SHRI VENKATESHWARA UNIVERSITY

Syllabus

Diploma
Mechanical Engineering (Production)
Vth Semester
(Three Years Programme)

(w.e.f. 2019-20)

SCHOOL OF ENGINEERING & TECHNOLOGY

Sl. No.	Subject Codes	Subject	Periods			Evaluation Scheme				End Semester		Total	Credit
			L	T	P	CT	TA	Total	PS	TE	PE		
1	PPE-501	Mechatronics and Robotics	3	0	0	20	10	30		70		100	3
2	PPE-502	Automation & CNC Machines	3	0	0	20	10	30		70		100	3
3	PPE- 503	Flexible Manufacturing Systems	3	0	0	20	10	30		70		100	3
4	PPE-504	Material Handling Systems	3	0	0	20	10	30		70		100	3
5	PME-503	Industrial Engineering & Management	3	0	0	20	10	30		70		100	3
6	POE-051	Operation Research	3	0	0	20	10	30		70		100	3
7	PPE-511	Summer Internship-II	0	0	0				50			50	3
8	PPE-512	Project Phase- I	0	0	4				50		50	100	2
	Summer Internship-II (6 weeks) after IVth Sem											750	23

Course Code	**:**	**PPE-501**
Course Title	**:**	**MECHATRONICS AND ROBOTICS**
Number of Credits	**:**	**3 (L: 3, T: 0, P: 0)**
Prerequisites	**:**	**NIL**
Course Category	**:**	**PC**

Course Learning Objectives

- To understand the basic concepts and characteristics of measurement systems.
- To learn various types of sensors and transducers various mechanical, electrical and pneumatic actuation systems.
- To learn the concepts of digital communications and develop PLC programs.
- To introduce the basic concepts, parts of robots and types of robots.
- To make the student familiar with the various drive systems for robot, sensors and their applica- tions in robots and programming of robots.

Course Content:

UNIT-I: Introduction: Mechatronic systems, closed and open loop measurement systems, The Mechatronics approach, Sensors microprocessors and transducers, displacement, position and prox- imity pickups. Mechanical and Electrical activation systems.

Measurement Systems: Measurement errors, modelling measurement systems, system, Reliability, signal conditioning & processing, Data acquisition and processing systems, Data presentation.

Applied Instrumentation: Measurement of mechanical and process parameters. Measurement of force, torque, temperature, pressure and flow. Measurement of displacement velocity and accelera- tion. Measurement of noise and vibration

UNIT-II: Programmable Logic Controller (PLC): Definition – Basic block diagram and structure of PLC – Input/Output processing – PLC Programming: Ladder diagram, its logic functions, latching and sequencing – PLC mnemonics – Timers, internal relays and counters – Shift registers – Master and jump controls – Data handling – Analog input/output – Selection of PLC.

UNIT-III: Fundamentals of Robot: Robot – Definition – Co-ordinate Systems, Work Envelope, types and classification – Specifications – Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Basic robot motions - Point to point control, Continuous path control. Robot Parts and Their Func- tions – Need for Robots – Different Applications. Robot drive systems and end effectors: Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor,
A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives. End Effectors
– Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Se- lection and Design Considerations

UNIT-IV: Sensors and Machine Vision: Requirements of a sensor, Principles and Applications of the following types of sensors – Position of sensors (Piezo Electric Sensor, LVDT, Resolvers, Opti- cal Encoders), Range Sensors (Triangulation Principle, Structured, Lighting Approach, Laser Range Meters), Proximity Sensors (Inductive, Capacitive, and Ultrasonic), 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.

UNIT-V: Robot kinematics and Robot Programming: Forward Kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of Manipulators with Two Degrees of Free- dom (In 2 Dimensional) – Deviations and Problems. Teach Pendant Programming, Lead through pro- gramming, Robot programming Languages – VAL Programming – Motion Commands, Sensor Com- mands, End effecter commands, and Simple Programs Industrial Applications: Application of robots in machining, welding, assembly, and material handling.

