

ME3791

MECHATRONICS AND IoT

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COURSE OBJECTIVES

- 1 To make students get acquainted with the sensors and the actuators, which are commonly used in mechatronics systems.
 - 2 To provide insight into the signal conditioning circuits, and also to develop competency in PLC programming and control
 - 3 To make students familiarize with the fundamentals of IoT and Embedded systems.
 - 4 To impart knowledge about the Arduino and the Raspberry Pi.
 - 5 To inculcate skills in the design and development of mechatronics and IoT based systems.

UNIT – I SENSORS AND ACTUATORS

9

Introduction to Mechatronics - Modular Approach, Sensors and Transducers: Static and Dynamic Characteristics, Transducers - Resistive, Capacitive, Inductive and Resonant, Optical Sensors – Photodetectors - Vision Systems – Laser - Fibre optic - Non-fibre Optic, Solid State Sensors, Piezoelectric and Ultrasonic Sensors. Actuators – Brushless Permanent Magnet DC Motor – PM, VR and Hybrid Stepper motors – DC and AC Servo Motors

UNIT - II SIGNAL CONDITIONING CIRCUITS AND PLC

9

Operational Amplifiers – Inverting and Non-Inverting Amplifier – Wheatstone bridge Amplifier – Instrumentation Amplifier – PID Controller, Protection Circuits, Filtering Circuits, Multiplexer, Data Logger and Data Acquisition System –, Switching Loads by Power Semiconductor Devices Circuits – Thyristors – TRIAC – Darlington Pair –MOSFET and Relays.

PLC – Architecture – Input / Output Processing – Logic Ladder Programming – Functional Block Programming using Timers and Counters – Applications.

UNIT - III FUNDAMENTALS OF IoT AND EMBEDDED SYSTEMS

9

The Internet of Things (IoT) - Introduction to the IoT Framework – IoT Enabling Technologies- The Effective Implementation of IoT: The Detailed Procedure. Embedded Systems: An Introduction - Single-Chip Microcontroller Systems - Single-Board Microcontroller Systems - Single-Board Computer Systems - Embedded Systems: Peripherals - Software Considerations

UNIT - IV CONTROLLERS

9

Foundation topics: Programming Languages: C++ and Python - The Linux Operating System. Arduino: The Arduino Boards - Arduino Peripherals- Arduino IDE – ESP8266 Wi-Fi module. Raspberry Pi: The Raspberry Pi Boards - The Raspberry Pi Peripherals - The Raspberry Pi Operating System. (typical peripherals) Interfacing and Controlling I/O devices by Arduino and Raspberry Pi: LEDs - Push buttons - Light intensity sensor - Ultrasonic distance sensor – Temperature sensor- Humidity sensor - Sensor and Actuator interactions

UNIT – V MECHATRONICS AND IoT CASE STUDIES

9

Mechatronics systems: Drone actuation and Control - Autonomous Robot with Vision System, Automotive Mechatronics: Electronic Ignition System - ABS - EBD - Adaptive Cruise Control. IoT case studies: Remote Monitoring Systems- Remotely Operated Autonomous Systems - Centralized Water Management System - IoT Enabled Robotic Camera Dolly - Portable, Wireless, Interactive IoT Sensors for Agriculture - IoT Vehicle Management System with Network Selection.

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to

- OUTCOMES** At the end of the course the students would be able to

 1. Explain Select suitable sensors and actuators to develop mechatronics systems.
 2. Discuss Devise proper signal conditioning circuit for mechatronics systems, and also able to implement PLC as a controller for an automated system.
 3. Elucidate the fundamentals of IoT and Embedded Systems
 4. Discuss Control I/O devices through Arduino and Raspberry Pi.
 5. Design and develop an apt mechatronics/IoT based system for the given real-time application.

TEXT BOOKS:

1. Bradley D.A., Burd N.C., Dawson D., Loader A.J., "Mechatronics: Electronics in Products and Processes", Routledge, 2017.
 2. Sami S.H and Kisheen Rao G "The Internet of Mechanical Things: The IoT Framework for Mechanical Engineers", CRC Press, 2022.

