Department of Manufacturing Engineering & Industrial Management

Honors

Manufacturing Systems Engineering

Sem	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
III	HON-01	<*tbd*>	Modeling and Design of Manufacturing System	3	-	-	1	**3**	30	20	50	--	--
IV	HON-02	<*tbd*>	Robot Integrated Manufacturing Automation	3	1	-	1	**4**	30	20	50	-	-
V	HON-03	<*tbd*>	Metrology and Computer aided Inspections	3	-	2	1	**4**	30	20	50	CIE-100	
VI	HON-04	<*tbd*>	Performance Modeling of Production Systems	3	1	-	1	**4**	30	20	50	-	-
VII	HON-05	<*tbd*>	Machine Tool System and Manufacturing Optimization	3	-	-	1	**3**	30	20	50	--	--
			Total	**15**	**02**	**02**	**05**	**18**					

Mechatronics

Sem	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
III	HON-01	<*tbd*>	Principles of Electronics	3	-	-	1	**3**	30	20	50	--	--
IV	HON-02	<*tbd*>	Industrial Instrumentation and Control	3	1	-	1	**4**	30	20	50	-	-
V	HON-03	<*tbd*>	Advanced Sensor Systems and Instrumentation	3	-	2	1	**4**	30	20	50	CIE-100	
VI	HON-04	<*tbd*>	Industrial Robotics	3	1	-	1	**4**	30	20	50	-	-
VII	HON-05	<*tbd*>	Mechatronics System Design	3	-	-	1	**3**	30	20	50	--	--
			Total	**15**	**02**	**02**	**05**	**18**					

Interdisciplinary Minor

Title: Manufacturing Technology

Sem	Course Type	Course Code	Course Name	L	T	P	S	Cr	Evaluation Scheme				
									Theory			Laboratory	
									MSE	TA	ESE	ISE	ESE
III	IDP-01	*<tbd>*	Production Processes	3	-	-	1	3	30	20	50	--	--
IV	IDP -02	*<tbd>*	Manufacturing Automation	3	-	2	1	**4**	30	20	50	50	50
V	IDP -03	*<tbd>*	Metrology & Quality Control	3	-	2	1	**4**	30	20	50	50	50
VI	IDP -04	*<tbd>*	Operations Research	3	1	-	1	**4**	30	20	50	-	-
VII	IDP -05	*<tbd>*	Product Design and Development	3	-	-	1	**3**	30	20	50	--	--
			Total	**15**	**1**	**04**	**05**	**18**					

Please use the above tables in case the department is offering more than one Honors/ Interdisciplinary Minors. Please restrict the number to TWO each for Honors and Interdisciplinary Minors

Detailed Syllabi

Production Processes						
Course Code	OEC-24006		**Examination Scheme**			
Teaching Scheme	3-0-0-0		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	3					--

Course Outcomes: Students will be able to:

1. Explain basic casting processes and their applications.
2. Aware of basic machining processes and their real-time applications
3. Select various joining processes for the practical applications.
4. Inspect linear and angular components and carry out measurements.
5. Evaluate the surface finish of the given specimen using a measuring instrument.
6. Demonstrate basic geometric parameters and their measurements.

Casting and moulding Processes. **[6 Hrs]**

Sand Casting, types of pattern materials, pattern making allowances, core prints, machine Moulding, core, core boxes, Melting and pouring, Investment casting, Shell moulding, Casting techniques of cast iron, Steels and nonferrous metals of alloys, Die casting, Low-pressure permanent mould casting–hot and cold chamber processes, Centrifugal casting, Semi-centrifugal casting, Centrifuging, Continuous casting. Plastic moulding processes. Basics of composite manufacturing.

Self-Study- *Study of furnaces – cupola, fuel-fired, Electric arc, Induction furnaces*,

Machining Processes **[6 Hrs]**

Fundamentals of turning and boring, Lathe – construction, accessories, operations, Thread cutting – single and multi-start threading, Different tools, Tool materials, Tool geometry, Concept of speed, feed, Depth of cut, Drilling and Milling Machines: Fundamentals of drilling process, twist drill geometry, tool holders, Types of drilling Operations performed on drilling machines, Reaming process, Milling Machines, Fundamentals of milling process, Cutters - types and geometry, Operations performed on milling machines.

Types of grinding machines: Honing, Lapping, Super Finishing, Buffing. Basics of CNC machines and operations.

Self-Study- Capstan and Turret Lathe- Construction, Working and Applications, Shaper, Planer and Slotting Machines

Joining Processes **[7 Hrs]**

Welding Processes: Theory, control, and applications, Arc Welding – SMAW, GTAW, GMAW, FCAW, Submerged arc welding, etc. Resistance welding, Spot, Seam, Projection welding processes, etc., Gas welding, Thermit welding, Friction welding, Ultrasonic welding, Electron beam, and Laser welding

Soldering and Brazing applications, Use of adhesives for joining, Classification of adhesives, Types of adhesives and their applications, Surface preparation and various joints.

Self-Study- Defects in welding, their cause and remedy, weldability, welding of dissimilar metals, NDT, and other methods of testing welded joints

Abrasive Machining Processes: **[7 Hrs]**

Abrasive machining, abrasives - types, size and geometry, Grinding wheels, Wheel marking, Wheel selection, Wheel mountings, Types of grinding machines, Honing, Lapping, Super Finishing, Buffing.

Surface treatment processes:

Honing, lapping, Buffing, Polishing, Honing tools, and lapping materials. Abrasive, Buffing, Polishing wheels and burnishing processes,

Self-study: Electroplating, Electroless plating, Plasma coating, Phosphating, Galvanizing, Metal spraying, Anodizing

Textbooks:	
[1]	Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition, 2002.
[2]	O.P. Khanna and M. Lal, "Production Technology", Vol. I,II, Dhanpatrai Publication,5th Edition, 1999.
[3]	"Elements of Workshop Technology Vol-I & II" by S.K. Hajra Chaudhary, Media Promoters & Publishers.
Reference Books:	
[1]	B.S. Raghuwanshi, "Workshop Technology", Dhanpatrai Publication, 9th Edition
[2]	R. K. Jain, A Textbook of Engineering Metrology, Khanna Publications Pvt. Ltd.18th Edition,2002
[3]	I.C. Gupta, A Textbook of Engineering Metrology, Dhanpat Rai Publications Pvt. Ltd.6th Edition, 2004.

Manufacturing Automation						
Course Code	PME-25003		**Examination Scheme**			
Teaching Scheme	3-0-2-1		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	3		**Laboratory**	CIE: 50	ESE: 50	--

Course Outcomes: Students will be able to:

1. Understand the principles of manufacturing automation and its significance in industry.
2. Analyze different types of manufacturing systems and automation strategies.
3. Analyze different types of automated material handling and storage systems.
4. Evaluate the role of sensors, actuators, and control systems in automation.
5. Analyze the design and operation of single station manufacturing cells.
6. Apply assembly line balancing techniques to optimize manual assembly lines.
7. Evaluate the functioning of automated production lines and their control strategies.

