UNIVERSITY DEPARTMENTS

ANNA UNIVERSITY, CHENNAI

REGULATIONS - 2013

M.E. MECHATRONICS (FULL TIME)

I TO IV SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1	MA8164	Advanced Engineering Mathematics	3	1	0	4
2	MR8101	Concepts in Electronics Engineering	3	0	0	3
	MR8102	Concepts in Mechanisms and Machines				
3	MR8103	Drives and Control for Automation	3	0	0	3
4	MR8104	Dynamics and Control Systems	3	0	0	3
5	MR8105	Sensors and Signal Conditioning	3	0	0	3
6		Elective I	3	0	0	3
PRACTICAL						
7	MR8111	Sensors, Drives and Control Lab	0	0	4	2
		TOTAL	**18**	**1**	**4**	**21**

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MR8201	Design of Machine Elements	3	1	0	4
2.	MR8202	Industrial Robotics	3	0	0	3
3.	MR8203	Machine Vision	3	0	0	3
4.	MR8204	Microcontrollers and PLC	3	0	0	3
5.		Elective II	3	0	0	3
6.		Elective III	3	0	0	3
PRACTICAL						
7	MR8211	Automation Laboratory	0	0	4	2
		TOTAL	**18**	**1**	**4**	**21**

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1		Elective IV	3	0	0	3
2		Elective V	3	0	0	3
3		Elective VI	3	0	0	3
PRACTICAL						
4	MR8311	Project Work Phase I	0	0	12	6
		TOTAL	**9**	**0**	**12**	**15**

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
PRACTICAL						
1	MR8411	Project Work Phase II	0	0	24	12
		TOTAL	**0**	**0**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 69

LIST OF ELECTIVES

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1.	MR8001	Advanced Computer Vision	3	0	0	3
2.	MR8002	Advanced Control Systems	3	0	0	3
3.	MR8003	Advanced Microcontrollers and Embedded Systems	3	0	0	3
4.	MR8004	Analytical Robotics	3	0	0	3
5.	MR8005	Fuzzy Logic and Genetic Algorithms	3	0	0	3
6.	MR8006	Machine Tool Control and Condition Monitoring	3	0	0	3
7.	MR8007	Materials Management and Logistics	3	0	0	3
8.	MR8008	Mechatronics in Metrology and CNC	3	0	0	3
9.	MR8009	Mechatronics System Design	3	0	0	3
10.	MR8010	PC based Automation	3	0	0	3
11.	MR8011	Vetronics	3	0	0	3
12.	MN8071	Nanotechnology	3	0	0	3
13.	MN8072	Financial management	3	0	0	3
14.	MN8073	Non Destructive Evaluation	3	0	0	3

MA8164 ADVANCED ENGINEERING MATHEMATICS L T P C
3 1 0 4

AIM :

- To relate the mathematical concepts in their field of Engineering and apply the same in their respective main stream.

OBJECTIVES:

- The students would be acquainted with the basic concepts of Linear Algebra and numerical methods & their applications, basics in Graph theory

UNIT I VECTOR SPACE AND LINEAR TRANSFORMATION 10

Vector spaces – Subspaces – Linear spans – Linear independence and Linear dependence – Basis and Dimension – Linear Transformation, Null space and range – Dimension theorem (no proof) – Matrix representation of Linear Transformation.

UNIT II LINEAR ALGEBRA, INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 16

Gauss elimination method-Gauss Jordan method – Jacobi, Gauss- Seidel iterative Method – Lagrange's and Newton's divided difference interpolation - Newton's forward and backward difference interpolation – Numerical differentiation by finite differences – Trapezoidal, Simpson's 1/3 and Gaussian Quadrature formula.

UNIT III NUMERICAL SOLUTION OF ORDINANRY DIFFERENTIAL EQUATIONS 12

Numerical solution of first order ordinary differential equations by tailor series method – Euler Method - Fourth order Runge -Kutta Method – Multi step methods: Adam's Bash forth, Milne's Predictor Corrector methods- Finite difference methods for two point boundary value problems.

UNIT IV FUNDAMENTALS OF GRAPHS 12

Graphs-subgraphs-Graph Isomorphism- vertex degree: Eulerian Graphs- Planar Graphs- Hamiltonian paths

UNIT V ALGORITHMS- GRAPHS . 10

Kriskal's algorithm- Dijkstra's shortest path Algorithm, Prim's Algorithm- Transport Networks

TOTAL: 60 PERIODS

REFERENCES:

1. Kumaresan, S.,"Linear Algebra – A geometric approach", Prentice –Hall of India, New Delhi, 2000.
2. Friedberg, A.H., Insel, A.J. and Spence, L., "Linear Algebra", Prentice Hall of India, New Delhi, 2004.
3. Strang, G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.
4. Jain, M.K, Iyengar, S.R.K, and Jain, R.K., "Numerical methods for Scientific and Engineering Computation", New Age International Publishers, New Delhi, 2003
5. Faires, J.D. and Burder, R., "Numerical Methods", Brooks/Cole (Thomson Publications), New Delhi, 2002.
6. Gerald, C.F, and Wheatly, P.O., "Applied Numerical Analysis", Pearson Education, New Delhi, 2002.
7. Bondy J.A. and Murthy, USR, Graph Theory and Applications.Mc Millan Press Ltd, 1982

MR8101	CONCEPTS IN ELECTRONICS ENGINEERING	L T P C
		3 0 0 3

AIM:

- To understand the basics and working principles of electronic components and their applications

OBJECTIVE:

- This course is intended for learning the Fundamentals, properties and applications of Electronic Components, Devices, analog circuits, digital circuits, test and measuring instruments .

UNIT I ELECTRONIC COMPONENTS AND DEVICES 12

Resistors, Capacitors, Inductors, Transformers – types and properties,- Junction diodes, Zener diodes, Bipolar transistors, Field Effect transistors, Uni junction Transistors, MOS Devices, LEDs – Characteristics and applications; Thyristor Devices – SCR, DIAC, TRIAC, QUADRAC – operating mechanism, characteristics and applications.

UNIT II ANALOG ELECTRONICS 8

Rectifiers and Filters; Regulated Power Supply – Switching Power Supplies, Thermal Considerations, Feedback and power amplifiers , Sine wave oscillators,

UNIT III OPERATIONAL AMPLIFIERS AND APPLICATIONS 9

Operational amplifiers – Principles, Specifications, characteristics and ,applications-. Arithmetic Operations, Integrator, Differentiator, Comparator, Schmitt Trigger, Instrumentation Amplifier, Active filters, Linear Rectifiers, Waveform Generators, D/A converters.

UNIT IV DIGITAL ELECTRONICS 10

Number systems – Logic gates – Boolean algebra – Simplification of Boolean functions using Map method. Tabulation method – Combinational logic circuits: Full adder, Code Converters, Multiplexers, Decoders – Sequential logic circuits: Flip-flops, Counters, Shift registers – A/D Converters.

UNIT V TEST AND MEASURING INSTRUMENTS 6

Measurement of voltage, current ,frequency and power using Multi meters , oscilloscopes, recorders, data loggers, signal sources, counters, analyzers and printers.

TOTAL: 45 PERIODS

REFERENCES:

1. Mill Man and Halkias ":Electron devices and circuits" McGraw-Hill 2004.
2. Jocob Mill Man, Micro electronics Digital and Analog circuits & Systems – McGraw-Hill 2004.
3. Ray & Chaudary, Linear Integrated Circuits, New Age 2006.
4. Malvino & Leach, Digital Principals & application, TMH 2002.
5. Helfrick A.D and Cooper .W. D. " Modern Electronic Instrumentation and Measurements Techniques" Printice Hall 2008.

