Shri Rawatpura Sarkar University, Raipur

Examination Scheme & Syllabus

for

M.Tech.(Production Engineering)

Semester-II

(Effective from the session: 2022-23)

SHRI RAWATPURA SARKAR UNIVERSITY, RAIPUR, CHHATTISGARH
FACULTY OF ENGINEERING

Faculty of Engineering
Shri Rawatpura Sarkar University, Raipur

M.TECH.(Production Engineering)
Semester-II
Examination Scheme
(Effective from the session: 2022-23)

S. N.	Course Code	Th/ Pr	Subject	Type of Course	Teaching hours per week			TC	Examination Scheme				Total Marks
									Theory		Practical		
					L	T	P		EX	IN	EX	IN	
1	MENPE201T	**Th**	Machine Tool Design	Core	3	1	-	4	70	30	-	-	100
2	MENPE202T	**Th**	Production and Materials Management	Core	3	1	-	4	70	30	-	-	100
3	MENPE203T	**Th**	Non-Conventional Machining Processes	Core	3	1	-	4	70	30	-	-	100
4	MENPE204B	**Th**	Elective-II	Core	3	1	-	4	70	30	-	-	100
5	MENPE205T	**Th**	Product Design and Development	Core	3	1	-	4	70	30	-	-	100
6	MENPE201P	**Pr**	Machine ToolDesign Lab	Core	-	-	4	2	-	-	50	25	75
7	MENPE206P	**Pr**	Computer Integrated Manufacturing Lab	Core	-	-	4	2	-	-	50	25	75
Total Contact hr per week: 28			**Total Credit: 24**						**Total Marks:**				**650**

L – LECTURE T- TUTORIAL P- PRACTICAL

ELECTIVE-II

I	Experimental Methods	MENPE204A
II	Design of Jigs and Fixtures	MENPE204B
III	Automation and Control Engineering	MENPE204C

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Course Title	**MACHINE TOOL DESIGN**				
Course Code	**MENPE201T**				
Course Credits	**L**	**T**	**P**	**TC**	
	3	**1**	**-**	**4**	
Prerequisites	Manufacturing science, Machine Design.				
Course Objectives	**This course will enable students:** • To familiarize with constructional & design features of machine tool structures like bed, columns, sideways, guide ways etc. • To give exposure of types of drives and drive elements and their selection criteria. • To develop skills in designing feed gear boxes, bearings, power screws, clutches etc. • To acquaint with the use of standards & hand books to retrieve relevant data for design/selection. • To appraise the students about safety and safety standards. • To acquaint with the recommended procedure of carrying out acceptance tests & their significance.				
Course Contents	**UNIT – I** **Elements of Machine Tools** Types and capabilities of various machine tools. General purpose and special purpose machine tools. Design of machine tool structures. Design of bed & columns: Materials of construction, Profiles, Static and dynamic stiffness. Designing for strength and rigidity. Methods of enhancing rigidity. Design of simple machine tool columns like pillar drill column etc. on the basis of strength and rigidity. Design of machine tool bed cross-section like lathe bed. Machine tool guideways: Materials of construction, Classification of guideways, Types of slideways, Clearance adjustment and wear compensation techniques, Fundamentals of **UNIT – II** **Design of Speed and Feed Boxes** Stepped and Stepless speed outputs, selection of spindle speed ranges, construction of structural, speed, gearing & deviation diagrams, layout of speeds on arithmetic and geometric progression, kinematic advantages of geometric progression series and selection of values of common ratio. Stepless drives: Mechanical stepless drives, single disc, double disc and cone disc transmissions, speed regulation by epicyclic gear train, positive infinitely variable drives (PIV drives), Kopp's and Svetozarav's drives. Feed boxes: Quadrant change gear mechanism, speed boxes with gear cone and sliding key, Norton gear drive, Meander gear drives, gear boxes				