Introduction to Manufacturing Systems and Manufacturing Automation: **[7 Hrs]**

Introduction to Manufacturing Systems and Manufacturing Automation :Overview of Manufacturing Systems and Their Evolution, Types of Manufacturing Systems: Job Shop, Batch, Mass, and Continuous Production, Fundamentals of Manufacturing Automation, Types of Automation: Fixed, Programmable, and Flexible, Automation Strategies in Manufacturing, Benefits and Limitations of Automation in Manufacturing, Industry 4.0 and Smart Manufacturing, Role of Artificial Intelligence and Industry 4.0 in Automation.

Self-Learning Topics:

Historical Evolution of Automation in Manufacturing, Case Studies on Automated vs. Traditional Manufacturing, Historical Development of Automation Technologies, Case Studies on Automation in Different Industries

Automated Material Handling and Storage Systems: **[7 Hrs]**

Functions and Types of Automated Material Handling Systems (AMHS), Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs), Automated Storage and Retrieval Systems (AS/RS), Conveyor Systems and Robotics in Material Handling

Self-Learning Topics:

Recent Advances in AGVs and AMRs, Case Studies on Smart Warehousing

Sensors, Actuators, and Control Systems in Automation: **[7 Hrs]**

Types of Sensors: Proximity, Vision, Force, and Temperature Sensors, Actuators: Hydraulic, Pneumatic, and Electric Drives, Programmable Logic Controllers (PLCs): Architecture and Programming, Supervisory Control and Data Acquisition (SCADA) Systems

Self-Learning Topics:

Smart Sensors and IoT in Manufacturing, Case Studies on Automated Quality Control

Single Station Manufacturing Cells: **[7 Hrs]**

Fundamentals of Single Station Manufacturing Cells, Machine Cell and Machine Cluster, Manual, Automated, and Semi-Automated Workstations, Machine Tool Automation and CNC Systems, Process Optimization in Single Station Cells

Self-Learning Topics:

Advances in CNC and Adaptive Control Systems, Case Studies on Automated Machining Cells

Manual Assembly Lines – Single Model: **[7 Hrs]**

Introduction to Manual Assembly Lines and Their Importance, Line Balancing Problems and Methods (Largest Candidate Rule, Kilbridge & Wester Method, Rank Positional Method), Single Model, Poka-Yoke: Motion step Method.

Self-Learning Topics:

Lean Manufacturing and its Impact on Assembly Line, Case Studies on Assembly Line Improvements

Automated Production Lines and Assembly Systems: **[7 Hrs]**

Structure and Working of Automated Production Lines, Transfer Mechanisms: Linear and Rotary Transfer Lines, Control Strategies in Automated Production Systems, Buffering and Accumulation in Production Lines, Types of Automated Assembly Systems, Part Feeding and Orientation Techniques, Design for Automated Assembly (DFA) Principles, Performance Analysis and Economic Justification of Automated Assembly.

Self-Learning Topics:

Case Studies on Successful Implementation of Automated Production Lines, Simulation and Optimization of Automated Production, Advances in Automated Micro-Assembly Systems, Case Studies on DFA and Assembly Line Automation

List of Experiments:

The term work shall consist of record of any seven assignments on following topics:

1. Study & Design of basic hydraulic and pneumatic circuits: such as Standard ON-OFF and Pneumatic Latch.
2. Study & Design of Pneumatic or Hydraulic circuit for Two Push Button Control and Clamping of Work piece.
3. Study & Design of Pneumatic or Hydraulic circuit for material handling.
4. Study & experiments in Programmable Logic Controllers (PLC).
5. Study of Displacement, Level, Pressure controls.
6. Measurements & Design of circuit for Speed & Temperature measurements.
7. Study & Design of Simple Hydraulic or Pneumatic and Electro-Hydraulic or Electro Pneumatic Automatic Control Circuit Problem.
8. Study & Design of Electro-hydraulic or Electro-pneumatic Control Circuit Problem.
9. Study of Maintenance and Troubleshooting of Fluid Power Systems.
10. Study/Demonstration of Electric actuators equivalent to hydraulic and pneumatic actuators.

Textbooks:

[1]	Mikell P. Groover, Automation, Production Systems, and Computer Integrated Manufacturing, Addison Wesley; 5th edition,2020, Prentice-Hall of India Private Limited.

[2]	W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering,6th Edition 2022 Pearson Education Limited.
[3]	Frank Lamb, Industrial Automation: Hands On, Tata McGraw Hill.
Reference Books:	
[1]	Geoffrey Boothroyd, "Assembly Automation and Product Design", CRC, Taylor & Francis Publishers.
[2]	N. P. Mahalik, Mechatronics: Principles, Concepts and Applications, Tata McGraw Hill.
[3]	S. R. Majumdar, Oil Hydraulic Systems: Principles and Maintenance, Tata McGraw Hill.
[4]	HMT Ltd. Mechatronics, Tata McGraw-Hill.
[5]	Joji P. Pneumatic Controls, Wiley India.

METROLOGY AND QUALITY CONTROL (MQC)						
Course Code			**Examination Scheme**			
Teaching Scheme	3-0-2-0		**Theory**	TA: 20	MSE: 30	ESE: 50
Credits	4		**Laboratory**	CIE: 100		--

Course Outcomes: Students will be able to:

1. Identify different measurement systems and common types of errors.
2. Describe and use different types of linear and angular measurement processes and instruments.
3. Explain and able to select appropriate techniques of interferometers, comparators and screw and gear measurements.
4. Explain surface roughness measurements, Optical instruments and 3Dmeasurements.
5. Explain industrial practices to analyze the cause for variation by statistical process control using variable and attribute control charts and sampling technique.
6. Explain principle, construction and working of various measuring instrument.
7. Selection of proper instruments for measurement.
8. Calculation of least count of instrument, take reading using the instrument.

Introduction: **[6 Hrs]**

Meaning of Metrology, Precision, Accuracy, Methods and Errors in Measurement, Calibration.

Linear Measurement: Standards, Line Standards, End Standard, Wavelength Standard, Classification of Standards, Precision and Non-Precision Measuring instruments and their characteristics, Slip Gauges.

Interferometry: Introduction, Flatness testing by interferometry, NPL Flatness Interferometer.

Study of Measuring Machines, Recent Trends in Engineering Metrology, use of interferometry for length, angle and surface roughness measurement.

Measurement System Analysis: Introduction, Influence of temperature, operator skills and the instrument errors etc. on the MSA, Gauge R and R study. Metrology for Additive manufacturing, laser metrology and measurement.

Self-Study- Angle Measurement: Sine bar, Sine centres, Uses of sine bars, angle gauges, Auto Collimator, Angle dekkor, Constant deviation prism.

Limits, Fits and Tolerances: **[5 Hrs]**

Meaning of Limit, Fits and Tolerance, Cost– Tolerance relationship, concept of Interchangeability, Indian Standard System.

Design of limits Gauges: Types, Uses, Taylor's Principle, Design of Limit Gauges, Three surface Generation.

