KAMARAJ
COLLEGE OF ENGINEERING & TECHNOLOGY
(An Autonomous Institution - AFFILIATED TO ANNA UNIVERSITY, CHENNAI)
S.P.G.Chidambara Nadar - C.Nagammal Campus
S.P.G.C. Nagar, K.Vellakulam – 625 701 (Near VIRUDHUNAGAR).

B.E. MECHATRONICS ENGINEERING
REGULATION – 2020
AUTONOMOUS SYLLABUS
CHOICE BASED CREDIT SYSTEM
VII TO VIII SEMESTER CURRICULUM AND SYLLABI

VISION:

To make the Department of Mechatronics Engineering of this Institution the unique of its kind in the field of Research and Development activities in this part of world.

MISSION:

To impart highly innovative and technical knowledge in the field of Mechatronics Engineering to the urban and unreachable rural student folks through Total Quality Education.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO 1: Graduates will be able to apply their multi-disciplinary knowledge to formulate, design, develop and analyse Mechatronics Systems.

PEO 2: Graduates will be able to come up with solution for any real time problems in the field of Mechatronics Engineering and allied areas demanded by the Industry and Society.

PEO 3: Graduates will be able to get familiarized with economical issues in Mechatronics Engineering and work in multi-disciplinary teams with ethical code of conduct.

PROGRAM OUTCOMES:

After going through the four years of study, the Mechatronics Engineering graduates will have the ability to

POs	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/Development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6	The engineer and society	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

7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long learning	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.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1 : Graduates will be able to apply their knowledge in sensors, drives, actuators, controls, mechanical design and modern software & hardware tools to design & develop cost effective Mechatronics systems.

PSO2 : Graduates will be able to become Technocrats and Entrepreneurs, build the attitude of developing new concepts on emerging fields and pursuing higher studies.

SEMESTER VII

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	GE1771	Principles of Management	HS	3	3	0	0	3
2	MT1701	Computer Aided Design and Manufacturing	PC	3	3	0	0	3
3	MT1702	Robotics and Machine Vision System	PC	3	3	0	0	3
4	PE IV	Professional Elective–IV	PE	3	3	0	0	3
5	PE V	Professional Elective–V	PE	3	3	0	0	3
6	OE II	Open Elective*	OE	3	3	0	0	3
		Online Course	OC	NPTEL/SWAYAM				3
PRACTICALS								
7	MT1711	Computer Aided Design and Manufacturing Laboratory	PC	4	0	0	4	2
8	MT1712	Robotics and Machine Vision System Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**25**

SEMESTER VIII

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1	MT1821	Project Work	EEC	16	0	0	16	8
			TOTAL	**16**	**0**	**0**	**16**	**8**

***** Course from the Curriculum of other UG programmes.

PROFESSIONAL ELECTIVES (PEs)

PROFESSIONAL ELECTIVE IV (SEMESTER VII)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	EI1634	Embedded System	PE	3	3	0	0	3
2	GE1671	Total Quality management	PE	3	3	0	0	3
3	MT1731	Autonomous Mobile Robot	PE	3	3	0	0	3
4	MT1732	Machine Learning and Deep Learning	PE	3	3	0	0	3
5	MT1733	Synthesis and characterization of Nano Materials	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE V (SEMESTER VII)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1	GE1471	Professional Ethics and Human Values	PE	3	3	0	0	3
2	ME1744	Maintenance Engineering	PE	3	3	0	0	3
3	MT1734	Automation system design	PE	3	3	0	0	3
4	MT1735	Data science for Business Decisions	PE	3	3	0	0	3
5	MT1736	Internet of Things for Mechatronics Engineers	PE	3	3	0	0	3

OPEN ELECTIVE COURSES (SEMESTER VII)

(Offered to AI & DS, CSE, ECE, EEE,EIE, IT)

S.NO.	COURSE CODE	COURSE TITLE	CATE GORY	CONTACT PERIODS	L	T	P	C
1.	OMT171	Industrial Robotics	OE	3	3	0	0	3

GE1771 **PRINCIPLES OF MANAGEMENT**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To give a basic idea about the need of management principles in all kinds of organization.
- To understand the managerial functions like planning, organizing, staffing, Directing and controlling.
- To gain some knowledge about different structures of organization.
- To understand the role played by leader in different levels, and to understand the qualities, skills required for the leader while leading a team globally.
- To gain some knowledge about international management.

UNIT I **INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS** **9**

Definition of Management – Nature, Scope and Functions of Management – Evolution of Management – Contributions of FW Taylor (14 principles of Management), Henri Fayol, Elton Mayo, Roethilisberger, H.A.Simon and P.F Drucker- Management theories - Science or Art – Manager Vs Entrepreneur- types of managers managerial roles and skills – Evolution of Management –Scientific, human relations , system and contingency approaches –Current trends and issues in Management.

UNIT II **PLANNING** **9**

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III **ORGANISING** **9**

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority –Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

Directing meaning - importance - principles of directing - Motivation - Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership - types and theories of leadership - Communication - Process of communication, types of communication and its uses - Barrier in communication - Effective Communication - Communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Inventory Management – PERT, CPM – Application - Control and performance – Direct and preventive control.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the trends and challenges of management in global scenario, the different types of organization and its effectiveness.

CO2: Utilize the strategies and policies which are involved in planning, Steps involved in the process of planning and use it for decision.