REFERENCES:

1. John Billingsley, "Essentials of Mechatronics", Wiley, 2006
 2. David H., Gonzalo S., Patrick G., Rob B. and Jerome H., "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Pearson Education, 2018.
 3. Nitin G and Sharad S, "Internet of Things: Robotic and Drone Technology", CRC Press, 2022
 4. Newton C. Braga, "Mechatronics for The Evil Genius", McGrawHill, 2005.
 5. Bell C., "Beginning Sensor Networks with Arduino and Raspberry Pi", Apress, 2013

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ME3792

COMPUTER INTEGRATED MANUFACTURING

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COURSE OBJECTIVES

- 1 To provide the overview of evolution of automation, CIM and its principles.
 - 2 To learn the various Automation tools, include various material handling system.
 - 3 To train students to apply group technology and FMS.
 - 4 To familiarize the computer aided process planning in manufacturing.
 - 5 To introduce to basics of data transaction, information integration and control of CIM.

UNIT - I

INTRODUCTION

9

Introduction to CAD, CAM, CAD/CAM and CIM - Evolution of CIM – CIM wheel and cycle – Production concepts and mathematical models – Simple problems in production models – CIM hardware and software – Major elements of CIM system – Three step process for implementation of CIM – Computers in CIM – Computer networks for manufacturing – The future automated factory – Management of CIM – safety aspects of CIM– advances in CIM

UNIT - II

AUTOMATED MANUFACTURING SYSTEMS

9

Automated production line – system configurations, work part transfer mechanisms – Fundamentals of Automated assembly system – System configuration, Part delivery at workstations – Design for automated assembly – Overview of material handling equipments – Consideration in material handling system design – The 10 principles of Material handling. Conveyor systems – Types of conveyors – Operations and features. Automated Guided Vehicle system – Types & applications – Vehicle guidance technology – Vehicle management and safety. Storage system performance – storage location strategies – Conventional storage methods and equipments – Automated storage/Retrieval system and Carousel storage system Deadlocks in Automated manufacturing systems – Petrinet models – Applications in Dead lock avoidance – smart manufacturing – Industry 4.0 - Digital manufacturing – Virtual manufacturing

UNIT - III

GROUP TECHNOLOGY AND FMS

9

Part families – Visual – Parts classification and coding – Production flow analysis – Grouping of parts and Machines by rank order clustering method – Benefits of GT – Case studies. FMS – Components – workstations – FMS layout configurations – Computer control systems – FMS planning and implementation issues – Architecture of FMS – flow chart showing various operations in FMS – Machine cell design – Composite part concept, Holier method, Key machine concept – Quantitative analysis of FMS – Bottleneck model – Simple and complicated problems – Extended Bottleneck model - sizing the FMS – FMS applications, Benefits.

UNIT - IV

PROCESS PLANNING

9

Process planning – Activities in process planning, Informations required. From design to process planning – classification of manufacturing processes – Selection of primary manufacturing processes – Sequencing of operations according to Anteriorities – various examples – forming of Matrix of Anteriorities – case study. Typical process sheet – case studies in Manual process planning. Computer Aided Process Planning – Process planning module and data base – Variant process planning – Two stages in VPP – Generative process planning – Flow chart showing various activities in generative PP – Semi generative process planning- Comparison of CAPP and Manual PP.

UNIT - V

PROCESS CONTROL AND DATA ANALYSIS

9

Introduction to process model formulation – linear feedback control systems – Optimal control – Adaptive control –Sequence control and PLC& SCADA. Computer process control – Computer process interface – Interface hardware – Computer process monitoring – Direct digital control and Supervisory computer control - Overview of Automatic identification methods – Bar code technology –Automatic data capture technologies.- Quality management (SPC) and automated inspection

TOTAL :45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss the basics of computer aided engineering.
 2. Choose appropriate automotive tools and material handling systems.
 3. Discuss the overview of group technology, FMS and automation identification methods.
 4. Design using computer aided process planning for manufacturing of various components
 5. Acquire knowledge in computer process control techniques.

TEXT BOOKS:

1. Shivanand H K, Benal M M and Koti V, Flexible Manufacturing System, New Age, 2016.
 2. CIM: Computer Integrated Manufacturing: Computer Steered Industry Book by August-Wilhelm Scheer

REFERENCES:

1. Alavudeen and Venkateshwaran, Computer Integrated ManufacturingII, PHI Learning Pvt. Ltd., New Delhi, 2013.
 2. Gideon Halevi and Ronald D. Weill, Principles of Process PlanningII, Chapman Hall, 1995.
 3. James A. Retrg, Herry W. Kraebber, Computer Integrated ManufacturingII, Pearson Education, Asia,3rdEdition,2004.
 4. Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 4thEdition, 2014.
 5. Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers, 3rd Edition, 2008.