Reference Books:

1. Mechatronics W. Bolton, Pearson Education, Asia 2007
2. A Text Book on Mechatronics, R. K. Rajput, S. Chand & Co, New Delhi 2011
3. K.S. Fu., R.C.Gonalez, C.S.G.Lee, " Robotics Control sensing ", Vision and Intelligence, McGraw Hill International Edition, 1987.
4. M. P. Groover, "Industrial Robotics – Technology, Programming and Applications", Mc-Graw-Hill, 2001
5. Fu. K. S. Gonzalz. R. C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw-Hill Book Co., 1987
6. Yoram Koren, "Robotics for Engineers", McGraw-Hill Book Co., 1992
7. Janakiraman. P. A., "Robotics and Image Processing", Tata McGraw-Hill, 1995
8. Elements of Robotics Process Automation, Mukherjee, Khanna Publishing House, Delhi, 2018

Course outcomes:

At the end of the course, the student will be able to:

		Describe about various types of sensors and transducers.
		Explain the various mechanical, electrical and pneumatic actuation systems.
		Explain the basic PLC architecture and PLC programming concepts.
		Explain the robot anatomy, classification, characteristics of robot, advantages and disad-vantages.
		Explain about various types of sensors and concepts on robot vision system.

Course Code	**:**	**PPE-502**
Course Title	**:**	**AUTOMATION & CNC MACHINES**
Number of Credits	**:**	**3 (L: 3, T: 0, P: 0)**
Prerequisites	**:**	**Basic Mechanical Engineering (PEPC102) Industrial Production Technology-I (PEPC205)**
Course Category	**:**	**PC**

Course Learning Objectives:

- To understand basics of industrial automation
- To identify various types of automation
- To create CAM Tool path and NC- G code output.

Course Content:

UNIT-I: Introduction: Basic concept of Automation, Types of Automation, Feasibility etc, Industrial Hydraulics: Introduction, basic concepts, Hydraulic fluids, Classification and properties of hydraulic fluids, Contaminates in hydraulic system, control and cleanliness standards, Fluid power generators,
i.e. Gear, Vane, Piston pumps, linear and Rotary Actuators, Direction Control Valves, types, actuation methods, pressure control valves; pressure reducing valves, pressure relief valve, Unloading valve, Sequence valve, Counterbalance valve, Flow control valves simple and pressure compensated type.

UNIT-II: Pneumatics: Introduction, Basic components, Source, storage and distribution, treatment of compressed air, linear and Rotary actuators, Direction control valves – types, actuation methods, pressure control valves, logic devices – twin pressure valve, shutter valve, time delay valve, Pneu- matic circuit design and analysis, conventional as well as computer aided design. Robotics: Basic concepts, classification based on Geometry, programming, drives, work volume of robots world and joint coordinates various joints, DOF, end effectors – Types and uses, Sensors in Robots, program- ming – Teach pendant and Computer programming

UNIT-III: Automatic Assembly System: Development of Automatic Assembly process, Transfer dev ices – continuous, Intermittent, synchronous and asynchronous, Vibratory feeders – Mechanics, ef- fect of frequency, acceleration, track angle, friction, load sensitivity, orientation of parts – active and passive devices, Mechanical feeders – computation and operational details, feed tracks, Escapement devices. Product design for high-speed automatic assembly, examples of design modifications.

UNIT-IV: CNC Machine and Components: CNC Machines: Numerical control – definition – compo- nents of NC systems – development of NC – DNC – Adaptive control systems – working principle of a CNC system – Features of CNC machines - advantage of CNC machines – difference between NC and CNC – Construction and working principle of turning centre – Construction and working principle of machining centers – machine axes conventions turning centre and machining centre – design con- siderations of NC machine tools. CNC EDM machine – Working principle of die sinking and wire EDM machines - Coordinate Measuring Machines: construction and working principles.

Drives: spindle drive – dc motor – Feed drives – dc servo motor and stepper motor – hydraulic sys- tems – Slide ways – requirement – types – friction slide ways and anti-friction slide ways - linear mo- tion bearings – recirculation ball screw – ATC – tool magazine – feedback devices – linear and rotary transducers – Encoders - in process probing.