CO3: Identify the structure, purpose, selection and recruitment process in organizations.

CO4: Explain the various motivational theories and processes of management including its functions.

CO5: Compare and contrast the various control techniques.

TEXT BOOKS

1. Harold Koontz and Heinz Weihrich, 1998, Essentials of Management, Tata McGraw Hill.
2. Stephen P. Robbins and Mary Coulter, 2009, Management, Prentice Hall (India)Pvt. Ltd.,

REFERENCE BOOKS

1. Robert Kreitner and Mamata Mohapatra, 2008, Management, Biztantra.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, 2011, Fundamentals of Management, Pearson Education, 7th Edition.
3. Tripathy PC and Reddy PN, 1999, Principles of Management, Tata McGraw Hill.

MT1701	COMPUTER AIDED DESIGN AND MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To know the fundamentals of CAD/CAM.
- To provide an overview of how computers are being used in mechanical component design.
- To know about solid modelling and graphic standards.
- To understand the application of computers in various aspects of Manufacturing i.e., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.
- To provide an overview Flexible Manufacturing System.

UNIT I INTRODUCTION 9

Product cycle - Design process - Sequential and concurrent engineering - Computer aided design – CAD system architecture- Computer graphics – Co-ordinate systems- 2D and 3D transformations - Homogeneous coordinates - Line drawing – Clipping - Viewing transformation - Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control - Introduction to CAD/CAM – CAD/CAM concepts –– Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance.

UNIT II GEOMETRIC MODELING 9

Representation of curves - Hermite curve - Bezier curve - B-spline curves - Rational curves - Techniques for surface modeling – Surface patch - Coons and bicubic patches - Bezier and B-spline surfaces. Solid modeling techniques - CSG and B-rep.

UNIT III CAD STANDARDS 9

Standards for computer graphics - Graphical Kernel System (GKS) - Standards for exchange images - Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - Communication standards.

UNIT IV FUNDAMENTAL OF CNC AND PART PROGRAMMING 9

Introduction to NC systems and CNC - Machine axis and Co-ordinate system - CNC machine tools - Principle of operation CNC - Construction features including structure

- Drives and CNC controllers - 2D and 3D machining on CNC - Introduction of Part Programming, types - Detailed Manual part programming (FANUC) on Lathe & Milling machines using G codes and M codes - Cutting Cycles, Loops, Sub program and Macros - Introduction of CAM package– Introduction of Computer Aided Part Programming.

UNIT V **CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS)** **9**

Group Technology (GT), Part Families – Parts Classification and coding – Cellular Manufacturing – Composite part concept – Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control – Quantitative analysis in FMS.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Illustrate the fundamentals of CAD/CAM, 2D and 3D transformations and clipping algorithm

CO2: Explain the representation of curves, surfaces and solid modelling

CO3: Explain the graphic, data exchange and communication standards

CO4: Apply NC & CNC programming concepts to develop part programme for Lathe & Milling Machines

CO5: Illustrate the different types of techniques used in Cellular Manufacturing and FMS

TEXT BOOKS

1. Ibrahim Zeid., 2007 , Mastering CAD CAM ,Tata McGraw-Hill Publishing Co
2. Mikell.P.Groover., 2019 , Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall of India.

REFERENCE BOOKS

1. Chris McMahon and Jimmie Browne., 1999, CAD/CAM Principles , Practice and Manufacturing management “ Second Edition, Pearson Education.

2. Donald Hearn and M. Pauline Baker., 1992 , Computer Graphics, Prentice Hall, Inc.
3. Foley, Wan Dam, Feiner and Hughes., 2014, Computer graphics principles & practice Pearson Education.
4. Radhakrishnan P, Subramanyan S.and Raju V.,2016 , CAD/CAM/CIM, 4th Edition, New Age International (P) Ltd, New Delhi.
5. Yoram Koren, 2005, Computer Control of Manufacturing Systems, Tata McGraw-Hill Publishing Co

MT1702 ROBOTICS AND MACHINE VISION SYSTEM

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the functions of the basic components of a Robot.
- To study the use of various types of End of Effectors.
- To impart knowledge in Robot Mechanics.
- To impart knowledge in Robot Programming.
- To study the basics of machine vision applications in robots.

UNIT I BASICS OF ROBOTICS 8

Introduction- Basic components of robot-Laws of robotics- Classification of robot-work space-accuracy- resolution and repeatability of robot- Applications of Robots.

UNIT II ROBOT END EFFECTORS 8

Robot End effectors: Introduction- Types of End effectors- Mechanical gripper- Types of gripper mechanism- Gripper force analysis- Other types of gripper- Special purpose grippers.

UNIT III ROBOT MECHANICS 11

Robot kinematics: Introduction- Matrix representation- Rigid motion & homogeneous transformation- Forward & Inverse kinematics- Trajectory planning. Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation.

UNIT IV ROBOT PROGRAMMING 9

Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages.

UNIT V MACHINE VISION FUNDAMENTALS 9

Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- Segmentation- Thresholding- Edge detection- Binary morphology – Grey morphology.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the basic concepts, laws, components and parameters of robots

CO2: Explain the types of grippers and its functions.

CO3: Evaluate the kinematic calculations and apply Lagrangian and Newton-Euler methods to analyze dynamic characteristics of robots.

CO4: Describing the various programming techniques used in industrial robots.

CO5: Explain basis of machine vision and apply the concept of image processing.

