



St. PETER'S INSTITUTE OF HIGHER EDUCATION AND RESEARCH

(Deemed to be University U/S 3 of the UGC Act, 1956)

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M.Tech (ADVANCED MANUFACTURING TECHNOLOGY)

(Approved by AICTE)

I to IV Semesters

REGULATIONS AND SYLLABI

UNDER CHOICE BASED CREDIT SYSTEM

REGULATIONS 2025

Effective from the Academic Year 2025-2026

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PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Classify, analyze, evaluate, design and develop production system and processes using appropriate advanced manufacturing techniques and approaches.

PEO2: Demonstrate in-depth knowledge of manufacturing systems and work effectively in diverse environments.

PEO3: Build successful careers as per the need of Indian and multinational industries.

PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

PROGRAMME SPECIFIC OBJECTIVES (PSOs):

Master of Engineering Programme in Advanced Manufacturing Technology is designed to prepare the graduates for following outcomes

PSO1: To be able to identify, formulate and develop solution methodology for various issues related to manufacturing processes.

PSO2: To be able to provide cost effective design solutions for various tools and dies in accordance with the manufacturing standards.

PSO3: To be able to apply effectively the automated manufacturing systems for overall productivity improvement.

Contribution 1: Reasonable

2: Significant

3: Strong

M.Tech. REGULATIONS (2025)

Regulations – 2025 is applicable to the students admitted to the Degree of Master of Technology (M.Tech.) (Four Semesters) programme effective from the academic year 2025-2026

1. NOMENCLATURE

- Programme** : Means Post Graduate Degree Programme (M.Tech).
- Course** : Refers to the course (Subject) that a student would have to undergo during the study in the Institution
- Batch** : Refers to the Starting and Completion year of a Programme of study. Eg. Batch of 2025–2026 refers to students belonging to a 2year Degree programme admitted in 2025 and completing in 2028.
- Department** : Each Programme of the Institution is grouped under a department. Eg. M.E. Advanced Manufacturing Technology is grouped under Department of Mechanical Engineering. This Department offers various Undergraduate and Postgraduate Programmes in Engineering like B.E. (Mechanical Engineering), M.E. (Advanced Manufacturing Technology).
- Dean (Engg)** : Means Dean of Engineering and Technology who administers the academic matters of Engineering and Technology.
- HoD** : Refers to the Head of a Department (HoD) offering various UG and PG programmes.
He/She will be the Head of all staff members and Students belonging to the Department

2. PROGRAMMES OFFERED

The various programmes and their mode of study are as follows:

Degree	Mode of Study
M. Tech	Full Time

Candidates admitted under “Full-Time” should be available in the Institution during the entire duration of working hours for the curricular, co-curricular and extra-curricular activities assigned to them.

The Full-Time candidates should not attend any other Full-Time programme (s)/course(s) or take up any Full-Time job / Part-Time job in any Institution or Company during the period of the Full-Time programme. Violation of the above rules will result in cancellation of admission to the PG programme.

3. QUALIFICATION FOR ADMISSION

- Candidates for admission to the first semester of the Post-Graduate Degree Programme shall be required to have passed an appropriate Under-Graduate Degree Examination of St. Peter's Institute of Higher Education and Research as specified in Annexure 1[Eligible entry qualifications for admission to P.G. programmes] or any other degree examination of any University or authority accepted by this Institution as equivalent there to.
- Admission shall be offered only to the candidates who possess the qualification prescribed against each programme.
- Any other relevant qualification which is not prescribed against each programme shall be considered for equivalence by the committee constituted for the purpose. Admission to such degrees shall be offered only after obtaining equivalence to such degrees.
- Eligibility conditions for admission such as class obtained, number of attempts in the qualifying examination and physical fitness will be as prescribed by the Institution from time to time.

St. Peter's Institute of Higher Education and Research
M.Tech (ADVANCED MANUFACTURING TECHNOLOGY)
REGULATION 2025 CHOICE BASED CREDIT SYSTEM

VISION & MISSION OF THE INSTITUTION

Vision

To achieve, Academic Excellence in Engineering, Technology and Science through Teaching, Research and Extension to Society

Mission

By generating, preserving and disseminating knowledge through rigorous academic study, inquisitiveness to understand and explore nature, entrepreneurship with creativity and innovation

VISION & MISSION OF THE DEPARTMENT

Vision

To emerge as dynamic centre for quality education and research, dedicated to produce outstanding Mechanical Engineers through strong theoretical knowledge and practical training.

Mission

M1: Contemporary and effective educational experiences that develop the competent engineers.

M2: Achieving intellectual excellence by providing facilities for students for higher education and research.

M3: To inculcate technical skills with integrity and ethical standards in students.

M4: To impart entrepreneurship qualities to indulge in promoting sustainable development of the society.

DEPARTMENT OF MECHANICAL ENGINEERING
FACULTY OF ENGINEERING & TECHNOLOGY
PG PROGRAM (CBCS) – M.Tech. Advanced Manufacturing Technology
(2025–2026 Batch onwards)

Semester I

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	POs		L	T	P		CIA	ESE	Total
I	25MAP109	Applied Probability and Statistics	IC	6.5	PEO1	PO1		3	1	0	4	40	60	100
I	25MEP101	Modern Manufacturing Process	PC	6.5	PEO2	PO3	7,9	3	0	0	3	40	60	100
I	25MEP102	Advanced Materials Engineering	PC	6.5	PEO2	PO2	7,9	3	0	0	3	40	60	100
I	25MEP103	Metal Cutting Theory and Tool Design	PC	6.5	PEO2	PO1	7,9	3	0	0	3	40	60	100
I	25MEP104	Research Methodology and IPR	PC	6.5	PEO2	PO3	7,9	3	0	0	3	40	60	100
I		Programme Elective-1	PE	6.5	PEO2	PO2	4-9	3	0	0	3	40	60	100
I		Audit Course I	AC	6.5	PEO2	PO2	4-9	2	0	0	0	100	0	100
I	25MEP111	CIM and Mechatronics Laboratory	PC	6.5	PEO3	PO3	7,9	0	0	4	2	40	60	100
I	25MEP112	Advanced Manufacturing Process Laboratory	PC	6.5	PEO3	PO3	7,9	0	0	4	2	40	60	100
Semester Total								20	1	8	23	420	480	900