UNIT-V: Part Programming: NC part programming – methods – manual programming – conversa- tional programming – APT programming - Format: sequential and word address formats - sequence number – coordinate system – types of motion control: point-to-point, paraxial and contouring – Da- tum points: machine zero, work zero, tool zero NC dimensioning – reference points – tool material
– tool inserts - tool offsets and compensation - NC dimensioning – preparatory functions and G codes, miscellaneous functions and M codes – interpolation: linear interpolation and circular interpolation
- CNC program procedure. Part Program – macro – sub-program – canned cycles: stock – mirror im- ages – thread cutting – Sample programs for lathe: Linear and circular interpolation - Stock

removal turning – Peck drilling – Thread cutting and Sample programs for milling: Linear and circular inter- polation – mirroring – sub program – drilling

Reference Books:

1. Anthony Esposito, "Fluid Power with Application", 5th Edition, Pearson Education (2003).
2. Majumdar S R, "Oil Hydraulic System", Tata McGraw Hill (2001).
3. Bolton W, "Mechatronics", 2nd Edition, Pearson Education, New Delhi (1999).
4. Necsulelscu Dan, "Mechatronics", Pearson Education, New Delhi (2002).
5. Geoffrey Boothroyd, "Assembly Automation and Product Design", Marcel Dekker Inc (1991).
6. CNC Programming, S. K. Sinha, Galgotia Publications Pvt. Ltd.
7. Computer Control of Manufacturing Systems, Yoram Koren, McGraw Hill Book.

Course outcomes:

At the end of the course, the student will be able to:

	Demonstrate basics of industrial automation
	Demonstrate use of automated controls using pneumatic and hydraulic systems
	Identify various types of automation
	Explain the concept of CNC machines and controls
	Prepare CNC part programming for various jobs

Course Code	**:**	**PPE-503**
Course Title	**:**	**FLEXIBLE MANUFACTURING SYSTEM**
Number of Credits	**:**	**3 (L: 3, T: 0, P: 0)**
Prerequisites	**:**	**NIL**
Course Category	**:**	**PE**

Course Learning Objectives:

- To understand the role of Flexible Manufacturing Systems(FMS) in manufacturing,
- Be familiar with organization and information processing in manufacturing,
- Have a basic knowledge of automation equipment,
- Understand logic control and associated technologies

Course Content:

UNIT-I: Understanding of FMS: Evolution of Manufacturing Systems, FMS: Definition, objective and Need, FMS: components, Merits, Demerits and Applications, Flexibility in Pull and Push type.

UNIT-II: Classification of FMS Layout: FMS: Layouts and their salient features, Single line, dual line, loop, ladder, robot centre, Salient features of processing stations: Processing stations-Machining Centers, Turning centre, Coordinate measuring machine (CMM), Washing/ Deburring station.

UNIT-III: MHS; An introduction: Material Handling System Conveyor, Robots, Automated Guided Vehicle (AGV), Automated Storage Retrieval System (ASRS).

UNIT-IV: Management Technology: Tool Management, tool magazine, Tool preset, identification, Tool monitoring and fault detection, FMS: Configuration planning and routing, FMS: Production Plan- ning and Control, FMS: Scheduling and loading.

UNIT-V: Design of FMS: FMS Performance Evaluation introduction, Analytical model of FMS, Simu- lation model of FMS; Case studies**:** Typical examples /case studies of FMS.

Reference Books:

1. William W Luggen, "Flexible Manufacturing Cells and System" Prentice Hall of Inc New Jersey, 1991
2. Reza A Maleki "Flexible Manufacturing system" Prentice Hall of Inc New Jersey, 1991
3. John E Lenz "Flexible Manufacturing" marcel Dekker Inc New York, 1989.
4. Groover, M.P "Automation, Production Systems and Computer Integrated Manufactur- ing", Prentice Hall of India Pvt.Ltd. New Delhi 2009

Course outcomes:

At the end of the course, the student will be able to:

		Classify and distinguish FMS and other manufacturing systems.
		Analyze processing stations and material handling systems used in FMS environments.
		Design and analyze FMS using simulation and analytical techniques.
		Develop management and control systems for tools, material handling and configurations in FMS
		Analyze the production management problems in planning, loading, scheduling, routing and breakdown in a typical FMS.