TEXT BOOKS

1. M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey,2012 Industrial Robotics - Technology, programming and Applications , Tata , McGraw-Hill Education Pvt Limited 2nd Edition, 2012
2. John.J.Craig.,2018, Introduction to Robotics: Mechanics & control, Pearson Publication, Fourth edition

REFERENCE BOOKS

1. Jazar., 2010 , Theory of Applied Robotics: Kinematics, Dynamics and Control, Springer, 2ndEdition .
2. K.S.Fu, R.C.Gonzalez, C.S.G.Lee., 1987, Robotics: Sensing, Vision & Intelligence, Tata McGraw-Hill Publication, First Edition.
3. Sathya Ranjan Deb., 2009 , Robotics Technology & flexible Automation, Second edition, Tata McGraw-Hill Publication.

MT1711	COMPUTER AIDED DESIGN AND MANUFACTURING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand and interpret drawings of machine components for the preparation of assembly drawings using standard CAD packages.
- To gain practical experience in handling 3D modelling software systems.
- To learn basic principles of finite element analysis procedure and enable the students to formulate the design problems into FEA.
- To understand program codes for manufacturing different machine components.
- To interpret program codes for manufacturing different machine components using standard CAM packages.

LIST OF EXPERIMENTS

1. Modelling of a part using any CAD package.
2. Modelling and assembling of the mechanical assembly using any CAD package.
3. Structural analysis using FEA software – any analysis package.
4. Beam deflection analysis using FEA software – any analysis package.
5. Modelling and tool path simulation – turning using any CAM package.
6. Modelling and tool path simulation – milling using any CAM package.
7. NC code generation for milling using any CAM package.
8. NC code generation for turning using any CAM package.

TOTAL: 60 PERIODS

EQUIPMENTS NEEDED (FOR 30 STUDENTS)

S.NO.	NAME OF THE EQUIPMENT	QTY.
1	CNC lathe	1 No.
2	CNC milling machine	1 No.
3	Desktop	30
4	Any solid modelling and analysis software packages	30

OUTCOMES:

Students will be able to

CO1 Develop a model using any CAD Package.

CO2 Model and assemble a given three-dimensional engineering components.

CO3 Analyses on simple structures for the application of different loads.

CO4 Develop tool path simulation using CAM package.

CO5 Develop CNC programs for a given components to work with CNC machines

MT1712 **ROBOTICS AND MACHINE VISION SYSTEM LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES:

- To introduce different types of robotics and demonstrate them to identify different parts and components.
- To introduce about different configuration of robots.
- To verify transformation with respect to gripper and world coordinate system.
- To estimate accuracy, repeatability and resolution of robot.
- To write programming for simple operations.

LIST OF EXPERIMENTS

1. Study of robotic links, joints and its configuration
2. Study of End effectors
3. Determination of maximum and minimum position of links.
4. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
5. Study of Forward and Inverse Kinematics.
6. 2 DOF manipulator simulation using ADAMS
7. Cylindrical configuration robot simulation using ADAMS
8. Gripping force analysis of 5 DOF robot using ADAMS
9. Path projection of robot
10. Robot programming and simulation for pick and place using ROS
11. Robot programming and simulation for Color identification using ROS
12. Robot programming and simulation for Shape identification using ROS

TOTAL: 60 PERIODS

EQUIPMENTS NEEDED (FOR 30 STUDENTS)

S.NO.	NAME OF THE EQUIPMENT	QTY.
1	ROS (Robotic Operating System)	30 No.
2	1DOF “R-configuration” robot.	3 No.
3	2DOF “R-R-configuration” robot.	2 No.
4	ADAMS software packages	10 No.

OUTCOMES:

Students will be able to

CO1 Understand the construction of robots and its configuration.

CO2 Understand about end effector and different parts of robots .

CO3 Apprehend Forward and Inverse kinematics in robots.

CO4 Use of any robotic simulation software to model the different types of robots and calculate work volume for different robots.

CO5 Write program for performing simple operations in robot.

MT1821 **PROJECT WORK**

L	T	P	C
0	0	16	8

OBJECTIVES:

- To develop knowledge to formulate a real world problem and project's goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

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

TOTAL: 240 PERIODS

OUTCOMES:

Students will be able to

CO1 To identify specific problems prevailing in the society or industry in the field of Mechatronics Engineering& allied areas.

CO2 To carry out the literature survey for the identified problem.

CO3 Integrate various systems into one Mechatronics product.

CO4 To develop an appropriate solution for the identified problem using modern tool or methodology.

CO5 To impart communication and presentation skills through effective documentation and delivery.

Professional Elective IV, Semester VII

EI1634	EMBEDDED SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concept of Embedded system.
- To provide the basic concepts of RTOS.
- To expose the ideas on ARM processor.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Embedded system Vs General Computing system-Structural unit in Embedded system-Design Process in Embedded system-Challenges in Embedded system-Hardware-Software Co-design-Selection of Processor and memory-Timer & Counting devices- Applications- Smart Card, Digital Camera and AVM.

UNIT II EMBEDDED NETWORKING 9

I/O Devices and Ports-Serial Communication Devices-Serial Peripheral Interface- I2C-CAN Bus-RS232-Wireless and Mobile system protocols- Need for device driver

UNIT III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9

Embedded Product Development Life Cycle- Objectives-Different phases-Modeling-Data Flow Graph Model-State Machine Model-Sequential Programing Model-Concurrent Programing Model- Object Oriented Model

UNIT IV REAL TIME OPERATING SYSTEMS 9

Introduction to RTOS- Process, Task, Thread-Multiprocessing and Multithreading-Scheduling algorithm-Inter-process communication-Signals, pipes, Semaphores, shared data problem, Queues and Mailbox- VxWorks-Mucos-II.