MR8102 CONCEPTS IN MECHANISMS AND MACHINES L T P C
3 0 0 3

AIM:

- To impart knowledge of basic mechanical engineering to the students.

OBJECTIVE:

- To make the students to understand the concepts, design, construction and properties of mechanical elements and machines.

UNIT I MECHANISMS 9

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinametic pairs – Constraint& motion - Degrees of freedom – Slider crank – Single and double – Crank rocker mechanisms – Inversions – applications. Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

UNIT II FRICTION 12

Types of friction – friction in screw and nuts – pivot and collar – thrust bearings – collar bearing – plate and disc clutches – belt (flat &vee) and rope drives – creep in belts – Jockey pulley – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tension – condition for maximum power transmission – basics of brakes, journal and rolling element bearings hydrostatic and aerostatic bearings – recirculating ball screw and nut assembly.

UNIT III GEARING AND CAMS 9

Gear profile and geometry-nomenclature of spur and helical gears – law of gearing – interference-requirement of minimum number of teeth in gears-gear trains-simple and compound gear trains-determination of speed and torque in epicyclic gear trains-Cam profile-different types of followers.

UNIT IV VIBRATION 9

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

UNIT V MACHINE TOOLS 6

Machine tool construction-features – operations of lathe, milling machine, drilling machine – Drive system for machine tools – mechanical, hydraulic and electric stepped and variable speeds – spindle speeds and feed drives-linear and reciprocation motion generation.

TOTAL: 45 PERIODS

REFERENCES:

1. BansalDr.R.K."Theory of Machines" Laxmi Publications (P) ltd., New Delhi. 2011.
2. G.C.Sen . and A. Bhattacharya, "Principles of machine tools" , New Central book Agency, 1999.
3. Joseph Edward Shigley, Charles R.Mischke, "Mechanical Engineering Design" Mcgraw Hill International Edition, 2008 .
4. Malhotra .D.R. and Gupta .H.C. "The Theory of machines" SatyaPrakasam, Tech. India Publications, 1989.
5. R.S.Khurmi and Gupta . " Theory of Machines" Eurasia Publishing House Pvt Ltd. 2012

MR8103	DRIVES AND CONTROLS FOR AUTOMATION	L	T	P	C
		3	0	0	3

AIM

- To impart knowledge in the area of hydraulic , pneumatic electric actuators and their control.

OBJECTIVE:

- To make the students to learn the basic concepts of hydraulic, pneumatics and electric drives and their controlling elements in the area of Mechatronics systems.To train the students in designing the hydraulics and pneumatic circuits using ladder diagram. And designing control circuits for electric drives.

UNIT I FLUID POWER SYSTEM GENERATION AND ACTUATORS 8

Need for automation, Classification of drives-hydraulic, pneumatic and electric –comparison – ISO symbols for their elements , Selection Criteria. Generating Elements**--** Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification -Drive characteristics – Utilizing Elements-- Linear actuator – Types, mounting details, cushioning – power packs –accumulators

UNIT II CONTROL AND REGULATION ELEMENTS 7

Control and regulation Elements—Direction, flow and pressure control valves--Methods of actuation, types, sizing of ports. spool valves-operating characteristics-electro hydraulic servo valves-Different types-characteristics and performance

UNIT III CIRCUIT DESIGN FOR HYDRAULIC AND PNEUMATICS 10

Typical Design methods – sequencing circuits design - combinational logic circuit.design--cascade method - -Karnaugh map method-- Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits.

UNIT IV ELECTRICAL ACTUATORS 10

D.C Motor--Working principle ,classification, characteristics, Merits and Demerits, Applications- AC Motor-- Working principle, Types, Speed torque characteristics, Merits and demerits, Applications Stepper motor- principle ,classification, construction. Piezo electric actuators – Linear actuators - Hybrid actuators – Applications

UNIT V ELECTRICAL DRIVE CIRCUITS 10

DC Motors - Speed ,direction and position control using H-bridge under PWM mode**.** Control of AC motor drives – Need for V/ F drives – Energy saving AC drives. – Stepper Motor – Drive circuits for speed and position control, BLDC motor – Controller – Switched reluctance motor .

TOTAL: 45 PERIODS

REFERENCES:

1. Antony Esposito, Fluid Power Systems and control Prentice-Hall, 2006
2. Peter Rohner, Fluid Power logic circuit design. The Macmillan Press Ltd.,London, 1979
3. E.C.Fitch and J.B.Suryaatmadyn. Introduction to fluid logic, McGraw Hill, 1978.
4. W.Bolton, Mechatronics, Electronic control systems in Mechanical and Electrical Engineering Pearson Education, 2003.
5. Gopal K.Dubey, Fundamentals of electrical drives. Narosa Pubilcations, 2001

MR8104 DYNAMICS AND CONTROL SYSTEMS L T P C
3 0 0 3

AIM:

- To understand dynamics, design and analysis of control systems to meet the desired specifications

OBJECTIVE:

- This course is intended for learning the all types of Control Systems and their modelling. With reference to mode controls, and determination of stability. In Time and Frequency domain .This course also discuss an example case study with reference to design of a servomotor

UNIT I SYSTEM REPRESENTATION AND MODELLING 9

Introduction and need for Control Systems with examples – Open loop and Closed loop systems – Transfer Function Model – State Space Model – Mathematical Modelling of Mechanical, Electrical, Pneumatic and Hydraulic systems – Block Diagram reduction – Signal flow graph.

UNIT II DESIGN OF FEEDBACK CONTROL SYSTEM 9

Feed back systems – Block Diagram – Definition of Process variable, Set-point, Manipulated variable and Final control element with examples – Characteristics of on-off, P, PI, PD and PID Controllers – Implementation issues of PID Controller – Modified PID Controller – Tuning of controllers.

UNIT III TIME DOMAIN ANALYSIS 9

Time response of First & Second order systems – Time domain specifications - steady state errors and error constants – Routh Hurwitz criterion – Root locus – Root locus approach to control system design – Lead, Lag, Lag-Lead Compensation using time domain analysis.

UNIT IV FREQUENCY DOMAIN ANALYSIS 9

Bode Plot – Polar Plot – Nyquist stability criterion – Stability analysis – Experimental determination of Transfer Functions – Control system design using Frequency domain analysis - Lead, Lag, Lag-Lead Compensation using frequency domain analysis.

UNIT V CASE STUDY ON CONTROL AND ANALYSIS OF SERVO MOTOR 9

Servo motor – Mathematical Modelling of Servo Motor – Analysis of Servo motor system using Routh Hurwitz criterion, Root locus, Bode Plot, Polar Plot and stability analysis – Implementation of P, PI , PD and PID controllers for servo motor and analysis.

TOTAL: 45 PERIODS

REFERENCES:

1. K.ogata, :modern controls engineering " Prentice Hall of India Pvt. Ltd., New Delhi, 2005.
2. B.C. kuo, "Automatic Control Systems", Prentice Hall of India Pvt. Ltd., New Delhi, 2004
3. I.J.Nagrath and Gopal. "Control system engineering", new age international (P) Ltd., 2006.
4. A. Nagoor Kani, "Control Systems", RBA publications (P) Ltd., 2007
5. M.Nakamura .S.Gata & N.Kyura, Mechatronic servo system control .Springer 2009.

MR8105 SENSORS AND SIGNAL CONDITIONING L T P C
3 0 0 3

AIM:

- To impart knowledge on various types of sensors and transducers for Automation in Mechatronics Engineering.