	with clutched drive, Schopke drive and Ruppert drive. Design of gear **UNIT – III** **Design of Belt Drives and Power Screws** Design of belts and pulleys: Materials of construction for belts. Types of belts- specifications & selection. Design of flat belt & v- belt pulleys. Design of power screws: Materials of construction. Power screw profiles and selection, design of machine tool power screws based on strength, buckling and stiffness, power requirements and efficiency, mounting of power screws elementary treatment of ball recirculating power screws. **UNIT – IV** **Design of Machine Tool Bearings** Bearing materials & their characteristics. Types of bearings- selection & application. Design of ball & roller bearings: Bearing designation (ISI, SAE, and SKF). Calculation of equivalent load, cubic mean load, static & dynamic load bearing capacities. Selection of ball & roller bearing from handbook. Mounting & maintenance of bearings. Design of journal bearings: Terminology. Theory of lubrication, bearing characteristic No., Sommerfeld No., calculations involving bearing dimensions, clearance, coefficient of friction, heat generated, and heat dissipated and power lost in friction. Mounting & maintenance of bearings. **UNIT – V** **Safety of Machine Tools & Acceptance Tests** Safety concepts, various safety devices incorporated in machine tools to safeguard safety of man, tools and equipment. Introduction to safety standards. Acceptance tests on machine tool: Significance, performance and geometrical tests on lathe, milling, drilling and shaping machines.
Course Outcomes	**At the end of this course students will be able to:** • Use codes and hand books to retrieve relevant data for design and selection. • Design machine tool structures & drive elements. • Design feed gear boxes, bearings and power screws. • Get exposure to requirements like maintaining of expected accuracy levels, parametric optimization, managing wear and tear problems etc.
Text Books	1. Sen and Bhattacharya “Principles of machine tools” New Central Book Agency. 2. N.K.Mehta “Machine tool design and Numerical Control” Tata MGH 3. G R Nagpal “Machine tool Engineering” Khanna Publishers. 4. PSG Design Data book: PSG College of engineering and technology, Coimbatore.
Reference Books	1. S.K. Basu and D.K.Pal “Design of Machine tool” Oxford and IBH publishing Co. 2. H.C.Town. “The design and construction of machine tools” 3. Machine tool design hand book: Central Machine Tool Research Institute, Bangalore. Tata MGH.

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<table>
<tr><td>Course Title</td><td colspan="5">PRODUCTION AND MATERIALS MANAGEMENT</td></tr>
<tr><td>Course Code</td><td colspan="5">MENPE202T</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Operation research and Industrial Management</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students:
To familiarize with the concepts, principles and knowledge of analytical problem solving at operational levels.
To acquaint with functions of operation management and its interrelation with other business functions.
To study key areas of production management and decision making.
To acquaint with importance of planning and control in production activities.</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT – I
Production System & Advanced Forecasting Method
Generalized Model of production system, design, optimization & control of production system. PPC – Production Planning, integrated part of corporate planning process, Integrative nature of production plans, centralized and decentralized production planning. Advanced Forecasting – Principles, SWOT analysis, and 7S approach, Advanced Techniques – multi item forecasting, slow item forecasting

UNIT – II
Capacity Planning
Measurement measures, estimating future capacity needs, factors influencing, factors favoring over capacity and under capacity, MPS.
Production Control Functions
Loading, sequencing, assignment models
High Volume Production System
Detroit type automation, automated flow lines, transfer mechanism, buffer storage.
UNIT – III
Inventory Management
Inventory models and safety stocks – Relevant costs, behaviour of costs in relation to level of inventory, optimal order quantity, EOQ, EBQ, Joint cycle for multiple products, model with purchase discounts, approaches to determine buffer stock, fixed order period models. ABC and other classification of Materials selective management control, VED analysis, combination of ABC and VED analysis, purpose classification. Material requirement planning (MRP – I) – Concepts, structure, working output reports, classes of users.</td></tr>
</table>

