VISION OF THE DEPARTMENT
To develop disciplined, socially committed and technically competent Production Engineers with Creativity, Comprehension and Managerial skills to design and manufacture innovative cost effective quality products for the benefit of mankind.

MISSION OF THE DEPARTMENT
1. Train the students who will be able to design and manufacture Innovative, Environment Friendly, Ergonomic and Cost Effective Quality Products and Services.
2. Improve the technical quality of the students to meet the challenges, competitions and opportunities in production engineering.
3. Prepare the students who will be able to solve socially relevant engineering problems and other complex problems by means of inculcating Managerial Skills.
4. Enhance the department industry / research centre interaction by means of training, internship and student projects to solve industrial problems.
ANNA UNIVERSITY :: CHENNAI 600 025
UNIVERSITY DEPARTMENTS
M.E. MECHATRONICS (FT)
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

I. Find gainful employment in industry and academia.
II. Achieve the scientific / managerial position and became a successful entrepreneur on their career paths by applying multi-disciplinary approach.
III. Ability to design, develop and analyze the mechatronic system and provide optimal solutions with basic and advanced technology for industrial and societal problems.
IV. Become an ethically responsible person with practice of life-long learning and effective communication to work as an individual and part of team for societal cause.

PROGRAM OUTCOMES (POs)

After going through post graduate in mechatronics, the graduates will exhibit ability to:

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<tr>
<th>PO. No.</th>
<th>Graduate Attribute</th>
<th>Programme Outcome</th>
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<tr>
<td>1</td>
<td>Engineering knowledge</td>
<td>Apply the fundamental knowledge of mechanics, electronics, sensors, actuators, control systems, microcontrollers, mechatronic system design, industrial automation and other engineering science serves the integrated solutions for various types of engineering problems.</td>
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<tr>
<td>2</td>
<td>Problem analysis</td>
<td>Identify and formulate problem statements and analyze engineering solutions to arrive at substantiated conclusions using principles of engineering sciences and mathematical models.</td>
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<td>3</td>
<td>Design/ development of solutions</td>
<td>Design, model, integrate and develop the solution for the engineering problems to meet the direct and indirect requirements of human and other living being in various levels of fundamental need search in socio-economical context.</td>
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<td>4</td>
<td>Conduct investigations of complex problems</td>
<td>Evaluate the design, analyze and optimize the integrated functionalities of systems and its parameters to create additional intelligence for valid decision making.</td>
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<td>5</td>
<td>Modern tool usage</td>
<td>Create, select, and use an appropriate modern devices and technologies for engineering problem with understanding the limitations of socio-economical context.</td>
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<td>6</td>
<td>The engineer and society</td>
<td>Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.</td>
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<td>7</td>
<td>Environment and sustainability</td>
<td>Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.</td>
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<td>8</td>
<td>Ethics</td>
<td>Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.</td>
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<td>9</td>
<td>Individual and team work</td>
<td>Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.</td>
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<td>10</td>
<td>Communication</td>
<td>Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.</td>
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Demonstrate the understanding of multi-disciplinary engineering concepts and apply these to one’s individual work, as a member and leader in a team.

Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

By completion of post graduate in mechatronics, the graduates will have following program specific outcomes:

I. Familiarization of conventional and modern mechatronic systems and its integrated functionalities.

II. Able to model, design, develop, analyze and implement automation solution to meet social and industrial demands with environmental considerations.

III. Knowledgeable to acquire employment in industry, academic profession, scientific position, managerial position and entrepreneur on their career paths with ethical values.

MAPPING OF PEOS WITH POS

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### ANNA UNIVERSITY

**UNIVERSITY DEPARTMENTS**

**REGULATIONS - 2019**

**M.E. MECHATRONICS (FULL – TIME)**

**CURRICULA AND SYLLABI FOR I TO IV SEMESTERS**

**THEORY**

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**TOTAL** 18 2 10 30 23

* Audit Course is optional.

**SEMESTER II**

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**TOTAL** 20 0 12 32 24

* Audit Course is optional.

6
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* * Minimum 14 Days during Vacation, # - Subject to the Prior Approval Head of the Department during Any Period before 3rd Semester (Minimum of 30 Hrs) and Maximum of Two Certificate Courses.

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#### SEMESTER III (ELECTIVE IV & V)

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12. MR5023  Mechatronics in Advanced Manufacturing Systems  PEC  3  0  0  3  3
13. MR5024  Industrial Solid State Drives  PEC  3  0  0  3  3

### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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### RESEARCH METHODOLOGY AND IPR COURSES (RMC)

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### OPEN ELECTIVE COURSES (OEC)

(Out of 6 Courses one Course must be selected)

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### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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COURSE OBJECTIVES

- To recall the functionality of fundamental electronic components.
- To understand the functions of operational amplifier and its applications.
- To review and use the logic gates for various digital circuit development.
- To understand the functions and uses in measurement.
- To learn the power management on various electronic units.

UNIT - I  ELECTRONIC COMPONENTS AND DEVICES  6+3

UNIT - II  OPERATIONAL AMPLIFIERS AND APPLICATIONS  6+3

UNIT - III  DIGITAL ELECTRONICS  6+3

UNIT - IV  MEASURING INSTRUMENTS  6+3

UNIT - V  POWER MANAGEMENT  6+3

LECTURE = 30, TUTORIAL = 15, TOTAL = 45 PERIODS

COURSE OUTCOMES

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

- CO1: Apply the fundamental electronic components in various circuits.
- CO2: Create the basic electronic circuits using op-amp for various applications.
- CO3: Develop the digital electronic circuits using logic gate ICs'.
- CO4: Use the power supply and measurement system appropriately for various applications.
- CO5: Measure, estimate and monitor the power for various applications to use battery or electrical power sources.

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REFERENCES

MR5102 CONCEPTS OF MACHINES AND MECHANISMS  L  T  P  C

COURSE OBJECTIVES
• To understand the functionality of basic mechanism and to determine the position, velocity and acceleration profiles of these mechanisms.
• To recognize the effect of friction in joints and to know the various types of mechanical power transmission using belt drives.
• To identify the nomenclature of gear and to understand the functions and typical uses of various types of gears and Cams.
• To understand the behaviors of the vibration in various machines.
• To make use of various conventional machine tools for component development.

UNIT- I MECHANISMS 6+3

UNIT - II FRICTION AND MECHANICAL DRIVES 6+3
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 – Open and Cross Belt Drives – Ratio of Tensions – Effect of Centrifugal and Initial Tension – Condition for Maximum Power Transmission

UNIT- III GEARING AND CAMS 6+3
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 6+3

UNIT - V MACHINE TOOLS 6+3

LECTURE = 30, TUTORIAL =15, TOTAL = 45 PERIODS
COURSE OUTCOMES
Upon completion of this course, the students will be able to:

CO1: Apply the fundamental mechanism in machinery development.

CO2: Consider the functions of friction in joints and select of appropriate belt drives for the typical applications.

CO3: Select and use of appropriate gears and cams for system development.

CO4: Evaluate the possibility of vibration generation in the system design.

CO5: Demonstrate the various conventional machine tools and CNC Machines.

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REFERENCES

MR5103 SENSORS AND SIGNAL CONDITIONING L T P C 3 0 0 3

COURSE OBJECTIVES
- To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
- To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
- To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
- To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
- To familiarize students with different signal conditioning circuits design and data acquisition system.

UNIT – I SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES

UNIT - II DISPLACEMENT, PROXIMITY AND RANGING SENSORS
UNIT – III  FORCE, MAGNETIC AND HEADING SENSORS  9

UNIT - IV  OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS  9

UNIT - V  SIGNAL CONDITIONING  10

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon the completion of this course, the students will able to;
CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.
CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.
CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.
CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.
CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.

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REFERENCES
CONTROL SYSTEM DESIGN

COURSE OBJECTIVES

- To represent and simplify the mathematical models for various types of physical systems.
- To recognize the time domain specifications and to analyze of various types of system and its characteristics in time domain.
- To know the frequency domain specifications and to analyze of various types of system and its characteristics in frequency domain methods.
- To design compensator and controller using time and frequency domain.
- To evaluate, analyze and design a control system of servomotors for motion control.