OBJECTIVE:

- To study basic concepts of various sensors and transducers
- To develop knowledge in selection of suitable sensor for mechatronics systems
- To design suitable signal conditioning circuits for mechatronics systems.

UNIT I INTRODUCTION 6

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types

UNIT II MOTION, PROXIMITY AND RANGING SENSORS 9

Motion Sensors – Brush Encoders, Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn , Accelerometer.,– GPS, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR)

UNIT III FORCE,MAGNETIC AND HEADING SENSORS 9

Strain Gage, Load CellMagnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers

UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 9

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric, Temperature – IC, Thermistor, RTD, Thermocouple,

UNIT V SIGNAL CONDITIONING 12

Need for Signal Conditioning – DC and AC Signal conditioning – Filter and Isolation Circuits – Operational Amplifier Specifications, Characteristics and Circuits – Voltage and Current Amplifiers – Transmitting Circuits – Fundamentals of Data Acquisition System.

TOTAL: 45 PERIODS

REFERENCES:

1. PatranabisD.,Sensor and Actuators, Prentice Hall of India (Pvt) Ltd. 2005.
2. Ernest O. Doeblin, Measurement system, Application and design, , Tata McGraw Hill Publishing Company Ltd., Fiftieth Edition, 2004
3. Bradley D.A., and Dawson, Burd and Loader, Mechatronics, Thomson Press India Ltd., 2004
4. RenganathanS.,Transducer Engineering, Allied Publishers (P) Ltd., 2003.
5. Bolton W., Mechatronics, Thomson Press, 2003.

MR8111 SENSORS, DRIVES AND CONTROL LAB L T P C
0 0 4 2

AIM

- To impart knowledge in the area of sensor characterization, hydraulic , pneumatic electric actuators and their control with PC as a hardware for the controller.

OBJECTIVE:

- To make students get exposed to instrument control, data acquisition and motor control.
- To train the students in designing and practical implementation of hydraulics and pneumatic circuits using ladder diagram. And designing control circuits for electric drives.

1. Familiarization of MATLAB, LABVIEW & VEE packages.
2. Temperature & Optical transducers Characterization.
3. Strain gage, Load cell and Torque transducer characterization & applications
4. LVDT, Acoustics Ranging and Hall effect sensor applications.
5. PC Interfacing of stepper motor - Unipolar & Bipolar.
6. Study of incremental optical encoders and DC brush motor characteristics & modeling.
7. Power control of AC & DC motors.
8. Operational Amplifier application circuits .
9. Closed loop position and velocity control of a DC brush servo motor.
10. Tuning of P, PI and PID controller using Simulink.
11. Study of basic Hydraulics & Pneumatic component and circuits
12. Simulation of sequential circuits using Pneumatic trainer kits.
13. Study of electro pneumatic and electrohydraulic circuits.
14. Study of electro pneumatic and electrohydraulic circuits using PLC.
15. Simulation of Pneumatic and Hydraulics circuits using Automation studio.

TOTAL: 60 PERIODS

MR8201 DESIGN OF MACHINE ELEMENTS L T P C
3 0 0 3

AIM:

- To impart the knowledge in the design of machine elements used in mechatronics systems.

OBJECTIVE:

- To make the students to learn and design of various machine elements used in mechatronics systems.

UNIT I INTRODUCTION 9

Introduction to national and international symbols- Engineering materials and their physical properties and applied to design- Selection of materials- Factors of safety in design- Dimensioning and detailing- Fitness and tolerance- Surface finish and machining symbols –Product development- Elementary concept of functional, aesthetic and form design- Principles of design optimization- Future trends- CAD.

UNIT II STATIC AND VARIABLE STRESSES 10

Static and variable loading in machine elements- Stress concentration- Goodmen and soderberg method of design- Design of power transmission shafts- Subjected to torsion, bending and axial loads- Design of close coiled helical spring.

UNIT III COUPLINGS AND GEAR 10

Design of couplings- Muff, Flange, Bushed and pin types- design of keys – Design of spur gears.

UNIT IV DESIGN OF TRANSMISSION ELEMENTS 10

Belt drives- flat and V belt- Selection and specification- Principle of hydrodynamic lubrication – Design of journal bearings – Selection and specification of anti-friction bearings – Life rating of roller bearings.

UNIT V CAD MODELLING AND SIMULATION 6

Simple machine elements in AUTOCAD – Modelling and simulation of simple mechanisms using ADAMS and CATIA.

TOTAL: 45 PERIODS

REFERENCES

1. Khurmi R.S and Gupta J.K A text book of machine design, Eurasia Publishing House (P) Ltd, New Delhi, 2006.
2. Jain R.K., Machine design, Khanna Publishers, Delhi, 2006.
3. Shigley J.E. Mechanical engineering design, McGraw-Hill BookCo., Delhi, 2004.
4. Spotts N.F. Design of machine elements, Prentice-Hall of India, 2004.
5. PSG Design data Handbook, Kalaikhathir Publications, CBE 2002

MR8202 INDUSTRIAL ROBOTICS L T P C
3 0 0 3

AIM:

- To impart knowledge in the area of mechanical design, sensors and programming of industrial robots.

OBJECTIVE:

- To make the students to learn about the mechanical design of robots, various sensors and its application in the area of industrial robotics.

UNIT I INTRODUCTION 10

Types of Industrial Robots, definitions – classifications based on work envelope – Generations configurations and control loops, co-ordinate system – need for robot – basic parts and functions – specifications.

UNIT II MECHANICAL DESIGN OF ROBOT SYSTEM 12

Robot motion – Kinematics of Robot motion – Direct and Indirect kinematics Homogeneous transformations – linkages and joints – mechanism – method for location and orientation of objects – drive systems – end effectors – types, selection, classification and design of grippers – gripper force analysis.

UNIT III SENSORS 8

Functions of Sensors – Position and proximity's sensing – tactile sensing – sensing joint forces – vision system – object recognition and image transformation – safety monitoring sensor systems – image analysis – application of image processing.

UNIT IV ROBOT PROGRAMMING & AI TECHNIQUES 8

Types of Programming – Teach pendant programming – Basic concepts in A1 techniques – Concept of knowledge representations – Expert system and its components.

UNIT V ROBOTIC WORK CELLS AND APPLICATIONS OF ROBOTS 7

Robotic cell layouts – Inter locks – Humanoid robots – Micro robots – Application of robots in surgery, Manufacturing industries, space and underwater.

TOTAL: 45 PERIODS

REFERENCES:

1. Groover.M.P. Industrial Robotics, technology, programming and application Mc-Graw Hill book and co. 2012
2. Fu.K.S , Gonzalac R.C ,Lee C.S.G, Robotics Control, sensing ,vision and intelligence, Mc- Graw Hill book co 2011.
3. Yoram Koren , Robotics, McGraw Hill 2006
4. Janakiraman P.A. Robotics and Image Processing, Tata McGraw Hill, 2002
5. Saeed B.Niku ,Introduction to Robotics , analyses , systems, applications, Prentice Hall Pvt Ltd. 2005

MR8203 **MACHINE VISION** **L T P C**
3 0 0 3

AIM:

- To impart knowledge on imaging, machine vision and its applications.

OBJECTIVE:

- To understand and apply the basic concepts of optics in imaging. To learn the various hardware components of an imaging system for machine vision applications. To understand the various image processing and image analysis algorithms and the issues involved in applying them to various machine vision applications. To expose students to various applications of vision and challenges involved in each.