Semester II

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	POs		L	T	P		CIA	ESE	Total
II	25MEP201	Optimization Techniques in Manufacturing	PC	6.5	PEO1	PO1	9,12	3	0	0	3	40	60	100
II	25MEP202	Manufacturing Automation (renamed 28th BoS)	PC	6.5	PEO2	PO2	9,8	3	0	0	3	40	60	100
II	25MEP203	Energy Management (28th BoS)	PC	6.5	PEO2	PO2	9,12	3	0	0	3	40	60	100
II		Programme Elective-2	PE	6.5	PEO2	PO3, 2	4-10	3	0	0	3	40	60	100
II		Programme Elective-3	PE	6.5	PEO2	PO2, 3	4-9	3	0	0	3	40	60	100
II		Open Elective-1	OE	6.5	PEO2	PO2, 3	4-9	3	0	0	3	40	60	100
II		Audit Course II	AC		PEO2	PO2, 3	4-9	2	0	0	0	100	0	100
II	25MEP211	Simulation and Welding Laboratories	PC	6.5	PEO3	PO3	9,8	0	0	4	2	40	60	100
II	25MEP212	Term Paper Writing and Seminar	PC	6.5	PEO1	PO4	9	-	-	4	2	40	60	100
Semester Total								20	0	8	22	420	480	900

Semester III

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	POs		L	T	P		CIA	ESE	Total
III	25MEP301	Modelling and Analysis of Manufacturing	PE	7.0	PEO2	PO2	9-12	3	0	0	3	40	60	100
III		Programme Elective-4	PE	7.0	PEO2	PO2	9-12	3	0	0	3	40	60	100
III		Programme Elective-5	PE	7.0	PEO2	PO3	4-9	3	0	0	3	40	60	100
III		Open Elective II	IE	7.0	PEO2	PO3	3-6	3	0	0	3	40	60	100
III	25MEP391	Project Work Phase-I	PRO	7.0	PEO2	PO11	4,9	0	0	12	6	40	50	100
		Viva Voce											10	
Semester Total								12	0	12	18	200	300	500

* Candidates who have completed Project Work (Phase I) successfully are eligible for the Project Work (Phase-II) Examination.

Semester IV

Semester	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)	Marks		
					PEOs	POs		L	T	P		CIA	ESE	Total
IV	25MEP392	Project Work Phase-II	PRO	7.0	PEO2	PO11	4,9	0	0	24	12	40	50	100
		Viva Voce											10	
Semester Total								0	0	24	12	40	60	100
Total Credit(s)											75			

- (i) **Institute Core courses (IC)** which includes General Foundation courses comprising Mathematics and Engineering Courses along with Laboratories.

(ii) Programme Core courses (PC) belonging to the Major Programme of study.**Programme Core Courses**

S.No	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Credit(s)	
					PEOs	POs			
1	25MEP101	Modern Manufacturing Process	PC	6.5	PEO2	PO1	9,5	3	
2	25MEP102	Advanced Materials Engineering	PC	6.5	PEO2	PO2	9,8	3	
3	25MEP103	Metal Cutting Theory and Tool Design	PC	6.5	PEO2	PO3	9,6	3	
4		Mechatronics in Manufacturing Systems	PC	6.5	PEO2	PO2	9	3	
5	25MEP111	CIM and Mechatronics Laboratory	PC	6.5	PEO2	PO3	9,4	2	
6	25MEP201	Optimization Techniques in Manufacturing	PC	6.5	PEO2	PO1	9	4	
7	25MEP202	Manufacturing Automation (renamed 28 th BoS)	PC	6.5	PEO2	PO2	9	3	
8	25MEP203	Energy Management (28 th BoS)	PC	6.5	PEO2	PO3	9,5	3	
9	25MEP301	Modelling and Analysis of Manufacturing Systems	PC	6.5	PEO2	PO2	9	3	
10	25MEP211	Simulation and Welding Laboratories	PC	6.5	PEO2	PO3	9	2	
11	25MEP391	Project Work Phase-I	PRO	7.0	PEO2	PO4	4,9	8	
12	25MEP392	Project Work Phase-II	PRO	7.0	PEO2	PO4	4,9	16	
		Total							53

Programme Elective-1

S.n0	Course Code	Title of the Course	Course Category	NCrF level	Objective s and outcomes		SDG Goal	Instruction Hours / week			Credit(s)
					PEOs	POs		L	T	P	
1	25MEP131 C	Fluid Power Automation	PE	6.5	PEO2	PO1	9,5	3	0	0	3
2	25MEP131 B	Micro and Nano Manufacturing	PE	6.5	PEO2	PO2	9,8	3	0	0	3
3	25MEP231 A	Quality and Reliability Engineering	PE	6.5	PEO2	PO3	9,5	3	0	0	3
4	25MEP132 A	Vibration Analysis and Condition Monitoring	PE	6.5	PEO2	PO1	9	3	0	0	3
5	25MEP132 C	Computer Integrated Manufacturing Systems	PE	6.5	PEO2	PO2	9,5	3	0	0	3
6	25MEP132 B	Additive Manufacturing	PE	6.5	PEO2	PO3	9,8	3	0	0	3
Programme Elective-2 & 3											
1	25MEP131 A	Finite Element Methods for Manufacturing	PE	6.5	PEO2	PO1	9,5	3	0	0	3
2	25MEP332 A	Industrial Ergonomics	PE	6.5	PEO2	PO2	9,4	3	0	0	3
3	25MEP231 B	Polymers and Composite Materials	PE	6.5	PEO2	PO3	9,6	3	0	0	3
4	25MEP332 B	Non-Destructive Testing and Evaluation	PE	6.5	PEO2	PO2	9,3	3	0	0	3
5	25MEP131 D	Production and Operation Management	PE	6.5	PEO2	PO3	9,4	3	0	0	3
6	25MEP231 C	Industrial Robotics	PE	6.5	PEO2	PO1	9,5	3	0	0	3
7	25MEP132 D	Project Engineering and Management	PE	6.5	PEO2	PO2	9,8	3	0	0	3
8	25MEP332 C	Metrology and Computer Aided Inspection	PE	6.5	PEO2	PO3	9,6	3	0	0	3
9	25MEP233 A	Concurrent Engineering (29 th BoS)	PE	6.5	PEO2	PO2	9	3	0	0	3