UNIT I SYSTEM REPRESENTATION AND MODELLING 9+3

UNIT II TIME DOMAIN ANALYSIS 9+3

UNIT III FREQUENCY DOMAIN ANALYSIS 9+3

UNIT IV DESIGN OF COMPENSATORS AND CONTROLLERS 9+3

UNIT V CONTROL AND ANALYSIS OF SERVO MOTOR 9+3

LECTURE = 45, TUTORIAL = 15, TOTAL = 60 PERIODS

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

CO1: Develop the mathematical model of physical systems.
CO2: Characterize the responses and evaluate the range of stability for the physical systems using time domain techniques.
CO3: Describe and assess the range of stability for the physical systems using frequency domain technique.
CO4: Design an appropriate control system and compensator for system dynamics.
CO5: Evaluate and demonstrate the motion control of motors.
**REFERENCES**


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**COURSE OUTCOMES**

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**COURSE OBJECTIVES**

- To recognize the standard symbols and to understand the functions of basic fluid power generation and actuation elements.
- To realize the functions of fluid regulation and control elements and its typical uses in fluid power circuit and to acquire the practice on assembling the various types of pneumatic circuits.
- To familiar and exercise the design procedure of various types of pneumatic and hydraulic fluid power circuits and to provide a training to create the various types of hydraulic circuits.
- To understand the typical functions and selections of various types electrical actuators and to provide the hands on training to the use of various electrical motors for automatic control.
- To apprehend the utilities of mechanical and power electronic drives for various functional requirements of actuators and control valves.

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**UNIT - I  FLUID POWER SYSTEM GENERATION AND ACTUATORS**


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**UNIT - II  CONTROL AND REGULATING ELEMENTS**


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**UNIT - III  CIRCUIT DESIGN FOR HYDRAULIC AND PNEUMATICS**

Typical Design Methods – Sequencing Circuits Design - Combinational Logic Circuit Design - Cascade Method – KV Mapping - Electrical Control of Pneumatic and Hydraulic Circuits - Use of Relays, Timers, Counters, Programmable Logic Control of Hydraulics - Pneumatics Circuits - PLC Ladder Programming
UNIT IV ELECTRICAL ACTUATORS


UNIT V ELECTRICAL DRIVE CIRCUITS


LECTURE = 45 PERIODS

COURSE OUTCOMES

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

CO1: Use the appropriate fluid power generation and actuation elements and fluid power symbols to design and integrate the pneumatic and hydraulic systems.

CO2: Select and design the basic fluid power circuits using control valves and regulating elements for various types’ of actuation and breaking.

CO3: Analyze and design the complex sequences of cylinders using advanced techniques for manual and automatic control.

CO4: Identify and select the appropriate electrical actuators for typical applications of system development.

CO5: Analyze the need of appropriate drive and its functions for various actuator and valve control in mechatronic system development.

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REFERENCES


LABORATORY

LIST OF EXPERIMENTS

FLUID POWER DRIVES

1. Experimental Verification of Speed Control Circuits in Pneumatic and Hydraulic Trainer.
2. Experimental Verification of Single and Double Acting Cylinder Circuits Using Different Directional Control Values.
3. Experimental Verification of Electro-Pneumatic Circuits.
4. Experimental Verification of Pneumatic Sequencing Circuits.
5. Experimental Verification of Logic, Metre-in and Metre-out Pneumatic Circuits.
7. Experiments on Control of PLC Based Electro Pneumatic Sequencing Circuits.
8. Experiments on Control of PLC Based Electro Hydraulic Sequencing Circuits.
ELECTRICAL DRIVES
1. Experiments on Position, Speed and Direction Control of AC and DC Motors.
2. Experiments on Position, Speed and Direction Control of Stepper Motor.
3. Experiments on Various Types of Switching and Protection Devices.

PRACTICAL = 30 PERIODS
TOTAL = 75 PERIODS

RM5151 RESEARCH METHODOLOGY AND IPR
L T P C
2 0 0 2

COURSE OBJECTIVES:
To impart knowledge and skills required for research and IPR:
- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6
Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICAL WRITING / PRESENTATION 6
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

COURSE OUTCOMES:
1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

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MR5111 COMPUTER AIDED MODELLING AND CONTROL SYSTEM DESIGN LABORATORY 0 0 4 2

COURSE OBJECTIVES
- To familiarize the commands and procedure for 2D drawing and 3D models in computer oriented Modelling environment.
- To assemble the parts and generate the motion simulation of 3D models.
- To familiarize and practice the computer oriented design, analysis and verification of control systems.
- To verify the effect of system dynamics with and without the control systems.

COMPUTER AIDED MODELLING AND SIMULATION
1. 2D and 3D Modelling of Components;
   - Bearing and Couplings.
   - Ball Screw and Gears
   - Sheet Metal Components
   - Jigs, Fixtures and Die Assemblies.
2. 3D Modelling of Machine Components using 3D Printer.
   - Gears
   - Links
3. Assembly and Simulation of Parts
   - Serial Robots
4. Modelling and Simulation of Mechanism
   - 4 Bar Chain
   - Slider Crank
   - Quick Return and Elliptical Trammel.
5. Analysis of Mechanical Components
   - Introduction to FEA Packages.
   - Machine Elements under Static Loads and Dynamic Loads.

CONTROL SYSTEM DESIGN
1. a) Mathematical Modelling and Simulation of a Physical Systems.
   b) Simulation and Reduction of Cascade and Parallel, and Closed Loop Sub-System
2. a) Simulation and Analysis of First and Second Order System Equations in Time and Frequency Domain.
   b) Simulation and Analysis of Root-Locus and Bode Plot.
3. Simulation and Implementation of PID Combination for First and Second Order Systems.
4. Stabilisation and Control of Linear and Rotary Inverted Pendulum.
5. Stabilisation and Control of Vision Based Ball Balancing System.
6. Realization of Motion Control in Pan and Tilt Axis Stabilization.
7. Realization of Control in Active Suspension System.
COURSE OUTCOMES
Upon completion of this course, the students will be able to:

CO1: Draw 2D drawing and 3D models for part design and model developments.
CO2: Assemble the parts and capable to simulate motion functionality of the model virtually.
CO3: Analyze, verify and develop the control systems for various system dynamics.
CO4: Practice and demonstrate control systems for typical applications.

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TOTAL: 60 PERIODS

MR5112 SENSORS AND SIGNAL CONDITIONING LABORATORY

COURSE OBJECTIVES
- To learn and gather the practical experience on sensors and its measurements for mechatronics system development.
- To have hands on experience on various sensors to understand the working principle and its characteristics.
- To do experiments on designing of signal conditioning circuit based on sensor output signal.

LIST OF EXPERIMENTS
2. Determine the characteristics of Pressure Sensor and Piezoelectric Force Sensor.
5. Determine the Characteristics of Various Temperature Sensors.
6. Determine the Characteristics of Various Light Detectors (Optical Sensors).
8. Determine angular velocity using Gyroscope, Vibration measurement using Accelerometer and Direction measurement using Magnetometer.
11. Design and Study the frequency response of Active Filters.
12. Design and realize circuit to convert change in resistance, inductance and capacitance to voltage.

TOTAL: 60 PERIODS

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

CO1: Demonstrate the ability to understand and compare the characteristics of sensors.
CO2: Design and develop signal conditioning circuits for sensors.
CO3: Select suitable sensor for the application.

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TOTAL: 60 PERIODS
COURSE OBJECTIVES

- To familiarize the fundamentals of symbols, dimensions, material, safety consideration in design.
- To understand the effect of static and dynamic stresses of rotating elements and to learn the detailed design of spring and couplings.
- To acquire the design skills of transmission elements of mechanical systems.
- To understand the consideration of various factors in product design and development.
- To acquaint with the finite elemental modelling of stress analysis of mechanical system elements.

UNIT- I INTRODUCTION TO MACHINE DESIGN

UNIT- II STATIC AND VARIABLE STRESSES

UNIT- III DESIGN OF TRANSMISSION ELEMENTS

UNIT- IV PRODUCT DESIGN AND DEVELOPMENT

UNIT- V FINITE ELEMENT ANALYSIS
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.

TOTAL = 45 PERIODS

COURSE OUTCOMES

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

CO1: Use various symbols, dimensions, materials and safety considerations for design.

CO2: Evaluate static and dynamic stresses of rotating elements and familiar with design of springs and couplings.

CO3: Design transmission elements for mechanical systems.

CO4: Remember the salient features of product design and development.

CO5: Evaluate effect of various parameters due to its elemental interactions using FEA.

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MR5251 MECHATRONICS SYSTEM DESIGN L T P C
3 0 2 4

COURSE OBJECTIVES
- To enlist the various elements required to design and integrate the mechatronic systems.
- To acquire the Modelling skill to capture the system dynamics of hybrid systems and to familiar
  the system identification techniques and to practice the design and assembly of mechanical
  system in software environment for integrating various system sub-elements.
- To familiar the standard simulation procedure for algorithm and controller development and to
  practice simulate and verify interactions and functions of integrated systems and its elements
  for fine tuning the design and control for real time system development.
- To apply the optimization procedure for the appropriate selection of mechatronic system
  elements and process parameter optimization.
- To understand, apply, analyze and evaluate the functions of systems models for integrating the
  virtual elements of mechatronics.

