics, spurious echos and noise. Ultrasonic flaw evaluation.

CASE STUDIES: NDT in flaw analysis of Pressure vessels, piping, Castings and Welded constructions. Train rail flaw analysis using ultrasonic tester with water couplant.

Total Hours : 45

REFERENCES:

1. Krautkramer and Krautkramer, "Ultrasonic testing" Springer-Verlag GmbH, 1990
2. Baldev Raj, T. Jayakumar and M. Thavsimuthu, "Practical Non-Destructive Testing" Woodhead Publishing, 2nd edition, 2002.
3. E. A. Gingel , "Ultrasonic inspection 2: Training for NDT", Prometheus books 1995.

U13MC*E*311 ENGINEERING METROLOGY

L	T	P	C
3	0	0	3

Course Objectives

- To understand the principle of Dimensional metrology
- To learn about Metrology instruments and application for various measurements
- To introduce concept of computer applications in Metrology
- To apply the principles, techniques and devices used for quality control in modern Industrial environment

Course Outcomes

After successful completion of this course, the students should be able to

- Summarize various linear and angular measuring devices used to check dimensions.
- Describe the methods and instruments used in gear & screw parameters measurements.
- Explain the automated systems used in Metrology.
- Choose latest measuring tools for the modern Industrial environment.

Course Content

LINEAR METROLOGY **9Hours** Definition of metrology – Linear measuring instrument : Vernier, micrometer measurement, dial indicator, Slip gauges and classification, interferometer, optical flats - limit gauges, Comparators - Mechanical, pneumatic, optical and electric types, applications

ANGULAR METROLOGY **9Hours**

Sine bar, Vernier bevel protractor, optical bevel protractor, auto collimator, angle gauges, Clinometer, angle Decker – taper measurements.

SCREW THREAD AND GEAR METROLOGY **9 Hours**

Screw thread terminology –Measurement of various elements of Thread-Measurement of Major and minor diameter-Measurement of Thread angle by Two Ball Method-Pitch Measurement. Types of Gear-Gear Terminology-Spur gear measurement -Run out ,Pitch ,Concentricity ,profile ,lead ,alignment ,Back lash- Chordal thickness Method-Constant chord method-Parkinson gear tester

SURFACE MEASUREMENT **9 Hours**

Surface evaluation, Stylus method, Numerical values for surface assessment, Surface texture specimens, straightness, flatness and roundness measurement.

ADVANCEDTECHNIQUESINMETROLOGY **9Hours**

Coordinate measuring machine – constructional features – types and application, digital devices – computer aided inspection — machine vision systems, Profile projector, Universal Measuring Machine, Laser principles – Laser interferometer – application in linear, angular measurement and machine tool metrology.

Total Hours : 45

REFERENCES

1. Jain. R K "Engineering Metrology" Khanna Publishers, 2009.
2. Manohar Mahajan, "A textbook of Metrology", Dhanpat Rai & Co (P) LTD.,2008.
3. Alan S. Morris "The Essence of Measurement" Prentice Hall of India, 1997.
4. Connie Dotson, Ronger Harlow and Richard L Thomson, "Fundamentals of Dimensional Metrology", Thompson – Delmar, 4th edition, 2006.
5. Gupta S C "Engineering Metrology "Dhanpat Rai Publications.

U13GS*T*003 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

Course Objectives

- Acquire knowledge on TQM concepts
- Acquire knowledge on quality systems
- Develop skills to use TQM tools for domain specific applications

Course Outcomes

After successful completion of this course, the students should be able to

- Distinguish various total Quality Management concepts, principles and the various tools used to implement TQM.
- use statistical methods used in industries for quality control.
- recognize the importance of ISO and Quality system certification process .

Course Content

INTRODUCTION **9Hours**

Definition of Quality, Dimensions of Quality, Quality costs, Top Management Commitment, Quality Council, Quality Statements, Barriers to TQM Implementation, Contributions of Deming, Juran and Crosby, Team Balancing

TQM PRINCIPLES **9Hours**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Continuous Process Improvement,5S, Kaizen, Just-In-Time and TPS

STATISTICAL PROCESS CONTROL **9Hours**

The seven tools of quality, New seven Management tools, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Concept of six sigma.

TQM TOOLS **9Hours**

Quality Policy Deployment (QPD), Quality Function Deployment (QFD), Benchmarking, Taguchi Quality Loss Function, Total Productive Maintenance (TPM), FMEA

QUALITY SYSTEMS **9Hours**

Need for ISO 9000 and Other Quality Systems, ISO 9001:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 14001:2004

Total Hours : 45

REFERENCES

1. Dale H.Besterfiled, “Total Quality Management”, Pearson Education JamesR.Evans& William M.Lidsay, “The Management and Control of Quality”, South-Western (Thomson Learning), 2008.
2. Feigenbaum.A.V. “Total Quality Management”, McGraw Hill
3. Oakland.J.S. “Total Quality Management”, Butterworth – Hcinemann Ltd., Oxford
4. Narayana V. and Sreenivasan, N.S. “Quality Management – Concepts and Tasks”, New Age International 2007.
5. Zeiri. “Total Quality Management for Engineers”, Wood Head Publishers.

INDUSTRIAL TRAINING

At the end of 4th or 6th semester, all the UG students to undergo 1 week industrial training. They will work in an industry under the guidance of a professional. The students shall keep a log book and submit a report on their work describing the assignment, acquired knowledge, activities performed, contribution to industry and other relevant matters. It is highly recommended to undergo atleast one industrial training during the programme.

FIRST ASSESSMENT

ASSESMENT RUBRICS FOR THE COMPANY

S.NO	ACTIVITY	RATING				
		Satisfactory	Competent	Extra ordinary	Outstanding	Satisfactory
1.	Assignment					
2.	Attitude and Motivation					
3.	Contribution to industry					
4.	Progress of the assignment					

Department of Mechatronics Engineering

VISION

We, Mechatronics Engineering Department of Kumaraguru College of Technology strive to achieve academic excellence in Robotics and automation research, postgraduate teaching and innovative product development.

MISSION

The Department is committed to set standards of excellence in its academic programmes by enabling its students to achieve a blending of knowledge acquisition and application of such knowledge in real life situations. It is also aimed to equip them to adapt themselves to changing global and local needs upholding professional ethics and contribute their might in transforming India into a world leader in technological advancement and prosperity.