10	25MEP331 C	Product Data Management (29 th BoS)	PE	6.5	PEO2	PO3	9,5	3	0	0	3
11	25MEP333 B	Advanced Tooling Design(29 th BoS)	PE	6.5	PEO2	PO1	9,6	3	0	0	3
Programme Elective-4 & 5											
1	25MEP2 31D	Process Planning and Cost Estimation	PE	7.0	PEO2	PO1	9,5	3	0	0	3
2	25MEP232 A	Design of Experiment	PE	7.0	PEO2	PO2	9,8	3	0	0	3
3	25MEP233 C	Manufacturing Information Systems	PE	7.0	PEO2	PO3	9,6	3	0	0	3
4	25MEP233 D	Research Methodology	PE	7.0	PEO2	PO2	9	3	0	0	3
5	25MEP232 D	Supply Chain and Logistics Management	PE	7.0	PEO2	PO3	9,4	3	0	0	3
6	25MEP331 B	Materials Testing and Characterization Techniques	PE	7.0	PEO2	PO1	9,5	3	0	0	3
7	25MEP331 A	Product Design and Development	PE	7.0	PEO2	PO1	9,8	3	0	0	3
8	25MEP232 C	Flexible Competitive Manufacturing System	PE	7.0	PEO2	PO2	9,6	3	0	0	3
9	25MEP232 B	Nanotechnology	PE	7.0	PEO2	PO3	9	3	0	0	3
10	25MEP233 B	Advanced Metal Joining Processes Assessment	PE	7.0	PEO2	PO1	9,4	3	0	0	3
11	25MEP331 D	Industrial Safety	PE	7.0	PEO2	PO2	9	3	0	0	3
12	25MEP332 D	Sustainable Manufacturing	PE	7.0	PEO2	PO2	9,6	3	0	0	3
13	25MEP234 C	Intelligent Manufacturing Systems	PE	7.0	PEO2	PO2	9	3	0	0	3
14	25MEP333 C	Digital Manufacturing & IoT	PE	7.0	PEO2	PO2	9	3	0	0	3

Open Elective Course (OEC): *(out of 6 courses one course must be selected)

S.n0	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)
					PEOs	POs		L	T	P	
1	25MEP041	Neural Network and Fuzzy Logics	OEC	7.0	PEO2	PO3	9,6	3	0	0	3
2	25MEP042	MEMS and Micro Systems Technology	OEC	7.0	PEO2	PO3	9,5	3	0	0	3
3	25MEP043	Occupational Health and Industrial Hygiene (25 th BoS)	OEC	7.0	PEO2	PO2	3,8	3	0	0	3
4	25MEP044	Artificial Intelligence & Machine Learning in Manufacturing (28 th BoS)	OEC	7.0	PEO2	PO2	9,1 2	3	0	0	3
5	25MEP045	Intellectual Property Rights (28 th BoS)	OEC	7.0	PEO2	PO3	9,8	3	0	0	3
6	25MEP046	Cost Management of Engineering Project	OEC	7.0	PEO2	PO2	9	3	0	0	3
7	25MEP234 B	Industry 4.0 Concepts	OEC	7.0	PEO2	PO2	9,1	3	0	0	3

AUDIT COURSES (AC)

S.n0	Course Code	Title of the Course	Course Category	NCrF level	Objectives and outcomes		SDG Goal	Instruction Hours / week			Credit(s)
					PEOs	POs		L	T	P	
1	25ACP101	English for Research Paper Writing	AC		PEO2	PO3	9,6	2	0	0	0
2	25ACP102	Disaster Management	AC		PEO2	PO3	9,5	2	0	0	0
3	25ACP201	Value Education	AC		PEO2	PO2	3,8	2	0	0	0
4	25ACP201	Stress Management by Yoga	AC		PEO2	PO2	9,1	2	0	0	0

DOMAIN WISE GROUPING OF ELECTIVES

Sl. No	Stream A: Design & Quality Engineering	Stream B: Manufacturing Processes & Materials	Stream C: Automation & Digital Systems	Stream D: Management & Sustainability
1.	25MEP131A- Finite Element Methods for Manufacturing	25MEP131B- Micro and Nano Manufacturing	25MEP131C- Fluid Power Automation	25MEP131D- Production and Operation Management
2.	25MEP132A- Vibration Analysis and Condition Monitoring	25MEP132B- Additive Manufacturing	25MEP132C- Computer Integrated Manufacturing Systems	25MEP132D- Project Engineering and Management
3.	25MEP231A- Quality and Reliability Engineering	25MEP231B- Polymers and Composite Materials	25MEP231C- Industrial Robotics	25MEP231D- Process Planning and Cost Estimation
4.	25MEP232A- Design of Experiment	25MEP232B- Nanotechnology	25MEP232C- Flexible Competitive Manufacturing System	25MEP232D- Supply Chain and Logistics Management
5.	25MEP233A- Concurrent Engineering	25MEP233B- Advanced Metal Joining Processes Assessment	25MEP233C- Manufacturing Information Systems	25MEP233D- Research Methodology
6.		25MEP234B- Industry 4.0 Concepts	25MEP234C- Intelligent Manufacturing Systems	
7.	25MEP331A- Product Design and Development	25MEP331B- Materials Testing and Characterization Techniques	25MEP331C- Product Data Management	25MEP331D- Industrial Safety
8.	25MEP332A- Industrial Ergonomics	25MEP332B- Non-Destructive Testing and Evaluation	25MEP332C- Metrology and Computer Aided Inspection	25MEP332D- Sustainable Manufacturing
9.	-	25MEP333B- Advanced Tooling Design	25MEP333C- Digital Manufacturing & IoT	-