UNIT - I ELEMENTS OF MECHATRONICS 8
Comparison of Conventional System vs. Mechatronic System – Identification of Mechatronic
System Requirements in Real World Problems - Mechatronics System Overview – Key Elements –
Identification of Key Elements in Various Systems - Application Overview – Mechatronics System
Design Process - Recent Advancements in Mechatronics System for Modern Automation.

UNIT - II MODELLING & SYSTEM IDENTIFICATION 9
Need for Modelling – Systems Overview – Representation of Systems in State Space –Analogue
Approach – Parametric and Non-Parametric Modelling - Bond Graph Approach for Modelling of
Electrical, Mechanical, Thermal, Fluid and Hybrid Systems – System Identification – White, Grey
and Block Box Modelling - Overview – Types - Least Square Method.

UNIT - III SIMULATION 8
Simulation Fundamentals – Simulation Life Cycle – Monte Carlo Simulation – Solution for Model
Equations and their Interpretations – Hardware-In-Loop Simulation (HIL) - Controller Prototyping –
Software’s for Simulation and Integration.

UNIT - IV DESIGN OPTIMIZATION 9
Optimization – Problem Formulation - Constraints – Overview of Linear and Nonlinear
Programming Techniques – Other Optimization Techniques - Optimal Design of Mechatronics
System with Case Studies.

UNIT - V CASE STUDIES ON MODELING OF MECHATRONIC SYSTEMS 11
Modelling and Simulation of Automotive System - Power Window, Engine Timing, Building Clutch
Look-Up, Antilock Braking System and Automatic Transmission Controller – Modelling of
Manufacturing Systems, Inspection System, Transportation System, Industrial Manipulator, Light

LECTURE: 45 PERIODS
COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1: Identify the list of elements required integrate the entire mechatronic systems developments.
CO2: Model the system dynamics of hybrid systems and to trial the system identification techniques and to practice the design, integration and simulation in virtual systems that are closer to the real time systems' functionalities and its parameters.
CO3: Follow standard simulation procedure for algorithm and controller development.
CO4: Use the optimization concepts mechatronics elements selection and process parameter optimization.
CO5: Integrate and analyze the mechatronics system design virtually and able to fine tune the system design and control algorithms in the software-in-loops before real time development.

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REFERENCES

LABORATORY

LIST OF EXPERIMENTS

1. Modelling and Simulation of Vehicle and its Automotive Sub System.
2. Modelling and Simulation of 6 DOF Serial Manipulators.
3. Modelling and Simulation of Parallel Manipulator.
5. Modelling and Simulation of Mobile Robot.

PRACTICAL: 30 PERIODS
TOTAL: 75 PERIODS
COURSE OBJECTIVES

- To understand the importance of automation in industry and various industrial standard sensors and process parameters to control the production process.
- To learn PLC hardware, and practice the PLC programming and simulation in real systems.
- To get knowledge on industrial standard data communication protocols, SCADA, centralized and decentralized control.
- To get introduced to factory layout, Total Integrated Automation on factory and Industry 4.0.
- To get exposure on building automation using sensors, controllers and actuators.

UNIT - I  INDUSTRIAL INSTRUMENTATION AND CONTROL  

UNIT - II  PROGRAMMABLE LOGIC CONTROLLER  

UNIT - III  DATA COMMUNICATION AND SUPERVISORY CONTROL SYSTEMS  

UNIT - IV  FACTORY AUTOMATION  
Factory Layout - Tools and Software Based Factory Modelling - 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  

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Understand the need of process parameter measurement and control.
CO2: Select, configure and program the PLC by interfacing the sensors and actuators and other input and output devices for automation.
CO3: Understand and compare various data communication protocols. Able to compare centralized, decentralized and smart control system.
CO4: Select and apply suitable sensor, control and actuation for factory automation. Also they can simulate the same using software.
CO5: Select appropriate sensor, controller and actuation unit for building automation.
COURSE OUTCOMES

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REFERENCES

LABORATORY
1. Experiments on Ladder Logic Program for Various Logic Gates AND, OR, NOT, NOR, NAND, EX-OR and EX-NOR.
2. Implement Various Mathematical Functions in PLC Using Ladder Diagram Programming Language.
3. Develop Ladder Diagram Programming to set Timer and Counter in PLC.
4. Develop PLC Program to Control Traffic Light.
5. Develop PLC Program to Maintain the Pressure and Level in a Bottle Filling System.
6. Develop Ladder Diagram Program in PLC For Material Filling, Object Shorting, Orientation Check and Material Property Check.
7. Develop the Ladder Diagram Program in PLC for Material Handling, Delaying Conveyor, Feeding, Pick and Place Operation.
8. Experiments on Sensor and Actuator Interfacing and PLC to PLC. Communication.

PRACTICAL: 30 PERIODS
TOTAL: 75 PERIODS

MR5203 EMBEDDED SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES
- To familiarize the architecture and fundamental units of microcontroller.
- To know the microcontroller programming methodology and to acquire the interfacing skills and data exchange methods using various communication protocols.
- To design the interface circuit and programming of I/O devices, sensors and actuators.
- To understand ARM processor architecture and its functions to meet out the computational and interface needs of growing mechatronic systems.
- To acquaint the knowledge of real time embedded operating system for advanced system developments.
UNIT- I  MICROCONTROLLER  9
Fundamentals Functions of ALU - Microprocessor - Microcontrollers – CISC and RISC – Types
Microcontroller - 8051 Family - Architecture - Features and Specifications - Memory Organization -
Instruction Sets – Addressing Modes.

UNIT- II  PROGRAMMING AND COMMUNICATION  9
Fundamentals of Assembly Language Programming – Instruction to Assembler – Compiler and
IDE - C Programming for 8051 Microcontroller – Basic Arithmetic and Logical Programming -
Timer and Counter - Interrupts – Interfacing and Programming of Serial Communication, I^2C, SPI and
CAN of 8051 Microcontroller – Bluetooth and WI-FI interfacing of 8051 Microcontroller.

UNIT- III  PERIPHERAL INTERFACING  9
I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic,
RTC, interfacing of ADC and DAC, Sensors - Relays - Solenoid Valve and Heater - Stepper
Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor –
Overview of Advanced Microcontrollers.

UNIT- IV  INTRODUCTION TO ARM 7 CORE  8
Introduction ARM 7 Processor - Internal Architecture – Modes of Operations – Register Set –
Instruction Sets – ARM Thumb - Thumb State Registers – Pipelining – basic programming of ARM
7 - Applications.

UNIT- V  REAL TIME MODELS, LANGUAGES AND OPERATING SYSTEMS  10
Models and Languages – State Machine and State Tables in Embedded Design – High Level
Language Descriptions – Real Time Kernel - OS Tasks - Task Scheduling - Kernel Services –
Real Time Embedded Operating Systems - Real Time Programming Languages - GPIO
Programming – Comparative Overview of C and Python for Embedded Systems.

TOTAL:  45 PERIODS

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

CO1: Select the microcontroller based on the features and specifications.
CO2: Setup the programming platform and establish the various communications.
CO3: Design the microcontroller based interfacing of sensors, actuators and other I/O’s for
controller development.
CO4: Use and program the ARM processor growing needs of mechatronic systems.
CO5: Establish and use the real time embedded operating systems and programming languages
for peripheral interfacing and control.

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REFERENCES
Applications”, 2003
COURSE OBJECTIVES

• To give the hands on experience on designing a microcontroller based I/O interface circuits.
• To acquire the practice on programming the interfaces of keyboards, sensors, actuators, timers and counters, display devices and communication protocols using 8051 microcontroller and ARM processor.

LIST OF EXPERIMENTS

1. Assembly Language Programming and Simulation of 8051.
2. Alphanumeric and Graphic LCD Interfacing using 8051 Microcontroller.
3. Input switches and keyboard interfacing of 8051.
4. Sensor Interfacing with ADC to 8051 and DAC & RTC Interfacing with 8051.
5. Timer, Counter and Interrupt Program Application for 8051.
6. Step Motor (Unipolar & Bipolar Motor) and PWM Servo Motor Control to Interfacing with 8051.
7. UART Serial and Parallel Port Programming of 8051.
8. I2C, SPI and CAN Programming of 8051.
9. Interfacing and Programming of Bluetooth and Wi-Fi with 8051.

TOTAL = 60 PERIODS

COURSE OUTCOMES

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

CO1: Design and use a microcontroller based system control with I/O interface circuit.

CO2: Program the interfaces of keyboards, sensors, actuators, timers and counters, display devices and communication protocols using 8051 microcontroller and ARM processor.