UNIT I INTRODUCTION **8**

Human vision – Machine vision and Computer vision – Benefits of machine vision – Block diagram and function of machine vision system implementation of industrial machine vision system – Physics of Light – Interactions of light – Refraction at a spherical surface – Thin Lens Equation

UNIT II IMAGE ACQUISITION **12**

Scene constraints – Lighting parameters – Lighting sources, Selection – Lighting Techniques – Types and Selection – Machine Vision Lenses and Optical Filters, Specifications and Selection – Imaging Sensors – CCD and CMOS, Specifications – Interface Architectures – Analog and Digital Cameras – Digital Camera Interfaces – Camera Computer Interfaces, Specifications and Selection – Geometrical Image formation models – Camera Calibration

UNIT III IMAGE PROCESSING **10**

Machine Vision Software – Fundamentals of Digital Image – Image Acquisition Modes – Image Processing in Spatial and Frequency Domain – Point Operation, Thresholding, Grayscale Stretching – Neighborhood Operations, Image Smoothing and Sharpening – Edge Detection – Binary Morphology – Color image processing.

UNIT IV IMAGE ANALYSIS **6**

Feature extraction – Region Features, Shape and Size features – Texture Analysis – Template Matching and Classification – 3D Machine Vision Techniques – Decision Making.

UNIT V MACHINE VISION APPLICATIONS **9**

Machine vision applications in manufacturing, electronics, printing, pharmaceutical, textile, applications in non-visible spectrum, metrology and gauging,OCR and OCV, vision guided robotics – Field and Service Applications – Agricultural, and Bio medical field, augmented reality, surveillance, bio-metrics.

TOTAL: 45 PERIODS

REFERENCES

1. EmanueleTrucco, Alessandro Verri, “Introductory Techniques For 3D Computer Vision”, First Edition, 2009
2. Rafael C.Gonzales, Richard.E.Woods, “Digital Image Processing Publishers”, Third Edition, 2007
3. Alexander Hornberg, “Handbook of Machine Vision”, First Edition,2006
4. Eugene Hecht, A.R. Ganesan “Optics”, Fourth Edition, 2001

MR8204 MICROCONTROLLER AND PROGRAMMABLE LOGIC CONTROLLERS (PLC) **L T P C 3 0 0 3**

AIM:

- To understand the programming interfacing and applications of various microcontrollers and programmable logic controller.

OBJECTIVE:

- This course is intended for learning the Introduction and Architecture of Microcontroller, Fundamentals of Assembly language Programming, Programming of Microcontroller and Interfacing of Microcontroller. This course is also gives the ideas of Fundamentals. Architecture and Operations of programmable logic controller, Problem solving using logic ladder diagrams and communication in PLCs.

UNIT I INTRODUCTION TO MICRO CONTROLLER 8

Microprocessors and Microcontrollers – CISC and RISC - Fundamentals of Assembly language Programming – Instruction to Assembler – C Programming for Microcontrollers – Compiler and IDE – Introduction to Embedded systems - Architecture 8051 family - PIC 18FXXX – family – Memory organization

UNIT II PROGRAMMING OF 8051 MICROCONTROLLER 8

Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication of 8051.

UNIT III PROGRAMMING OF PIC18FXXX MICROCONTROLLER 8

Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication,CCP, ECCP PWM programming of PIC18FXXX.

UNIT IV PERIPHERAL INTERFACING 9

Interfacing of Relays, Memory, key board, Displays – Alphanumeric and Graphic, RTC, ADC and DAC, Stepper motors and DC Motors, I^2C, SPI with 8051 and PIC family

UNIT V PLC PROGRAMMING 12

Fundamentals of programmable logic controller – Functions of PLCs – PLC operations – Evaluation of the modern PLC – Memory– Selection of PLC – Features of PLC – Architecture – Basics of PLC programming – Developing Fundamental wiring diagrams – Problem solving using logic ladder diagrams – communication in PLCs – Programming Timers – Programming counters – Data Handling.

TOTAL : 45 PERIODS

REFERENCES

1. Muhammad Ali Mazidi and Janice GillispicMazdi, “The 8051 Microcontroller and Embedded Systems” Pearson Education, Inc 2006.
2. John B. Peatman, PIC programing, McGraw Hill International, USA, 2005.
3. John B. Peatman, Design with Micro controllers, McGraw Hill International, USA, 2005.
4. Kenneth J. Aylala, “The 8051 Micro controller, the Architecture and Programming applications”:2003..
5. James W. Stewart, “The 8051 Micro controller hardware, software and interfaciung, regents Prentice Hall, 2003.
6. Frank D. Petro Zella, “Programmable logic controller” McGraw – Hill Publications, 1998

MR8211 **AUTOMATION LAB** **L T P C**
0 0 4 2

AIM

- To impart knowledge in the area of microcontroller and PLC based automation, machine vision and robotics

OBJECTIVE:

- To make the students to learn the basic concepts of microcontrollers and its interfacing to various peripherals. To train the students in unconventional applications based on PLC. Expose students to machine vision applications such as inspection and gauging. To impart students the knowledge in robot modeling and simulation
  1. Assembly language programming and simulation of 8051 in Keil IDE.
  2. Assembly language programming and simulation of PIC 18FXXX, MPLAB IDE.
  3. Alphanumeric and Graphic LCD interfacing using X8051 & PIC18FXXX.
  4. Sensor interfacing with ADC to X8051 & PIC18FXXX.
  5. DAC & RTC interfacing to X8051 & PIC18FXXX.
  6. Timer, Counter and Interrupt program application for X8051 and PIC18FXXX.
  7. Step motor(uni polar & bipolar motor) and PWM servo motor control to interfacing with X8051.
  8. Printer interfacing of X8051 and PIC.
  9. UART serial programming in X8051 and PIC.
  10. Simulation of Ladder diagram program.
  11. Closed loop position control of DC brush servo motor using PLC, X8051µc & PIC 18FXXX.
  12. Vision based pallet inspection.
  13. Vision based Gear parameter measurement.
  14. Forward kinematics, Inverse kinematics & Trajectory planning for PUMA 560 and Stanford arm using Robotic toolbox for MATLAB.
  15. Simulation of planar and spatial mechanisms using ADAMS view.

TOTAL: 60 PERIODS

MR8001 **ADVANCED COMPUTER VISION** **L T P C**
3 0 0 3

AIM:

- To impart knowledge in the area of 3D computer vision and its application to Robotics

OBJECTIVE:

- To understand the various fundamental mathematics behind computer vision algorithms
- To expose students to various 3D surface reconstruction algorithms.
- To impart knowledge on stereo vision and structure from motion.

UNIT I BASIC CONCEPTS FOR COMPUTER VISION **6**

Sampling Theorem – Numerical Differentiation – Differential Geometry – Singular Value Decomposition – Robust Estimators and Model Fitting

UNIT II IMAGE FORMATION AND CAMERA CALIBRATION **6**

Projective Geometry - Imaging through lenses and pin-hole – Basic Photometry – Basic model of imaging geometry – Ideal Camera – Camera with intrinsic parameters – Approximate camera models – Camera Calibration – Methods and Procedure

UNIT III SURFACE RECONSTRUCTION TECHNIQUES 9

Depth Perception in Humans, Cues – Shape from Texture, Shading, Focus, Defocus, Structured Light Reconstruction – Time of Flight Methods

UNIT IV COMPUTATIONAL STEREO AND MOTION 12

Computational Stereopsis – Geometry, parameters –correlation based methods, feature-based methods – Epipolar Geometry, eight point algorithm – Reconstruction by triangulation, scale factor and up to a projective transformation – Visual Motion – Motion field of rigid objects – Optical Flow – Estimation of motion field – 3D structure and motion from sparse and dense motion fields – Motion based segmentation.

