PROGRAM EDUCATIONAL OBJECTIVES (PEO)
1. The graduates acquire ability to create mathematical model, design, analysis and synthesis the system based on the knowledge of integration specifically from the mechanical, electrical, electronic, control, computer science, fluid and other engineering domains.
2. The graduates use their talent, self-confidence, knowledge and engineering practice which facilitate them to presume position of scientific and/or managerial leadership in their career paths.
3. The graduates apply their consciousness of moral, professional responsibilities and motivation to practice life-long learning in a team work environment.

PROGRAMME OUTCOMES (PO)
1. Graduate will demonstrate strong basics in mathematics, mechanics and its design, electronics engineering serves the foundation for the Programme.
2. Graduate will be familiar about the importance of the sensors, signal conditioning, and control system design for the appropriate use of mechatronic system developments.
3. Graduate able to demonstrate the effective use of actuators and its elements for the generation, control and conversion of energy for the typical automation.
4. Graduate able to develop the mechatronic systems by the integration mechanical, electrical, electronics, fluid, and other multidisciplinary systems.
5. Graduate able to build the real time automation system within realistic constraints such as industrial, economic, environmental, ethical, social, health and safety.
6. Graduate will become familiar with modern automation tools and such as incorporating robots and vision based intelligence automation.
7. Graduate will acquire the capability to identify, formulate and solve engineering problems related to mechatronic systems.
8. Graduate will has an understanding of social, professional and ethical responsibility when developing automated system.
9. Graduate will be able to communicate effectively both in verbal and non verbal forms.
10. Graduate will be trained towards developing and understanding the impact of development of mechatronics system on global, economic, environmental and societal context.
11. Graduate will be capable of understanding the value for life-long learning and motivating them to involve the research works.
12. Graduate will be able to design and develop innovative/ manufacturable / marketable / environmental friendly products useful to the nation and the society.

13. Graduate will be able to manage any organisation well and will be able to emerge as a successful entrepreneur.

Mapping of PEOs with POs

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* Minimum 2 weeks during vacation

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**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 75**

### FOUNDATION COURSES (FC)

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4. Mechatronics System Design          PC  4  2  0  2  3  
5. Microcontrollers          PC  3  3  0  0  3  
6. Industrial Robotics          PC  3  3  0  0  3  
7. Machine Vision          PC  5  3  0  2  4  
8. Computer Aided Modeling, Simulation and Automation Laboratory          PC  4  0  0  4  2  
9. Automation Laboratory          PC  4  0  0  4  2  
10. Microcontroller Laboratory          PC  4  0  0  4  2  

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OBJECTIVE

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

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

UNIT III NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

UNIT IV FUNDAMENTALS OF GRAPHS 12
Graphs-sub graphs-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

OUTCOME

- The students would be acquainted with the basic concepts of Linear Algebra and numerical methods & their applications, basics in Graph theory and also this course will helpful for mathematical modeling for engineering problems.

REFERENCES

OBJECTIVE

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

UNIT I ELECTRONIC COMPONENTS AND DEVICES
Resistors, Capacitors, Inductors, Transformers – types and properties - Junction diodes, Zener diodes, transistors and thyristors- types-operating mechanism-characteristics and applications.
LEDs – Characteristics and applications

UNIT II OPERATIONAL AMPLIFIERS AND APPLICATIONS
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, Feedback and power amplifiers , Sine wave oscillators,

UNIT III DIGITAL ELECTRONICS

UNIT IV MEASURING INSTRUMENTS
Rectifiers and Filters; Regulated Power Supply – Switching Power Supplies, Thermal Considerations. Measurement of voltage, current ,frequency and power using Multi meters, oscilloscopes, recorders, data loggers, signal sources, counters, analysers and printers.

UNIT V POWER MANAGEMENT
Pulse width modulation and pulse position modulation – batteries- power optimization of integrated system- sensors, actuators and controllers.

TOTAL: 30 PERIODS

OUTCOME

- This course is intended for learning the fundamentals and applications of Electronic Components, Devices, analog circuits, digital circuits, test and measuring instruments. Further, students will learn to develop customized electronics components for mechatronic applications.

REFERENCES

LABORATORY

OBJECTIVE

- To give hands on experience on basic electronics unit developments for the mechanical stream students.

LIST OF EXPERIMENTS
2. Experimentation with CRO.
3. Design of DC power supplies
4. Design of Inverting Amplifier And Non Inverting Amplifiers
5. Design of Instrumentation amplifier.
7. Design of combinational circuits and sequential circuits.
9. RC Servo motor driver circuit.
10. Design of stepper motor driver circuit.

**TOTAL: 30 PERIODS**

**OUTCOME**
- The laboratory experiments provides a hands on experience onboard electronics developments particularly the students come from mechanical stream.