UNIT V ARM PROCESSORS 9

Block diagram-Features of LPC 214x- ARM 9- ARM Cortex M3-- Simple instruction sets in LPC214x- Case study using LPC 214x.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Illustrate the basic concept of embedded systems.

CO2: Apply the suitable embedded protocol for different applications.

CO3: Explain the embedded system development.

CO4: Distinguish real time tasks and scheduling concepts.

CO5: Describe ARM processor.

TEXT BOOKS

1. Rajkamal., 2017. Embedded System-Architecture, Programming, Design, McGraw Hill.
2. Peckol., 2019. Embedded system Design, John Wiley & Sons.

REFERENCE BOOKS

1. Lyla, B, Das., 2013. Embedded Systems-An Integrated Approach, Pearson.
2. Shibu, K.V., 2016. Introduction to Embedded Systems, Tata McGraw Hill.
3. Elicia White., 2011. Making Embedded Systems, O' Reilly Series, SPD.

GE1671 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the concepts of quality and quality management, TQM framework, Barriers and Benefits of TQM.
- To apply the Principles and techniques of Quality Management for real time.
- To understand the need and importance of quality assurance and certification.

UNIT I INTRODUCTION 9

Concept of Quality and Quality Management– Determinants of quality of product & service – Quality vs. Reliability – Definition of TQM – Basic concepts of TQM – TQM Framework – Barriers to TQM – Benefits of TQM.– Gurus of TQM (Brief introduction) – Quality statements – vision, mission, Policy.

UNIT II PRINCIPLES AND PHILOSOPHIES OF QUALITY MANAGEMENT 9

Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi, Shingeo and Walter Shewhart - Concepts of Quality circle, Japanese 5S principles and 8D methodology.

UNIT III TOOLS AND TECHNIQUES FOR QUALITY MANAGEMENT 9

Quality functions development (QFD) – Benefits, Voice of customer, information Organisation, House of quality (HOQ), building a HOQ, QFD process. Failure mode effect analysis (FMEA) – requirements of reliability, failure rate, FMEA stages, design, process and documentation – Taguchi technique.

UNIT IV STATISTICAL QUALITY CONTROL 9

Juran's concept of quality cost – components of Quality Cost – Statistical Quality Control - Inspection, Sampling, Sample Size, Sampling Plan, AQL, OC curve, Producer Risk, Consumer Risk, AOQ, AOQL, Control Charts & Control Limits – X, R & S charts and their application – causes of variations – Assignable & Random; Runs – Test, Chart – Sensitivity Test and Run - Sum Test; Normal – Distribution curve and concept of Six Sigma.

UNIT V QMS – QUALITY MANAGEMENT SYSTEM 9

Introduction - Benefits of ISO Registration – ISO 9000 Series of Standards – Sector – Specific Standards – AS 9100, TS16949 and TL 9000 – ISO 9001 Requirements – Implementation – Documentation - Internal Audits – Registration - ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction – ISO 14000 Series Standards – Concepts of ISO 14001– Requirements of ISO 14001– Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Apply TQM concepts in a selected enterprise.

CO2: Apply TQM principles in a selected enterprise.

CO3: Explain Taguchi's techniques, Performance Measures, QFD, HOQ.

CO4: Explain Six Sigma and apply Traditional tools, New tools, Benchmarking.

CO5: Confirm quality standards and implementing QMS in business organization.

TEXT BOOKS

1. L. Suganthi & Dr. Anand Samuel 2004. *Total Quality Management*, Prentice Hall, Publications.
2. Dale H.Besterfiled, Carol B.Michna, Glen H. Bester field, Mary B.Sacre, Hemant Urdhwareshe & Rashmi Urdhwareshe, 2013. *Total Quality Management*, Revised Third Edition, Indian Reprint, Sixth Impression, Pearson Education Asia.

REFERENCE BOOKS

1. Rose J.E. 1997. *Total Quality Management*, S. Chand & Co.
2. Kiran.D.R, 2016. *Total Quality Management: Key concepts and case studies*, Butterworth – Heinemann Ltd.
3. Shridhara Bhat K, 2016. *Total Quality Management: Text and Cases*, (2nd Edition), Himalaya Publishing House India, ISBN: 9789352622399.

MT1731 **AUTONOMOUS MOBILE ROBOTS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce the fundamentals of mobile robotics.
- To expose the student to kinematics of mobile robots.
- To expose the sensor used in mobile robots.
- To study the method used for mobile robot localization.
- To study the method used for planning and navigation of mobile robots .

UNIT I LOCOMOTION 9

Introduction, key issue for locomotion, legged mobile robots, leg configuration and stability, examples of legged robot locomotion, wheeled mobile robots, wheeled locomotion: the design space, wheeled locomotion: case studies

UNIT II MOBILE ROBOT KINEMATICS 9

Kinematic models and constraints, representing robot position, forward kinematic models, wheel kinematic constraints, robot kinematic constraints, examples: robot kinematic model and constraints, mobile robot maneuverability, degree of mobility, degree of steerability, robot maneuverability, mobile robot workspace, degree of freedom, motion control- open loop control (trajectory-following), feedback control.