Course Code	**:**	**PPE-504**
Course Title	**:**	**MATERIAL HANDLING SYSTEM**
Number of Credits	**:**	**3 (L: 3, T: 0, P: 0)**
Prerequisites	**:**	**Basic Mechanical Engineering (PEPC102)**
Course Category	**:**	**PC**

Course Learning Objectives:

- To know the operational features of the material handling equipment & its practical applica- tions.
- To understand, select, operate and maintain the material handling equipments.
- To understand different material handling processes used in industries.
- To understand & appreciate safety instrumentation for equipment.

Course Content:

UNIT-I: Introduction to Material Handling System: Main types of Material handling equipments & their applications; Types of load to be handled; Types of Movements; Methods of stacking, loading & unloading systems; Principles of Material Handling Systems; Modern trends in Materials handling.

UNIT-II: Hoisting Machinery & Equipments: Construction, Working & Maintenance of different types of hoists such as Lever operated hoist, Portable hand chain hoist, Differential hoists, Worm geared and Spur geared hoists, Electric & Pneumatic hoists, Jumper; Construction, Working & Main- tenance of different types of cranes such as Rotary cranes, Trackless cranes, Mobile cranes, Bridge cranes, Cable cranes, Floating cranes & Cranes traveling on guide rails; Construction, Working & Maintenance of Elevating equipments such as Stackers, Industrial lifts, Freight elevators, Passenger lifts, and Mast type's elevators, Vertical skip hoist elevators.

UNIT-III: Conveying Machinery: Construction, Working & Maintenance of Traction type convey- ors such as Belt conveyors, Chain conveyors, Bucket elevators, Escalators; Construction, Working & Maintenance of Traction less type conveyors such as Gravity type conveyors, Vibrating & Oscillating conveyors, Screw conveyors, Pneumatic & Hydraulic conveyors, Hoppers gates & Feeders.

Surface Transportation Equipment: Construction, Function, Working of Trackless equipment such as Hand operated trucks, Powered trucks, Tractors, Automatic Guided vehicle, Industrial Trailers; Construction, Function, Working of Cross handling equipment such as Winches, Capstans, Turnta- bles, Transfer tables, Monorail conveyors.

UNIT-IV: Components of Material Handling Systems: Flexible hoisting appliances such as Welded load chains, Roller chains, Hemp ropes, Steel wire ropes, Fastening methods of wire & chains, Eye bolts, Lifting tackles, Lifting & Rigging practices; Load handling attachments: a) Various types of hooks-Forged, Triangular eye hooks, Appliances for suspending hooks b) Crane grab for unit & piece loads c) Electric lifting magnet, vacuum lifter. d) Grabbing attachment for loose materials e) Crane attachment for handling liquids/molten metals; Construction & Working of Arresting gear & Brakes; Construction & use of electromagnetic shoe brakes, Thruster operated shoe brakes, Control brakes.

UNIT-V: Mechanism used in Material Handling Equipment: Steady state motion; Starting & stop- ping of motion in following mechanisms: Hoisting mechanism, Lifting Mechanism, Traveling Mecha- nism, Slewing Mechanism, Rope & chain operated Cross- Traverse Mechanism.

Selection of Material Handling Equipment: Factors affecting choice of material handling equip- ment such as Type of loads, Hourly capacity of the unit, Direction & length of travel, Methods of stocking at initial, final & intermediate points, Nature of production process involved, Specific load conditions & Economics of material handling system.