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**MR7102 CONCEPTS OF MACHINES AND MECHANISMS**

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

**UNIT I MECHANISMS**

**UNIT II FRICTION**

**UNIT III GEARING AND CAMS**
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**

**UNIT V MACHINE TOOLS**

**OUTCOME**
- The students will understand the concepts, design, construction and properties of mechanical elements and machines.

**REFERENCES**

MR7103 CONTROL SYSTEM DESIGN L T P C

OBJECTIVE

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

UNIT I SYSTEM REPRESENTATION AND MODELLING 6+6

UNIT II DESIGN OF FEEDBACK CONTROL SYSTEM 6+6

UNIT III TIME DOMAIN ANALYSIS 6+6

UNIT IV FREQUENCY DOMAIN ANALYSIS 6+6

UNIT V CONTROL AND ANALYSIS OF SERVO MOTOR 6+6

OUTCOME

- The students will know the various types of control systems and their modelling, with reference to mode controls, and determination of stability in time and frequency domain.

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

UNIT I FLUID POWER SYSTEM GENERATION AND ACTUATORS 8

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 12
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 8
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

OUTCOMES
- The students able to familiar with basic concepts of hydraulic, pneumatics and electric drives and their controlling elements and also gather the knowledge on designing the hydraulic and pneumatic circuits using ladder diagram.

REFERENCES

LABORATORY

OBJECTIVE
- To study the functional aspects of different pneumatic and hydraulic Components and its use in circuits and also to train the student in designing different pneumatic and hydraulic circuits for different applications.

OUTCOME
- The outcome of this laboratory is to create familiarization with fluid power drives and its electronic control for automation application.
LIST OF EXPERIMENTS
1. Simulation of speed control circuits in a hydraulic trainer.
2. Simulation of hydraulic circuits in a hydraulic trainer.
3. Simulation of single and double acting cylinder circuits using different directional control values.
4. One shot and regenerative pneumatic circuits.
5. Simulation of Ladder diagram program.
7. Simulation of Electro-pneumatic circuits.
8. Simulation of Logic pneumatic circuits.
9. Simulation of electro pneumatic sequencing circuits.
10. Simulation of PLC based electro pneumatic sequencing circuits.
11. Simulation of pneumatic circuits using PLC.
12. To design and connect the circuits for the given problem (case study).
13. To compare the ladder diagram for electrical and PLC control for the given sequence.

TOTAL: 30 PERIODS

MR 7105  SENSORS AND SIGNAL CONDITIONING  L  T  P  C
3  0  2  4

OBJECTIVE
• To learn the various types of sensors, transducers and signal conditioning circuits for Mechatronics system development.

UNIT I  INTRODUCTION

UNIT II  MOTION, PROXIMITY AND RANGING SENSORS

UNIT III  FORCE, MAGNETIC AND HEADING SENSORS

UNIT IV  OPTICAL, PRESSURE AND TEMPERATURE SENSORS
Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric, Temperature – IC, Thermistor, RTD, Thermocouple.

UNIT V  SIGNAL CONDITIONING

TOTAL: 45 PERIODS

OUTCOME
• The students will learn the principles of various sensors and transducers and also able to study the characteristics of sensors.

REFERENCES

LABORATORY

OBJECTIVE
• To learn and gather the practical experience on sensors and its measurements for mechatronics system development.

LIST OF EXPERIMENTS
1. Study on various kinds of sensors and its characteristics.
2. Study on signal conditioning units.
3. Experimentation on voltage, current, power, and frequency measurement.
4. Strain gage, load cell and torque transducer characterization & applications – data acquisition & instrument control.
5. Experimentation with tactile sensor for force and touch detection.
6. LVDT, acoustics ranging, Hall Effect sensor and ultrasonic distance measurement applications.
8. Study on eddy current sensor for thickness measurement.
9. Study on ultrasonic sensors for material fault diagnosis.
10. Experimentation on laser sensor for non-contact dimension measurement.
11. Study on Experimentation with Gyroscope, Accelerometer and magnetometer.
12. Experimentation with speed and position measurement using encoders.

TOTAL: 30 PERIODS

OUTCOME
• Students able to come with suitable sensor selection for the mechatronics system development based on the laboratory experience.

MR7111 COMPUTER AIDED MODELING, SIMULATION AND AUTOMATION LABORATORY

OBJECTIVES
• To learn the drawing, modeling, simulation of machine components.
• To learn the open and closed loop control of electrical drives.

OUTCOMES
• The computer aided modeling and simulation laboratory will give the hands on experience on modeling the mechanical structure and its elements and also it delivers the simulation of mechanisms.
• The automation lab will delivers the basic control of DC, AC, servo, and stepper motor through various control modes.

COMPUTER AIDED MODELING AND SIMULATION
1. 2D modeling and 3D modeling of components such as
   • Bearing
   • Couplings.
   • Ball screw
- Gears
- Sheet metal components
- Jigs, Fixtures and Die assemblies.