Semester – I

25MP109-APPLIED PROBABILITY AND STATISTICS 3H-3C

Instruction Hours/ week: L: 3 T: 0 P: 0

Marks: Internal: 40

External: 60

Total: 100

End Semester Exam: 3 Hours

Course Objectives

Cos	Course Objectives	Blooms Level
CO1	Demonstrate a solid understanding of probability concepts and distributions by applying axioms, Bayes theorem, and moment-generating functions to real-world problems.	Remember
CO2	Develop analytical skills to evaluate joint, marginal, and conditional distributions in two-dimensional random variables.	Apply
CO3	Apply estimation techniques such as the method of moments and maximum likelihood for deriving unbiased estimators and regression models.	Analyze
CO4	Interpret results of statistical hypothesis tests using Normal, t, Chi-square, and F- distributions to make data-driven decisions.	Create
CO5	Summarize and analyze multivariate data using principal component analysis (PCA), covariance matrices, and multivariate normal distribution principles.	Evaluate

Course Outcomes (COs)

At the completion of the course the student will be able to

Cos	Course Outcomes	Blooms Level
CO1	Identify appropriate probability distributions for a given random process and solve problems involving single and multiple random variables.	Analyse
CO2	Evaluate estimators and fitting models using least squares, ensuring minimal error and strong predictive power.	Evaluate
CO3	Create and test statistical hypotheses using various distributions and interpret the statistical significance of results.	Remember
CO4	Manipulate multivariate data structures to extract meaningful patterns using PCA and covariance analysis.	Understand
CO5	Adjust statistical methods to handle varying sample sizes and assumptions, ensuring robustness and reliability in real-time applications.	Apply

CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	3	3	3	2	2	2	3	2
CO2	3	3	2	2	3	2	3	2	3	2	3	3	3	3
CO3	3	3	3	2	3	2	2	2	2	1	3	3	3	3
CO4	2	2	2	2	2	2	2	2	3	2	2	2	2	2
CO5	3	2	2	2	2	3	3	3	3	2	3	3	3	2
UNIT 1:	PROBABILITY AND RANDOM VARIABLES											9		
Probability – Axioms of probability – Conditional probability – Baye’s theorem – Random variables-Probability function–Moments–Moment generating functions and their properties–Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions–Function of a random variable.														
UNIT 2:	TWO DIMENSIONAL RANDOM VARIABLES											9		
Joint distributions – Marginal and conditional distributions – Functions of two dimensional and random variables–Regression curve–Correlation.														
UNIT 3:	ESTIMATION THEORY											9		
Unbiased estimators – Method of moments – Maximum likelihood estimation - Curve fitting by principle of least squares–Regression lines.														
UNIT 4:	TESTING OF HYPOTHESIS											9		
Sampling distributions–Type I and Type II errors–Small and large samples–Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions –Tests for independence of attributes and goodness of fit.														
UNIT 5:	MULTIVARIATE ANALYSIS											9		
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties–Principal components–Population principal components–Principal components from standardized variables.														
														45 HOURS

SUGGESTED READINGS

1. Devore, J. L., “Probability and Statistics for Engineering and the Sciences”, 8 th Edition, Cengage Learning, 2014.
2. Gupta S.C. and Kapoor V.K., Fundamentals of Mathematical Statistics, Sultan and Sons, New Delhi, 2017.
3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8 th Edition, 2019.
4. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, 5 th Edition, Pearson Education, Asia, 2021.

25MEP101-MODERN MANUFACTURING PROCESS**3H-3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objectives**

Cos	Course Objectives	Blooms Level
CO1	Demonstrate an in-depth understanding of unconventional machining processes such as EDM, ECM, LBM, and their applications in precision manufacturing.	Remember
CO2	Develop competence in analyzing and selecting advanced metal forming and welding techniques suited for complex industrial applications.	Apply
CO3	Interpret micromachining and nanofabrication processes by examining principles like size effect, LIGA, molecular manufacturing, and lithographic techniques.	Analyze
CO4	Apply rapid prototyping technologies and surface modification methods for product development and coating performance enhancement.	Create
CO5	Evaluate various precision machining operations including ultra-precision grinding and chemical mechanical polishing for achieving micro-level tolerances.	Evaluate

Course Outcomes (COs)**At the completion of the course the student will be able to**

Cos	Course Outcomes	Blooms Level
CO1	Identify suitable unconventional machining techniques based on material properties, shape complexity, and desired accuracy.	Analyse
CO2	Create tool design and process plans for micromachining operations such as micro- drilling, micro-turning, and nano-fabrication techniques.	Apply
CO3	Summarize the principles and working mechanisms of high-energy forming and welding methods used in advanced manufacturing.	Remember
CO4	Manipulate parameters of surface engineering and deposition techniques like PVD, CVD, and plasma spraying for performance enhancement.	Understand
CO5	Adjust and optimize rapid prototyping processes (e.g., SLA, SLS, FDM) to achieve dimensional accuracy and reduce manufacturing lead time.	Evaluate

CO-PO Mapping

CO /PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	3	3	3	2	2	2	3	2
CO2	3	3	2	2	3	2	3	2	3	2	3	3	3	3
CO3	3	3	3	2	3	2	2	2	2	1	3	3	3	3
CO4	2	2	2	2	2	2	2	2	3	2	2	2	2	2
CO5	3	2	2	2	2	3	3	3	3	2	3	3	3	2

UNIT 1:	UNCONVENTIONAL MACHINING	9
Introduction-Bulk processes - surface processes- Plasma Arc Machining- Laser Beam Machining-Electron Beam Machining-Electrical Discharge Machining–Electrochemical Machining-Ultrasonic Machining-Water Jet Machining-Electro Gel Machining-Anisotropic machining-Isotropic machining-Elastic Emission machining–Ion Beam Machining.		
UNIT 2:	PRECISION MACHINING	9
Ultra Precision turning and grinding: Chemical Mechanical Polishing (CMP) – ELID process – Partial ductile mode grinding-Ultra precision grinding- Binder less wheel –Free form optics. a spherical surface generation Grinding wheel- Design and selection of grinding wheel-High-speed grinding-High-speed-milling- Diamond turning.		
UNIT 3:	ADVANCES IN METAL FORMING & WELDING	9
Orbital forging, Isothermal forging, Warm forging, Over view of Powder Metal techniques–Hot and Cold isostatic pressing-high speed extrusion, rubber pad forming, Hydro forming, Super plastic forming, Peen forming-micro blanking –Powder rolling– Tooling and process parameters-Advance welding process, techniques, scope and application of friction welding, diffusion welding, cold pressure welding and ultrasonic welding, high energy rate welding, electron beam and laser welding processes, under water welding - process & problem.		
UNIT 4:	MICROMACHINING AND NANO FABRICATION	9
Theory of micromachining-Chip formation-size effect in micromachining-micro turning, micro milling, micro drilling- Micromachining tool design-Micro EDM-Micro wire EDM-Nano fabrication: LIGA, Ion beam etching, Molecular manufacturing techniques –Atomic machining- Nano machining techniques – Top/Bottom up Nanofabrication techniques -Sub micron lithographic technique, conventional film Growth technique, Chemical etching, Quantum dot fabrication techniques–MOCVD–Epitaxy techniques.		
UNIT 5:	RAPID PROTOTYPING AND SURFACE MODIFICATION TECHNIQUES	9
Introduction–Classification–Principle advantages limitations and applications-Stereo lithography– Selective laser Sintering –FDM, SGC, LOM,3D-Printing-Surface modification Techniques: Sputtering-CVD-PVD- Diamond like carbon coating-Plasma Spraying Technique.-Diffusion coatings-Pulsed layer deposition.		
		45 HOURS