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MR5212 SIMULATION, PROGRAMMING AND AUTOMATED INSPECTION LABORATORY

COURSE OBJECTIVES

• To Model, Simulate and verify the forward and inverse kinematics of serial manipulators for trajectory generation and to attain the exposure on robot programming.
• To realize the integrated operation of mechatronics system thorough CNC Programming methods for part manufacturing.
• To observe, practice and analyze the function of automated quality inspection and classifications system for dimensional and non-dimensional features.
SIMULATION AND PROGRAMMING OF ROBOTS
1. Simulation of Forward and Inverse Kinematics of Planar Manipulators.
2. Simulation of Forward and Inverse Kinematics of Spatial Manipulators.
3. Trajectory Planning of Planer Manipulators.
4. Trajectory Planning of Spatial Manipulators.
5. Experiments on Programming of Serial Manipulators.
   - Articulated Robot.
   - Cartesian Robot.

PROGRAMMING OF CNC MACHINES
1. NC Programming on CNC Routers, Vertical Machining Centre and Turning Centre
2. Programming of EDM and Water Jet Cutting.

AUTOMATED MEASUREMENT AND INSPECTION
1. Conveyor Based Object Sorting using Sensors.
2. Conveyor with Vision Based Object Classification.

TOTAL = 60 PERIODS

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

CO1: Simulate and validate the kinematics and trajectory of various configurations and qualified on programming the industrial serial manipulator for the desired applications.

CO2: Formulate the programming of part manufacturing using CNC based machines according to the nature of the part and materials.

CO3: Use the automated dimensions measurement system and give the design suggestion for vision based quality inspection and classification system for manufactured products.

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MR5311 DISSEMINATION - I

OBJECTIVES:
- To enable students to select and define a problem/need for analysis in the field of mechatronic and its interdisciplinary area based on the complexity of the problem.
- To review and analyse literature/data of selected problem for study and propose objective and scope of dissertation work.
- To develop hypothesis and identify methodology based on ethical, scientific and systematic application of knowledge in the proposed field of dissertation work.
- To design, model and experiment/develop optimal solution for problem being investigated
- To analysis and interpretation of system and its performance, data, and synthesis of the information to provide valid conclusions and submit dissertation.
EVALUATION:

- 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 in design, modelling, simulation, developing algorithms, fabrication and integration of system elements for automation and research. Literature survey and a part of the project work be carried out in dissertation-I.
- The progress of the project is evaluated based on a minimum of three reviews and review committee may be constituted by the Head of the Department.
- 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 dissertation-I is to be submitted at the end.
- Project work evaluation is based on the Regulations of the Credit system for the Post graduate programmes of Anna University

TOTAL = 180 PERIODS

OUTCOMES:

CO1: 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 and get trained in planning, organizing and coordination various components of dissertation work.

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MR5312 INDUSTRIAL TRAINING/ INTERNSHIPS/ CERTIFIED TRAINING COURSES

COURSE OBJECTIVES

INTERNSHIPS

- To assess defined problems in the industry and to provide the feasible solutions based on the skills of the graduate through internship.

INDUSTRIAL TRAINING

- To assess and acquire the training by observing and analyzing the functioning of various machineries and its elements in the industrial training.

CERTIFIED TRAINING COURSES

- To acquire certified training on various design and automation systems and its technologies offered by state / central approved institution.

COURSE OUTCOMES

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

INTERNSHIPS

CO1: Give feasible solutions to the industrial problem using systematic approach.
INDUSTRIAL TRAINING
CO2: Get qualified and practiced to work in the industrial environment.

CERTIFIED TRAINING COURSES
CO3: Work in the industrial technologies on the certified platform.

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TOTAL = 30 PERIODS

MR5411 DISSESSATION - II

OBJECTIVES:
- The students will be able to propose and define a problem/need for development and analysis in the field of mechatronic and its interdisciplinary area and it may be a continuation dissertation - I or newly formulated problem for dissertation - I.
- To comprehensively review and analyse literature/ data to develop hypothesis and identify methodology based on ethical, scientific and systematic application of knowledge in the field of problem.
- To design, modelling, simulation, developing algorithms, fabrication and integration of system elements for automation for development of sustainable and economical solution for problem being investigated.
- To analyse and interpretation of system and its performance, data, and synthesize of the factual information’s to arrive at valid conclusions
- To enable students to communicate technical information in form of oral presentation and technical report in form of dissertation

EVALUATION:
- 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 Department based on oral presentation and the project report.
- Project work evaluation is based on the Regulations of the Credit system for Post graduate programmes of Anna University.

OUTCOMES:
CO1: 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.

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TOTAL = 360 PERIODS
COURSE OBJECTIVES
To familiarize the measurement standards and to know the instruments used and various errors in measurements
- To recognize the use of basic and advanced instruments for measurements.
- To learn the applications of opto-electronics device for measurements.
- To observe the machine vision based inspections.
- To acquire the measurement strategies in inspection using CMM.

UNIT – I FUNDAMENTALS AND CONCEPTS IN METROLOGY 9

UNIT – II INSPECTION AND GENERAL MEASUREMENTS 10

UNIT – III OPTO ELECTRONICS IN ENGINEERING INSPECTION 8

UNIT – IV MACHINE VISION 9

UNIT – V COORDINATE METROLOGY AND QUALITY CONTROL 9

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1: Practice the standards in measurements and to avoid the various forms of errors in measurements.
CO2: Use of basic and advanced metrology instruments for measurements.
CO3: Acquire the knowledge on non-contact opto-electronics device for measurements.
CO4: Apply machine vision based inspections.
CO5: Plan the measurement strategies in inspection using CMM.

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REFERENCES

MR5002 DIGITAL MANUFACTURING

COURSE OBJECTIVES
- To interpret the classification of conventional machine tools and differences of NC, CNC and DNC.
- To understand the architecture of CNC and to identify the mechatronic elements and its functions in CNC machine reliable performance.
- To know the function various instrumentation system for parameter measurement and interface
- To understand standards and programming techniques in CNC machine.
- To learn the testing and maintenance of various sub systems of CNC.

UNIT – I NC, CNC, AND DNC

UNIT – II MECHATRONIC ELEMENTS IN CNC MACHINE TOOLS

UNIT – III INSTRUMENTATION SYSTEM AND AUTO TOOLING

UNIT – IV CNC PROGRAMMING
UNIT – V  TESTING AND MAINTENANCE OF CNC MACHINES


TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Aware the differences of NC, CNC and DNC.
CO2: Analyze architecture of CNC and to identify the mechatronic elements and its functions in CNC machine reliable performance.
CO3: Realize the functions of instrumentation systems
CO4: Write the part programing in CNC machine.
CO5: Perform the testing and maintenance of various sub systems of CNC.

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REFERENCES:


MR5003 SINGLE BOARD COMPUTERS AND PROGRAMMING

COURSE OBJECTIVES

- To know the architecture Single board computers
- To understand the function and uses of Real time operating system
- To familiar the python programming
- To develop the embedded based python programming
- To experiment the application development in SBC using python programming.

UNIT- I INTRODUCTION TO SINGLE BOARD COMPUTERS

UNIT- II    REAL TIME OPERATING SYSTEM  8

UNIT- III    PYTHON PROGRAMMING  10

UNIT- IV    EMBEDDED PYTHON PROGRAMMING  9

UNIT- V    APPLICATIONS  9

TOTAL = 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1: Select the Single board computers for mechatronics system development
CO2: Access the library and functions for Real time operating system
CO3: Write the python programming for various applications
CO4: Use the GPIO and peripherals using embedded based python programming
CO5: Develop the application in SBC using python programming.

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REFERENCES

MR5004    MICRO AND NANO SYSTEMS  L T P C
          3 0 0 3

COURSE OBJECTIVES
- To introduce to microsystem of MEMS, material and fabrication technique
- To provide overview of characterization tools for MEMS
- To create awareness about principles and applications of various sensors
- To impart knowledge on different kind of Micro-Nano actuators
- To introduce Bio MEMS, Microfluidic and Nano position system
UNIT- I INTRODUCTION TO MICRO AND NANO TECHNOLOGY

UNIT- II CHARACTERIZATION OF MATERIALS

UNIT- III MICRO AND NANO SENSORS

UNIT- IV MICRO AND NANO ACTUATORS

UNIT- IV MICRO AND NANO SYSTEM

TOTAL: 45 PERIODS

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

CO1: Understand material and fabrication involved in Microsystems
CO2: Explain techniques to visualize and measure geometrical features of MEMS system and chemical composition.
CO3: Select a type of sensors based on application with working knowledge and principles.
CO4: Select a type of factor based on application with knowledge of working principle.
CO5: Discuss on Micro fluidic, Bio MEMS and Nano position systems.