2. 3D modeling of machine components using 3D printer.
   - Gears
   - Links
3. Modeling and simulation of mechanism
   - 4 Bar chain
   - Slider crank,
   - Quick return and elliptical trammel.
4. Analysis of mechanical components
   - Introduction to FEA packages.
   - Machine elements under Static loads and dynamic loads.

AUTOMATION
1. DC brush motor characteristics & modelling.
2. Power control of AC & DC motors.
3. Electrical energy planning and management of autonomous system.
4. Closed loop position and velocity control of a DC brush servo motor.
5. Tuning of P, PI and PID controller using simulation software.
6. Various types of stepper motor control.

TOTAL: 60 PERIODS

MR7201  DESIGN OF MACHINE ELEMENTS AND PRODUCT DEVELOPMENT

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

UNIT I  INTRODUCTION  9+6
Introduction to national and international symbols- Engineering materials and their physical properties and applied to design- Selection of materials- selection for new design and material considerations-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  9+6
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 -Design of couplings- Muff, Flange, Bushed and pin types.

UNIT III  DESIGN OF TRANSMISSION ELEMENTS  9+6
UNIT IV PRODUCT DESIGN AND DEVELOPMENT 9+6
Quality function development (QFD) - product design and specification, design for manufacturability (DFM), design for assembly and disassembly, human factors in design ergonomics, creativity in design, TRIZ- axiomatic design.

UNIT V FINITE ELEMENT ANALYSIS 9+6
Basic Concept of FEA - finite element analysis of one dimensional and two dimensional problems- variational formulation of B.V.P. – Ritz Method-Examples related to one-dimensional and two-dimensional problems.

L=45, T=30 TOTAL =75 PERIODS

OUTCOME
• The students will learn the design of machine elements, product design concepts and introduction to finite element analysis.

REFERENCES
UNIT V  ROBOTIC WORK CELLS AND APPLICATIONS OF ROBOTS

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

TOTAL: 45 PERIODS

OUTCOME

• The students will learn basis of robotics, sensors, programming and AI techniques used in robotics.

REFERENCES:


MR7203  MECHATRONICS SYSTEM DESIGN

OBJECTIVE

• To impart through knowledge in system modelling, system identification and simulation of mechatronic system.

UNIT I  INTRODUCTION

Mechatronics system overview – recent advancements – application – key elements – mechatronics system design process.

UNIT II  MODELING OF SYSTEM


UNIT III  SIMULATION


UNIT IV  DESIGN OPTIMIZATION

Optimization – problem formulation - constraints – over view of linear and nonlinear programming techniques – other optimization techniques- optimal design of mechatronics system with case studies.

UNIT V  CASE STUDIES ON BUILDING A MECHATRONICS SYSTEM

Modeling and simulation of automotive system - power window, engine timing, building clutch look up - antilock braking system ABS and automatic transmission controller - modeling of stewart platform with actuators.

TOTAL: 30 PERIODS

OUTCOME

• The students will gain the basic system modeling, simulation and design optimization for mechatronics systems developments.
REFERENCES

LABORATORY
OBJECTIVE
- To learn the system design and its integration for modeling the mechatronics systems.

LIST OF EXPERIMENTS
1. Modeling of electrical motors and with gear train
2. Modeling and simulation of automotive system
   - Power window.
   - Engine timing.
   - Building clutch look up.
   - Antilock braking system ABS.
   - Automatic transmission controller.
3. Modeling of Stewart platform with actuators.
4. Modeling of object sorting system using various sensors.
5. Modeling of quadcopter.

TOTAL: 30 PERIODS

OUTCOME
- The students will acquire the hands on experience in design, modeling and simulation of mechatronic system.

MR7204 MICROCONTROLLERS

OBJECTIVE
- To understand the programming interfacing and applications of various microcontrollers.

UNIT I INTRODUCTION TO MICRO CONTROLLER 8
Microcontrollers – CISC and RISC - Architecture - 8051 family - PIC 18FXXX family – Memory organization.

UNIT II PROGRAMMING OF MICROCONTROLLER 12

UNIT III PROGRAMMING & PERIPHERAL INTERFACING 9
CCP, ECCP, PWM programming of PIC18FXXX - Interfacing of Relays, Memory, key board, Displays – Alphanumeric and Graphic, RTC, ADC and DAC, Stepper motors and DC Motors, I2C, SPI with 8051 and PIC family.
UNIT IV INTRODUCTION TO ARM 7 CORE

UNIT V REAL TIME MODELS, LANGUAGE AND OPERATING SYSTEMS
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

OUTCOME
This course is intended for learning the Introduction and Architecture of Microcontroller, fundamentals of Assembly language Programming, and Interfacing of Microcontroller.

REFERENCES

MR7211 AUTOMATION LABORATORY

OBJECTIVE
To create exposure in the computer aided inspection and manufacturing, robot modeling and programming.

COMPUTER AIDED INSPECTION
1. Measurements of Surface Roughness.
2. Measurements using CMM.
3. Measurements using toolmaker Microscope.