UNIT V ROBOT VISION 12

Visual Tracking – Kalman Filtering and Sequential Monte Carlo – Visual SLAM, solutions, EKF-SLAM, FastSLAM – 3D SLAM – Advanced Visual Servoing, hybrid visual servo, partitioned visual servo.

TOTAL: 45 PERIODS

REFERENCES

1. Eugene Hecht, A.R. Ganesan “Optics”, Fourth Edition, 2001.
2. EmanueleTrucco, Alessandro Verri, “Introductory Techniques For 3D Computer Vision”, First Edition, 1998.
3. Boguslaw Cyganek, J. Paul Siebert, An Introduction To 3D Computer Vision Techniques And Algorithms, First Edition, 2009.
4. Yi Ma, Jana Kosecka, Stefano Soatto, Shankar Sastry, An Invitation to 3-D Vision From Images to Models, First Edition, 2004.

MR8002 ADVANCED CONTROL SYSTEMS L T P C

3 0 0 3

AIM:

- To impart knowledge on advanced techniques in control engineering.

OBJECTIVE:

- To introduce various control algorithms and their implementations To expose students to the state space representation and its analysis.To introduce non-linear systems and their control. To impart knowledge on advanced control techniques

UNIT I CONVENTIONAL CONTROL SYSTEM DESIGN 12

Review of feedback systems and design of PID Controllers - Electronic PID controller – Digital PID algorithm – Auto/manual transfer - Reset windup – Practical forms of PID Controller - Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – Tuning using Process reaction curve method, Continuous cycling method and Damped oscillation method – pole placement – Lamda tuning.

UNIT II ENHANCEMENT TO SINGLE LOOP CONTROL 8

Feed-forward control – Ratio control – Cascade control – Inferential control – Split-range – override control–- selective control –Auto tuning.

UNIT III STATE SPACE ANALYSIS 9

Concepts of state variable and state model – State space to Transfer function and Transfer function to State space modes – Solving time invariant state equation – Controllability – Observability – State Observers – Design of control systems with observers.

UNIT IV NONLINEAR SYSTEMS AND CONTROL 10

Non-linear Systems – Common physical nonlinearities – Linearization of Nonlinear systems – Phase portrait analysis – Isocline method – Liapnov's stability concept – Popov criterian – Kalman algorithm.

UNIT V CONTROL METHODS 6

Adaptive Control – Optimal Control – Robust Control – Model Predictive Control – Multivariable Control systems.

TOTAL: 45 PERIODS

REFERENCES:

1. K.Ogata, :modern controls engineering " Prentice Hall of India Pvt. Ltd., New Delhi, 2008..
2. I.J.Nagrath and Gopal. "Control system engineering", new age international (P) Ltd., 2006.
3. M. Gopal, " Control Systems principles and Design" Tata McGraw Hill Publishing Ltd, 2003.
4. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2004.
5. Automatic Control System: George J. Thaler Brown, Jaico Publications 2002
6. Nonlinear Systems: Hasan A. Khalil, Prentice Hall of India 2002

MR8003 ADVANCED MICROCONTROLLER AND EMBEDDED SYSTEMS L T P C
3 0 0 3

AIM:

- To impart knowledge in the area of real time embedded system.

OBJECTIVE:

- To teach and understand about the definitions, ARM Processor, high level language descriptions of software for embedded system.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 6

Definitions – Brief overview of micro-controllers - DSPs,-Typical classifications –Memory Devices and application scenarios of embedded systems.

UNIT II ARM 7 CORE 9

Introduction about ARM 7 Processor- Internal Architecture – Modes of Operations – Register set – Instruction Sets – ARM Thumb -.Thumb State Registers – Pipelining _ Applications.

UNIT III ARM 9 CORE 6

Introduction about ARM 9 Processor--DSP Processor—Sharc Processor -- Internal Architecture – Modes of Operations – Register set – Pipelining – AMBA - Applications.

UNIT IV REAL TIME MODELS, LANGUAGE AND OPERATING SYSTEMS 15

Models and languages – State Machine and state tables in embedded design – High level language descriptions - Java based embedded system design – Petrinet models-Real time languages – The real time Kernel - OS tasks - Task Scheduling - kernel services – Real time languages and their features.

UNIT V CASE STUDIES IN REAL TIME EMBEDDED SYSTEMS 9

Specific examples of time-critical and safety-critical embedded systems - applications in automation - automotives – aerospace - medical and manufacturing.

TOTAL: 45 PERIODS

REFERENCES

1. Wayne Wolf, Computers as Components – Principles of Embedded Computing System Design, Morgan Kaufmann Publishers 2009.
2. Ball S.R., Embedded microprocessor Systems – Real World Design, Prentice Hall, 2006
3. C.M. Krishna, Kang G. Shin, Real Time systems, McGraw Hill 2009
4. Frank Vahid and Tony Givagis , Embedded System Design
5. Tim Wilmshurst, An Introduction to the design of small – scale Embedded Systems.

MR8004 ANALYTICAL ROBOTICS L T P C

3 0 0 3

AIM:

- To impart knowledge in the advanced area of Robotics

OBJECTIVES:

- To teach the students about the kinematic arrangement of robots and its applications in the area of manufacturing sectors.

UNIT I INTRODUCTION 8

Definition, Types and Classifications of robots – control loops, controls and intelligence, specify degrees of freedoms, actuators and end effectors – grippers , force analysis, serial and parallel manipulators.

UNIT II ROBOT KINEMATICS 10

Introduction – Representation of a rigid body – Mappings and Operators – Homogeneous transformation, position analysis - Forward Kinematics – Geometric Approach, Algebraic approach, Denvit–Hartenbers representations – Inverse Kinematics. Velocities -Differential motion and velocity of frames – Jacobian

UNIT III ROBOT DYNAMICS AND TRAJECTORY PLANNING 10

Lagrangeon mechanics, dynamic equations for single , double and multiple DOF robots – static force analysis of robots, Trajectory planning – Joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning

UNIT IV ROBOT PROGRAMMING & AI 9

Types of Programming,– Teach Pendant programming – Requirement of Robot Programing Language ,Structure of Robot Programming Language – Offline Programming Systems – Basic concepts in AI techniques – Concept of knowledge representations and Inference – Robot Learning

UNIT V MODELLING AND SIMULATION 8

Modeling and simulation of robotic joints,- position , velocity and acceleration analyses of simple mechanisms and robots, -synthesis of robots,- simulation of robot configuration.

TOTAL: 45 PERIODS

REFERENCES

1. Fu.K.S , Gonzalac R.C ,Lee C.S.G, Robotics Control, sensing ,vision and intelligence, Mc- Graw Hill book co 2011.
2. John J. Craig, Introduction to Robotics: Mechanics and Control, Third Edition.2008

3. Yoram Koren , Robotics, McGraw Hill 2006
4. Groover.M.P. Industrial Robotics, McGraw – Hill International edition, 2004.
5. Saeed.B.Niku, 'Introduction to Robotics, Analysis, system, Applications', Pearson educations, 2002.

MR8005 FUZZY LOGIC AND GENETIC ALGORITHMS L T P C
3 0 0 3

AIM

- To understand the various types and applications of Fuzzy Logics and Artificial Neural Networks.

OBJECTIVE:

- This course is intended for learning the basic concepts, Operations and Principles of Fuzzy Logic, applications of various Fuzzy Logic systems, architecture and Taxonomy of Neural Networks. This course is also gives the ideas of ANN Architectures, Genetic Algorithms.