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	UNIT – IV **Material Management** Spare parts Management – Characteristics, codification concept, stocking, policy analysis, Maintenance or breakdown capital, insurance, rotable spares. Other aspects of Material Management Codification, characteristics, standardization, material handling, stores management. **UNIT – V** **Physical Distribution Management** Transportation problem, Route scheduling problem, logistics management. **Material Management** An integrated view, Adaptability considerations, inventory.inventory – a part of production strategy, organization, effectiveness, a multilevel interactive process
Course Outcomes	**At the end of this course students will be able to:** • Identify and analyse operation flow, primary and supporting activities to achieve quality and targets. • Conceptualize products/services, Select site and plan layout • Get exposure to latest trends in production and operations management.
Text Books	1. S.N. Chary "Production and Operation Management" TMH, Delhi 2. Seetharama L. Narasimham"Production Planning & Inventory Control" Dennis W. Mc. 3. M.P. Groover "Automation, Production System and CIM" PHI, Delhi
Reference Books	1. MartandTelsang"Industrial Engineering & Production Management" S. Chand & Company, Delhi. 2. Adam and Elbert "Production & Operation Management" PHI, Delhi. 3. G. Nadha Muni Reddy "Industrial Engineering & Management" Newage International.

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Course Title	**NON-CONVENTIONAL MACHINING PROCESSE**				
Course Code	**MENPE203T**				
Course Credits	**L**	**T**	**P**	**TC**	
	3	**1**	**-**	**4**	
Prerequisites	Material science, Applied Physics and Applied Chemistry.				
Course Objectives	**This course will enable students:** • Understand conventional and non-conventional manufacturing term. • Learn different types of unconventional machining process and advance machines. • Learn different types of unconventional joining process and advance joining machines. • Learn different types of unconventional forming process				
Course Contents	**UNIT – I** **Introduction** Mechanical Processes, Abrasive jet Technology, Ultrasonic machining, whirling jet machining. Fundamental principles, process parameters, characteristics, **UNIT – II** **Tool design** Metal removal rate-analysis, important part design, Analysis of the Process.Chemical and Electro-chemical machining –Introduction. Principles & scheme, **UNIT – III** **Process parameter** Metal removal rate, dynamic and hydro-dynamic & hydro-optimization, electrolytes. EDM: Introduction-basic principles & scheme, circuitry controls, metal removal rate, machining accuracy, **UNIT – IV** **Optimization** Selection of tool material and tool design, Di-electric, Analysis. Laser Beam Machining & Electron beam machining back ground, production of Laser, machining by Laser and other applications. **UNIT – V** **Electron beam** Dimensionless analysis to establish correlation, behavior EBM parameters. High Velocity forming of metals, explosive forming principles and applications, Electro-hydraulic and other applications, Analysis of the process				

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Course Outcomes	**At the end of this course students will be able to:** • To implement the mechanical energy, chemical and electrochemical based unconventional machining process. • To implement explosive energy and high energy beam to welding process. • To implement water energy, electro-magnetic, electrodischarge and explosive energy for forming process • To model mathematically and analyse various unconventional machining process • To recognize the need of industries' current necessity and environment related issue
Text Books	1. P. Pandey "Modern Machining Processes" Mc Grew Hill India, New Delhi; 2001. 2. R.K.Jain Production Technology 3. V.K. Jain Advanced Machining Process
Reference Books	1. J. P. Kaushish "Manufacturing Processes" PHI Publication, New Delhi, Delhi 110092 2. P.N.Rao"Manufacturing Technology" 3. P. K. Mishra "Nonconventional Machining" the institution of engineering (India)

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<table>
<tr><td>Course Title</td><td colspan="5">PRODUCT DESIGN AND DEVELOPMENT</td></tr>
<tr><td>Course Code</td><td colspan="5">MENPE205T</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>3</td><td>1</td><td>-</td><td>4</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Industrial Engineering, Design of Elements and Basic Knowledge of computer</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students:
Competence with a set of tools and methods for product design and development.
Confidence in your own abilities to create a new product.
Awareness of the role of multiple functions in creating a new product
Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective.
Reinforcement of specific knowledge from other courses through practice and reflection in an action-oriented setting.
Enhanced team working skills.
Practical problems will be considered in cooperation with companies in order to simulate real product development situations.</td></tr>
<tr><td>Course Contents</td><td colspan="5">UNIT – I
Introduction
Definition of product design, Classification of products, Design by evolution, Design by innovation, Various phases in product development and Design, Morphology of Design, Considerations in product design, Product specifications. Conceptual Design: Market research, Need based origin of product, Technology driven products, Analysis of ideas from various angles of design methodology and user needs, Function analysis and component process study, 2-D and 3-D representations in the form of concept drawing, Computer generated images, dummy and prototypes. Materials: Overview of materials including new generation materials, Tailor made material concepts, Material selection process.