CNC AND WATER JET MACHINING
1. Profile milling operation, circular interpolation.
3. Experimentation on EDM and ECM.
4. Experimentation on water jet cutting.

ROBOT MODELING and PROGRAMMING
1. Modeling and simulation five different configuration of serial manipulator.
2. Forward and inverse kinematics and trajectory planning of robot using computation software.
3. Programming and experimentation with articulated robot.
4. Programming and experimentation with SCARA robot for pick and place application.
OUTCOME
- The students will get the practical experience in computer aided inspection, basic machining process, robot modeling and programming.

MR7212  MICROCONTROLLERS LABORATORY  
L T P C 0 0 4 2

OBJECTIVE
- To learn the programming of 8051, PIC microcontroller and also to learn the programming of ARM processor.

LIST OF EXPERIMENTS
1. Assembly language programming and simulation of 8051 in Keil IDE.
2. Assembly language programming and simulation of PIC using MP lab.
3. Alphanumeric and Graphic LCD interfacing using X8051 & PIC Microcontroller.
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 (unipolar & bipolar motor) and PWM servo motor control to interfacing with X8051.
8. UART serial programming in X8051 and PIC.
9. Program of Microcontroller using Keil C.
10. Introduction to computation and data acquisition software.
11. PC interfacing of stepper motor - Unipolar & Bipolar.
13. Programming of ARM Processor for display interface.
15. Serial communication of ARM processor with computation platform.

OUTCOME
- The students will acquire the hands on experience in programming 8051, PIC, and ARM processor.

MR 7301  MACHINE VISION  
L T P C 3 0 2 4

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
UNIT III  IMAGE PROCESSING

UNIT IV  IMAGE ANALYSIS

UNIT V  MACHINE VISION APPLICATIONS
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

OUTCOME
- The outcome of this course is to apply the vision concepts in various mechatronics applications.

REFERENCES

PRACTICAL

OBJECTIVE
- To gather the practical exposure on machine vision elements, lighting technique, processing softwares and algorithms.

LIST OF EXPERIMENTS
1. Study on different kinds of vision sensors.
2. Study on lighting techniques for machine vision
4. Experimentation on image acquisition towards the computation platform.
5. Pre-processing techniques in image processing
6. Edge detection and region of interest extraction.
7. Experimentation with image processing algorithm for feature extraction.
8. Experimentation with pattern recognition.
10. Vision based Gear parameter measurement.

TOTAL: 30 PERIODS

MR7312  PROJECT WORK PHASE I

OBJECTIVES
- A project topic may be selected based on the literature survey and the creative ideas of the students themselves in consultation with their project supervisor.
- The topic should be so chosen that it will improve and develop the skills to design, fabricate;
analyse, test and research. Literature survey and a part of the project work be carried out in phase I.

- The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.
- A project report for phase I is to be submitted at the end.

EVALUATION

- Project work evaluation is based on the Regulations of the Credit system for the Post graduate programmes of Anna University

TOTAL : 90 PERIODS

OUTCOME

The students would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative, well planned, organized, coordinated in their project work phase – II.

MR7411

PROJECT WORK PHASE II

OBJECTIVES

- To continue the work from phase I and complete the project work in order to meet the stated objectives of the topic chosen.
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Division based on oral presentation and the project report.
- To improve the research and development activities of the students.

EVALUATION

- Project work evaluation is based on the Regulations of the Credit system for Post graduate programmes of Anna University

TOTAL = 180 PERIODS

OUTCOME

The students’ would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative, well planned, organized, coordinated project outcome of the aimed work.

MR7001

ADVANCED COMPUTER VISION

OBJECTIVES

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

UNIT I

IMAGE FORMATION AND CAMERA CALIBRATION

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 II  BASICS FOR COMPUTER VISION  6
Decomposition – Robust Estimators and Model Fitting

UNIT III  SHAPE FROM X  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 – Correspondence problem, correlation based
methods, feature-based methods – Epipolar Geometry, essential matrix and fundamental matrix,
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, Fast SLAM – 3D SLAM – Advanced Visual Servoing, hybrid visual servo, partitioned visual
servo.

TOTAL: 45 PERIODS

OUTCOMES
- The students exposed to the techniques used in the computer vision analysis and its
  applications.

REFERENCES
2. Emanuele Trucco, Alessandro Verri, “Introductory Techniques For 3D Computer Vision”, First
   Edition
3. Boguslaw Cyganek, J. Paul Siebert, An Introduction To 3D Computer Vision Techniques And
4. Yi Ma, Jana Kosecka, Stefano Soatto, Shankar Sastry, “An Invitation to 3-D Vision From

MR7002  ADVANCED CONTROL SYSTEMS  L T P C
3 0 0 3

OBJECTIVE
- To learn and model the nonlinear and complex control strategies for advanced
  mechatronics system developments.