GE3791

HUMAN VALUES AND ETHICS

L T P C

2 0 0 2

COURSE DESCRIPTION

This course aims to provide a broad understanding about the modern values and ethical principles that have evolved and are enshrined in the Constitution of India with regard to the democratic, secular and scientific aspects. The course is designed for undergraduate students so that they could study, understand and apply these values in their day to day life.

COURSE OBJECTIVES:

- To create awareness about values and ethics enshrined in the Constitution of India
- To sensitize students about the democratic values to be upheld in the modern society.
- To inculcate respect for all people irrespective of their religion or other affiliations.
- To instill the scientific temper in the students' minds and develop their critical thinking.
- To promote sense of responsibility and understanding of the duties of citizen.

UNIT I DEMOCRATIC VALUES

6

Understanding Democratic values: Equality, Liberty, Fraternity, Freedom, Justice, Pluralism, Tolerance, Respect for All, Freedom of Expression, Citizen Participation in Governance – World Democracies: French Revolution, American Independence, Indian Freedom Movement.

Reading Text: Excerpts from John Stuart Mills' *On Liberty*

UNIT II SECULAR VALUES

6

Understanding Secular values – Interpretation of secularism in Indian context - Disassociation of state from religion – Acceptance of all faiths – Encouraging non-discriminatory practices.

Reading Text: Excerpt from *Secularism in India: Concept and Practice* by Ram Puniyani

UNIT III SCIENTIFIC VALUES

6

Scientific thinking and method: Inductive and Deductive thinking, Proposing and testing Hypothesis, Validating facts using evidence based approach – Skepticism and Empiricism – Rationalism and Scientific Temper.

Reading Text: Excerpt from *The Scientific Temper* by Antony Michaelis R

UNIT IV SOCIAL ETHICS

6

Application of ethical reasoning to social problems – Gender bias and issues – Gender violence – Social discrimination – Constitutional protection and policies – Inclusive practices.

Reading Text: Excerpt from *21 Lessons for the 21st Century* by Yuval Noah Harari

UNIT V SCIENTIFIC ETHICS

6

Transparency and Fairness in scientific pursuits – Scientific inventions for the betterment of society - Unfair application of scientific inventions – Role and Responsibility of Scientist in the modern society.

Reading Text: Excerpt from *American Prometheus: The Triumph and Tragedy of J. Robert Oppenheimer* by Kai Bird and Martin J. Sherwin.

TOTAL: 30 PERIODS

COURSE OUTCOMES

Students will be able to

- CO1 : Identify the importance of democratic, secular and scientific values in harmonious functioning of social life
- CO2 : Practice democratic and scientific values in both their personal and professional life.
- CO3 : Find rational solutions to social problems.
- CO4 : Behave in an ethical manner in society
- CO5 : Practice critical thinking and the pursuit of truth.

REFERENCES:

1. The Nonreligious: Understanding Secular People and Societies, Luke W. Galen Oxford University Press, 2016.
2. Secularism: A Dictionary of Atheism, Bullivant, Stephen; Lee, Lois, Oxford University Press, 2016.
3. The Oxford Handbook of Secularism, John R. Shook, Oxford University Press, 2017.
4. The Civic Culture: Political Attitudes and Democracy in Five Nations by Gabriel A. Almond and Sidney Verba, Princeton University Press,
5. Research Methodology for Natural Sciences by Soumitro Banerjee, IISc Press, January 2022

GE3792**INDUSTRIAL MANAGEMENT****L T P C**
3 0 0 3**COURSE OBJECTIVES**

- 1 To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
- 2 To study the planning; organizing and staffing functions of management in professional organization.
- 3 To study the leading; controlling and decision making functions of management in professional organization.
- 4 To learn the organizational theory in professional organization.
- 5 To learn the principles of productivity and modern concepts in management in professional organization.