Inspection of Geometric parameters: GD&T symbols and concept,Straightness, Flatness, Parallelism, Concentricity, Squarenessand Circularity.
Self Study- Comparators:Uses, Types, Advantages and Disadvantages of

Surface Finish Measurement: **[5 Hrs]**

Surface Texture, Meaning of RMS and CLA values, Roughness Measuring Instruments, Tactile and Non-tactile measuring instruments, difference between waviness and roughness, Grades of Roughness, Specifications, Assessment of surface roughness as per IS, Relationship between surface roughness and Manufacturing Processes.
Screw Thread Metrology: External Screw Thread terminology, Floating Carriage Instruments, Pitch and flank Measurement of External Screw Thread, Application of Tool Maker's Microscope, Use of Profile Projector.
Self-Study- Gear Metrology**:** Spur Gear Parameters, Gear tooth thickness measurement: Gear tooth vernier caliper, Constant chord method, Span Micrometer.

Quality Control: **[3 Hrs]**

Meaning of Quality, Approaches- Deming's Approach, Juran's Approach,Quality of Product, Quality of Service, Cost of Quality, Value of Quality, and Difference between Inspection, Quality Control and Quality Assurance, Role of Quality in Present day environment. Meaning of quality Control, 100% Inspection and Selective Inspection, Statistics in Selective inspection, Quality Assurance system and standards.
Self-Study-Total Quality Management: 7 Tools of problem solving, Like cause and effect diagram, Pareto Analysis ,etc. QFD, Kaizen, 5s system, Quality Circles

Statistical Quality Control: **[5 Hrs]**

Interpretation of SPC Charts, benefits for use on shop floor, Control charts- Attribute (P, nP, C, U) and Variable (X bar, R chart and X & R chart), Sampling inspection, OC Curves and Sampling Plan, Process Capability Index (Cp, Cpk), Concept, Methods of determining Cp and Cpk.
Self-Study-ISO 9001-2000 Series of Standards: History and evolution of ISO 9000 series, importance and overview of ISO series, Structure of ISO 9001-2000 Series Standards, clauses of ISO 9000 series standards and their interpretation and implementation

List of experiments:

Term work consists of following experiments (Any Eight)

01	Determination of Linear/Angular dimensions of a part using Precision and Non-Precision measuring Instruments.	**02hrs**
02	Precision angular measurement using a) Sine Bar, b) Auto Collimator, c) Angle Dekkor.	**02hrs**
03	Machine Tool alignment tests on any machine tool like Lathe, Drilling Machine or Milling machine (minimum three tests)	**04hrs**
04	Measurement of screw thread parameters using Floating Carriage Micrometer.	**02hrs**
05	Measurement of Gear parameters: a) Gear Tooth thickness and depth, b) constant Chord, c) Span Measurement, d) Pitch Circle Diameter.	**02hrs**
06	Surface Finish measurement using suitable instrument	**02hrs**
07	Interferometry: Measurement of surface flatness using optical flat.	**02hrs**
08	Study and Measurement of parameters using Profile Projector.	**04hrs**
09	Exercise on Design of Limit Gauges using Taylor's Principles.	**02hrs**
10	Study and Measurement of parameters using Tool Makers Microscope.	**02hrs**
11	Study and Measurement of parameters using Co-ordinate measuring machine (CMM).	**02hrs**
12	Measurement of circularity using comparator	**02hrs**

Textbooks:

[1]	R. K. Jain, A Textbook of Engineering Metrology, Khanna Publications Pvt. Ltd.22nd Edition, 2022.

[2]	Dr.S.P. Gupta, Statistical Methods, Sultan Chand and Sons, 46th Edition, 2021.
[3]	Grant and Leavenworth," Statistical Quality Control", McGraw Hill publication,2017
[4]	Amitava Mitra, Fundamental of Quality Control and improvement, Prentice Hall of India Publications, 4th Edition 2016
[5]	I.C. Gupta, A Textbook of Engineering Metrology, Dhanpat Rai Publications Pvt. Ltd.6thEdition, 2004
Reference Books:	
[1]	G.M.S. De Silva, Basic Metrology for ISO 9000 Certification Elsevier Publications, 3rd Edition 2002.
[2]	A.S.T.M.E., "Handbook of Industrial Metrology", Prentice Hall, ISBN 10: 0070015368, 1968.
[3]	G.S. Patnaik, Quality Assurance in Industries: A Comprehensive Guide to Quality Assurance in Industries, Notion Press Media Pvt. Limited, ISBN: 9781639403134, 1639403132.
[4]	Kumar D S," Mechanical Measurements and Control" Metropolitan publication, Delhi.,5th edition,2012
[5]	John S. Oakland, Total Quality Management, Elsevier Publications, 3rd Edition 2006.
[6]	P. N. Mukerjee, Total Quality Management, Prentice Hall of India Publications, 2nd Edition 2005

Operations Research						
Course Code			**Examination Scheme**			
Teaching Scheme	3-1-0-0		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	4					--
Course Outcomes: Students will be able to:						
1. Gain an understanding and appreciation of the breadth and depth of the field of Manufacturing Engineering. 2. Understand the various basic Production Processes and Machine Tools. 3. Learn how to select a particular production process for the given component from the available conventional as well as non-conventional manufacturing processes. 4. Learn development and application of advanced technologies and components & processes for Manufacturing.						
Introduction: Operations Research:						**[8 Hrs]**
Development, history, definitions, objectives, characteristics, limitations, phases, and applications. Optimization models and their classifications. Linear Programming: Formulation of LP problem, Simplex method (minimization / maximization cases). Degeneracy in LP, Duality in LP, Sensitivity analysis.						
Transportation:						**[8 Hrs]**
Introduction, methods for finding initial basic solution. Test of optimality Maximization Transportation problem. Degeneracy. Assignment Problem: Introduction. Solution methods. Variations of the assignment problem. Traveling Salesman Problem						
Sequencing Models:						**[8 Hrs]**

Scheduling and sequencing. Assumptions in sequencing models. Processing "n" jobs on "m" machines. Graphical Method.
Inventory Control System (Quantitative Approach): Introduction. Meaning of Inventory Control. Functional classifications of Inventories. Advantages of Inventory Control. Deterministic Inventory Models: economic lot size with instantaneous replenishment with and without shortage costs, economic lot size models with quantity discount.

Queuing Theory: Queuing Systems	**[8 Hrs]**

Queuing Theory: Queuing Systems: Introduction, cost associated with, Classification of queuing models. Kendall's notations. Models: {(M/M/1): (α / FSFS)}. Single server models.
Simulation: Introduction to discrete event Simulation. Monte -Carlo Simulation. Problems related to Monte-Carlo Simulation.
Theory of Games: Introduction, two–person zero-sum game. Minimax and Maximin principle. Saddle point. Methods for solving game problems with mixed strategies. Introduction to graphical and iterative methods for solving game problems

Sequencing Models	**[8 Hrs]**

Scheduling and sequencing. Assumptions in sequencing models. Processing "n" jobs on machines. Processing of two jobs on machines with each having different processing order

Network Models	**[8 Hrs]**

Introduction to PERT / CPM and its importance in project management. (Concepts and construction of network diagrams. Critical path and project duration, floats, network crashing, optimum project duration and cost, PERT activity, time estimate, probability of completion of a project on before specified time, Resource allocation and load smoothening.