SUGGESTED READINGS

1.	Benedict,G.F.,"Non Traditional manufacturing Processes",CRC press,2014
2.	Madou, M.J., Fundamentals of Micro fabrication: The Science of Miniaturization,Second Edition, CRC Press (ISBN: 0849308267), 2019.
3.	McGeough,J.A.,"Advanced methods of Machining",Springer,2020
4.	Narayanaswamy,R., Theory of Metal Forming Plasticity, Narosa Publishers,2021.
5.	Pandey, P.S. and Shah.N., —Modern Manufacturing Processesl, Tata McGraw Hill, 2022.

25MEP102- ADVANCED MATERIALS ENGINEERING**3H-3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objectives**

Cos	Course Objectives	Blooms Level
CO1	Demonstrate the fundamental understanding of elastic and plastic deformation behavior in metals	Remember
CO2	Interpret fracture mechanism theories in terms of mechanical characteristics	Apply
CO3	Evaluate criteria for materials selection in terms of mechanical properties	Analyze
CO4	Summarize the characteristics and applications of modern metallic materials	Create
CO5	Apply knowledge of non-metallic materials	Evaluate

Course Outcomes (COs)**At the completion of the course the student will be able to**

Cos	Course Outcomes	Blooms Level
CO1	Identify suitable strengthening mechanisms to improve material performance under various loading and environmental conditions.	Analyse
CO2	Create fracture and deformation mechanism maps to predict failure modes in engineering components.	Apply
CO3	Adjust material selection based on service conditions, corrosion and wear resistance, and economic considerations for aerospace, marine, and nuclear sectors.	Remember
CO4	Manipulate advanced metallic materials including TRIP steels, shape memory alloys, and metallic glasses for engineering applications requiring high performance.	Understand
CO5	Develop and compare structural properties of engineering polymers and ceramics for use in industrial coatings, adhesives, and high-performance components.	Evaluate

CO-PO Mapping

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	1	2	2	3	3	3	2	2	2	3	2
CO 2	3	3	2	2	3	2	3	2	3	2	3	3	3	3
CO 3	3	3	3	2	3	2	2	2	2	1	3	3	3	3
CO 4	2	2	2	2	2	2	2	2	3	2	2	2	2	2
CO 5	3	2	2	2	2	3	3	3	3	2	3	3	3	2

UNIT 1:	INTRODUCTION	9
Elastic and plastic behavior–Elasticity in metals and polymers–Mechanism of plastic deformation, role of dislocation, yield stress, shear strength of perfect and real crystals–Strengthening mechanism ,work hardening, solid solution, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior-super plasticity–Deformation of non crystalline material.		
UNIT 2:	FRACTURE MECHANISM	9
Fracture behavior–Griffith's theory, stress intensity factor and fracture toughness-Toughening mechanisms – Ductile brittle transition in steel- High temperature fracture, creep-Larsen Miller parameter –Deformation and fracture mechanism maps-Fatigue low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law- Effect of surface and metallurgical parameters on fatigue- Fracture on non-metallic materials–Failure analysis, source of failure, procedure of failure analysis.		
UNIT 3:	MATERIAL SELECTION AND CASE STUDIES	9
Selection of materials–Motivation for selection, cost basis and service requirement–Selection of material properties, strength, toughness, fatigue and creep- Selection of surface durability corrosion and wear resistance– Relationship between material selection and processing– case studies in materials selection with relevance to aero, auto, marine machinery and nuclear application.		
UNIT 4:	MODERN METALLIC MATERIALS	9
Modern metallic materials- alpha steels, Micro alloyed, high strength low alloy(HLSA)steel, Transformation induced in plasticity (TRIP)steel, Maraging steel-Inter metallic Ni and Ti aluminides –Smart materials, shape memory alloys– Metallic glass-Quasicrystal and nano crystalline materials.		
UNIT 5:	NON-METALLIC MATERIALS	9
Non-metallic materials –polymeric materials –Formation of polymer structure –production techniques of fibre, foams, adhesives and coatings– structure, properties and application of engineering polymers– advanced structural ceramics, WC, TiC, TaC, Al ₂ O ₃ , SiC, Si ₃ N ₄ , CBN and diamond-properties, processing and application.		
		45 HOURS

SUGGESTED READINGS

1.	Thomas H. Courtney, Mechanical behavior of materials, (2 nd edition), McGraw-hill, 2016.
2.	Charles J.A. Crane, F.A.A and Furness, J.A.G., Selection and use of engineering materials, (3 rd edition), Butterworth Heiremann, 2019.
3.	Flinn, r.a and Trojan, P.K., Engineering materials and their application, (6 th edition), Jaico, 2020
4.	George E. Dieter, Mechanical metallurgy, McGraw Hill, 2021.