UNIT – I INTRODUCTION TO MANAGEMENT**9**

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT – II FUNCTIONS OF MANAGEMENT – I**9**

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT – III FUNCTIONS OF MANAGEMENT – II**9**

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mouton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT – IV ORGANIZATION THEORY**9**

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivation-hygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT – V PRODUCTIVITY AND MODERN TOPICS**9**

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits); Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- CO1 Explain basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
- CO2 Discuss the planning; organizing and staffing functions of management in professional organization.
- CO3 Apply the leading; controlling and decision making functions of management in professional organization.
- CO4 Discuss the organizational theory in professional organization.
- CO5 Apply principles of productivity and modern concepts in management in professional organization.

TEXT BOOKS:

1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009.
2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCES:

1. Joseph J. Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.
2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.
3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.
4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012.
5. S. TrevisCerto, "Modern Management Concepts and Skills", Pearson Education, 2018.

MAPPING OF COS AND POS:

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ME3781

MECHATRONICS AND IoT LABORATORY

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COURSE OBJECTIVES

1. To study the concept of mechatronics to design, modelling and analysis of basic electrical hydraulic systems.
 2. To provide the hands on-training in the control of linear and rotary actuators.
 3. To study the concepts and fundamentals of IoT, sensors, actuators and IoT boards

MECHATRONICS

LIST OF EXPERIMENTS:

1. Measurement of Linear/Angular of Position, Direction and Speed using Transducers.
 2. Measurement of Pressure, Temperature and Force using Transducers.
 3. Speed and Direction control of DC Servomotor, AC Servomotor and Induction motors.
 4. Addition, Subtraction and Multiplication Programming in 8051.
 5. Programming and Interfacing of Stepper motor and DC motor using 8051/PLC.
 6. Programming and Interfacing of Traffic Light Interface using 8051.
 7. Sequencing of Hydraulic and Pneumatic circuits.
 8. Sequencing of Hydraulic, Pneumatic and Electro-pneumatic circuits using Software.
 9. Electro-pneumatic/hydraulic control using PLC.
 10. Vision based image acquisition and processing technique for inspection and classification.

INTERNET OF THINGS

- TERM PROJECT**

 1. Familiarization with concept of IoT and its open source microcontroller/SBC.
 2. Write a program to turn ON/OFF motor using microcontroller/SBC through internet.
 3. Write a program to interface sensors to display the data on the screen through internet.
 4. Interface the sensors with microcontroller/SBC and write a program to turn ON/OFF Solenoid valve through internet when sensor data is detected.
 5. To interface sensor with microcontroller/SBC and write a program to turn ON/OFF Linear/Rotary Actuator through IoT when sensor data is detected.
 6. To interface Bluetooth/Wifi with microcontroller/SBC and write a program to send sensor data to smart phone using Bluetooth/wifi.

TOTAL · 60 PERIODS

OUTCOMES: At the end of the course the students would be able to

- OUTCOMES:** At the end of the course the students would be able to

 1. Demonstrate the functioning of mechatronics systems with various pneumatic, hydraulic and electrical systems.
 2. Demonstrate the microcontroller and PLC as controllers in automation systems by executing proper interfacing of I/O devices and programming
 3. Demonstrate the sensing and actuation of mechatronics elements using IoT.

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Low (1) ;				Medium (2) ;				High (3)				

ME3811

PROJECT WORK

L T P C

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COURSE OBJECTIVE:

The objective of this course is to help the students to develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same, and to train the students in preparing project reports and to face reviews and viva voce examination.

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

TOTAL: 300 PERIODS

COURSE OUTCOME:

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

1. Take up any challenging practical problems and find solution by formulating proper methodology.

CME331

AUTOMOTIVE MATERIALS, COMPONENTS, DESIGN AND TESTING

L T P C
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COURSE OBJECTIVES

1. To study the functional requirements of engine components and suitable materials
 2. To learn to design of cylinder and piston components
 3. To learn to design of connecting rod and crank shaft
 4. To learn to design of flywheel and valve train
 5. To study the Engine Testing cycles, Emission measurement technologies

UNIT - I

FUNCTIONAL REQUIREMENTS OF ENGINE COMPONENTS AND SUITABLE MATERIALS

6

Functional requirements of engine components – Piston, piston pin, cylinder liner, connecting rod, crank shaft, valves, spring, engine block, cylinder head, and flywheel. Suitable materials for engine components.

UNIT - II

DESIGN OF CYLINDER AND PISTON COMPONENTS

6

UNIT - III

DESIGN OF CONNECTING ROD AND CRANK SHAFT

6