UNIT III SENSORS FOR MOBILE ROBOTS 9

Sensor classification, characterizing sensor performance, wheel/motor sensor, Heading sensors, Ground based beacons, active ranging, motion/speed sensor, vision based sensor, representing uncertainty, statistical representation, error propagation: combining uncertain measurements.

UNIT IV MOBILE ROBOT LOCALIZATION 9

The challenge of localization: noise and aliasing, sensor noise, sensor aliasing, effector noise, an error model for odometric position estimation, localization based navigation versus programmed solutions, belief representation, map representation, probabilistic map based localization, autonomous map building – the stochastic map technique

UNIT V PLANNING AND NAVIGATION 9

Competences for navigation: planning and reacting, path planning, obstacle avoidance, navigation architectures, modularity for code reuse and sharing, control localization, techniques for decomposition, case studies: tiered robot architectures.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Design wheeled robots.

CO2: Control mobile robots of different geometry.

CO3: Select and device suitable sensor for any mobile robots.

CO4: Identify and map the location of mobile robots.

CO5: Navigate mobile robots by avoiding obstacles.

TEXT BOOKS

1. Todd, D, J, Walking Machines.,2012, An Introduction to Legged Robots. Springer.
2. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzz., 2004,Introduction to Autonomous Mobile Robots, Bradford Company Scituate, USA.

REFERENCE BOOKS

1. Mason, M.,2001, Mechanics of Robotics Manipulation ,Cambridge, MA, MIT Press.
2. Borenstein, J., Evereat ., Feng, L.,1996, Navigation Mobile Robots, System and Techniques. A.K.Peters,Ltd.,USA.
3. Roland Siegwart, Illah Reza Nourbakhsh and Davide Scaramuzza.,2004 Introduction to Autonomous Mobile Robots, MIT Press Cambridge, England.
4. Craig, J.J.,2008 , Introduction to Robotics: Mechanics and Control, Pearson Education India.
5. Cox, I.J., Wilfong, G.T. (Editors).,1990, Autonomous Robot Vehicles. New York, Springer Verlag.

MT1732 MACHINE LEARNING AND DEEP LEARNING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To acquire knowledge on the types of Machine Learning.
- To introduce various learning techniques.
- To learn the fundamental concepts of Artificial Neural Networks.
- To get familiar with Deep Learning Networks.
- To get exposure convolutional networks and sequence modelling.

UNIT I INTRODUCTION 9

Linear Algebra: Scalars, Vectors, Matrices and Tensors – Multiplying Matrices and Vectors – Identity and Inverse Matrices – Norms – Trace operator – Determinant.
Introduction to Machine Learning, supervised, unsupervised, reinforcement and semi-supervised modeling -Machine Learning pipeline- Linear regression, Logistic regression and Evaluation metrics.

UNIT II LEARNING ALGORITHMS 9

Clustering: k-means, Hierarchical and Density Based clustering, Classification: Naive Bayes, Support Vector Machine, Decision Tree- -Random Forest- Adaboost and Evaluation Metrics Reinforcement Learning: Task – Q-Learning – Temporal Difference Learning

UNIT III ARTIFICIAL NEURAL NETWORKS 9

Biological Neuron, Idea of computational units, McCulloch–Pitts unit, Single and Multi layer Perceptron learning Algorithms, Feedforward Networks, Backpropagation, Convolutional Neural Networks, Recurrent Neural Networks.

UNIT IV DEEP LEARNING 9

Deep Feed Forward network, regularizations, training deep models, dropouts, Gradient- Descent Strategies, Training Deep Neural Networks using Back Propagation, Training Deep Neural Networks using Convolution, Probabilistic Neural Network: Hopfield Net, Boltzman machine

UNIT V CONVOLUTIONAL NETWORKS AND SEQUENCE MODELLING 9

Convolutional Networks – Convolution operation – Motivation Pooling – Basic Convolution function – Algorithms – Recurrent and recursive nets: Recurrent neural networks – Bidirectional RNN – Recursive Neural networks – Auto regressive networks.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Describe the basic learning methodologies of Machine learning

CO2: Paraphrase various clustering, classification and reinforcement learning algorithms.

CO3: Outline the fundamental concepts of Artificial Neural Networks.

CO4: Model Deep Neural Network framework to solve real world problems.

CO5: Implement convolutional networks and sequence modelling for problem solving.

TEXT BOOKS

1. Tom M. Mitchell.,2013, Machine Learning, McGraw Hill Education (India) Private Limited.
2. Ian Goodfellow and Yoshua Bengio and Aaron Courville.,2016 , Deep Learning, MIT Press.

REFERENCE BOOKS

1. Li Deng, Dong Yu.,2014 ,Deep Learning: Methods and Applications, now publishers, 2014.
2. Simon Haykin., 2009, Neural Networks and Learning Machines, Prentice Hall, Pearson Education, 3rd edition .
3. Ethem Alpaydin., 2020, Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press.
4. Stephen Marsland.,2019, Machine Learning: An Algorithmic Perspective,CRC Press.
5. Michael Nielsen.,2015, Neural Networks and Deep Learning, Determination Press, 2015.