UNIT I INTRODUCTION TO FUZZY LOGIC 9

Basic concepts in Fuzzy Set theory – Operations of Fuzzy sets – Fuzzy relational equations – Propositional, Predicate Logic – Inference – Fuzzy Logic Principles – Fuzzy inference – Fuzzy Rule based systems – Fuzzification and defuzzification – Types.

UNIT II FUZZY LOGIC APPLICATIONS 9

Fuzzy logic controllers – Principles – Various industrial Applications of Fuzzy logic control – Adaptive Fuzzy systems – Fuzzy Decision making – Fuzzy classification – Fuzzy pattern Recognition – Image Processing applications – Fuzzy optimization.

UNIT III INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS 9

Fundamentals of Neural networks – Neural network architectures – Learning methods – Taxonomy of Neural Network Architectures – Standard back propagation Algorithms – Selection of various parameters – Variations.

UNIT IV OTHER ANN ARCHITECTURES 9

Associative memory – Exponential Bidirectional Associative Memory – Adaptive Resonance Theory – Introduction – Adaptive Resonance Theory 1 – Adaptive Resonance Theory 2 – Applications – Kohen Self organizing maps – counter propagation networks – Industrial Applications.

UNIT V RECENT ADVANCES 9

Fundamentals of Genetic Algorithms – Hybrid systems – Meta heuristic techniques like simulated Annealing, Tabu Search, Ant colony optimization, Perpetual self organizing, Artificial immune systems – Applications in Design and Manufacturing.

TOTAL: 45 PERIODS

REFERENCES:

1. S. Rajasekaran, GA Vijayalakshmi Pai, 'Neural Networks, Fuzzy Logic and Genetic Algorithms', Prentice Hall of India Private Limited, 2003.
2. Klir, G.J. Yuan Bo, 'Fuzzy sets and Fuzzy Logic: Theory and Applications', Prentice Hall of India Pvt. Ltd., 2005.
3. Simon Haykin, 'Neural Networks – A comprehensive foundation', Prentice Hall, 3rd Edition, 2004.
4. Laurene Fausett, 'Fundamentals of Neural Networks, Architectures, Algorithms and Applications, Prentice Hall, Englewood cliffs, 2000.

MR8006 MACHINE TOOL CONTROL AND CONDITION MONITORING L T P C
3 0 0 3

AIM:

- To impart the knowledge in the area of machine tool control and condition monitoring in a mechatronics perspective.

OBJECTIVE:

- This course intends to expose students to various types of control systems in machine tools and the various methods of condition monitoring for tools used.

UNIT I OVERVIEW OF AUTOMATIC CONTROL IN MACHINE TOOLS 9

Open loop and closed loop system in machine tools- process model formulation-transfer function-control actions-block diagram representation of mechanical pneumatic and electrical systems. Process computer - peripherals-Data logger-Direct digital control-Supervisory computer control.

UNIT II DRIVE SYSTEMS AND FEED BACK DEVICES IN MACHINE TOOLS 9

Hydraulic and Pneumatic drives, Electrical drives – A.C. Motor, D.C. Motor, Servo motor and Stepper motor. Feedback devices - Syncro, resolver, diffraction gratings, potentiometer, Inductosyn and encoders-application in machine tools.

UNIT III ADAPTIVE CONTROL AND PLC 9

Adaptive control-types – ACC, ACO, Real time parameter estimation, Applications- adaptive control for turning, milling, grinding and EDM. Programmable logic controller-Functions-Applications in machine tools.

UNIT IV VIBRATION, ACOUSTIC EMISSION / SOUND. 9

Primary & Secondary signals, Online and Off-line monitoring. Fundamentals of Vibration, Sound, Acoustic Emission. Machine Tool Condition Monitoring through Vibration, Sound, Acoustic Emission, Case Studies

UNIT V CONDITION MONITORING, THROUGH OTHER TECHNIQUES 9

Visual & temperature monitoring, Leakage monitoring, Lubricant monitoring, condition monitoring of Lube and Hydraulic systems, Thickness monitoring, Image processing techniques in condition monitoring.

TOTAL: 45 PERIODS

REFERENCES:

1. MikellP.Groover, “Automation Production system and Computer Integrated Manufacturing”, Prentice Hall of India Pvt. Ltd., 2010
2. Sushil Kumar Srivstava, “Industrial Maintenance Management” S.Chand & Company Ltd., New Delhi, 1998.
3. Manfred Weck, “Hand Book of Machine Tools” – Vol.3, John Wiley & Sons, 1995 .

MR8007 MATERIALS MANAGEMENT AND LOGISTICS L T P C
3 0 0 3

AIM:

- To introduce to the students the various functions of materials management and logistics

OBJECTIVE:

- To make the students familiar with the various concepts and functions of material management, so that the students will be in a position to manage the materials management department independently.

UNIT I INTRODUCTION 6

Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT II MANAGEMENT OF PURCHASE 7

Purchasing policies and procedures – Selection of sources of supply – Vendor development – Vendor evaluation and rating – Methods of purchasing – Imports – Buyer – Seller relationship – Negotiations.

UNIT III MANAGEMENT OF STORES AND LOGISTICS 12

Stores function – Location – Layout – Stock taking – Materials handling – Transportation – Insurance – Codification – Inventory pricing – stores management – safety – warehousing – Distribution linear programming – Traveling Salesman problems – Network analysis – Logistics Management.

UNIT IV MATERIALS PLANNING 10

Forecasting – Materials requirements planning – Quantity – Periodic – Deterministic models – Finite production.

UNIT V INVENTORY MANAGEMENT 10

ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.

TOTAL: 45 PERIODS

REFERENCES

1. Dr.R. Kesavan, C.Elanchezian and B.VijayaRamnath, Production Planning and Control, Anuratha Publications, Chennai, 2008.
2. G. Reghuram, N. Rangaraj, Logistics and supply chain management – cases and concepts, Macmillan India Ltd., 2006.
3. Dr. R. Kesavan, C.Elanchezian and T.SundarSelwyn, Engineering Management – Eswar Press – 2005.
4. Guptha P.K. and Manmohan, Problems in Operations Research, Suttan Chand & Sons, 2003.
5. Lamer Lee and Donald W.Dobler, Purchasing and Material Management, Text and cases, Tata McGraw Hill, 1996.
6. Gopalakrishnan.P, Handbook of Materials Management, Prentice Hall of India, 1996.

MR8008 MECHATRONICS IN METROLOGY AND CNC L T P C
3 0 0 3

AIM:

- To impart the knowledge in the area of metrology and CNC machine system and programming.

OBJECTIVE:

- This course is intended to expose the mechatronics elements in the modern mechanical measuring instruments and CNC system design and programming.

UNIT I FUNDAMENTALS CONCEPTS IN METROLOGY 8

Introduction to Metrology and Dimensional Metrology – Angular measurements, Form Measurement, Surface Roughness, Contour Measurements, Roundness, Tool wear measurement.

UNIT II INSTRUMENTS FOR DIMENSIONAL METROLOGY 12

Digital Small Tool Instruments – Caliper, Micrometer, Height Gauge – Coordinate Measuring Machines, Types, Design and applications, Opto-electronic Devices for Measurement, Vision Measuring Systems, optical comparators Applications in on-line and in-process monitoring systems – 3D Surface roughness measuring instruments – Applications of LASER in Metrology, Roundness measurement, Laser interferometer in machine tool Inspection – use of laser in on-line Inspection – Laser micrometer – Laser Alignment telescope

UNIT III COMPUTER CONTROL OF MACHINES 8

Classification of machine tools – types, functions and processes – Need for CNC in Machine Tools – CNC systems - configuration of the CNC system – interfacing – monitoring – diagnostics - machine data - compensations for machine accuracies Open and closed loop control Adaptive control - types, application and benefits - general configuration of adaptive control and function – reasons for process change - practical problems with adaptive control - example for feedback and adaptive control.