25MEP103-METAL CUTTING THEORY AND TOOL DESIGN**3H-3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objectives**

Cos	Course Objectives	Blooms Level
CO1	Demonstrate the principles and scope of tool engineering	Remember
CO2	Apply the theory of metal cutting to analyze chip formation	Apply
CO3	Develop appropriate tooling systems for both conventional and non-traditional metal removal processes	Analyze
CO4	Interpret the design principles for dies and tools used in metal forming processes such as blanking	Create
CO5	Evaluate the design	Evaluate

Course Outcomes (COs)**At the completion of the course the student will be able to**

Cos	Course Outcomes	Blooms Level
CO1	Identify suitable tools, materials, and design approaches based on specific manufacturing process requirements and economic considerations.	Analyse
CO2	Create tool layouts for various machining centers and develop jigs, fixtures, and dies using conventional and CAD-based design methods.	Apply
CO3	Summarize the thermal, mechanical, and wear characteristics affecting tool performance and lifespan in cutting operations.	Remember
CO4	Manipulate tool design parameters for complex forming operations including progressive dies and plastic molding dies.	Understand
CO5	Adjust tooling and fixture designs for different metal joining techniques, ensuring accuracy, repeatability, and production efficiency.	Evaluate

CO-PO Mapping

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	2	2	3	3	3	2	2	2	3	2
CO2	3	3	2	2	3	2	3	2	3	2	3	3	3	3
CO3	3	3	3	2	3	2	2	2	2	1	3	3	3	3
CO4	2	2	2	2	2	2	2	2	3	2	2	2	2	2
CO5	3	2	2	2	2	3	3	3	3	2	3	3	3	2

UNIT 1:	INTRODUCTION	9
Manufacturing Processes-objectives of manufacturing processes-classification of manufacturing process-Objectives of Tool design-tool design process-Nature and scope of Tool engineering-principles of economy for tooling-problems of economy in tooling-planning and tooling for economy- Manufacturing principles applicable to process and tool planning-tool control-tool maintenance-tool materials and its selection.		
UNIT 2:	THEORY OF METAL CUTTING	9
Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools–nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and machinability.		
UNIT 3:	TOOLING FOR METAL REMOVAL PROCESSES	9
Traditional machining processes-work and tool holding devices-tool nomenclatures-Mechanism of machining-force temperature and tool life of single point tool-multipoint tools -tool design-tool wear- special processes-capstan and turret lathe-tooling layout of automats-tooling in NC and CNC machines-tooling for machining centres-CAD in tool design-Jigs and fixtures-design-Non-traditional material removal processes-mechanical, electrical thermal and chemical energy processes-principles-operation-equipment-tooling parameters and limitations.		
UNIT 4:	TOOLING FOR METAL FORMING PROCESSES	9
Classification of Forming processes-Types of presses-design of -blanking and piercing dies-simple, compound, combination and progressive dies-Drawing dies-Bending dies-forging dies-plastic moulding dies.		
UNIT 5:	TOOLING FOR METAL CASTING & METAL JOINING PROCESSES	9
Tools and Equipment for moulding-patterns –pattern allowances – pattern construction-die casting tools-mechanization of foundries. Tooling for Physical joining processes, Design of welding fixtures – Arc welding, Gas welding, Resistance welding, laser welding fixtures- Tooling for Soldering and Brazing Tooling for Mechanical joining processes.		
		45 HOURS

SUGGESTED READINGS

1.	Cyril Donaldson, Tool Design, TataMcGrawHill, 2013.
2.	Hoffman E.G, Fundamentals of tool design SME 2017.
3.	Kalpak Jian S., Manufacturing Engineering and Technology Addison Wesley 2020.
4.	Wellar, J, Non-Traditional Machining Processes, SME, 2022.

25MEP104- RESEARCH METHODOLOGY AND IPR**3H-3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objectives**

Cos	Course Objectives	Blooms Level
CO1	Interpret knowledge in the principles of scientific methodology in business enquires.	Remember
CO2	Ability to understand the develop analytical skills of business research	Apply
CO3	Discuss about Various types of skills for scientific communications	Analyze
CO4	Identify various types of Budgets involved in Cost Management process	Create
CO5	Broaden the career potential of available techniques and problems available in Cost Management.	Evaluate

Course Outcomes (COs)**At the completion of the course the student will be able to**

Cos	Course Outcomes	Blooms Level
CO1	Discuss various construction costs to manage a construction project.	Analyse
CO2	Summarize different construction activities and its application related to cost based on the field requirements.	Apply
CO3	Identify Cost Behaviour of various types of cost and Quality Management	Remember
CO4	Identifying various procedure for patent and copy rights process.	Understand
CO5	Discussing various types of Techniques and Problem-solving techniques involved in trademarks and design	Evaluate

CO-PO Mapping

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PSO 1	PSO2	PSO3
CO1	3	2	1	1	2	2	3	3	3	2	2	2	3	2
CO2	3	3	2	2	3	2	3	2	3	2	3	3	3	3
CO3	3	3	3	2	3	2	2	2	2	1	3	3	3	3
CO4	2	2	2	2	2	2	2	2	3	2	2	2	2	2
CO5	3	2	2	2	2	3	3	3	3	2	3	3	3	2

UNIT 1:	RESEARCH DESIGN	9
Research Design – definition – essentials and types of research design – errors and types of errors in research design. Research problem: Selecting and analyzing the research problem – problem statement formulation – formulation of hypothesis. Literature review: purpose, sources, and importance - literature review procedure. Objectives: Learning Objectives; Definitions; Formulation of the research objectives.		
UNIT 2:	DATA ANALYSIS AND TOOLS	9
Processing of Data: Editing of Data – Coding of Data – Classification of Data – Statistical Series. Qualitative vs Quantitative data analyses – Univariate, Bivariate and Multivariate statistical techniques Measures of Central Tendency, Dispersion, correlation and Regression, Chi-square test: Applications, Steps, characteristics, limitations, Analysis of Variance and Covariance, Factor analysis – Discriminant analysis – cluster analysis – multiple regression and correlation – multidimensional scaling – Conjoint Analysis - Application of statistical software for data analysis.		
UNIT 3:	RESEARCH REPORT WRITING	9
Research report – Different types – Contents of report –executive summary – chapterization – contents of chapter – report writing – the role of audience – readability – comprehension – tone – final proof – report format – title of the report – Ethical issues in research: Code of Ethics in Research – Ethics and Research Process – Importance of Ethics in Research.		
UNIT 4:	PATENT RIGHTS AND COPY RIGHTS	9
Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and licence, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties. Copy right-Origin, Definition &Types of Copy Right, Registration procedure, Assignment & licence, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software.		
UNIT 5:	TRADE MARKS AND DESIGN	9
Trade marks- Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties. Design- Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.		
		45 HOURS

SUGGESTED READINGS

1. Cooper, D.R., Schindler, P.S. and Sun, J., 2006. Business research methods (Vol. 9). New York: McGraw-Hill Irwin.
2. Creswell, J.W. and Creswell, J.D., 2017. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications.
3. Kothari, C.R., 2020. Research methodology: Methods and techniques. New Age International.