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36
REFERENCES:

MN5072 GREEN CONCEPTS L T P C
3 0 0 3

OBJECTIVES
- To impart knowledge about air pollution and its effects on the environment.
- To enlighten the students with knowledge about noise and its effects on the environment.
- To enlighten the students with knowledge about water pollution and its effects on the environment.
- To impart the knowledge of fire safety and its production.
- To impart the knowledge about the need, procedure and benefits of Green-Co rating.

UNIT I AIR POLLUTION SAMPLING AND MEASUREMENT
Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behaviour dispersion of air Pollutants-solution to the atmosphere dispersion equation-the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants collection of particulate pollutants-stock sampling, analysis of air pollutants-sulphur dioxide-nitrogen dioxide, carbon monoxide, oxidants and ozone

UNIT II NOISE POLLUTION AND CONTROL
Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise-Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.

UNIT III WATER DEMAND AND WATER QUALITY
Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

UNIT IV FIRE SAFETY

UNIT V GREEN CO-RATING

TOTAL: 45 PERIODS
OUTCOMES:
Students will be able to

CO1: Understand manufacturing processes towards minimization or prevention of air pollution.
CO2: Understand manufacturing processes towards minimization or prevention of noise pollution.
CO3: Understand manufacturing processes towards minimization or prevention of water pollution.
CO4: Presenting the knowledge of fire safety and its production.
CO5: Predicting green co-rating and its benefits.

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MR5071 INDUSTRIAL ROBOTICS

L T P C 3 0 0 3

COURSE OBJECTIVES
- To know the basic terminologies, classification of robot and configurations of serial manipulator.
- To understand the mechanical design and kinematics of serial manipulator.
- To learn the robot programing and safety consideration of industrial manipulator.
- To understand the concepts and stabilization of legged and wheeled mobile robots.
- To demonstrate the robots in various applications.

UNIT - I INTRODUCTION TO SERIAL MANIPULATORS 9

UNIT - II MECHANICAL DESIGN OF ROBOT SYSTEM 11

UNIT- III ROBOT PROGRAMMING & ROBOTIC WORK CELLS 9
UNIT- IV  MOBILE ROBOTICS

UNIT - V  APPLICATIONS OF ROBOTS

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1: Classify the various configurations of serial manipulators.
CO2: Develop the kinematics solution of serial manipulator.
CO3: Find the differences of robot programing languages and safety consideration of industrial manipulator.
CO4: Develop the legged and wheeled mobile robots.
CO5: Demonstrate the robots in various applications.

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REFERENCES:

MR5005  MULTI-BODY DYNAMICS

COURSE OBJECTIVES
- To understand the important concepts of multi-body dynamics.
- To familiar the various computational methods multi-body dynamics.
- To characterize the nonlinear concepts of multi-body dynamics.
- To recognize the need of control in nonlinear dynamics multi body interactions.
- To interpret the nonlinear dynamics of multi body systems and its realization of control.

UNIT - I  INTRODUCTION TO DYNAMICS
UNIT- II  COMPUTATIONAL METHODS FOR DYNAMIC ANALYSIS  10
Jacobian Matrix - Newton-Raphson Method - Nonlinear Kinematic Constraint Equation – System

UNIT - III  NONLINEAR SYSTEMS AND CONCEPTS  10
Linear Time Varying and Linearization – Input and Output Stability - Lyapunov Stability Analysis –
Asymptotic Stability - Popov’s and Circle Criterion - Perturbed System – Chaos – Periodic Orbits-
Index theory and Limit Cycle – Center Manifold Theory- Normal Forms- Nonlinear analysis-
Poincare Maps - Bifurcations – Maps - Vector Fields - Methods – Control System Design using
Lyapunov's Direct Method

UNIT - IV  SYSTEM CHARACTERIZATION  8
Stability, Controllability, Observability - Phase Plane Analysis - Phase Portrait - Limit Cycle -
Describing Function - Assumption – Limit Cycles

UNIT - V  CONTROL OF NONLINEAR MECHANICAL SYSTEMS  8

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1: Use the important concepts in multi-body dynamics.
CO2: Formulate mathematical model for capturing the dynamics of multi-body interactions.
CO3: Describe the nonlinear behavior of multi-body dynamics.
CO4: Practice the control in nonlinear dynamics of multi body interactions.
CO5: Demonstrate control for the nonlinear behavior of multi body systems.

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REFERENCES
5. Stephen Wiggins, “Introduction to Applied Nonlinear Dynamics System and Chaos”, Springer-
   Verlag, 2000.
COURSE OBJECTIVES

- To equip students with fundamentals of finite element principles.
- 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 to emphasis on structural, thermal, Electrical and fluid engineering applications.
- To make them to understand to shape functions and higher order formulation.
- To learn various quantities in engineering problems and also make them to work on preprocessing, meshing, boundary condition assigning and post processing.
- To make them to work on real time problem by giving various case studies and explore them to the FEM software available in the market.

UNIT- I INTRODUCTION 8

UNIT- II ONE DIMENSIONAL ANALYSIS 10

UNIT- III SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS 9

UNIT-IV ELECTROMECHANICAL SYSTEMS AND IMPLEMENTATION 9

UNIT-V CASE STUDIES 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the fundamentals of finite element principles.
CO2: Select appropriate elements to solve Physical and Engineering problem in structural, thermal, Electrical and fluid engineering applications.
CO3: Understand shape functions and higher order formulation.
CO4: Do pre-processing and select appropriate element, boundary condition, meshing and Post processing for any engineering problem.
CO5: Know about various software packages used for FEM analysis and analyse a production process through FEA and control it’s parameters.
REFERENCES

COURSE OUTCOMES  

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COURSE OBJECTIVES
- To familiarize the fundamentals of biomechanics.
- To characterize and relate the behaviors of skeletal and muscular systems for engineering solutions.
- To understand the servomechanism of biological systems.
- To design artificial structural elements for replacements.
- To simulate and develop the applications of biomechatronics.

UNIT- I  BIOMECHANICS

UNIT- II  MECHANICS IN SKELETAL AND MUSCULAR SYSTEM

UNIT - III  CONTROL MECHANISM OF BIOLOGICAL SYSTEMS
Skeletal Muscles Servo Mechanism, Cardio Vascular Control Mechanism, Respiratory Control Mechanism – Interfacing Techniques with Natural Servo Mechanism.

UNIT - IV  PROSTHETIC AND ORTHOTIC DEVICES
UNIT - V  
SIMULATION AND MODELLING OF BIOMECHANTRONICS


TOTAL: 45 PERIODS

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

CO1: Know the fundamentals of biomechanics.

CO2: Describe and relate the behaviors of skeletal and muscular systems.

CO3: Realize the servomechanism of biological systems for biomechatronic development.

CO4: Design the artificial biomechatronics systems.

CO5: Establish and develop the applications of biomechatronics.

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REFERENCES

MR5008  
APPLIED SIGNAL PROCESSING  
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COURSE OBJECTIVES
- To understand the characteristics of various types of signals.
- To carry out the preprocessing of different form of signals using digital filters and denoising methods.
- To learn FFT and ARMA methods in signals processing.
- To demonstrate the signal processing in time and frequency domain.
- To utilize the spectral and cepstral analysis of signals.

UNIT - I  
SOURCES OF SIGNALS

UNIT - II  
**PRE-PROCESSING OF SIGNALS**  
9  

UNIT - III  
**DIGITAL SIGNAL PROCESSING**  
9  

UNIT - IV  
**FEATURE EXTRACTION METHODS**  
9  

UNIT - V  
**ANALYSIS AND APPLICATION OF SIGNAL PROCESSING**  
9  

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES**  
Upon completion of this course, the students will be able to:  
CO1: Classify the various types of signals.  
CO2: Develop the preprocessing of different form of signals.  
CO3: Use the FFT and ARMA methods in signals processing.  
CO4: Demonstrate the signal processing in time and frequency domain.  
CO5: Utilize the spectral and cepstral analysis of signals.

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**REFERENCES**  
COURSE OBJECTIVES

- To recall the fundamentals of PID control and familiar various performance measures used in control systems.
- To interpret the single loop control and it’s tuning.
- To model, analyse the system in state space and its observer design in detail
- To familiar the nonlinear control system and its concepts.
- To learn the functions and used of various control methodology.

UNIT - I CONTROLLER AND PEREFORMANCE MEASURES

UNIT- II ENHANCEMENT TO SINGLE LOOP CONTROL

UNIT - III STATE SPACE ANALYSIS

UNIT - IV NONLINEAR SYSTEMS AND CONTROL

UNIT - V OTHER CONTROL METHODS

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

CO1: Develop the PID control and capable to analyze performances of the control systems.
CO2: Know the functions of various types of single loop control and its tuning.
CO3: Examine the system in state space and its observer design in detail
CO4: Approach the nonlinear control system and its concepts.
CO5: Recognize the uses of various control methodology.