Textbooks:

[1]	S.K. HajraChoudhary and S.K. Bose, Elements of workshop Technology, Volume I, II, AsiaPublishing House, 10th Edition 2000
[2]	P.N. Rao, Manufacturing Technology, Tata McGraw-Hill Publishing Limited, II Edition, 2002

Reference Books:

[1]	Chapman W.A.J, Workshop Technology, Volume I, II, III, CBS Publishers and distributors.5th Edition 2002
[2]	Degarmo, Black and Kohser, Materials and processes in Manufacturing, Prentice Hall of India.2nd Edition 1998
[3]	Milton Shaw, Metal Cutting Principles, Oxford University Press, 4th Edition 2001
[4]	O.P. Khanna and M. Lal, Production Technology, Vol. I,II, Dhanpatrai Publication, 5th Edition,1999.
[5]	B.S. Raghuwanshi, Workshop Technology, Dhanpat Rai Publication, 9th Edition, 1999

Manufacturing Automation						
Course Code			**Examination Scheme**			
Teaching Scheme	4-0-0-1		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	4					--

Course Outcomes: Students will be able to:

1. Understand the principles of manufacturing automation and its significance in industry.
2. Analyze different types of manufacturing systems and automation strategies.
3. Analyze different types of automated material handling and storage systems.
4. Evaluate the role of sensors, actuators, and control systems in automation.
5. Analyze the design and operation of single station manufacturing cells.
6. Apply assembly line balancing techniques to optimize manual assembly lines.
7. Evaluate the functioning of automated production lines and their control strategies.

Introduction to Manufacturing Systems and Manufacturing Automation: **[7 Hrs]**

Introduction to Manufacturing Systems and Manufacturing Automation :Overview of Manufacturing Systems and Their Evolution, Types of Manufacturing Systems: Job Shop, Batch, Mass, and Continuous Production, Fundamentals of Manufacturing Automation, Types of Automation: Fixed, Programmable, and Flexible, Automation Strategies in Manufacturing, Benefits and Limitations of Automation in Manufacturing, Industry 4.0 and Smart Manufacturing, Role of Artificial Intelligence and Industry 4.0 in Automation.

Self-Learning Topics:

Historical Evolution of Automation in Manufacturing, Case Studies on Automated vs. Traditional Manufacturing, Historical Development of Automation Technologies, Case Studies on Automation in Different Industries

Automated Material Handling and Storage Systems: **[7 Hrs]**

Functions and Types of Automated Material Handling Systems (AMHS), Automated Guided Vehicles (AGVs) and Autonomous Mobile Robots (AMRs), Automated Storage and Retrieval Systems (AS/RS), Conveyor Systems and Robotics in Material Handling

Self-Learning Topics:

Recent Advances in AGVs and AMRs, Case Studies on Smart Warehousing

Sensors, Actuators, and Control Systems in Automation: **[7 Hrs]**

Types of Sensors: Proximity, Vision, Force, and Temperature Sensors, Actuators: Hydraulic, Pneumatic, and Electric Drives, Programmable Logic Controllers (PLCs): Architecture and Programming, Supervisory Control and Data Acquisition (SCADA) Systems

Self-Learning Topics:

Smart Sensors and IoT in Manufacturing, Case Studies on Automated Quality Control

Single Station Manufacturing Cells: **[7 Hrs]**

Fundamentals of Single Station Manufacturing Cells, Machine Cell and Machine Cluster, Manual, Automated, and Semi-Automated Workstations, Machine Tool Automation and CNC Systems, Process Optimization in Single Station Cells

Self-Learning Topics:

Advances in CNC and Adaptive Control Systems, Case Studies on Automated Machining Cells

Manual Assembly Lines – Single Model: **[7 Hrs]**

Introduction to Manual Assembly Lines and Their Importance, Line Balancing Problems and Methods (Largest Candidate Rule, Kilbridge & Wester Method, Rank Positional Method), Single Model, Poka-Yoke: Motion step Method.

Self-Learning Topics:

Lean Manufacturing and its Impact on Assembly Line, Case Studies on Assembly Line Improvements	
Automated Production Lines and Assembly Systems:	**[7 Hrs]**
Structure and Working of Automated Production Lines, Transfer Mechanisms: Linear and Rotary Transfer Lines, Control Strategies in Automated Production Systems, Buffering and Accumulation in Production Lines, Types of Automated Assembly Systems, Part Feeding and Orientation Techniques, Design for Automated Assembly (DFA) Principles, Performance Analysis and Economic Justification of Automated Assembly. **Self-Learning Topics:** Case Studies on Successful Implementation of Automated Production Lines, Simulation and Optimization of Automated Production, Advances in Automated Micro-Assembly Systems, Case Studies on DFA and Assembly Line Automation	
Textbooks:	
[1]	Mikell P. Groover, Automation, Production Systems, and Computer Integrated Manufacturing, Addison Wesley; 5th edition,2020, Prentice-Hall of India Private Limited.
[2]	W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering,6th Edition 2022 Pearson Education Limited.
[3]	Frank Lamb, Industrial Automation: Hands On, Tata McGraw Hill.
Reference Books:	
[1]	Geoffrey Boothroyd, “Assembly Automation and Product Design”, CRC, Taylor & Francis Publishers.
[2]	N. P. Mahalik, Mechatronics: Principles, Concepts and Applications, Tata McGraw Hill.
[3]	S. R. Majumdar, Oil Hydraulic Systems: Principles and Maintenance, Tata McGraw Hill.
[4]	HMT Ltd. Mechatronics, Tata McGraw-Hill.
[5]	Joji P. Pneumatic Controls, Wiley India.

Product Design and Development						
Course Code	PME(PE)-25011)		**Examination Scheme**			
Teaching Scheme	3-1-0-0		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	4					--

Course Outcomes: Students will be able to:

1. Learn basics of product design process and morphology of design.
2. Students are exposed to Concept design, detail design, manufacturing, marketing, Introduction strategy of new product. Students learn about process of design for production of metal components.
3. Understand producibility requirements in the Design of Machine Components.
4. To understand optimization tools and ergonomic principles applied on typical product design as well as concept of value engineering in new product design.
5. To prepare a brief presentation on design morphology of at least one product as well as assignments is given to students to evaluate manufacturability and design for production.
6. At the end of course students should aware of different stages of product design.