UNIT – II
Design for manufacturing (DFM)
Producibility requirements, Accuracy and Precision requirements, Forging and casting design, Design for pressed, mechanical components, powder metallurgical components, Die cast and special cast components, expanded metals and wire forms. Design for Assembly (DFA): Analysis of assembly requirements, Standardization, Ease of Assembly and disassembly, Design for bolted, welded and riveted components, Design for hinge and snap fit assemblies, maintenance, consideration of handling and safety, Modular concepts.</td></tr>
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	UNIT – III **Strength considerations in Design** Criteria and objectives, Designing for uniform strength, Designing for stiffness and rigidity, Practical ideas for material saving in design of ribs, corrugations, rim shapes, bosses, laminates, etc.Designing with plastics: Mechanical behavior, special characteristics and considerations, Design concepts for product features to be manufactured by various production process technologies, Special considerations for designing of components for load bearing applications, Designing for safety, Reliability and environmental considerations. **UNIT – IV** **Value Engineering** Product value and its importance, Value analysis job plan, Steps to problem solving and value analysis, Value analysis tests, Value Engineering idea generation check list, Material and process selection in value engineering, Cost reduction, case studies and exercises. **UNIT – V** **Product Ergonomics** Anthropometry, Environmental conditions, thermal, noise, vibration, displays, illusions, Psycho and psychological aspects in design, Man-machine information exchange. Product Aesthetics: Visual awareness, Form elements in context of product design, Concepts of size, shape and texture, Introduction to colour and colour as an element in design, Colour classifications and dimensions of colour, Colour combinations and colour dynamics, Interaction / communication of colours, Psychological aspects of colours, generation of products forms with analogies from nature.
Course Outcomes	**At the end of this course students will be able to:** • To Identify and analyse the product design and development processes in manufacturing industry. • To Define the components and their functions of product design and development processes and their relationships from concept to customer over whole product lifecycle. • To analyse, evaluate and apply the methodologies for product design, development and management. • To undertake a methodical approach to the management of product development to satisfy customer needs. • To carry out cost and benefit analysis through various cost models. • To be familiar with the design protection and Intellectual Property.
Text Books	1. Morgon C. T. "Human Engineering Guide & Equipment Design" 2. Baldwin E. W. &Niebel B. W. Edwin "Design for Production" Homewood Illinois. 3. Seider, Seader , Lewin , Widagdo "Product and Process Design Principles: Synthesis, Analysis and Evaluation" Wiley

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Reference Books	1. Kavinotto "Product Design: Techniques in Reverse Engineering and New Product Development" prentice Hall. 2. Barron D.ed, Creativity, New York, Art Directors. 3. Yves Pigneur "Value Proposition Design: How to Create Products and Services Customers Want" Wiley.

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<table>
<tr><td>Course Title</td><td colspan="5">MACHINE TOOL DESIGN-LAB</td></tr>
<tr><td>Course Code</td><td colspan="5">MENPE201P</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>-</td><td>-</td><td>4</td><td>2</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Workshop and Manufacturing process.</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students:
Technical knowledge and computing skills necessary to design, analyze and create novel products and solutions.
suitable tools for machining processes including turning, facing, thread cutting and tapping.
Practice on machine tools and their operations.
gain the knowledge of design of structures, guide ways, spindles of machine tools</td></tr>
<tr><td>Course Contents</td><td colspan="5">LIST OF EXPERIMENTS
Step Turning and Taper Turning on Lathe
Thread Cutting and Knurling on Lathe
Machining Flat Surface using Shaper Machine
Square bar Manufacturing of using Milling Machine
Making Internal Splines using Slotting Machine
Drilling, Tapping & Grinding
Grinding of Single Point Cutting Tool
Planning Machine
Lathe Tool and Drill Tool Dynamometers</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">At the end of this course students will be able to:
Calculate the values of various forces involved in the machining operations
Design various single and multipoint cutting tools.
Analyze heat generation in machining & coolant operation
Illustrate the properties of various cutting tool materials and hence select an appropriate tool material for particular machining application
Demonstrate the inter-relationship between cutting parameters and machining performance measures like power requirement, cutting time, tool life and surface finish
Analyze economics of machining operations</td></tr>
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Text Books	1. Mehta N. K., "Machine Tool Design", Tata McGraw Hill 2. Pal D. K. and Basu S. K., "Design of Machine Tools", 4th Revised Edition, Oxford-IBH. 3. Bhattacharya A., Sen G. C., "Principles of Machine Tools", New Central Book Agency, Calcutta.
Reference Books	1. Acherkan N. S., "Machine Tool", Vol. I to Vol. II, MIR publications 2. Kundra T, Rao P.M., Tiwari N. K., "Numerical Control and Computer Aided Manufacturing", Tata McGraw Hill 3. Martin S. J., "NC Machine Tools", ELBS publication