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TOTAL: 45 PERIODS
REFERENCES:

MR5010 HAPTICS AND MIXED REALITY

COURSE OBJECTIVES
- To identify the terminologies of haptic devices.
- To understand the structure of haptic system and to aware the tele-operation for various applications.
- To acquire the knowledge on modelling for haptic system development relevant to the human.
- To emphasize the significance of knowledge in virtual and augmented reality.
- To know the concepts and hardware of mixed reality.

UNIT - I INTRODUCTION TO HAPTICS
- Definition - Importance of Touch - Tactile Proprioception - Tactual Stereo Genesis - Kinesthetic Interfaces - Tactile Interfaces - Human Haptics - Overview of Existing applications - Basics of Force Feedback Devices - Kinesthetic Vs. Tactile Haptic Devices - Configurations of Kinesthetic Devices - Types of Kinesthetic Devices -

UNIT – II KINESTHETIC HAPTIC DEVICES AND TELEOPERATION

UNIT - III HUMAN HAPTICS ITS PLATFORM

UNIT-IV VIRTUAL AND AUGMENTED REALITY
UNIT-V  MIXED REALITY


TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Recognize the haptic technology and its concepts in various haptic systems.
CO2: Classify the elements of haptics system and tele-operation in detail.
CO3: Design and use the devices in human haptic applications.
CO4: Combine and build the virtual and augmented reality based models.
CO5: Develop the design and model the hardware of mixed reality.

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REFERENCES


MR5011  HUMAN MACHINE INTERFACE

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COURSE OBJECTIVES

- To familiar the need for HMI in mechatronic systems
- To distinguish the software and hardware elements of HMI
- To enlist the requirement of human for machine interaction
- To model the integrated framework for man and machine interface.
- To elaborate the EEG signals and its types based brain machine interface.
UNIT - I  
INTRODUCTION TO HMI  
9

UNIT - II  
ELEMENTS OF HMI  
9

UNIT - III  
PERCEPTION, MEMORY, COGNITION  
9

UNIT - IV  
INTEGRATED MODELLING FRAMEWORK  
9

UNIT - V  
BRAIN COMPUTER INTERFACE  
9
Introduction to BCI – Brain Regions and Responsibilities - Active Methods for Measuring Brain Activity – Invasive and Non-Invasive Procedures - EEG – P300 - VEP - ERD - NIRS – Application in Prosthetic Control - Neurorehabilitation – Neurotraining – Brain Controlled Wheel Chairs

TOTAL: 45 PERIODS

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

CO1: Understand the need for HMI in mechatronic systems
CO2: Know the software and hardware elements of HMI
CO3: Familiar the requirement for human machine interaction
CO4: Model the integrated framework for man and machine interface
CO5: Design and analyze EEG signals based machine interface.

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REFERENCES
COURSE OBJECTIVES
- To familiar the fundamentals of image processing and functioning of camera.
- To appreciate 3 dimensional structure and motions.
- To learn the visual servicing for robotic applications
- To understand the fundamentals of Neural network
- To appreciate and develop the deep learning networks for image processing

UNIT – I  IMAGE FORMATION AND CAMERA CALIBRATION  9

UNIT – II  3-D STRUCTURE AND MOTION  10
Computational Stereopsis – Geometry, Parameters – Correspondence Problem, Epipolar Geometry, Essential Matrix And Fundamental Matrix, Eight Point Algorithm – Reconstruction by Triangulation, 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 – Image Processing.

UNIT – III  ACTIVE AND ROBOT VISION  8

UNIT – IV  INTRODUCTION TO NEURAL NETWORKS  8

UNIT – V  DEEP LEARNING  10

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1: Process and practice the basic images.
CO2: Develop the 3-Dimensional structures and motions.
CO3: Model the visual serving for robotic applications
CO4: Acquire and practice the basic neural networks.
CO5: Develop and train the deep learning networks for image processing.
REFERENCES

MN5074 QUALITY AND RELIABILITY ENGINEERING L T P C
3 0 0 3

OBJECTIVES:
- To study the approaches and techniques to assess quality by statistical process control.
- To study the methodology to assess and sampling of parameters
- To introduce to experimental design and Taguchi method.
- To illustrate the students the concepts of reliability engineering tools.
- To train students the design for reliability and maintainability.

UNIT I QUALITY AND STATISTICAL PROCESS CONTROL 8

UNIT II ACCEPTANCE SAMPLING 8

UNIT III EXPERIMENTAL DESIGN AND TAGUCHI METHOD 9

UNIT IV CONCEPT OF RELIABILITY AND DESIGN 9
Definition – reliability vs quality, reliability function – MTBF, MTTR, availability, bathtub curve – time dependent failure models – distributions – normal, Weibull, lognormal – Reliability of system and models – serial, parallel and combined configuration – Markove analysis, load sharing systems, standby systems, covariant models, static models, dynamic models.
UNIT V  DESIGN FOR RELIABILITY AND MAINTAINABILITY  11

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.

TOTAL: 45 PERIODS

OUTCOMES:
Student will be able to

CO1 : Understand the basic techniques of quality improvement, fundamental knowledge of statistics and probability and use control charts.

CO2 : Describe different sampling plans.

CO3 : Solve problems by various design methods.

CO4 : Acquire basic knowledge of reliability.

CO5 : Implement the concepts of reliability and maintainability.

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MR5013  MACHINE VISION  L T P C  3 0 0 3

COURSE OBJECTIVES
- To understand human vision, computer vision, machine vision and physics of light.
- To learn about the different light source, lighting technique, lens, sensors, interfacing and need to learn how to select all of them based on application.
- To understand various image processing techniques and need to develop image processing algorithm.
- To learn about various 3D image reconstruction techniques.
- To apply hardware selection steps, to develop software for various application.
UNIT- I INTRODUCTION TO MACHINE VISION

UNIT – II IMAGE ACQUISITION

UNIT – III IMAGE PROCESSING

UNIT – IV IMAGE ANALYSIS

UNIT – V MACHINE VISION APPLICATIONS

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon the completion of this course, the students will be able to;
CO1: Understand the difference between the vision systems and were able to remember the functions of vision system.
CO2: Select appropriate lighting source, lighting technique, lens, sensor and interfacing.
CO3: Develop image processing algorithms.
CO4: Understand various 3D image reconstruction techniques.
CO5: Select appropriate hardware and develop algorithms to solve the real time monitoring and inspection problem.

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REFERENCES
COURSE OBJECTIVES

- To introduce the architecture, sub-systems of car and engines types and its functions of automobile.
- To familiar the elements and functions of manual and automatic transmission, suspension and steering systems.
- To understand functions of safety and diagnostic system and to familiar the role of ECU, communication protocols and modern automotive.
- To understand integration of various sub-system in aerial vehicles.
- To appreciate the integration of various subsystems in aerial vehicles.

UNIT – I  INTRODUCTION TO AUTOMOTIVE AND ENGINE CONTROL  10

UNIT – II  TRANSMISSION, SUSPENSION, STEERING SYSTEMS  9

UNIT – III  SAFETY SYSTEMS AND ECU  8

UNIT – IV  AIRCRAFT MECHATRONICS  9

UNIT – V  MARINE MECHATRONIC SYSTEMS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Acquainted the architecture, sub-systems of car and engines types and its functions of automobile.

CO2: Model automatic transmission, suspension and steering systems

CO3: Use the ECU with communication protocols for modern automotive sub-systems.

CO4: Model and realize the integrated functions of various subsystem in aerial vehicles.

CO5: Model and understand the integrated functions of various subsystems in marine vehicles.
REFERENCES

COURSE OUTCOMES | Programme Outcomes
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MR5015 MOBILE ROBOTICS L T P C
UNIT-I INTRODUCTION TO MOBILE ROBOTICS 8

UNIT - II KINEMATICS 10

UNIT - III PERCEPTION 9
UNIT- IV  LOCALIZATION


UNIT - V  PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS


COURSE OUTCOMES

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

CO1: Select and configure the appropriate mobile robots for the desired application.

CO2: Formulate the kinematics of wheeled and legged robot.

CO3: Select the sensors for the intelligence of mobile robotics.

CO4: Articulate the localization strategies and mapping technique for mobile robot.