Introduction To Product Design:	
Asimov's Model Definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production-consumption Cycle, The Morphology of Design (The sever phases), Primary Design Phases and flowcharting, Role of Allowance Process Capability, and. Tolerance in Detailed Design and Assembly.	**[6 Hrs]**
Product Design Practice and Industry:	
Introduction, Product Strategies Time to Market, Analysis of the Product, The Three S's, Standardization Renard Series (Preferred Numbers), Simplification, The Designer and it's Role, The Designer: Myth and Reality, The Industrial Design Organization Basic Design Considerations, Problems faced by Industrial Designer. Procedure adopted by Industrial Designers, Types of Models designed by Industrial Designers, What the Designer contributes, Role of Aesthetics in Product Design, Functional Design Practice. Review of Strength, Stiffness and Rigidity Considerations in Product Design Principal Stress Trajectories (Force -Flow Lines), Balanced Design, Criteria and Objectives of Design, Material Toughness: Resilience, Designing for Uniform Strength, Tension vis-à-vis Compression	**[7 Hrs]**
Design for Production:	
Metal Parts: Producibility Requirements in the Design of Machine Components, Forging Design, Pressed Components Design, Casting Design, Design for Machining Ease, The Role of Process Engineer, Ease of Location and Clamping, Some Additional Aspects of Production Design, Die Casting and Special Castings, Design for Powder Metallurgical Parts, Expanded Metals and Wire Forms.	**[7 Hrs]**
Designing with Plastics, Rubber, Ceramics and Wood:	
Approach to Design with Plastics, Plastic Bush Bearings, Gears in Plastic, Fasteners in Plastic, Rubber Parts, Design Recommendations for Rubber Parts, Distortion in Rubber, Dimensional Effects, Tolerances, Ceramics and Glass Parts, Production Design Factors for Ceramic Parts, Special Considerations for Design of Glass Parts, Dimensional Factors and Tolerances, Wood. Design for assembly and disassembly.	**[7 Hrs]**
Optimization in Design:	

Introduction, Siddal's Classification of Design Approaches, Optimization by Differential Calculus, Lagrange Multipliers, Simplex search Method, Geometric Programming, Johnson's Method of Optimum Design.	**[7 Hrs]**
Economic Factors Influencing Design:	
Product Value, Design for Safety, Reliability and Environmental Considerations, Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Break-even Analysis, Economics of a New Product Design (Samuel Eilon Model).Human Engineering Considerations in Product Design Introduction, Human being as Applicator of Forces, Anthropometry: Man as Occupant of Space, The Design of Controls, The Design of Displays, Man/Machine Information Exchange	**[7 Hrs]**
Value Engineering and Product Design:	
Introduction, Historical & Perspective, What is Value? Nature and Measurement of Value, Maximum Value, Normal Degree of Value, Importance of Value, The Value Analysis, Job Plan, Creativity, Steps to Problem-solving and Value Analysis, Value Analysis Tests, Value Engineering Idea Generation Cheek-list, Cost Reduction through Value Engineering Case Study on Tap Switch Control Assembly, Material and Process Selection in Value Engineering. Modern Approaches to Product Design Concurrent Design, Quality Function Deployment (QFD) for design.	**[7 Hrs]**

Textbooks:	
[1]	Karl T. Ulrich & Steven D., Product Design & Development Eppinger Tata McGraw Hill, 3rdEdition, 2003
[2]	A.C. Chitale and R.C. Gupta, Product Design and Manufacturing by PHI.
[3]	Tim Jones, Butterworth Heinmann, New Product Development by Oxford, TAC-1997
Reference Books:	
[1]	Roland Engene Y. Inetoviez, New Product Development: Design & Analysis, John Wiley and Sons Inc., N.Y. 1990.
[2]	Geofferry Boothroyd, Peter Dewhurst and Winston Knight. Product Design for Manufacture and Assembly, Amherst, 1983.
[3]	Bill Hollins, Stwout Pugh, Butterworth, Successful Product Design by London 1990.
[4]	Boothroyod & Dewburst, Design for Assembly, a Designer's Hand book, University of Massachusets, Amherst, 1983.
[5]	Keyinotto & Kristini Wood, Product Design Pearson Education 2004

Honors- Manufacturing Systems Engineering

<table>
<tr><td colspan="7">Modeling and Design of Manufacturing System</td></tr>
<tr><td>Course Code</td><td colspan="2">PME-25010</td><td colspan="4">Examination Scheme</td></tr>
<tr><td>Teaching Scheme</td><td>3-0-0-0</td><td></td><td>Theory</td><td>CIE: 20</td><td>MSE: 30</td><td>ESE: 50</td></tr>
<tr><td>Credits</td><td>3</td><td></td><td></td><td></td><td></td><td>--</td></tr>
<tr><td colspan="7">Course Outcomes: Students will be able to:</td></tr>
<tr><td colspan="7">1. Student will be able to understand various manufacturing system existing in Industries.
2. The course will enable the student to apply latest techniques in manufacturing systems.
3. Students will be able to understand inventory management systems currently used in industries
4. The concepts of systems and inventory will be useful in perusing Industrial projects in the second year.</td></tr>
<tr><td colspan="6">Essentials of Manufacturing Systems</td><td>[9 Hrs]</td></tr>
<tr><td colspan="6">Flows in Manufacturing processes</td><td>[9 Hrs]</td></tr>
<tr><td colspan="7">Process for Manufacturing; material and Technological Information Flows in manufacturing systems including manufacturing cost and product cost structure
Product planning and design, Process planning and design, Logistic planning and Design
Management Systems for Manufacturing: managerial information flow in manufacturing systems, Aggregate Production planning</td></tr>
<tr><td colspan="6">JIT and Kanban Production Control</td><td>[6 Hrs]</td></tr>
<tr><td colspan="6">Stochastic Processes in manufacturing</td><td>[7 Hrs]</td></tr>
<tr><td colspan="7">Discrete time Markov Chain models, DTMC with and without repair facilities for two machines systems, Continuous time Markov chain with resume and discard policies</td></tr>
<tr><td colspan="6">Manufacturing system Analysis</td><td>[10 Hrs]</td></tr>
<tr><td colspan="7">Manufacturing system Analysis through TRIZ, PETRI Nets, ETPN and GSPN, Reachability graphs etc</td></tr>
<tr><td colspan="7">Textbooks:</td></tr>
<tr><td>[1]</td><td colspan="6">Katsundo Hitomi, “Manufacturing Systems Engineering”, Viva Low-Priced Student Edition</td></tr>
<tr><td>[2]</td><td colspan="6">Y. Narahari and N. Vishwanadhan, “Performance Modeling and Automated Manufacturing Systems” Prentice Hall India, 1994.</td></tr>
<tr><td colspan="7">Reference Books:</td></tr>
<tr><td>[1]</td><td colspan="6">Stanley B. Gershwin, “Manufacturing Systems Engineering”, PHI latest Editon.</td></tr>
<tr><td>[2]</td><td colspan="6">Joseph Martinich, “Production and Operations Management: An Applied Approach”, 1997, Wiley.</td></tr>
<tr><td>[3]</td><td colspan="6">Eliyahu Goldratt, “The Goal: A Process of Ongoing Improvement”, 2nd Joji P. Pneumatic Controls, Wiley India.</td></tr>
</table>

Robot Integrated Manufacturing Automation						
Course Code	PME-25011		**Examination Scheme**			
Teaching Scheme	3-1-0-0		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	4					--

Course Outcomes: Students will be able to:

1. Understand the basics of robotics and artificial intelligence.
2. Use fundamentals of FMS, and AGV in manufacturing situations.
3. Apply concepts of hard and soft automation in industries.