UNIT IV MECHATRONICS ELEMENTS IN CNC MACHINE TOOLS 9

Guide ways and types - mechanical transmission elements - elements for rotary motion to linear motion - ball screw and types - roller screw and types - rack and pinion - various torque transmission elements - requirements of feed drives and spindle drive Types of positional control – Control of Spindle speed – Control of slide movement and velocity. Identification and gauging of work piece. Tool locking system - ball lock mechanism and contact pressure monitoring. Automatic tool changing system - types and benefits - tool magazine.

UNIT V CNC PROGRAMMING 8

M/C axis identification –Primary and Secondary – Manual Programming – Turning and Milling Programming fundamentals –fixed cycles – subroutines and other Productivity Packages- CAPP and APT in programming.

TOTAL: 45 PERIODS

REFERENCES:

1. Groover . M.P , Automation ,and Computer Integrated Manufacturing , Prentice Hall Pvt Ltd 2010
2. Ulrich- Rembold, Armbruster and Ulzmann -" Interface technology for computer controlled manufacturing processes ", Marcel Dekker Pub. New York, 1993
3. N RADHAKRISHNAN,P., Computer Numerical Control (CNC) Machines, New Central Book Agency, 1992.
4. Steave Krar and Arthur Gill, CNC Technology and Programming, McGraw-Hill Publishing Company , 1990.
5. Robert. G. Seippel,-"Optoelectronics for Technology and Engineering ",Prentice Hall New Jersey,1989

MR8009 MECHATRONICS SYSTEM DESIGN L T P C
3 0 0 3

AIM:

- To impart knowledge in the area of system design in an integrated approach.

OBJECTIVE:

- To make the students to learn system modelling, system identification and simulation.
- To expose students to various

UNIT I INTRODUCTION 6

Mechatronic systems – Key elements – Mechatronic design process – Application types – Interfacing issues – Man Machine Interfaces – Safety features – optimization of Mechatronic design – Fault diagnosis.

UNIT II SYSTEM MODELLING AND IDENTIFICATION 12

Mathematical models – Block diagram modelling – Analogy approach – Impedance diagrams – Models for Electrical, Mechanical, Electro-mechanical and Fluid systems – System Identification – Least square method – Closed loop identification – joint input/output identification – State estimators – Model Validation

UNIT III SIMULATION 10

Simulation basics – Probability concepts in simulation – Discrete event simulation – Simulation Methodology – Queuing system model components – Continuous system modelling – Monte Carlo simulation – Analysis of simulation results – Simulation life cycle.

UNIT IV CASE STUDY ON BASIC SYSTEMS 8

Mass-Spring-Oscillation and Damping system – Position Control of Permanent magnet DC motor using Hall sensor and optical encoder – Auto-control system for Green House Temperature – Transducer Calibration system – Strain Gauge Weighing system – Solenoid Force-Displacement Calibration system.

UNIT V CASE STUDY ON ADVANSED SYSTEMS 9

Automatic Washing Machine – Hard Drive control – Auto-focusing in Digital Cameras – Active suspension in vehicles – Visual Servoing models – Thermal cycle fatigue of a Ceramic plate – pH Control system – De- icing temperature control system – Skip control of a CD player – Simulation of Rocket thrust control – Time delay Blower.

TOTAL: 45 PERIODS

REFERENCES

1. Devadas Shetty, Richard A.Kolkm, “Mechatronics system design, PWS publishing company, 2009.
2. Bolton, “Mechatronics – Electronic control systems in mechanical and electrical engineering, 2nd edition, Addison Wesley Longman Ltd., 2009.
3. Brian morriss, “Automated manufacturing Systems – Actuators Controls, sensors and Robotics”, McGraw Hill International Edition, 2000.
4. Bradley, D. Dawson, N.C.Burd and A.J. Loader, “Mechatronics: Electronics in product and process”, Chapman and Hall, London, 1999

MR8010 PC BASED AUTOMATION L T P C
3 0 0 3

AIM:

- To impart knowledge on architectural information about PC as a hardware for controllers.

OBJECTIVE:

- To expose students to various communication protocols in PC standard for test, measurement and automation. To impart knowledge on the fundamentals of data acquisition systems and theory and structure of programming languages.

UNIT I COMPUTER BASICS AND COMMUNICATION PROTOCOLS 7

Basic Computer Architecture – Components of a PC – Serial and Parallel Communications - Parallel port – OSI Model – RS232, USB, ISA, PCI, PXI, PCI Express, GPIB Protocols.

UNIT II NETWORK PROTOCOLS 7

LAN, WAN and MAN Networks – RS485, RS 422, LXI Protocols – Modbus – Field bus – Ethernet – CAN bus – SCADA and DCS.

UNIT III DATA ACQUSITION SYSTEMS 12

Continuous and Discrete signals – Sampling theorem – Quantization – Sampling and Hold – ADC – DAC – Resolution and Sampling Frequency – Multiplexing of input signals – Single ended and differential inputs – Sampling of Multi-channel analog signals – Concept of Universal DAQ card – Timer & Counter and analog output in Universal DAQ card.

UNIT IV PROGRAMMING TECHNIQUES 9

Algorithm – Flowchart – Variables & Constants – Expressions – Data types – Input output operations – Conditional Statements – Looping – Sub-programs/Functions – Arrays, Structures and Classes – Inheritance – Polymorphism – Debugging.

UNIT V GRAPHICAL PROGRAMMING 10

GUI – Graphical Programming – Data Flow techniques – Processing Data in GP – Loops and Structures – Event based & Schedule based operations – Global and Local Variables – File I/O operations – Parallel processing of data – Virtual Instrument and control – VISA & SCPI.

TOTAL: 45 PERIODS

REFERENCES:

1. Morris Mano M., Computer System Architecture, Prentice Hall of India, Third Edition, 2002.
2. John P. Hayes, Computer Architecture and Organization, McGraw Hill International, Third Edition, 1998.
3. William Stallings, “Computer Organization and Architecture”, VI Edition, Prentice Hall of India, 2003.
4. Krishna Kant , ‘Computer based Industrial Control’, Prentice Hall of India, 1997.
5. Gary Johnson, ‘LabVIEW Graphical Programming’, II Ed. , McGraw Hill, 1997.
6. Sanjeev Gupta, ‘Virtual Instrumentation using Labview’ Tata McGraw Hill, 2004.
7. Jovitha Jeome ‘Virtual Instrumentation using Lab View’ PH1 Learning Pvt Ltd,2009.

MR8011 **VETRONICS** **L T P C**
3 0 0 3

AIM:

- To understand the design and specifications of various automotive, aircraft and marine electronic control systems.

OBJECTIVE:

- This course is intended for learning the Fundamentals of Automobile Engineering, Automotive applications of all types of sensors and actuators systems, avionics and marine electronics.