MT1733	SYNTHESIS AND CHARACTERIZATION OF NANO MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide knowledge about the evolution of nano science and basic concepts and properties of nano materials.
- To gain knowledge about the bulk synthesis methods for nano materials.
- To provide knowledge about the chemical, physical approaches for the fabrication of nano materials.
- To gain knowledge about the applications of spectroscopy and Differential Thermal Analysis.
- To provide knowledge about the advanced imaging techniques for nano materials.

UNIT I INTRODUCTION 9

Introduction to Nano technology – Definition - Scientific revolutions - Basic principles of nano scale materials - Nano sized metals and alloys - Classification of nano structures – Effects of nano scale dimensions on various properties – structural, mechanical, thermal, chemical, magnetic, optical and electronic properties.

UNIT II BULK SYNTHESIS 9

High-energy ball mill – types of balls – ball ratio – medium for grinding – limitations – severe plastic deformation – Mechano chemical process – Arc plasma - Nano composite materials.

UNIT III PHYSICAL AND CHEMICAL METHODS OF SYNTHESIS 9

Vapour deposition and different types of epitaxial growth techniques (CVD, MOCVD, MBE) -Pulsed laser deposition, Sputter deposition (PVD) and types - Lithography: Photo/UV/EB/FIB techniques - Etching process: Dry and wet etching - Sol gel processing - Solvo thermal, hydrothermal, precipitation, Spray pyrolysis - Electro spraying and spin coating.

UNIT IV CHEMICAL AND THERMAL ANALYSIS 9

Raman Spectroscopy - Basic Principles, Practice and Applications of X-Ray

Spectrometry, Wave Dispersive X-Ray Spectrometry, Auger Spectroscopy, Fourier Transform Infra-Red Spectroscopy (FTIR)-X-ray powder diffraction, Importance of thermal analysis for nanostructures, Differential Thermal Analysis, Differential Scanning Calorimetry (DSC) And Thermo Gravity metric Analysis (TGA).

UNIT V ADVANCED IMAGING TECHNIQUES 9

Specimen Preparation Techniques –Optical microscopy, Construction and working - Scanning Electron Microscopy – Construction & working of SEM – various Imaging Techniques – Applications- Transmission Electron Microscopy – Imaging Techniques – Atomic Force Microscopy- Construction & working of AFM – Applications - Scanning Tunneling Microscopy, 3D map of electronic structure.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Illustrate the basic concepts and various properties of nano materials

CO2: Explain the bulk synthesis of nano materials

CO3: Illustrate the methods used for the synthesis of nano materials

CO4: Analyze the molecular and thermal properties of nano material by spectroscopy and Differential thermal analysis

CO5: Differentiate morphology and topography of nano materials

TEXT BOOKS

1. G. Cao, 2004, Nanostructures & Nano materials: Synthesis, properties & applications, Imperial college press.
2. J.Goldstein, D. E. Newbury, D.C. Joy & C.E. Lym, 2003, Scanning electron microscopy and X-ray microanalysis, Kluwer Academic, New York.

REFERENCE BOOKS

1. J.George, 2005, Preparation of thin films, Marcel Dekker, Inc., New York.
2. Springer Handbook of Nanotechnology: Bharat Bhushan

3. W. Gaddand, D. Brenner, S. Lysherski and G. J. Infrate (Eds),2002, Handbook of nanoscience, Engg. and Technology, CRC Press.
4. ASM Hand book-Materials characterization, Vol – 10, 2004.
5. S.L. Flegler, J.W. Heckman & K.L. Klomparens, 1993, Scanning and transmission electron microscopy: A Introduction, WH Freeman & Co.

Professional Elective V, Semester VII

GE1471 PROFESSIONAL ETHICS AND HUMAN VALUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To create an awareness on Engineering Ethics and Human Values.
- To instill Moral and Social Values and
- To impart Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 9

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation –Commitment – Empathy – Self-confidence – Character – Spirituality – Stress management Techniques.

UNIT II ENGINEERING ETHICS 9

Senses of Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas –Moral Autonomy – Kohlberg‘s theory – Gilligan‘s theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics –A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk -Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest –Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES 9

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development –Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors –Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Summarize the various Morals, Values, Ethics, Integrity and other Human Values

CO2: Describe the Senses of Engineering ethics, its related Theories and Models of Professional Roles

CO3: Explain the Codes of Ethics for various Engineering Experiments.

CO4: Examine the various Risk, Safety and Risk Benefit Analysis for a Product/Service in an Organization

CO5: Explain the Various Global Issues in Ethics and Review the Responsibilities and Rights of Professionals and Employees in an Organization

REFERENCE BOOKS

1. Mike W. Martin and Roland Schinzinger,2017. Ethics in Engineering, 4th Edition, McGraw Hill.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, 2004. Engineering Ethics, Prentice Hall of India.
3. Charles B. Fleddermann, 2012. Engineering Ethics, 4th Edition, Prentice Hall.
4. Charles E. Harris, Michael S. Pritchard, Raw W. James, Elaine E. Englehardt, and Michael J. Rabins, 2019. Engineering Ethics – Concepts and Cases, 12th Edition, Cengage Learning.
5. John R Boatright, Jeffery Smith, 2016. Ethics and the Conduct of Business, 8th Edition, Pearson Education.
6. Edmund G Seebauer and Robert L Barry, 2001. Fundamentals of Ethics for Scientists and Engineers, South Asia Edition, Oxford University Press.