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<table>
<tr><td>Course Title</td><td colspan="5">COMPUTER INTEGRATED MANUFACTURING - LAB</td></tr>
<tr><td>Course Code</td><td colspan="5">MENPE206P</td></tr>
<tr><td rowspan="2">Course Credits</td><td>L</td><td>T</td><td>P</td><td>TC</td><td></td></tr>
<tr><td>-</td><td>-</td><td>4</td><td>2</td><td></td></tr>
<tr><td>Prerequisites</td><td colspan="5">Basic Knowledge of computer, workshop and industrial Management</td></tr>
<tr><td>Course Objectives</td><td colspan="5">This course will enable students:
• To introduce the concepts of computer aided engineering for design & manufacture.
• To develop skills in preparing machining sequence and estimate manufacturing time.
• To appraise the significance and control of tolerance in design &manufacturing.
• To impart knowledge on computer graphics, which are used in diverse areas of engineering.</td></tr>
<tr><td>Course Contents</td><td colspan="5">LIST OF EXPERIMENTS
1- Introduction to Computer Integrated Manufacturing (CIM) Lab.
2- Introduction to OPEN CIM Software.
3 - Operating Scorbot ER-9.
4 - Operating AS/RS.
5(a) – Making the tutorial CIM setup in OPEN CIM Software.
5(b) - Making UET AMS Lab CIM setup in OPEN CIM Software.
6- Operating the UET AMS lab CIM setup practically.
7- Introduction to CNC and Part Programming.
8- Operating CNC mill.
9- Introduction to CNC Simulator Pro
10(a) - Construction of a stairs model in CNC Simulator Pro.
10(b) - Making Channels in a work piece.
11 - Making holes in a rectangular plate using G and M codes in CNC Simulator Pro.
12- Operating CNC Lathe in CNC Simulator Pro.
13- Operating Denford CNC.</td></tr>
<tr><td>Course Outcomes</td><td colspan="5">At the end of this course students will be able to:
• Illustrate software configuration of graphic packages.
• Demonstrate use of Computer graphics in design.
• Get oriented with CNC and related software tools.
• Solve physical and engineering problems with emphasis on Structural and Thermal Engineering applications.</td></tr>
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Text Books	1. P.N. Rao "CAD / CAM" Tata- McGraw-Hill. 2. William M Neumann and Robert F.Sproul "Principles of Computer Graphics" McGraw Hill Book Co. Singapore. 3. Barr, Krimger and Lazaer "CAD Principles and Applications"
Reference Books	1. IbarahimZeid "Mastering CAD – CAM" Tata- McGraw-Hill. 2. Donald Hearn and M. Pauline Baker "Computer Graphics" Prentice Hall, Inc.