UNIT I FUNDAMENTALS OF VEHICLE ENGINEERING 6

Engine – Types – Modern Engines –Advanced GDI, Turbo-charged engines Transmissions, Chassis systems – Need for Avionics in Civil and Military aircraft and Space systems

UNIT II AUTOMOTIVE ENGINE CONTROL, MONITORING AND DIOGNASTICS SYSTEMS 9

Components of Electronic Engine Management– Engine control functions, Engine control modes, Fuel delivery systems, MPFI, Ignition Systems, Diagnostics – Compression Ignition Engines – Emission control Management – Hybrid Power Plants - BAS

UNIT III AUTOMOTIVE TRANSMISSION AND SAFETY SYSTEMS 12

Transmission control – Autonomous cruise control – Braking control, ABS – Traction control, ESP, ASR – Suspension control – Steering control – Stability control– Parking Assist Systems– Safety Systems,SRS, Blind Spot Avoidance – Auto transmission electronic control, Telematics,Automatic Navigation, Future Challenges

UNIT IV AIRCRAFT MECHATRONICS 12

Fundamentals - components of an airplane and their functions - motions of a plane - Inertial Navigation – Sensors - Gyroscope- Principles , Gyro equations, Rate Gyros - Rate integration and free Gyro, Vertical and Directional Gyros, Laser Gyroscopes, Accelerometers. Direct reading compass, Types of actuation systems-Linear and non-linear actuation system, modeling of actuation systems, Performance testing equipments for sensors and actuation systems. measurement and control of Pressure , temperature fuel quantity, rpm, torque, engine vibration and power. Electrical Power requirement for Military and Civil standards. Satellite navigation - GPS -system description - basic principles -position and velocity determination

UNIT V MARINE MECHATRONIC SYSTEMS 6

Basics of Marine Engineering – Marine Propulsion Mechatronics elements in ships, submarines, Variable Buoyancy Systems

TOTAL: 45 PERIODS

REFERENCES:

1. William B.Ribbens, “Understanding Automotive Electronics – 7th Edition, Butterworth, Heinemann Wobum, 2004..
2. Robert N Brady, Automotive Computers and Digital Instrumentation, Areston Book Prentice Hall, Eagle Wood Cliffs, New Jersey, 2000..
3. R.K. Jurgen, Automotive Electronics Handbook, McGraw Hill 2nd Edition. 2000
4. Collinson R.P.G. ‘Introduction to Avionics’, Chapman and Hall, 2002
5. Pallet, E.H.J. ’Aircraft Instruments & Integrated systems’, McGraw-Hill, 2002
6. Myron Kyton, Walfred Fried, ‘Avionics Navigation Systems’, John Wiley& Sons, 2000
7. Pallett, E.H.J. ‘Aircraft instruments, principles and applications’, Pitman publishing Ltd., London, 1995

MN8071 **NANO TECHNOLOGY** **L T P C**
3 0 0 3

AIM:

- To inspire the students to expect to the trends in development and synthesizing of nano systems and measuring systems to nano scale.

OBJECTIVES:

- To expose the students to the evolution of Nano systems, to the various fabrication techniques.
- Also to impart knowledge to the students about nano materials and various nano measurements techniques.

UNIT I OVER VIEW OF NANOTECHNOLOGY 6

Definition – historical development – properties, design and fabrication Nanosystems, , working principle ,applications and advantages of nano system. Nanomaterials – ordered oxides – Nano arrays – potential health effects

UNIT II NANODEFECTS, NANO PARTILES AND NANOLAYERS 8

Nanodefects in crystals – applications – Nuclear Track nano defects. Fabrication of nano particles – LASER ablation – sol gels – precipitation of quantum dots. Nano layers – PVD, CVD, Epitaxy and ion implantation – formation of Silicon oxide- chemical composition – doping properties – optical properties

UNIT III NANOSTRUCTURING 8

Nanophotolithography – introduction – techniques – optical – electron beam – ion beam – X-ray and Synchrotron – nanolithography for microelectronic industry – nanopolishign of Diamond – Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography nanoarrays –Near-Field Optics - case studies and Trends

UNIT IV SCIENCE AND SYNTHESIS OF NANO MATERIALS 12

Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source based production techniques – Gaseous carbon source based production techniques – Diamond like carbon coating. Top down and bottom up processes.

UNIT V CHARACTERIZATION OF NANO MATERIALS 11

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

TOTAL: 45 PERIODS

REFERENCES:

1. Tai – Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata-McGraw Hill, New Delhi, 2002.
2. Fahrner W.R.,Nanotechnology and Nanoelectronics, Springer (India) Private Ltd., 2011.
3. Mark Madou , Fundamentals of Microfabrication, CRC Press, New York, 1997.
4. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
5. Mohamed Gad-el-Hak, MEMS Handbook, CRC press, 2006, ISBN : 8493-9138-5

6. Waqar Ahmed and Mark J. Jackson, Emerging Nanotechnologies for Manufacturing, Elsevier Inc.,2013,ISBN : 978-93-82291-39-8
7. Sami Franssila, Introduction to Micro fabrication , John Wiley & sons Ltd, 2004. ISBN:470-85106-6
8. Charles P Poole, Frank J Owens, Introduction to Nano technology, John Wiley and Sons, 2003
9. Julian W. Hardner Micro Sensors, Principles and Applications, CRC Press 1993.

MN8072 FINANCIAL MANAGEMENT L T P C
3 0 0 3

AIM:

- To introduce the concepts of financial and various functions of financial management so that the students will be able to handle higher level financial decisions.

OBJECTIVES:

- To train students in various functions of finance such as working capital management, current assets management so that students will be able to make high investment decisions when they take up senior managerial positions.

UNIT I FINANCIAL ACCOUNTING 8

Accounting principles - Basic records - Preparation and interpretation of profit and loss statement - balance sheet - Fixed assets - Current assets.

UNIT II COST ACCOUNTING 12

Elements of cost - cost classification - material cost - labour costs - overheads - cost of a product - costing systems - cost determination - process - costing - Allocation of overheads - Depreciation - methods.

UNIT III MANAGEMENT OF WORKING CAPITAL 10

Current assets - Estimation of working capital requirements - Management of accounts receivable - Inventory - Cash - Inventory valuation methods.

UNIT IV CAPITAL BUDGETING 8

Significance of capital budgeting - payback period - present value method - accounting rate of return method - Internal rate of return method.

UNIT V PROFIT PLANNING AND ANALYSIS 7

Cost - Volume profit relationship Relevant costs in decision making profit management analysis - Break even analysis.

TOTAL: 45 PERIODS

REFERENCES:

1. R Kesavan, C. Elanchezian, B.Vijaramnath, Engineering Economics and Cost Analysis Anuratha Publications, Chennai. 2007
2. RKesavan, C.Elanchezian, Sundar Selwyn, Engineering Economics and Financial Accounting, Laxmi Publications, New Delhi, 2005.
3. R Kesavan, C.Elanchezian, Vijayaramnath, Process Planning and cost estimation, New Age International Publishers, New Delhi 2004
4. Presanna Chandra, Financial Management, Tata McGraw Hill, 1998.
5. C.James, Vanhorn, Fundamentals of Financial Management PHI 1996
6. G.B.S. Narang, Production and Costing, Khanna Publishers, 1993.

MN8073 **NON DESTRUCTIVE EVALUATION** **L T P C**
3 0 0 3

AIM:

- To stress the importance of NDT in engineering.

OBJECTIVES:

- To introduce all types of NDT and their applications in Engineering.

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING 6

Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.
Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications

UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION 10

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications. Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY 10

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications. Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT IV ULTRASONIC TESTING 10

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

UNIT V RADIOGRAPHY 9

Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test. Case studies on defects in cast, rolled, extruded, welded and heat treated components - Comparison and selection of various NDT techniques

TOTAL: 45 PERIODS

REFERENCES:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., “Practical Non Destructive Testing” Narosa publishing house, New Delhi, 2002
2. Krautkramer. J., “Ultra Sonic Testing of Materials”, 1st Edition, Springer – Verlag Publication, New York, 1996.
3. Peter J. Shull “Non Destructive Evaluation: Theory, Techniques and Application” Marcel Dekker, Inc., New York, 2002
4. www.ndt.net