Fundamentals of Robotics **[7 Hrs]**

Robot anatomy, Robot configurations
Drives in robotics, Robot controllers
End Effectors: types, design considerations, gripper design

Robot kinematics **[4 Hrs]**

Forward & Inverse kinematics, D-H approach

Sensors and Machine vision **[7 Hrs]**

Sensors in robotics, classification, considerations and applications
Machine vision system in robotics, Image processing

Robot programming **[7 Hrs]**

Robot programming methods, Robot programming languages, commands and programming using VAL, Programming for welding applications
Trajectory planning, safety in robotics, robot economics, Robot applications Artificial Intelligence and Robotics

Automation **[7 Hrs]**

Elements of automated systems, advanced automation functions, levels of automation
Types of automation, Fixed, programmable, flexible, Hard & soft automation

Automated production lines **[7 Hrs]**

Fundamentals of automated production lines, analysis of transfer lines, material handling in automated systems, Geneva mechanisms, feeders, Inspection techniques in automation

Textbooks:

[1]	S.R. Deb, “Robotics Technology and Flexible Automation”, Tata McGraw Hill.
[2]	M.P.Groover, Weiss, Nagel & Odery, “Industrial Robotics Technology, Programming & Applications” , Tata McGraw Hill
[3]	M.P.Groover, “Automation Production systemsand Computer Integrated Manufacturing”, PHI learning Pvt. Ltd.

Reference Books:

[1]	Yoram Koren, “Robotics for Engineers”, Tata McGraw Hill.
[2]	K. S. Fu, R. C. Gonzalez, C. S. G. Lee, “Robotics – Control, Sensing, Vision and Intelligence”, McGraw Hill Int.
[3]	H. J. Warneck and R.D. Sehfart “Industrial Robots” , I.F.S. Pub., U. K.
[4]	R. Paul, “Robots – Manipulators, Mathematics, Programming and Control”, MIT Press.
[5]	P.A. Janakiraman, “Robotics and Image Processing”, Tata McGraw Hill 1995.
[6]	Nanua Singh, “System Approach to Computer Integrated Design and Manufacturing”,

Metrology & Computer Aided Inspection

Course Code	PME-25011		**Examination Scheme**			
Teaching Scheme	3-0-2-0		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	4		**Laboratory**	CIE-100		--

Course Outcomes: Students will be able to:

1. Students will be able to handle high precision measurement requirements of industry.
2. Knowledge of different instruments used for high precision will be applied by the student in the industry and research work.

Metrological concepts	**[7 Hrs]**
Abbe's principle - need for high precision measurements - problems associated with high precision measurements. Standards for length measurement - Shop floor standards and their calibration	
Light interference - Method of coincidence - Slip gauge calibration - Measurement errors. Various tolerances and their specifications, gauging principles, selective assembly, comparators.	**[7 Hrs]**
Angular measurements - principles and instruments, Gear and Thread measurements	**[7 Hrs]**
Surface and form metrology - flatness, roughness, waviness, roundness, cylindricity, etc. Computer Aided Metrology - Principles and interfacing, software metrology. Laser metrology - Applications of Lasers in Precision Measurements. Laser interferometer, speckle measurements, laser scanners.	**[7 Hrs]**
Coordinate Measuring Machine Types of CMM - Probes used - Applications - Noncontact CMM using Electro optical sensors for dimensional metrology - Noncontact sensors for surface finish measurements	**[7 Hrs]**
Image processing and its application in Metrology. Large scale Metrology, Laser Trackers, Stereo vision, Micro and Nano Metrology. Metrology for additive manufacturing parts, CT Scan technologies in inspection	**[7 Hrs]**

Textbooks:

[1]	K.J.Hume, “Engineering Metrology”, Kalyani Publisher Latest Editon, New Delhi
[2]	R. K. Jain, “Engineering Metrology”, Khanna Publishers, New Delhi
[3]	I.C. Gupta, “Engineering Metrology”, Dhanapat Rai New Delhi

Reference Books:

[1]	Robert G. Seippel , “Opto Electronics for Technology and Engineering”, Prentice Hall New Jersey, 1989.
[2]	Thomas G.G, “Engineering Metrology”, Butter worth publications-1974
[3]	Anil K. Jain, “Fundamentals of Digital image processing”, Prentice Hall of India Pvt. Ltd. 2004
[4]	Dale H. Besterfield, “Total Quality Management”, Pearson Education Asia, 2002.
[5]	Manuals of Co-ordinate measuring machines and systems

Performance Modeling of Production System						
Course Code	PE 5301		**Examination Scheme**			
Teaching Scheme	3-1-0-0		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	4					--

Course Outcomes: Students will be able to:

1. Identify the type of Production system and its modeling.
2. Perform line balancing and buffer stock simulation.
3. Analyze the production system using Markov chain & Petri Net.

Manufacturing Systems and Assembly Line Balancing	
Dedicated manufacture versus Flexible manufacture, mechanization versus automation, semi-automatic versus automatic systems using 'in-line' transfer, rotary transfer, Balancing of assembly line using available algorithms. Transfer line-monitoring system (TLMS) using Line Status, Line efficiency. Buffer stock Simulation.	**[9 Hrs]**
Automation and Control Systems in Manufacturing	
Hard automation using relays, solenoid operated valves, magnetic selectors, hydraulic and pneumatic systems in automation. 'In travel' control, 'centralized travel' control and 'time sequence' control.	**[9 Hrs]**
Robotic Inspection and Machine Vision Systems	
Automatic inspection of parts and loading unloading using Robots and Vision systems with CCD cameras, LED's for three-dimensional On-line inspection.	**[8 Hrs]**
AGV and its various guiding technologies.	**[6 Hrs]**
Markov Chain Analysis and Cellular Manufacturing Systems	
Markov chain analysis for production systems with discrete time and continuous time analysis. Markov chain analysis with zero or with one or more repair facility, Reversible Markov chains in manufacturing. Use of analytical hierarchy process in Cellular Manufacturing Systems.	**[8 Hrs]**
Petri Nets and Applications in Production Systems	
Uses of Petri Nets. Generalized timed Petri Nets, Extended stochastic Petri Nets and their applications in Production systems.	**[8 Hrs]**

Textbooks:

[1]	Y. Narahari and N. Vishwanadhan, "Performance Modeling and Automated Manufacturing Systems" Prentice Hall India, 1994.
[2]	Katsundo Hitomi, "Manufacturing Systems Engineering", Viva Low-Priced Student Edition

Reference Books:

[1]	Stanley B. Gershwin, "Manufacturing Systems Engineering", PHI latest Editon.
[2]	Joseph Martinich, "Production and Operations Management: An Applied Approach", 1997, Wiley.
[3]	Eliyahu Goldratt, "The Goal: A Process of Ongoing Improvement", 2nd Joji P. Pneumatic Controls, Wiley India.