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ELECTIVE-II

Course Title	**EXPERIMENTAL METHOD**				
Course Code	**MENPE204A**				
Course Credits	**L**	**T**	**P**	**TC**	
	3	**1**	**-**	**4**	
Prerequisites	Mechanical Measurement and metrology, Applied Physics and Mechanics				
Course Objectives	**This course will enable students:** • Familiarity with different types of measurement systems/devices for engineering measurements • Capability to handle different types of measurement signals and utilize this capability to obtain reliable measurement results • Ability and practice in engineering report writing, including assessment and manipulation of data, and drawing conclusions from that data				
Course Contents	**UNIT – I** **Theory and Experimentation in Engineering** Problem solving approaches, Types of engineering experiments, computer simulation and physical experimentation; Generalized measuring system, types of inputs, analog and digital signals, standards, calibration and uncertainty, **UNIT – II** **Measurement System** Performance characteristics, static performance characteristics-static calibration-linearity, static sensitivity, repeatability, hysteresis-threshold- resolution, readability and span; **UNIT – III** **Analysis of Experimental Data** Causes and types of experimental error, un-certainty analysis, statistical analysis of data, probability distributions and curve fitting; Dynamic performance characteristics; Input types; Instrument types- zero order instrument, first order instrument, second order instrument; **UNIT – IV** **Experiment Plans** Model building; Measurement Methods and Applications : Measurement of force and torque; Measurement of strain and stress; Measurement of pressure; Flow measurement and flow visualization; measurement of temperature; optical methods of measurements; **UNIT – V** **Data Acquisition and Processing** Types and configurations of DAS, signal conditioning, A/D, D/A conversion;				

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	Design, Planning, Execution and Analysis of experimental projects.
Course Outcomes	**At the end of this course students will be able to:** • Apply analytical and experimental methods to make measurements and to find and correct defects in measurement systems. • Use a variety of equipment and techniques to measure force, flow, pressure, temperature, speed, strain. • Setting the instruments for zero error adjustment • To understand principle, working of various measuring instruments.
Text Books	1. Beckwith, Buck, and Marangoni, Mechanical Measurements, Narosa Publishing House, 1995. 2. Doeblin, Measurement Systems - Application and Design, McGraw-Hill, 1990. 3. Doeblin, Engineering Experimentation, McGraw-Hill, 1995.
Reference Books	1. Holman, Experimental Methods for Engineers, 6e, McGraw-Hill, 1994. 2. M. I. Eremets “High Pressure Experimental Methods” Oxford University Press, 1996

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ELECTIVE-II

Course Title	**DESIGN OF JIGS AND FIXTURE**				
Course Code	**MENPE204B**				
Course Credits	**L**	**T**	**P**	**TC**	
	3	**1**	**-**	**4**	
Prerequisites	Workshop Technology, Manufacturing Process.				
Course Objectives	**This course will enable students:** • To acquaint concepts pertaining to planning and sequencing of operations • To develop capability to identify and select location and clamping faces/points on jobs • To develop capabilities of designing simple productive and cost effective jigs and fixtures,				
Course Contents	**UNIT – I** **Introduction to Tool Design** Production Tooling's(Jigs, Fixtures, Diesetc)and their difference, their Requirement(accuracy, machinability, quantity modifications so as to assist production, Interchange ability, Simplicity, Swarf disposal, Handling, Ease of operation, Skill reduction, Cost reduction). Analysis for Operation planning, sequencing of operations. **UNIT – II** **Basic Construction of Jig & Fixture** **Location & Locating Devices** Locating principles: Degrees of freedom, Redundant location, Fool proofing, nesting. Locators: locators that control work piece from flat surfaces, location from cylindrical surfaces, conical locators, centralizers. **Clamping & clamping Devices** Requirement of clamping system, Position of clamps. Design of clamps. Clamping devices; examples of typical clamps(multiple clamping and equalizing devices, quick acting clamping mechanisms such as link, toggle, cam, eccentric, pneumatic, hydraulic and electric devices). Component distortion under clamping and cutting forces. Material used for different elements of jigs/fixture and recommended hardness where necessary. **UNIT – III** **Construction of Drill Jig** Introduction, Selection of location, supporting and clamping faces /points choice, cutting tools and means of guiding and supporting Jigs, various types of Jig Bushes, Commonly used drill jigs. Case Study on Drill Jig Design. **UNIT – IV** **Construction of Milling fixture**				