UNIT I  CONVENTIONAL CONTROL SYSTEM DESIGN  7
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  7
Feed-forward control – Ratio control – Cascade control – Inferential control – Split-range –
override control— selective control –Auto tuning.
UNIT III STATE SPACE ANALYSIS
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

UNIT V OTHER CONTROL METHODS

TOTAL: 45 PERIODS

OUTCOME
- The students will acquire the knowledge in nonlinear control and methods used to design the stable system.

REFERENCES:

MR7003 ANALYTICAL ROBOTICS

OBJECTIVE
- To impart knowledge in the advanced area of Robotics.

UNIT I INTRODUCTION
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

UNIT III ROBOT DYNAMICS AND TRAJECTORY PLANNING
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
UNIT V MODELLING AND SIMULATION  
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

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

REFERENCES

MR7004 APPLIED SIGNAL PROCESSING  L T P C 
3 0 0 3

OBJECTIVE
- To emphasize the significance of knowledge on signal processing.

UNIT I SOURCES OF SIGNALS

UNIT II PRE-PROCESSING SIGNALS

UNIT III DIGITAL SIGNAL PROCESSING
Time series analysis –Time varying analysis - Time frequency representation - ARMA Signal modelling- FFT - power spectral density Estimation

UNIT IV FEATURE EXTRACTION METHODS

UNIT V ANALYSIS AND APPLICATION OF SIGNAL PROCESSING
Cepstral analysis of speech signals– spectral analysis bio signals and vibration signals- Radar signal processing for multiple sensor information- signal processing in affective state computation and brain computer interface – introduction to Fusion technique.

TOTAL: 45 PERIODS

OUTCOME
- The outcome of this course is to get exposure with various kinds of signal acquisition, processing and feature extraction technique that used process the information’s in the various kinds of sensors.

REFERENCES

MR7005 
APPROPRIATE MANUFACTURING PROCESSES

L T P C
3 0 0 3

OBJECTIVE
- To introduce the unconventional manufacturing process, latest manufacturing process for micro fabrication and devices.

UNIT I  NEWER MACHINING PROCESSES - I

UNIT II  NEWER MACHINING PROCESS – II

UNIT III  NEWER MACHINING PROCESS – III

UNIT IV  FABRICATION OF MICRO DEVICES

UNIT V  MICROFABRICATION TECHNOLOGY

TOTAL: 45 PERIODS

OUTCOME
- The students will gather the knowledge on latest manufacturing process.

REFERENCES
OBJECTIVES

- To get the clear understanding of application of mechanics in medicine.
- To study the properties and kinematics of bone and muscles.

UNIT I  INTRODUCTION 10
Introduction to bio-mechanics, relation between mechanics and Medicine, Newton’s laws, stress, strain, shear rate, viscosity, visco elasticity, non-Newtonian viscosity, soft tissue mechanics, mechanical properties of soft biological tissues-Bio fluid mechanics-Introduction to Biomechatronic Systems

UNIT II  MECHANICS IN SKELETAL AND MUSCULAR SYSTEM 10

UNIT III  CONTROL MECHANISM OF BIOLOGICAL SYSTEMS 8
Skeletal muscles servo mechanism, Cardio vascular control mechanism, respiratory control mechanism – interfacing techniques with natural servo mechanism.

UNIT IV  PROSTHETIC AND ORTHOTIC DEVICES 9
Analysis of force in orthopaedic implants, Hand and arm replacement, different types of models for externally powered limb prosthetics, Lower limb, Upper limb orthotics, and material for prosthetic and orthotic devices, Functional Electrical Stimulation, Sensory Assist Devices.

UNIT V  SIMULATION AND MODELLING OF BIOMECHANTRONICS 8
Physics-based modelling and simulation of biological structures- variables of interest –geometry-Introduction to model the skeletal system using open source software– human leg prosthesis and normal gait vs prosthesis leg analysis - Upper Extremity Kinematic Model

TOTAL: 45 PERIODS

OUTCOMES

- The students able to understand the skeletal mechanics for rehabilitation and prosthetic developments.
- The students will learn to develop the rehabilitation devices and its interface.

REFERENCES

MR7007  COMPUTER AIDED INSPECTION  

OBJECTIVE
- To make the learner to design and fabricate inspection methods and systems incorporating electronic systems for inspection and quality control in engineering.

UNIT I  FUNDAMENTALS AND CONCEPTS IN METROLOGY  
Standards of measurement – Analog and digital measuring instruments-comparators – Limits, Fits and Tolerances – Gauge design – Angular measurements – Surface Roughness – Form errors and measurements.

UNIT II  INSPECTION AND GENERAL MEASUREMENTS  

UNIT III  OPTO ELECTRONICS IN ENGINEERING INSPECTION  
Use of opto electronics in Tool wear measurement – Micro hole measurement and surface Roughness – Applications in In-Process measurement and on line Inspection.