Reference Books:

1. Material Handling (Principles & Practice) – Allegri T. H., CBS Publisher, New Delhi.
2. Plant Layout & Materials Handling – Apple J. M., John Wiley Publishers.
3. Material Handling Equipment – N. Rundenko, Peace Publisher, Moscow.
4. Material Handling Equipment – M. P. Alexandrov, MIR Publisher, Moscow.
5. Material Handling Equipment – Y. I. Oberman, MIR Publisher, Moscow.

Course outcomes:

At the end of the course, the student will be able to:

		Understand constructional & operational features of various materials handling systems.
		Identify, compare & select proper material handling equipment for specified applications.
		Know the controls & safety measures incorporated on material handling equipment.
		Appreciate the role of material handling devices in mechanization & automation of indus- trial process.
		Understand & appreciate safety instrumentation for equipment

Course Code	**:**	**PME-503**
Course Title	**:**	**INDUSTRIAL ENGINEERING & MANAGEMENT**
Number of Credits	**:**	**3 (L: 3, T: 0, P: 0)**
Prerequisites	**:**	**NIL**
Course Category	**:**	**PC**

Course Learning Objectives:

- To take the right decisions to optimize resources utilization by improving productivity of the Lands, Buildings, People, Materials, Machines, Money, Methods and Management effectively.
- To eliminate unproductive activities under the control of the Management, Supervisor, worker and the Design of Products and Processes.
- To use the Charts to record the Activities of the people, materials and Equipment to find alterna- tive methods which minimize waste and to implement the best method.

Course Content:

UNIT-I: Plant Engineering: Plant; Selection of site of industry; Plant layout; Principles of a good layout; Types; Process; Product and Fixed position; Techniques to improve Layout; Principles of Ma-

terial handling equipment; Plant maintenance; Importance; Break down maintenance; Preventive maintenance and Scheduled maintenance.

Plant Safety: Importance; Accident: Causes and Cost of an Accident, Accident Proneness, Prevention of Accidents; Industrial disputes; Settlement of Industrial disputes; Collective bargaining; Concilia- tion; Mediation; Arbitration; Indian Factories Act 1948 and its provisions related to health, welfare and safety.

UNIT-II: Work Study: Productivity; Standard of living; Method of improving Productivity; Objec- tives; Importance of good working conditions.

Method Study: Definition; Objectives; Selection of a job for method study; Basic procedure for con- duct of Method study; Tools used; Operation process chart; Flow process chart; Two handed process chart; Man Machine chart; String diagram and flow diagram.

Work Measurement: Definition; Basic procedure in making a time study; Employees rating fac- tor; Application of time allowances: Rest, Personal, Process, Special and Policy allowances; Calcula- tion of standard time; Numerical Problems; Basic concept of production study; Techniques of Work Measurement; Ratio delay study; Synthesis from standard data; Analytical estimating and Pre deter- mined Motion Time System (PMTS).

UNIT-III: Production Planning and Control: Introduction; Major functions of Production Planning and Control; Pre planning; Methods of forecasting; Routing and Scheduling; Dispatching and Con- trolling; Concept of Critical Path Method (CPM); Types of Production: Mass Production, Batch Pro- duction and Job Order Production; Characteristics; Economic Batch Quantity (EBQ); Principles of Product and Process Planning; Make or Buy decision; Numerical problems.

Quality Control: Definition; Objectives; Types of Inspection: First piece, Floor and Centralized In- spection; Advantages and Disadvantages; Statistical Quality Control; Types of

Measurements; Meth- od of Variables; Method of Attributes; Uses of X, R, p and c charts; Operating Characteristics curve (O.C curve); Sampling Inspection; Single and Double Sampling plan; Concept of ISO 9001:2008 Qual- ity Management System Registration/Certification procedure; Benefits of ISO to the organization.

UNIT-IV: Principles of Management: Definition of Management; Administration; Organization; F.W. Taylor's and Henry Fayol's Principles of Management; Functions of Manager; Types of Organiza- tion: Line, Staff, Taylor's Pure functional types; Line and staff and committee type; Directing; Leader- ship; Styles of Leadership; Qualities of a good leader; Motivation; Positive and Negative Motivation; Modern Management Techniques; Just In Time; Total Quality Management (TQM); Quality circle; Zero defect concept; 5S Concept; Management Information Systems.