	Introduction, Selection of location, supporting and clamping faces /points choice, Tool setting & cutter guiding (Tennons& Setting block). Case Study on Milling Fixture Design. **UNIT – V** **Indexing Jig & Fixture** Introduction. Application of indexing. Essential features of an indexing jig /fixture, Indexing Devices.
Course Outcomes	**At the end of this course students will be able to:** • Demonstrate concepts pertaining to planning and sequencing of operations • Identify and select location and clamping faces/points on jobs. • Design and develop simple productive and cost effective jigs and fixtures.
Text Books	1. Erik K. Henrikson, "Jig and Fixture Design Manual"Industrial Press. 2. Jigs and Fixture Handbook, A.K. Goroshkin, Mir Publication. 3. M.H.A. Kempster "An introduction to jig and tool Design" III Ed.Pub ELBS. 4. P.H. Joshi "Jigs and Fixture" THM.
Reference Books	1. C. Donaldson, George H. Lecain, V.C. Goold "Tool design" THM. 2. Jigs and Fixture, ASTME. 3. Hiran E. Grant "Non- Standards Calming Devices" TMH, New Delhi.

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ELECTIVE-II

Course Title	**AUTOMATION AND CONTROL ENGINEERING**				
Course Code	**MENPE204C**				
Course Credits	**L**	**T**	**P**	**TC**	
	3	**1**	**-**	**4**	
Prerequisites	Applied physics and Instrumentation and control				
Course Objectives	**This course will enable students:** • To acquaint with basic concepts of industrial automation involving pneumatic and hydraulic controls. • To familiarize with the elements of electro-pneumatic interface with control systems. • To learn about the application of microprocessors and microcontrollers.				
Course Contents	**UNIT – I** **Automation** Definition; Automation in production systems; Automation principles and strategies; Basic elements of an automated system; Advanced automation functions; Levels of automation; Types of automation; Benefits and Impact of Automation in Manufacturing and Process Industries. Architecture of Industrial Automation Systems. **UNIT – II** **Pneumatic control systems** Overview of different types of valves and Actuators in Pneumatics, their applications and their ISO symbols. Design of Pneumatic circuits using Cascade method and Shift register method (up to 3 cylinders). Design of Electro-Pneumatic Circuits using single solenoid and double solenoid valves with and without grouping. Design of Pneumatic circuits using PLC Control (ladder programming only and up to 3 cylinders) with applications of Timers and Counters and concept of Flag and latching. **UNIT – III** **Hydraulic control systems** Overview of different types of valves, Actuators and Accumulators used in Oil hydraulic circuits, their applications and their ISO symbols. Basic hydraulic circuits involving linear and rotary actuators (No sequential circuits). Fundamental concepts of digital and servo hydraulic controls. Comparison between proportional, digital and servo hydraulic control systems. **UNIT – IV** **Sensors and Transducers** Fundamentals of displacement, position and Proximity Sensors; Velocity and				

	Motion Sensors; Force and Fluid Pressure Sensors; Liquid level and Flow sensors; Temperature and light Sensors; Control of stepper motors. **UNIT – V** **Fundamentals of Control System** Control system concepts, classification of control systems, mathematical representation of system equations, response characteristics of components and systems through classical solution. Analog computer and Laplace transformation, Frequency response analysis, polar plots, Testing of System's stability using Routh's criteria, Bode plots, Nyquist plot and Root locus method of analysis.
Course Outcomes	**At the end of this course students will be able to:** • Apply automation techniques to manufacturing set-ups. • Design and develop pneumatic and hydraulic control circuits of medium complexity. • Illustrate the use of PLC in control systems. • Model the system and check the stability of a mechanical system.
Text Books	1. Mikell P. Groover "Automation, Production Systems, and Computer-integrated Manufacturing" (3rd Edition), PHI Learning Private Limited, New Delhi. 2. U.A.Bakshi, V.U.Bakshi, "Principles Of Control Systems" Technical Publications Pune . 3. Peter Croser, Frank Ebel "Pneumatics Basic Level"Festo Didactic GmbH & Co. Germany 4. G. Prede, D. Scholz "Electropneumatics Basic Leve"
Reference Books	1. S.Ilango and V. Soundararajan "Introduction to Hydraulics and Pneumatics" PHI Learning Pvt. Ltd. New Delhi. 2. P.N. Paraskevopoulos "Modern Control Engineering" CRC Press.