CO5: Plan the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

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TOTAL: 45 PERIODS

REFERENCES


MR5016  FIELD PROGRAMMABLE GATE ARRAYS FOR EMBEDDED SYSTEMS

COURSE OBJECTIVES

- To understand the various architectures of field programmable gate arrays.
- To familiar synchronous and asynchronous sequential circuit design
- To aware the fault diagnosis methods in FPGA.
- To learn the system design and programming of FPGA.
- To create the application specific system design.
UNIT - I  ARCHITECTURE OVERVIEW OF FPGA  9
Architecture of EPLD, Programmable Electrically Erasable Logic, CPLD Architectures – Xilinx
FPGA – Xilinx 2000 - Xilinx 4000 family - Architecture of EPLD, Programmable Electrically
Erasable Logic –TMS320C54x and TMS320C6x Architecture - Finite State Machines (FSM).

UNIT-II  SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN  10
FPGA Programming Technologies - FPGA Logic Cell Structures - FPGA Programmable
Interconnect and I/O Ports - FPGA Implementation of Combinational Circuits - FPGA Sequential
Circuits - Timing Issues in FPGA Synchronous Circuits - Analysis of Clocked Synchronous
Sequential Networks (CSSN) - Modelling of CSSN – State Stable Assignment and Reduction –
Design of CSSN – ASM Chart – ASM Realization - Analysis of Asynchronous Sequential Circuit
(ASC) – Flow Table Reduction – Races in ASC – State Assignment Problem and the Transition
Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards

UNIT-III  PROGRAMMING OF FPGA  9
FPGA Arithmetic Circuits - Design of SDRAM, Partial Reconfigurable FIR Filter Design, Design of
A/D Converter - Introduction to Verilog HDL and FPGA Design Flow with using Verilog HDL -
Programming FPGAs - Application Specific Integrated Circuit (ASIC) Systems Design and Library
Cell Design - Verilog and Logic Synthesis - VHDL and Logic Synthesis - Types of Simulation -
Boundary Scan Test - Fault Simulation - Automatic Test Pattern Generation.

UNIT IV  FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS  8
Fault Table Method – Path Sensitization Method – Boolean Difference Method – Kohavi Algorithm

UNIT V  DEVELOPMENT OF FPGA BASED HARDWARE  9
Design of Data Acquisition Device – 4 Channel, 8 Channel, Variable Sampling Rate and Design of
FPGA Based Controller - Design of Controller for High Speed Drives - Applications in Automation-
Automotive.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to: students learn to

CO1: Select the architectures of field programmable gate arrays for the desired applications.
CO2: Design the synchronous and asynchronous sequential circuits
CO3: Perform the fault diagnosis and Testing FPGA.
CO4: Develop system design and programming of FPGA.
CO5: Demonstrate the application of FPGA based specific system development.

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REFERENCES
Press, 2011
7. Rahul Dubey, "Introduction to Embedded System Design using Field Programmable Gate

56
COURSE OBJECTIVES

- To know the structure of robots and grippers in details
- To familiar the various approaches of kinematics solution of manipulator
- To accomplish the understanding of dynamics analysis of manipulator.
- To acquire the knowledge of AI techniques in robotics.
- To learn the computer oriented Modelling of Robots

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

UNIT-III ROBOT DYNAMICS AND TRAJECTORY PLANNING 10

UNIT-IV ROBOT PROGRAMMING AND AI 9

UNIT-V MODELLING AND SIMULATION 8

TOTAL: 45 PERIODS

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

CO1: Configure the robot and grippers in details
CO2: Solve the kinematics solution of manipulator
CO3: Analyze the dynamics analysis of manipulator.
CO4: Use the AI techniques in robotics.
CO5: Practice the computer oriented Modelling of Robots

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REFERENCES

MR5018 MACHINE LEARNING

COURSE OBJECTIVES
- To know the basic supervised learning methods for classification
- To understand the unsupervised learning and reinforced learning methods for classification
- To acquire the knowledge on neural network concepts and its types
- To recognize the fuzzy theory and classifications.
- To understand the genetic algorithm for various applications.

UNIT I SUPERVISED AND SEMI SUPERVISED LEARNING METHODS

UNIT II UNSUPERVISED & REINFORCEMENT LEARNING METHODS
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
Perceptron – Basic Networks, Probabilistic Neural Network (PNN) - Back-Propagation (BPN) - Hopfield Network - Self-Organizing Map (SOM) - Learning Vector Quantization (LVO)- Adaptive Resonance Theory I – Adaptive Resonance Theory II - Case Studies on GA based Algorithm Development.

UNIT IV FUZZY CLASSIFICATION

UNIT V GENETIC ALGORITHMS

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1: Use supervised learning methods for classification
CO2: practice unsupervised learning and reinforced learning methods for classification
CO3: Experiment the neural network concepts and its types
CO4: Establish the fuzzy theory for classifications in various applications.
CO5: Demonstrate the genetic algorithm for various applications.
REFERENCES

MR5019 MEDICAL MECHATRONICS L T P C
3 0 0 3

COURSE OBJECTIVES
• To know the various types of human functional system and basic human functional measurement instrumentation.
• To understand the mechatronic elements in various assisting and therapeutics equipment.
• To realize the integrations of in cardiac and regulatory functions assist systems.
• To acquire the architecture and functions of medical imaging equipment.
• To introduce the sensory assist devices and automated analysed in medical field.

UNIT- I INTRODUCTION TO MEDICAL MECHATRONICS 10

UNIT - II ASSISTING AND THERAPEUTIC EQUIPMENTS 8

UNIT- III CARDIAC AND REGULATORY ASSIST SYSTEM 10
UNIT-IV  MEDICAL IMAGING


UNIT- V  SENSORY ASSIST DEVICES AND AUTOMATED ANALYZER


TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Realize the uses of human functional measurement instrumentations.

CO2: Recognize the mechatronic elements in various assisting and therapeutics equipment.

CO3: Observe the integrations of in cardiac and regulatory functions assist systems.

CO4: Describe the elements and functions of medical imaging equipment.

CO5: Suggest the appropriate sensory assist devices and automated analysed in medical field.

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MR5020  COMMUNICATION PROTOCOLS

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<td>To develop the wired and wireless functions of various protocols.</td>
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UNIT - I WIRED BUSES AND PROTOCOLS

UNIT - II WIRELESS PROTOCOLS

UNIT - III INDUSTRIAL AND AUTONOMOUS SYSTEMS WIRED NETWORKS

UNIT - IV INDUSTRIAL WIRELESS NETWORKS
Overview of Industrial Wireless Networks - IWLAN - ISA100 Standards – Remote Networks- Controller-Based Networks - Wireless HART Technology - 3G/4G for Automation – RFID Data Tags.

UNIT - V APPLICATION OF COMMUNICATION PROTOCOLS

TOTAL =45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1: Design wired protocols for electronic system.
CO2: Use wireless protocols for electronic system.
CO3: Practice industrial wired protocols in automation.
CO4: Select wireless protocols for industrial automation.
CO5: Demonstrate the wired and wireless functions of various protocols in application development.

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REFERENCES
MR5072  INDUSTRY 4.0 AND INTERNET OF THINGS  L T P C  3 0 0 3

COURSE OBJECTIVES
- To introduce and familiarize the industry 4.0 and its physical structure and inter-connectivity.
- To understand the architecture, IOT and its protocols
- To outline the cloud computing and data analytics
- To familiar the concepts of integrated IOT.
- To learn the IOT, cloud computing, data analytics and Industry 4.0

UNIT - I  INDUSTRY 4.0  10
Digitalization and the Networked Economy - Introduction to Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory - Internet of Things (IoT) - Industrial Internet of Things (IIoT) - Smart Devices and Products - Smart Logistics - Support System for Industry 4.0 - Cyber-physical Systems Requirements - Data as a New Resource for Organizations - Cloud Computing - Trends of Industrial Big Data and Predictive Analytics for Smart Business- Architecture of Industry 4.0.

UNIT - II  IOT AND ITS PROTOCOLS  8

UNIT - III  CLOUD COMPUTING  10

UNIT - VI  INTEGRATED IOT  9

UNIT - V  APPLICATIONS  8

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1: Realize the need of industry 4.0 and its inter-connectivity.
CO2: Interpret the architecture of IOT and its protocols
CO3: Recognize the uses of cloud computing and data analytics
CO4: Familiar the concepts of integrated IOT.
CO5: Plan the uses of IOT, cloud computing, data analytics and Industry 4.0 technologies.
REFERENCES:

MR5021 COMPUTER AIDED PRODUCTION AND AUTOMATION OF PLANTS

COURSE OBJECTIVES
- To acquire the knowledge on computer oriented digital factory modelling, process planning, inventory control, factory layout and machine works cell design.
- To understand the grouping and technology and flexible manufacturing systems and its techniques.
- To familiar the architecture of various types of material transportation and storage system and its functions in detail.
- To acquainted the manual and automated assembly design for automation.
- To learn the application of automation in various production industry

UNIT - I COMPUTER AIDED PRODUCTION PLANING

UNIT - II GROUP TECHNOLOGY AND FLEXIBLE MANUFACTURING SYSTEMS
UNIT - III  AUTOMATED MATERIAL TRANSFER AND STORAGE SYSTEM  9

UNIT - IV  ASSEMBLY LINE SYSTEMS AND AUTOMATION  8

UNIT - V  CASE STUDIES  9

TOTAL =45 PERIODS

OUTCOMES
Upon the completion of this course, the students will able to;

CO1: Model the digital factory and its process planning, inventory control, factory layout and machine works cell design.