ME1744 **MAINTENANCE ENGINEERING**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the principles, functions and practices adapted in industry for the successful management of maintenance activities.
- To explain the different maintenance categories like Preventive maintenance, condition monitoring and repair of machine elements.
- To illustrate the instruments used for condition monitoring in industry.
- To enhance the repair methods for basic machine elements and material handling equipment.
- To expose the maintenance budgeting & human factors.

UNIT I **PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING** **9**

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity – Importance and benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR and MWT – Factors of availability – Maintenance organization – Maintenance economics.

UNIT II **MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE** **9**

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenance schedules, repair cycle - Principles and methods of lubrication – TPM.

UNIT III **CONDITION MONITORING** **9**

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methods and instruments for CM- vibration monitoring- crack monitoring – corrosion monitoring – lubricant monitoring - wear-debris analysis.

UNIT IV **REPAIR METHODS FOR BASIC MACHINE ELEMENTS AND MATERIAL HANDLING EQUIPMENT** **9**

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Belt, conveyer , crane , Forklift - Failures and their development.

UNIT V **MAINTENANCE BUDGETING & HUMAN FACTORS** **9**

Maintenance budgeting – types of maintenance budget – preparation of maintenance

budget - Human factors in maintenance – manpower planning for maintenance – objectives and stages of manpower planning – training for maintenance personnel - Computer-aided maintenance management system (CMMS) – functions, applications and advantages of CMMS.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the Principles and Importance of Maintenance Planning, Reliability and also the factors affecting Availability.

CO2: Discuss the Principles of Maintenance Schedule and Repair Schedule for machineries.

CO3: Describe the Condition monitoring techniques and instruments for On-Load and Off-Load Testing of machineries.

CO4: Predict the Failure modes and Repair Methods for basic machine elements and material handling equipment.

CO5: Explain the budgeting methods & human factors for maintenance

TEXT BOOKS

1. Srivastava S.K., 1998, Maintenance Engineering Principles, Practices & Management , S. Chand and Co.,
2. Venkataraman .K., 2010, Maintenance Engineering and Management, PHI Learning, Pvt. Ltd.

REFERENCE BOOKS

1. Bhattacharya S.N.,1995, Installation, Servicing and Maintenance, S. Chand and Co.
2. Higgins L.R., 2008 , Maintenance Engineering Hand book, 5th Edition, McGraw Hill.
3. Armstrong ., 1988, Condition Monitoring, BSIRSA.
4. Davies ., 1966 , Handbook of Condition Monitoring, Chapman & Hall

MT1734 **AUTOMATION SYSTEM DESIGN**

L	T	P	C
3	0	0	3

OBJECTIVES:

- To know about the basic concepts in industrial automation.
- To design automated systems.
- To know about transfer lines and automated assembly.
- To be exposed to pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations.
- To know about the advancement in hydraulics and pneumatics.

UNIT I **FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION** **9**

Fundamental concepts in manufacturing and automation, Definition of Automation, reasons for automating. Types of production and types of automation, automation strategies, Levels of automation.

UNIT II **TRANSFER LINES AND AUTOMATED ASSEMBLY** **9**

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

UNIT III **DESIGN OF MECHATRONIC SYSTEMS** **9**

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

UNIT IV **PROGRAMMABLE AUTOMATION** **9**

Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; Condition monitoring of manufacturing systems.

UNIT V **DESIGN FOR HIGH SPEED AUTOMATIC ASSEMBLY** **9**

Introduction, Design of parts for high speed feeding and orienting, high speed

automatic insertion. Analysis of an assembly. General rules for product design for automation.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Summarize the fundamental concepts of industrial automation

CO2: Explain the basic principle behind the transfer lines and automated assembly system

CO3: Summarize the stages in design of mechatronics system using case studies

CO4: Explain about the programmable automation in CNC and CIM

CO5: Explain the principle behind high-speed automatic assembly system

TEXT BOOKS

1. Mikell P Groover,2019, Automation Production Systems and Computer- Integrated Manufacturing, Pearson Education, New Delhi.
2. Geoffrey Boothroyd, 2005, Assembly Automation and Product Design, Taylor & Francis Group.

REFERENCE BOOKS

1. Mikell P Groover., 2000, Industrial Robots – Technology Programmes and Applications , McGraw Hill , New York, USA.
2. Steve F Krar., 2001, Computer Numerical Control Simplified, Industrial Press.
3. Joffrey Boothroyd, Peter Dewhurst and Winston A. Knight., 2011, Product Design for manufacture and Assembly, CRC Press.
4. Bolton W, 2019, Mechatronics, Pearson Education.

MT1735 DATA SCIENCE FOR BUSINESS DECISIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To provide foundations of business data analysis.
- To describe the fundamentals of Descriptive and Probabilistic statistics.
- To examine the various statistical inference techniques .
- To describe multivariate exploratory data analysis.
- To describe the various optimization models for decision making.

UNIT I FOUNDATIONS OF BUSINESS DATA ANALYSIS 8

Introduction to Data Analysis and Decision Making-hierarchy between data, information, and knowledge - types of variables and measurement and accuracy scales.

UNIT II DESCRIPTIVE AND PROBABILISTIC STATISTICS 10

Univariate Descriptive Statistics- Frequency Distribution table- Graphical Representation of the results- the most common summary-measures in univariate Descriptive Statistics-practical example. Bivariate Descriptive Statistics- -association between two qualitative variables-correlation between two quantitative variables. Introduction to probability- terminology and concepts-definition-rules-conditional probability-Bayes' theorem-combinatorial analysis - Random variables and probability distributions.