Programme Elective 1

25MEP131B-MICRO AND NANO MANUFACTURING**3H – 3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objectives**

Cos	Course Objectives	Blooms Level
CO1	Construct a foundational understanding of precision Engineering and Practices	Remember
CO2	Execute analysis of machine tool variables and design aspects affecting accuracy	Apply
CO3	Assemble knowledge of micromachining techniques such as micro-EDM	Analyze
CO4	Implement appropriate joining techniques and its applications	Create
CO5	Demonstrate the use of micro-casting and semiconductor fabrication techniques	Evaluate

Course Outcomes (COs)**At the completion of the course the student will be able to**

Cos	Course Outcomes	Blooms Level
CO1	Construct precise component models by understanding micro/nano-scale manufacturing principles and associated error sources.	Remember
CO2	Execute precision measurement and error analysis in machine tools and apply corrective design strategies.	Apply
CO3	Assemble and evaluate micromachining processes such as micro-milling, micro-EDM, and laser ablation for micro-scale applications.	Analyze
CO4	Implement advanced joining techniques suited for precision assembly of micro components.	Create
CO5	Demonstrate micro-casting processes and semiconductor fabrication methods used in high-precision industries.	Evaluate

CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	2	3	3	2	2	2	3	2
CO2	2	1	2	2	3	2	3	2	3	2	3	3	2	3
CO3	3	3	3	3	3	1	2	2	2	1	3	3	3	3
CO4	2	2	2	2	2	2	2	2	3	2	2	2	2	1
CO5	1	2	2	2	2	3	3	3	3	2	3	3	3	2

UNIT 1:	INTRODUCTION TO PRECISION ENGINEERING AND PRACTICES	9
Definitions- origin and application of micro and nano manufacturing- scope of precision manufacturing, sources of error.		
UNIT 2:	BASIC CONCEPTS OF MACHINING AND PRECISION ENGINEERING	9
Machine tool variable accuracy, repeatability, stiffness, spindle vibration, flatness, straightness, and smoothness of motion, 1-2 DOF systems, feedback variables, cutting tool variables, work piece variables, environment effects and thermal errors. Machine design for precision manufacturing, principles of measurement mechanical errors.		
UNIT 3:	MICROMACHINING TECHNIQUES	9
Diamond micromachining introduction, diamond as a tool material, compatible materials, diamond performance, diamond machining, micro-mechanical applications. Micro-ECM, micro-EDM, Micromilling: micro-milling tools, process results and micro-milling applications. Microdrilling: micro-drilling and macro-drilling techniques. Laser micromachining: laser optics, laser ablation, heat affected zone and laser polymerization.		
UNIT 4:	JOINING PROCESSES	9
Joining processes in similar and dissimilar materials; welding processes like ultrasonic, electron beam, laser beam and associated applications,		
UNIT 5:	MICROCASTING	9
Casting processes-vacuum, semi-solid state; applications processing of integrated circuits, cleanrooms, crystal growing and shaping of wafers, etching, photo and other lithography techniques, impurity introduction, thermal oxidation, CVD etc.		
		45 HOURS

SUGGESTED READINGS

1.	Murthy R.L., Precision engineering manufacturing, New Age International, 2014.
2.	Suryaprakash M.V., Precision Engineering, Narosa publications, 2016.
3.	Venkatesh V.C., Precision Engineering, McGraw Hill Publications, 2019.
4.	Nakazawa H., Principles of precision engineering, Oxford University Press, 2022.

25MEP111-CIM AND MECHATRONICS LABORATORY**4H-2C****Instruction Hours / week: L: 0 T: 0 P: 4****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objectives**

Cos	Course Objectives	Blooms Level
CO1	Demonstrate the basic knowledge on Solid modeling, CNC programming and simulations	Remember
CO2	Manipulate each issues and the gain knowledge in the definition and elements of mechatronics system.	Apply
CO3	Equip students with essential know how to acquire and process real time signals by using sensors.	Analyze
CO4	Understand the various mathematical functions and also electronic devices.	Create

Course Outcomes (COs)**At the completion of the course the student will be able to**

Cos	Course Outcomes	Blooms Level
CO1	Demonstrate the students should be capable the base of knowledge in areas of mathematics, and physics relevant to mechatronics, and be able to apply and extend this knowledge.	Analyse
CO2	Apply the designing and manufacturing machines, products and processes.	Apply
CO3	Create and use the effectively on problem-solving teams and to coordinate and provide leadership for teams, including multi disciplinary teams.	Remember

CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	3	3	3	2	2	2	3	2
CO2	3	3	2	2	3	2	3	2	3	2	3	3	3	3
CO3	3	3	3	2	3	2	2	2	2	1	3	3	3	3
CO4	2	2	2	2	2	2	2	2	3	2	2	2	2	2
CO5	3	2	2	2	2	3	3	3	3	2	3	3	3	2

	CIM LAB	20
Computer Aided Drafting – Operating Systems – Wire Frame, Surface and Solid Modeling –Pro E Study -Helical Gear Solid Modeling using Pro-E –XL Mill CNC Milling [Projection] -Study of Profile Projector -Measurement of Thread Parameter Using Profile projector – Study of Co-ordinate Measuring Machine - XL Turn CNC Lathe [Turning, Facing, drilling and Contouring]–study of feed back milling machine (linear and circular interpolation)- Manufacturing Simulation Using LEKINS scheduling Software Package-Mini Project in LEKIN		
	FIRST CYCLE	20
Study of Mechatronics system Design Introduction to Lab view Temperature control system using Lab view Design of Vehicles speed indicator using Lab view Measurement of Pressure using Load cell and Lab view Bio signal measurement and Analysis using Lab view		
	SECOND CYCLE	20
Resistor simulation Capacitor simulation Simple Servo simulation Simple pendulum Simulation Mat lab Simulation for performing simple mathematical functions Mat lab Simulation of four bar mechanism.		
		60 HOURS

Course Objective:

To expose students for operating and handling CNC machine by themselves and performing the given task.