Personnel Management: Responsibility of Human Resource Management; Selection Procedure; Training of Workers; Apprentice Training; On the Job training and Vestibule School Training; Job Evaluation and Merit Rating; Objectives and Importance; Wages and Salary Administration; Compo- nents of Wages; Wage Fixation; Type of Wage Payment: Halsey's 50% Plan, Rowan's Plan and Emer- son's efficiency plan; Numerical Problems.

UNIT-V: Financial Management: Fixed and Working Capital; Resources of Capital; Shares Prefer- ence and Equity Shares; Debentures; Type of debentures; Public Deposits; Factory Costing: Direct Cost; Indirect Cost; Factory Overhead; Selling Price of a product; Profit; Numerical Problems; Depre- ciation; Causes; Methods: Straight line, sinking fund and percentage on Diminishing Value Method; Numerical Problems.

Material Management: Objectives of good stock control system; ABC analysis of Inventory; Pro- curement and Consumption cycle; Minimum Stock, Lead Time, Reorder Level-Economic Order Quan- tity problems; Supply Chain.

Reference Books:

1. Industrial Engineering & Management, S.C. Sharma, Khanan Book Publishing Co (P) Ltd., New Delhi
2. Industrial Engineering and Management, O.P. Khanna, Revised Edition, Dhanpat Rai Publications (P) Ltd., New Delhi – 110002.
3. Management, A global perspective, Heinz Weihrich, Harold Koontz, 10th Edition, McGraw Hill In- ternational Edition 1994.
4. Essentials of Management, 4th Edition, Joseph L.Massie, Prentice-Hall of India, New Delhi 2004.
5. Principles and Practices of Management, Premvir Kapoor, Khanna Publishing House, N. Delhi

Course outcomes:-At the end of the course, the student will be able to

		Explain the different types of layout and plant maintenance with safety
		List and explain the need of method study and work measurements
		Explain the production planning and quality control, and its functions
		Define the principles of personnel management and organizational behavior
		List and explain the different financial and material management

Course Code	:	POE-051
Course Title	:	OPERATIONS RESEARCH
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Prerequisites	:	NIL
Course Category	:	PE

Course Learning Objectives:

- To provide a broad and in depth knowledge of a range of operation research models and tech- niques, which can be applied to a variety of industrial applications.

Course Content:

UNIT-I: Development, Definition, Characteristics and phase of Scientific Method, Types of models;
General methods for solving operations research models.

UNIT-II: Allocation: Introduction to linear programming formulation, graphical solution, Simplex Method, artificial variable technique, Duality principle. Sensitivity analysis.

UNIT-III: Transportation Problem Formulation optimal solution. Unbalanced transportation prob- lems, Degeneracy. Assignment problem, Formulation optimal solution.

UNIT-IV: Sequencing: Introduction, Terminology, notations and assumptions, problems with n-jobs and two machines, optimal sequence algorithm, problems with n-jobs and three machines.

UNIT-V: Theory of games: introduction, Two-person zero-sum games, The Maximum –Minimax prin- ciple, Games without saddle points – Mixed Strategies, 2 x n and m x 2 Games – Graphical solutions, Dominance property, Use of L.P. to games.

Reference Books:

1. Operations Research: an introduction, Hamdy A. Taha, Pearson Education.
2. Operations. Research: theory and application, J.K. Sharma, Macmillan Publishers.
3. Introduction to Operations Research: concept and cases, Frederick S. Hillier and Gerald J. Lieberman, Tata McGraw-Hill

Course outcomes:

At the end of the course, the student will be able to:

	Understand the formulation of Liner Programming
	Analyze and Convert the problem into a mathematical model.
	Understand and implement the transportation problems at workplace
	Understand sequencing to optimize the process time for n- job and m-machine
	Identify and select suitable methods for various games and apply the LP