UNIT III STATISTICAL INFERENCE 9

Sampling-probability or random sampling-nonprobability or nonrandom sampling-estimation-point and interval estimation-point estimation methods-hypotheses tests-nonparametric tests

UNIT IV MULTIVARIATE EXPLORATORY DATA ANALYSIS 9

Cluster Analysis-Introduction-Similarity Measures in Cluster Analysis-Similarity Measures Between Observations for Binary Variables Principal Component Factor Analysis-Pearson's Linear Correlation and the Concept of Factor.

UNIT V OPTIMIZATION MODELS FOR DECISION MAKING 9

Decision Making- A Model for a Simple Decision-Making Problem-Optimization Models-The Simplex Method for Solving LPs-Primal Algorithm for the Transportation Problem-An Application at a Bus Rental Company.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Identify phases involved in the business data analysis

CO2: Discuss descriptive and probabilistic statistics

CO3: Summarize the various test in statistical inference

CO4: Explain about multivariate exploratory data analysis.

CO5: Discuss various optimization models for decision making.

TEXT BOOKS

1. Luiz Favero Patrícia Belfiore.,2019, Data Science for Business and Decision Making, Academic press, Elsevier.
2. Katta.G.Murty., Optimization Models For Decision Making: Volume 1, Internet edition

REFERENCE BOOKS

1. Wes Mckinney.,2013, Python for Data Analysis, O'Reilly Media.
2. Field Cady.,2017, Data Science Hand Book, John Wiley & Sons.
3. Samuel Burns., 2019, Fundamentals of Data Science, Amazon KDP printing and Publishing.

   Cathy O'Neil and Rachel Schutt.,2014, Doing Data Science, Straight Talk From The Frontline, O'Reilly

MT1736	INTERNET OF THINGS FOR MECHATRONICS ENGINEERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand Smart Objects and IoT Architectures.
- To learn about various IOT-related protocol.
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT.
- To develop IoT infrastructure for popular applications.

UNIT I INTRODUCTION TO IoT 9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II IoT ARCHITECTURE 9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model- Domain model - information model - functional model - communication model - IoT reference architecture

UNIT III IoT PROTOCOLS 9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP – Security

UNIT IV BUILDING IoT WITH RASPBERRY PI & ARDUINO 9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms – Arduino-Nodemcu.

UNIT V CASE STUDIES AND REAL-WORLD APPLICATIONS 9

Real world design constraints - Applications - Asset management, Industrial

automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT -Amazon Web Services for IoT.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Interpolate the fundamentals of Internet of Things.

CO2: Analyze various protocols for IoT.

CO3: Design a portable IoT using Raspberry Pi, Arduino.

CO4: Discuss data analytics and cloud environment in IoT.

CO5: Examine applications of IoT in various applications.

TEXT BOOKS

1. Arshdeep Bahga, Vijay Madisetti.,2015, Internet of Things – A hands-on approach, Universities Press.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds).,2011, Architecting the Internet of Things, Springer.

REFERENCE BOOKS

1. Honbo Zhou., 2012 , The Internet of Things in the Cloud: A Middleware Perspective, CRC Press.
2. Jan Holler, VlasiosTsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle.,2014, From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence, Elsevier.
3. Olivier Hersent, David Boswarthick, Omar Elloumi .,2012 The Internet of Things – Key applications and Protocols, Wiley.

OPEN ELECTIVES

OMT171 **INDUSTRIAL ROBOTICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- Understand the functions of the basic components of a Robot.
- Study the use of various types of Drive system and End of Effectors
- Study the use of various types of sensors and machine vision system
- Impart knowledge in Robot Kinematics and Programming.
- Learn Robot safety issues and economics

UNIT I FUNDAMENTALS OF ROBOT 9

Robot - Definition - Robot Anatomy - Co ordinate Systems, Work Envelope Types and Classification- Specifications-Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load- Robot Parts and their Functions-Need for Robots-Different Applications.

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers.

UNIT III SENSORS AND MACHINE VISION 9

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data-Signal Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification, Visual Serving and Navigation.

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 9

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

OUTCOMES

CO1: Explain the fundamentals of various basic components in robot.

CO2: Explain the various types of drive system and end of Effectors.

CO3: Summarize the various types of sensors and machine vision system.

CO4: Explain the robot kinematics and robot programming.

CO5: Summarize the basics of robot safety issues and economics.

TEXT BOOKS

1. Klafter R.D., Chmielewski T.A and Negin M., 2003, Robotic Engineering - An Integrated Approach, Prentice Hall.
2. Groover M.P., 2001, Industrial Robotics -Technology Programming and Applications, McGraw Hill.

REFERENCE BOOKS

1. Craig J.J., 2008, Introduction to Robotics Mechanics and Control, Pearson Education.
2. Deb S.R., 1994, Robotics Technology and Flexible Automation, Tata McGraw Hill Book Co.

3. Koren Y., 1992, Robotics for Engineers, Mc Graw Hill Book Co.

4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., 19878, Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co.

5. Janakiraman P.A., 1995, Robotics and Image Processing, Tata McGraw Hill.

6. Rajput R.K., 2008, Robotics and Industrial Automation, S.Chand and Company.

7. Surender Kumar, 1991, Industrial Robots and Computer Integrated Manufacturing, Oxford and IBH Publishing Co. Pvt. Ltd.