UNIT IV  MACHINE VISION  

UNIT V  COORDINATE METROLOGY AND QUALITY CONTROL  
Co-ordinate measuring machines – Applications and case-studies of CMM in Inspection – Use of Computers in quality control – Control charts – Reliability.

TOTAL: 45 PERIODS

OUTCOME
- The students will acquire the knowledge on computer aided inspection of various geometries.

REFERENCES

MR7008  CONCEPTS OF SUSTAINABLE MANUFACTURING  

OBJECTIVE
- To provide the student with the knowledge of sustainability in manufacturing, its evaluation, strategy to achieve sustainability, supply chain management and sustainable operations.

UNIT I  ENVIRONMENTAL VALUATION  
Introduction to the environmental issues pertaining to the manufacturing sector - pressure to reduce costs - processes that minimize negative environmental impacts - environmental legislation and energy costs - acceptable practice in society - adoption of low carbon technologies - need to reduce the carbon footprint of manufacturing operations. Techniques for non-market valuation: cost and income based approaches, demand estimation methods - expressed and revealed...
preference, choice modeling - Multi-criteria analysis- Stakeholder analysis - Environmental accounting at sector and national levels.

UNIT II EVALUATING SUSTAINABILITY 9
Sustainability performance evaluators- Frameworks and techniques - environmental management systems - life cycle assessment - strategic and environmental impact assessments - carbon and water foot-printing.

UNIT III MANUFACTURING STRATEGY FOR SUSTAINABILITY 9

UNIT IV SUPPLY CHAIN MANAGEMENT 9
Challenges in logistics and supply chain - developing the right supply chain strategy for the products - need to align the supply network around the strategy - Tools that can be used systematically to identify areas for improvement in supply chains - Specific challenges and new thinking in the plan, source and delivering of sub-processes.

UNIT V SUSTAINABLE OPERATIONS 9

TOTAL: 45 PERIODS

OUTCOME
- On completion of the course the students will be able to apply techniques of environmental valuation, formulate strategy for sustainable manufacturing and plan sustainable operations and supply chain management.

REFERENCES

MR7009 DIGITAL MANUFACTURING

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OBJECTIVE
- To explain in detail about the various Mechatronics elements in CNC machines and also programming of CNC machines.

UNIT I INTRODUCTION OF NC, CNC, DNC AND ADAPTIVE CONTROL 6
Classification of machine tools – types, functions and processes - fundamentals of NC and CNC technologies 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 II  MECHATRONIC ELEMENTS IN CNC MACHINE TOOLS
CNC systems - configuration of the CNC system – interfacing – monitoring – diagnostics - machine data - compensations for machine accuracies - PLC in CNC – PLC programming for CNC, steps in programming and case studies - machine structure -types of loads on CNC machine - 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.

UNIT III  MECHATRONICS ELEMENT IN CNC MEASURING SYSTEM AND TOOLING

UNIT IV  CNC PROGRAMMING

UNIT V  TESTING AND MAINTENANCE OF CNC MACHINES

TOTAL: 45 PERIODS

OUTCOME
• The students will learn mechatronics elements, control and programming in CNC machine.

REFERENCES:

MR7010  EMBEDDED SYSTEMS WITH ADVANCED MICROCONTROLLERS

OBJECTIVES
• To impart knowledge in the area of real time embedded system.
• To understand the ARM & FPGA Processor, high level language descriptions of software for embedded system.
UNIT I  INTRODUCTION TO EMBEDDED SYSTEMS AND ARM 9 CORE  10

UNIT II  PROGRAMMING OF ARM PROCESSOR  8

UNIT III  INTRODUCTION TO FPGA  10

UNIT IV  PROGRAMMING OF FPGA  8
Introduction to Verilog HDL and FPGA Design flow with using Verilog HDL - FPGA Arithmetic Circuits - FPGAs in DSP Applications - Design of SDRAM & Halftone Pixel Converter - Programming FPGAs. Introduction to DSP processor - TMS320C54x and TMS320C6x architecture

UNIT V  APPLICATIONS OF ARM 9 AND FPGA CONTROLLERS  9

TOTAL: 45 PERIODS

OUTCOMES
• The students learn to develop the controller for the real time application.
• The students will gather the knowledge for the effective use of advanced controllers and its programing in real time product development.

REFERENCES

MR7011  HAPTICS AND AUGMENTED REALITY  L T P C  3 0 0 3

OBJECTIVES
• To learn the human touch perception and Tactile Proprioception.
• To learn the haptic components and virtual models.
• To emphasize the significance of knowledge on haptic and augmented reality.