Machine Tool System and Manufacturing Optimization						
Course Code	PME(PE)-25013		**Examination Scheme**			
Teaching Scheme	3-0-0-0		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	3					--

Course Outcomes: Students will be able to:

1. Knowledge gain of modern and advanced machine tools.
2. Study of analysis of machine tool configuration system.
3. Study of system parameter optimization.
4. Study on characteristics and process parametric effect of machine tool system.

Recent trends in machine tool development, ultra precision machine tools, Machine tool systems and category of machine tool .	**[6 Hrs]**
Advance system configuration, CNC and machining center system. Multi axis machine tools and axes designation, conceptual diagram of anti-crush system. System structure of vertical CNC machine, lubrication system and tilting of guides, stick slip system analysis and machine tool component vibration analysis etc.	**[7 Hrs]**
Machine tool system pre selective, selective and adaptive control system study	**[7 Hrs]**
Reliability and availability of machine tool analysis, Principal of automation and automatic machine tools.	**[8 Hrs]**
Machining process optimization for maximum power and tool life condition, optimization using maximum production rate, minimum cost etc.	**[7 Hrs]**
Availability optimization using markov chain analysis etc, optimum allocation of parameters for desired objective.	**[6 Hrs]**

Textbooks:

[1]	S. K. Basu and D. K. Pal, “Design of Machine Tools” , Oxford – IBH, 6th Edition, 2015
[2]	A. Bhattacharya and G.C. Sen, “Principles of Machine Tools”, New Central Book Agency, Calcutta
[3]	B. Leatham and Jones, “Computer Numerical Control Machines”

Reference Books:

[1]	Yoram Koren, “Computer Control in Manufacturing” , Tata McGrew Hill.
[2]	Kundra, Rao and Tiwari, “Numerical Control and Computer Aided Manufacturing”, Tata McGraw Hill.
[3]	S.J. Martin, “NC Machine tools”, ELBS.
[4]	N. K. Mehta, “Machine Tool Design”, Tata McGraw Hill.

Honors- Mechatronics

Principles of Electronics						
Course Code	MCH-25003		**Examination Scheme**			
Teaching Scheme	3-0-0-0		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	3					
Course Outcomes: Students will be able to:						
1. Learn how to develop and employ circuit models for elementary electronic components, e.g., resistors, sources, inductors, capacitors, diodes and transistors; 2. Become adept at using various methods of circuit analysis. 3. Use basic techniques for analyzing analogue and digital electronic circuits						
Role of various Engineering disciplines in Mechatronics, Mechatronics Design elements, Scope and Applications of Mechatronics						**[7 Hrs]**
Analog electronic components and devices, Oscillators as signal generators, Power supplies and voltage regulators						**[4 Hrs]**
Power Electronics- Devices, Industrial electronic circuits, Digital Electronics- Arithmetic circuits, Multiplexers/Demultiplexers, Registers, Counters, Memories, Few examples of transducer						**[7 Hrs]**
Signal conditioning Circuits using Operational amplifiers, Noise Problems, Grounding and shielding						**[7 Hrs]**
Data acquisition systems, Single channel and multichannel, Data loggers						**[7 Hrs]**
Control Systems Components, Classification of Control Systems, Transfer functions, Time and Frequency response Analysis tools.						**[7 Hrs]**
Textbooks:						
[1]	Allen Mottershed, “Electronic Devices and Circuits”, Prentice Hall International, Third Edition					
Reference Books:						
[1]	M. D. Singh and J. G. Joshi, “Mechatronics – Principles and Applications”, Prentice Hall India publication-EEE.					

Industrial Instrumentation and Control						
Course Code	MCH(PE)-25008		**Examination Scheme**			
Teaching Scheme	3-1-0-0		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	4					

Course Outcomes: Students will be able to:

1. Identify, formulate and solve a problem of Instrumentation and Control Engineering
2. Design and conduct experiments for measurement and ability to analyze and interpret data.
3. Demonstrate an understanding of sensors / transducers.

General concepts and terminology of measurement systems, static and dynamic characteristics, errors, standards and calibration	**[7 Hrs]**
Introduction, principle, construction and design of various active and passive transducers.	**[4 Hrs]**
Introduction to semiconductor sensors and its applications. Design of signal conditioning circuits for various Resistive, Capacitive and Inductive transducers and piezoelectric transducers	**[7 Hrs]**
Introduction to transmitters, two wire and four wire transmitters, Smart and intelligent Transmitters	**[7 Hrs]**
Design of transmitters. Introduction to EMC, interference coupling mechanism, basics of circuit layout and grounding, concept of interfaces, filtering and shielding	**[7 Hrs]**
Safety: Introduction, electrical hazards, hazardous areas and classification, non-hazardous areas, enclosures – NEMA types, fuses and circuit breakers. Protection methods: Purging, explosion proofing and intrinsic safety.	**[7 Hrs]**

Textbooks:

[1]	M. Sze, “Semiconductor sensors”, John Wiley & Sons Inc., Singapore, 1994.
[2]	Noltingk B. E., “Instrumentation Reference Book”, 2nd Edition, Butterworth Heinemann, 1995.

Reference Books:

[1]	L. D. Goettsche, “Maintenance of Instruments and Systems – Practical guides for measurements and control”, ISA, 1995.
[2]	John P. Bentley, Principles of Measurement Systems, Third edition, Addison Wesley Longman Ltd., UK, 2000
[3]	Doebelin E. O, Measurement Systems - Application and Design, Fourth edition, McGraw-Hill International Edition, New York, 1992.

Advanced Sensor Systems and Instrumentation						
Course Code	MCH-25006		**Examination Scheme**			
Teaching Scheme	3-0-2-1		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credit	4		**Laboratory**	CIE: 100		

Course Outcomes: Students will be able to:

1. Comprehensive fundamental and technical knowledge of advanced sensor systems and instrumentation.
2. Understand the problem and select a sensor and design, model the system.
3. Use Numerical modeling for sensors

Fundamentals and Principles of Sensors **[9 Hrs]**

Sensor classification, Sensing mechanisms of Mechanical, Electrical, Thermal, Magnetic, Optical, Chemical and Biological Sensors

Sensor Characterization and Modeling **12 Hrs]**

Static and Dynamic Characteristics of sensors, Sensor reliability, aging tests, failure mechanisms and stability study, Numerical modeling techniques and model equations, Effects on modeling: Mechanical, Electrical, Thermal, Magnetic, Optical, Chemical and Biological effects, Examples of sensor modeling

Sensor Design and Fabrication Technologies **[9 Hrs]**

Sensor design and packaging concepts, Partitioning, layout, technology constraints, scaling and compatibility study, thick and thin film fabrication processes, Micromachining techniques, Integrated Optical Circuit (IOC) fabrication process, Ceramic material fabrication process

Sensor Packaging and Interface Systems **[9 Hrs]**

Wire bonding and packaging techniques, Signal processing and multi-sensor signal processing, Smart sensors and interface systems

Sensor Applications **[9 Hrs]**

Sensors in Process Engineering, Medical diagnostics and patient monitoring, Environmental monitoring, Industrial and emerging sensor applications

Textbooks:

[1]	Eric Udd, Fiber Optic Sensors: An Introduction for Engineers and Scientists, John Wiley & Sons, New York, 1991 (ISBN: 0471830070).
[2]	André Preumont, Vibration Control of Active Structures: An Introduction, 2nd Edition, Kluwer Academic Publishers, Dordrecht; Boston, 2002 (ISBN: 1402004966).