CO2: Exercise the grouping technology and flexible manufacturing systems for industry.

CO3: Apply the automated material transportation in the industrial floors.

CO4: Experiment the automated assembly in production line.

CO5: Practise the application of automation concepts in various production industry to meet out the quality, demand and reduction of production cost.

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REFERENCES
COURSE OBJECTIVES
- To understand the basic principles of various NDT methods, Visual Inspection and Liquid Penetrant Testing.
- To learn the principle, instrumentation in Eddy current and Acoustic Emission techniques to determine and analyse defects.
- To understand the principle, instrumentation in Magnetic Particle Testing, Thermography, Ultrasonic Testing and Radiography to determine and analyse defects.
- To understand the role of NDT in quality assurance.
- To select suitable NDT technique based on application.

UNIT - I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING
9

UNIT – II EDDY CURRENT TESTING & ACOUSTIC EMISSION
9

UNIT – III MAGNETIC PARTICLE TESTING & THERMOGRAPHY
9

UNIT – IV ULTRASONIC TESTING & RADIOGRAPHY
9

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.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO2: Understand the working of Eddy current and Acoustic Emission techniques and apply to determine and analyse defects.
CO3: Apply Magnetic Particle Testing, Thermography, Ultrasonic Testing and Radiography and able to determine and analyse defects.
CO4: Understand the role of NDT in quality assurance.
CO5: Select suitable NDT technique based on application and acquainted the knowledge of all types of NDT and their applications in Engineering.
MR5023 MECHATRONICS IN ADVANCED MANUFACTURING SYSTEMS

COURSE OBJECTIVES

- To understand various mechatronics elements present in unconventional machines.
- To learn about Additive Manufacturing types, equipment’s and its impact on product development.
- To understand, analyse and make new compatible products using reverse engineering.
- To learn the principle, advantage and limitations of Additive Manufacturing base on liquid, solid, powder and various other types.
- To select an Additive Manufacturing process and material for a specific application.

UNIT - I UNCONVENTIONAL MACHINING PROCESSES


UNIT - II INTRODUCTION TO ADDITIVE MANUFACTURING


UNIT - III REVERSE ENGINEERING AND CAD MODELLING


REFERENCES:
4. www.ndt.net.
UNIT - IV  LIQUID AND SOLID BASED ADDITIVE MANUFACTURING

UNIT - V  POWDER BASED AND OTHER ADDITIVE MANUFACTURING

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1: Understand and compare various mechatronics elements present in unconventional machines.
CO2: Know the additive manufacturing types, equipment’s, its impact on product development and concepts of Rapid Prototyping.
CO3: Acquire the skills for modelling and developing the product using reverse engineering.
CO4: Understand the concept and compare product development using various additive manufacturing methods.
CO5: Select appropriate additive manufacturing method and develop a cutting-edge perspective on digital transformation and the factory of the future

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REFERENCES
COURSE OBJECTIVES

- To understand electrical actuator steady state operation and transient dynamics of a motor load system.
- To learn the operation and construction of solid state switching devices.
- To study the operation of various D.C. Motor drives and to select appropriate drive for speed and position control.
- To study the operation of various A.C Motor drives and to select appropriate drive for speed control.
- To study the operation of various Special Motor drives.

UNIT I  ELECRICAL ACUATORS AND DRIVE CHARACTERISTICS  

UNIT II  SOLID STATE SWITCHING DEVICES  
Solid State Relay - Switching Characteristics - Bipolar Junction Transistor (BJT), Metal Oxide Semiconductor - Field Effect Transistor Silicon Controlled Rectifier (SCR) - DIAC- TRIAC- Gate Turn-Off Thyristor (GTO) – Insulated Gate Bipolar Transistor (IGBT) - Classification Of PWM Techniques

UNIT III  D.C. MOTOR DRIVES  

UNIT IV  A.C. MOTOR DRIVES  

UNIT V  SPECIAL ELECTRICAL MOTOR DRIVES  

TOTAL = 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand electrical actuator steady state operation and transient dynamics of a motor load system.

CO2: Select suitable solid state switching devices.

CO3: Identify and apply appropriate drive for speed and position control for various D.C Motors.

CO4: Identify and apply appropriate drive for speed control for various A.C Motors.

CO5: Select suitable drives for special motors.
REFERENCES

OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS

COURSE OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.
UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE


Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:
- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK


Suggested Activities:
- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:
- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:
- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:
- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student will be able to:
- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce.
• Use open source frameworks for modeling and storing data.
• Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

OE5092 INDUSTRIAL SAFETY L T P C
3 0 0 3

COURSE OBJECTIVES:
• Summarize basics of industrial safety
• Describe fundamentals of maintenance engineering
• Explain wear and corrosion
• Illustrate fault tracing
• Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

UNIT IV FAULT TRACING 9
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.
UNIT V PERIODIC AND PREVENTIVE MAINTENANCE

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

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REFERENCES:

OE5093 OPERATIONS RESEARCH

COURSE OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I

Transportation problems -Northwest corner rule, least cost method, Voges’s approximation method - Assignment problem - Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II

Shortest path problem: Dijkstra’s algorithms, Floyd’s algorithm, systematic method - CPM/PERT
UNIT V NETWORK ANALYSIS – III
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

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OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS

OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.
UNIT IV  COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL  9
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-
Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, 
Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V  QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT  9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning 
Curve Theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control 
techniques
CO5 - Become familiar with quantitative techniques in cost management

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2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988

OE5095  COMPOSITE MATERIALS  L T P C
3 0 0 3

COURSE OBJECTIVES:
- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I  INTRODUCTION  9
Definition – Classification and characteristics of Composite materials - Advantages and application
of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement 
(size, shape, distribution, volume fraction) on overall composite performance.

UNIT II  REINFORCEMENTS  9
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical 
Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.
UNIT III  MANUFACTURING OF METAL MATRIX COMPOSITES

UNIT IV  MANUFACTURING OF POLYMER MATRIX COMPOSITES

UNIT V  STRENGTH
Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

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OE5096  WASTE TO ENERGY  L T P C  3 0 0 3

OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I  INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

75
UNIT II BIOMASS PYROLYSIS 9
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

UNIT IV BIOMASS COMBUSTION 9
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY 9
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

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AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING

COURSE OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS

UNIT III TITLE WRITING SKILLS
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES

CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

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REFERENCES

COURSE OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I  INTRODUCTION  6
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II  REPERCUSSIONS OF DISASTERS AND HAZARDS  6
Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Faminis, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Sicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III  DISASTER PRONE AREAS IN INDIA  6
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV  DISASTER PREPAREDNESS AND MANAGEMENT  6
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V  RISK ASSESSMENT  6
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

COURSE OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

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AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE

COURSE OBJECTIVES
- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS
Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES
Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS
Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE
Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING
Technical concepts of Engineering - Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

COURSE OUTCOMES
- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

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REFERENCES
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
COURSE OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

UNIT II

UNIT III

UNIT IV

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING

COURSE OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.
UNIT I   HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II   PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III   CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

UNIT IV   ORGANS OF GOVERNANCE:
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V   LOCAL ADMINISTRATION:

UNIT VI   ELECTION COMMISSION:
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING
1. The Constitution of India,1950 (Bare Act),Government Publication.
COURSE OBJECTIVES
Students will be able to:
- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the Dfid, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

COURSE OUTCOMES
Students will be able to understand:
- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING
AX5097  STRESS MANAGEMENT BY YOGA  L T P C  2 0 0 0

COURSE OBJECTIVES
- To achieve overall health of body and mind
- To overcome stress

UNIT I
Definitions of Eight parts of yoga.(Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don’t’s in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects- Types of pranayam

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. “Yogic Asanas for Group Tarining-Part-I”-Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098  PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS  L T P C  2 0 0 0

COURSE OBJECTIVES
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont’s) - Verses- 71,73,75,78 (do’s)

UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.
UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter 2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16, 17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter 2- Verses 17, Chapter 3-Verses 36, 37, 42 - Chapter 4-Verses 18, 38, 39 Chapter 18 – Verses 37, 38, 63

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

SUGGESTED READING
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar- vairagya, New Delhi, 2010