UNIT I  INTRODUCTION TO HAPTICS  6
Definition - Importance of Touch - Tactile Proprioception - Tactual Stereo genesis - Kinesthetic Interfaces - Tactile Interfaces - Human Haptics - Overview of existing applications.
UNIT II  KINESTHETIC HAPTIC DEVICES  10

UNIT III  TELEOPERATION  10

UNIT IV  HUMAN HAPTICS  9

UNIT V  INTRODUCTION TO HAPTIC PLATFORM  10

TOTAL: 45 PERIODS

OUTCOMES
• The students will learn to build and control haptic devices.
• The students learn the salient properties of human touch perception that are necessary to be recreated in virtual environments.
• The students will gather the knowledge to use the modeling software that used in the Haptics device development.

REFERENCES
Interaction -strategies Interface metaphors and conceptual models HCI and the World Wide Web 
HCI - security Accessibility of User Interfaces Usability engineering and evaluation 
HCI and social computing.

UNIT II  ELEMENTS OF HMI  8

UNIT III  PERCEPTION, MEMORY, COGNITION  8

UNIT IV  INTEGRATED MODELLING FRAMEWORK  9

UNIT V  BRAIN COMPUTER INTERFACE  12

TOTAL: 45 PERIODS

OUTCOMES
- The students gather the ideas about the human machine and brain computer interface for the advanced mechatronics system development.

REFERENCES
UNIT II  PROGRAMMABLE LOGIC CONTROLLER  9

UNIT III  DATA COMMUNICATION AND SUPERVISING CONTROL SYSTEMS  9

UNIT IV  FACTORY AUTOMATION  9
Factory layout - Tools and software based factory modeling - case study on automated manufacturing units, assembly unit, inspection systems and PLC based automated systems- Introduction to factory automation monitoring software

UNIT V  BUILDING AUTOMATION  9

TOTAL: 45 PERIODS

OUTCOME
• The students to able to develop the automation models by the use of PLC, Supervisory control and factory and building automated tools.

REFERENCE

MR7014  MACHINE LEARNING  

OBJECTIVE
• To know fundamental behind the various machine algorithms, and also to familiarize the important methods in ANN, Fuzzy and Genetic algorithm.

UNIT I  SUPERVISED AND SEMI SUPERVISED LEARNING METHODS  10
Introduction to learning & classifiers- LDA – ANN - Naive Bayes classifier- decision tree- Regression-Ordinary Least Squares – linear and Logistic Regression- Gaussian process -

UNIT II UNSUPERVISED & REINFORCEMENT LEARNING METHODS 8
Expectation–maximization (EM) - Vector quantization, Clustering Fuzzy K &C means algorithm - Density-based spatial clustering of applications with noise (DBSCAN) - Conceptual clustering-Association rule learning - Apriori algorithm-SVD.

UNIT III NEURAL NETWORK 9
Perceptron – Probabilistic Neural Network (PNN) - Back-Propagation (BPN) - Hopfield Network - Self-Organizing Map (SOM) - Learning Vector Quantization (LVQ)-Adaptive Resonance Theory 1 – Adaptive Resonance Theory 2 - Case studies on GA based algorithm development.

UNIT IV Fuzzy classification 9

UNIT V GENETIC ALGORITHMS 9

TOTAL: 45 PERIODS

OUTCOME
- The students will gain the knowledge on artificial learning and classification algorithms for the implementation of intelligent machine.

REFERENCES

MR7015 MATERIALS MANAGEMENT AND LOGISTICS

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

UNIT I INTRODUCTION 6
Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT II MANAGEMENT OF PURCHASE 7
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 –

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

OUTCOME
• 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 independenly.

REFERENCES
1. Lamer Lee and Donald W.Dobler, “Purchasing and Material Management, Text and cases”,
2003.
5. Dr.R. Kesavan, C.Elanchelian and B.Vijaya Ramnath, Production Planning and Control,
Macmillian India Ltd., 2006.

MR7016  MEDICAL MECHATRONICS  L  T  P  C
3   0   0   3

OBJECTIVE
• To know the principle, design and application of various human measurement and assisted
device for the human functional system.

UNIT I  INTRODUCTION TO MEDICAL MECHATRONICS  9
Role of Mechatronics in Medical – Overview of human functional system – cell and origin
bioelectric potential-Measurement of blood pressure-invasive and noninvasive methods-
transducers role in measurement–Heart rate – pressure-temperature- Heart sound – Pulmonary
function measurements

UNIT II  ASSISTING AND THERAPEUTIC EQUIPMENTS  9
Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart
Lung machine — Dialyzers – centrifuge- coagulators- aspirator – oximeter – spirometer- Nebulizer
– Anesthesia machine-Operating Table – examination couches- infusion systems

UNIT III  CARDIAC AND REGULATORY ASSIST SYSTEM  12
Defibrillator - Muscle and nerve stimulator, Location for Stimulation -Synchronous Counter
pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass
Pump, Open Chest and closed Chest type, Intra-Aortic Balloon Pumping Veno Arterial Pumping,
Prosthetic Cardio Valves, Principle and problem, Biomaterials for implantable purposes, its characteristics and testing. Lithotripsy-Indication and Principle of Haemodialysis, Membrane, Dialysate, Different types of haemodialysis, Monitoring Systems, Wearable Artificial Kidney, Implanting Type.