Reference Books:

[1]	Hojjat Adeli, Control, Optimization, and Smart Structures: High-Performance Bridges and Buildings of the Future, John Wiley, New York, 1999 (ISBN: 047135094X).
[2]	T.T. Soong, Passive Energy Dissipation Systems in Structural Engineering, Wiley, Chichester; New York, 1997 (ISBN: 0471968218).
[3]	G. Engdahl, Handbook of Giant Magnetostrictive Materials, Academic Press, San Diego, Calif.; London, 2000 (ISBN: 012238640X).
[4]	K. Otsuka and C.M. Wayman, Shape Memory Materials, Cambridge University Press, Cambridge; New York, 1998 (ISBN: 052144487X).

Mechatronics System Design						
Course Code	MCH-25005		**Examination Scheme**			
Teaching Scheme	3-0-0-1		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	3					

Course Outcomes: Students will be able to:

1. Demonstrate how mechatronics integrates knowledge from different disciplines in order to realize engineering and consumer products that are useful in everyday life.
2. Apply theoretical knowledge: understanding selection of suitable sensors and actuators; designing electro-mechanical systems.
3. Work with mechanical systems that include digital and analogue electronics as a data acquisition model.

Rotational drives **[6 Hrs]**

Pneumatic Motors: continuous and limited rotation - Hydraulic Motors: continuous and limited rotation - Brushless DC Motors - Motion converters, Fixed ratio, invariant motion profile, variators, remotely controlled couplings Hydraulic Circuits and Pneumatic Circuits.

Mechanical Systems and Design **[8 Hrs]**

Mechatronics approach - Control program control, adaptive control and distributed systems - Design process - Types of Design - Integrated product design - Mechanisms, load conditions, design and flexibility Structures, load conditions, flexibility and environmental isolation – Man machine interface, industrial design and ergonomics, information transfer from machine from machine to man and man to machine, safety.

Real time interfacing **[4 Hrs]**

Introduction Elements of data acquisition and control Overview of I/O process-Installation of I/O card and software - Installation of application software- Over framing.

Microcontrollers **[8 Hrs]**

Introduction to use of open-source hardware (Arduino & Raspberry Pi); shields/modules for GPS, GPRS/GSM, Bluetooth, RFID, and Xbee, integration with wireless networks, databases and web pages; web and mobile phone apps.

Case studies on Data Acquisition **[6 Hrs]**

Transducer calibration system for Automotive applications Strain Gauge weighing system - Solenoid force - Displacement calibration system - Rotary optical encoder - Inverted pendulum control - Controlling temperature of a hot/cold reservoir -Pick and place robot - Carpark barriers.

Case studies on Data Acquisition and Control **[6 Hrs]**

Thermal cycle fatigue of a ceramic plate - pH control system - De-Icing Temperature Control System - Skip control of a CD Player - Autofocus Camera, exposure control.

Case studies on design of Mechatronics products **[4 Hrs]**

Motion control using D.C. Motor, A.C. Motor & Solenoids - Car engine management - Barcode reader.

Textbooks:

[1]	Bolton, Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering-, 2nd Edition, Addison Wesley Longman Ltd., 1999.
[2]	Devdas Shetty, Richard A. Kolk, Mechatronics System Design, PWS Publishing company, 1997

Reference Books:

[1]	Bradley, D. Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products and Processes, Chapman and Hall, London, 1991
[2]	Brian Morris, Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics, Mc Graw Hill International Edition, 1995
[3]	Gopal, Sensors- A comprehensive Survey Vol I & Vol VIII, BCH Publisher

Industrial Robotics						
Course Code	MCH-25009		**Examination Scheme**			
Teaching Scheme	3-1-0-0		**Theory**	CIE: 20	MSE: 30	ESE: 50
Credits	4					

Course Outcomes: Students will be able to:

1. Comprehensive fundamental and technical knowledge of Robotics
2. Ability to apply computing design criteria's of robot elements
3. Ability to apply the knowledge of specifying the robot elements and selection of robots
4. Ability to analyze robots through Kinematic and Dynamic study & its programming
5. Ability to learn effective practices in uses of robots, robot economics and novel advancements in this area.

Basic concepts, Robot anatomy, Robot configurations, Basic robot motions, Types of drives, Applications-Material handling, processing -Assembly and Inspection, safety considerations.	**[9 Hrs]**
End effectors, Classification, Mechanical, Magnetic, Vacuum, Adhesive. Force analysis and Gripper design.	**[6 Hrs]**
Sensors in robot systems, non-optical and optical position sensors, Velocity and Acceleration, Range, Proximity, touch, Slip, Force, Torque sensors, Machine vision system, Image components, Representation, Hardware, Picture coding , Object recognition and categorization - Software consideration, Vector operations	**[9 Hrs]**
Translational transformations and Rotational transformations, Properties of transformation matrices-Homogeneous transformations and Manipulator, Robot kinematics, Forward solution, Inverse solution , Control system concepts, Analysis, control of joints ,Adaptive and optimal control ,Trajectory Planning, Robot Dynamics, Lagrangian formulation, D Alemberts principle	**[9 Hrs]**
Robot programming Methods - Robot programming languages - VAL Language, Computer controller and Robot communication, Economics of Robots, Teleclinic robots	**[6 Hrs]**

Textbooks:

[1]	M. P. Grover, M. Weiss, R. N. Nagel, N. G. Odrey: Industrial Robotics Technology, Mc Graw Hill book Co. 1995
[2]	Fu K.S., Gonzalez R.C.., and Lee C.S.G., "Robotics control, sensing, vision, and intelligence", McGraw-Hill Book Co., 1987

Reference Books:

[1]	Robert J. Schilling, Fundamentals of Robotics-Analysis and Control, Prentice Hall India, 1990. .
[2]	Klafter R.D., Chmielewski T.A. and Negin M., " Robot Engineering An Integrated approach", Prentice Hall of India, New Delhi, 1994.
[3]	Deb S.R., "Robotics Technology and Flexible Automation ", Tata McGraw-Hill Publishing Co., Ltd., 1994.
[4]	Robot Dynamics and Control : Mark W. Spong and M. Vidyasagar, Wiley
[5]	Craig J.J., "Introduction to Robotics Mechanics and Control", Addison-Wesley, 1999
[6]	Foundations of Robotics : T. Yoshikawa , PHI India
[7]	Advances Robotics – Redundancy and Optimization, Y. Nakamura , Addison-Wesley