UNIT IV  MEDICAL IMAGING  12

UNIT V  SENSORY ASSIST DEVICES AND AUTOMATED ANALYSER  9
Types of deafness, hearing aids, application of DSP in hearing aids- Ear irrigator- Voice synthesizer, speech trainer. Ultra sonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually challenged, ophthalmoscopy Text voice converter, screen readers and automated analyser and medical equipment’s.

TOTAL: 45 PERIODS

OUTCOMES
- The students able to know the role and importance of artificial assisting devices and also able to gather functionality and development related issues of assisting devices used in the medical field

REFERENCES

MR7017  MICRO AND NANO SYSTEMS  L T P C
3 0 0 3

OBJECTIVES
- To inspire the students about the trends in development and synthesizing of micro and nano systems.
- To introduce students the characterisation tools required in micro and Nano material synthesis and fabrication.

UNIT I  INTRODUCTION TO MICRO AND NANO TECHNOLOGY  6
Over view of nanotechnology and MEMS- Nano structuring- Nano defects, Nano particles and Nano layers-science and synthesis of Nano materials-lithography-based micromachining-Photolithography, vacuum systems, etching methods, deposition methods, and process integration- LIGA and laser-assisted processing
UNIT II  CHARACTERIZATION OF NANO MATERIALS


UNIT III  MICRO AND NANO SENSORS


UNIT IV  MICRO AND NANO ACTUATORS


UNIT V  MICRO AND NANO SYSTEM


TOTAL: 45 PERIODS

OUTCOMES

- The students exposed to the evolution of micro- Nano systems elements and fabrication technique.
- The Students aware a characterisation tools for synthesizing materials for micro and nano sensors, devices and actuators and its fabrication technique.

REFERENCE

OBJECTIVE

- To impart the knowledge on mobile robots and its autonomy, locomotion and navigation.

UNIT I INTRODUCTION

UNIT II KINEMATICS

UNIT III PERCEPTION

UNIT IV LOCALIZATION

UNIT V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS
Introduction - competences for navigation: planning and reacting - path planning - obstacle avoidance - navigation architectures - modularity for code reuse and sharing - control localization - Techniques for decomposition - case studies – Collaborative robots – Swarm robots.

TOTAL: 45 PERIODS

OUTCOME

- To make the students to learn concepts of mobile robots and also gather the ideas on building an autonomous robot, motion, path planning and navigation.

REFERENCES
elements to solve physical and engineering problems with emphasis on structural and thermal engineering applications.

UNIT I INTRODUCTION

UNIT II ONE DIMENSIONAL ANALYSIS
Steps in FEA – Discretization, function – derivation of element characteristics matrix, shape function, assembly and imposition of boundary conditions – solution and post processing – One dimensional analysis in solid mechanics and heat transfer.

UNIT III SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS

UNIT IV ANALYSIS OF PRODUCTION PROCESSES

UNIT V COMPUTER IMPLEMENTATION
Pre Processing, Mesh generation, elements connectivity, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages such as ANSYS and DEFORM – Development of code for one dimensional analysis and validation.

TOTAL: 45 PERIODS

OUTCOMES:
- To equip students with fundamentals of finite element principles so as to enable them to understand the behavior of various finite elements and to be able to select appropriate elements to solve physical and engineering problems with emphasis on structural and thermal engineering applications.

TEXT BOOKS

REFERENCES
MR7020  NON DESTRUCTIVE EVALUATION  L T P C
                      3 0 0 3

OBJECTIVE

- To learn the NDT, methods and their applications

UNIT I  NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING  6
Introduction to various non-destructive methods, Comparison of Destructive and Nondestructive 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

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 & RADIOGRAPHY  10

UNIT V  COMPARISON AND SELECTION OF NDT METHODS  9
Case studies on defects in cast, rolled, extruded, welded and heat treated components. Comparison and selection of various NDT techniques. Codes, standards, specification and procedures.

OUTOCOME

- The students will acquainted the knowledge of all types of NDT and their applications in Engineering.

REFERENCES:
4. www.ndt.net.
OBJECTIVES

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

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 DIAGNOSTICS SYSTEMS  9

UNIT III  AUTOMOTIVE TRANSMISSION AND SAFETY SYSTEMS  12

UNIT IV  AIRCRAFT MECHATRONICS  12

UNIT V  MARINE MECHATRONIC SYSTEMS  6
Basics of Marine Engineering – Marine Propulsion Mechatronics elements in ships, submarines, Variable Buoyancy Systems

TOTAL: 45 PERIODS

OUTCOMES

- The students able to gather the knowledge in particularly of automotive engines, engine controls, Fuel delivery systems, all types of transmission control systems, electromagnetic interference and electronic dashboard instruments in Automobiles, Aircraft and Marine applications.

REFERENCES