Course Outcomes:

- After successful completion of the course, the student would be able to Program a CNC turning or milling machine for preparing a job.
- Evaluate the process parameters involved in CNC machining
- Analyze the principles of Robot programming and carryout hands on practice
Elaborate any nonconventional machining process and 3D printing.

Equipments:

S.No.	Description
1	CNC Lathe and Milling Machine
2	Robot
3	Milling and turning operation on given specimen.
4	Slotting operation on given work piece.
5	Making a pocket on given work piece.
6	Thread cutting operation on given work piece.
7	Making a spigot on given work piece.
8	Drilling operation as required.
9	Pick & place operation by robotic arm

III Semester

25MEP301- MODELLING AND ANALYSIS OF MANUFACTURING SYSTEMS 3H-3C**Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objectives**

Cos	Course Objectives	Blooms Level
CO1	Interpret different modeling approaches of physical systems, including block diagrams, signal flow graphs, and transfer functions using Laplace transforms.	Remember
CO2	Apply response and stability analysis techniques to linear time-invariant systems using methods like Routh's stability criterion.	Apply
CO3	Demonstrate the principles of feedback control systems and develop control structures using various control actions such as P, PI, PD, and PID.	Analyze
CO4	Evaluate the frequency response of control systems using Bode and Nyquist plots, and identify key system performance metrics such as gain/phase margins and bandwidth.	Create
CO5	Create control system designs using compensators like lead, lag, and lag-lead based on root locus and frequency response techniques.	Evaluate

Course Outcomes (COs)**At the completion of the course the student will be able to**

Cos	Course Outcomes	Blooms Level
CO1	Summarize the fundamentals of system modeling and manipulate block diagrams and signal flow graphs to represent linear dynamic systems.	Analyse
CO2	Perform transient and steady-state response analysis and adjust system parameters to ensure stability using Routh's criteria.	Apply
CO3	Identify different control actions and develop root locus plots for systems with proportional, PI, PD, and PID controllers.	Remember
CO4	Interpret the frequency response characteristics of control systems and evaluate their stability using gain and phase margins.	Understand
CO5	Assemble and design control elements and compensators using both time-domain (root locus) and frequency-domain methods for improved system performance.	Evaluate

CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	3	3	3	2	2	2	3	2
CO2	3	3	2	2	3	2	3	2	3	2	3	3	3	3
CO3	3	3	3	2	3	2	2	2	2	1	3	3	3	3
CO4	2	2	2	2	2	2	2	2	3	2	2	2	2	2
CO5	3	2	2	2	2	3	3	3	3	2	3	3	3	2

UNIT 1:	INTRODUCTION TO MODELLING & REPRESENTATION	9
Objective, basic modeling concepts & types of models, Models of simple physical systems, linearization of nonlinear models and role of Linear Time Invariant (LTI) forms, I/O form, block diagram representation and manipulation, signal flow graphs, Laplace transform and transfer function concept		
UNIT 2:	RESPONSE & STABILITY ANALYSES	9
Test signals, response of 1st and 2nd order, as well as, higher order systems, Stability / its connection to response, asymptotic and BIBO stability, role of characteristic roots, Routh's stability criterion & procedure		
UNIT 3:	INTRODUCTION TO CONTROL	9
Control objectives, open/closed loop control and structures, unity negative feedback systems, and basic control actions, Transient & steady-state responses, tracking & transient response features, Proportional control action, relative stability and response, concept of root locus and its application to proportional, PI, PD and PID control actions		
UNIT 4:	CONCEPT OF FREQUENCY RESPONSE	9
Frequency response & its representation using bode's, Nyquist plots, Nyquist stability analysis, concepts of gain & phase crossover, gain and phase margins, band width and resonant amplitude as closed-loop system attributes		
UNIT 5:	DESIGN OF CONTROL ELEMENTS	9
Design of P, PI, PD & PID control elements using both root locus and frequency response techniques, Design of lead, lag, lag-lead compensators using both root locus and frequency response techniques.		
		45 HOURS

SUGGESTED READINGS

1. Ogata, K., Modern Control Engineering, 5 th Edition, Prentice-Hall India, (EEE)
2. Nise, N.S., Control Systems Engineering, 6 th Edition, John-Wiley India, (WSE)
3. Gopal, M., Control Systems - Principles & Design, 3 rd Edition, Tata McGraw-Hill
4. Dorf, R.C. & Bishop, R.H., Modern Control Systems, 11 th Edition, Pearson

Programme Elective 4 & 5

25MEP332D - SUSTAINABLE MANUFACTURING**3H-3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objectives**

Cos	Course Objectives	Blooms Level
CO1	Construct a comprehensive understanding of the need for sustainable manufacturing practices and their societal and environmental implications.	Remember
CO2	Execute methods for environmental and economic accounting in manufacturing at sectoral and national levels.	Apply
CO3	Assemble strategic frameworks for sustainable system design and evaluate competitive manufacturing strategies.	Analyze
CO4	Implement tools to analyze and improve logistics and supply chain management in alignment with sustainability goals.	Create
CO5	Demonstrate the application of lean manufacturing principles and life cycle thinking to optimize operations with minimal environmental impact.	Evaluate

Course Outcomes (COs)**At the completion of the course the student will be able to**

Cos	Course Outcomes	Blooms Level
CO1	Construct sustainable manufacturing models that address environmental challenges and reduce carbon footprints.	Remember
CO2	Execute accounting and valuation techniques like stakeholder analysis, multi-criteria analysis, and environmental income-based models.	Apply
CO3	Assemble strategic improvement programs for manufacturing system design using structured sustainability frameworks.	Analyze
CO4	Implement improvements in supply chains and logistics systems that align with sustainable operational goals.	Create
CO5	Demonstrate the principles of sustainable operations including life cycle assessment, lean tools (5S, TPM, JIT), and resource-efficient designs for enhanced consumer well-being.	Evaluate

CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	2	3	3	3	2	2	2	3	2
CO2	3	3	2	2	3	2	3	2	3	2	3	3	3	3
CO3	3	3	3	2	3	2	2	2	2	1	3	3	3	3
CO4	2	2	2	2	2	2	2	2	3	2	2	2	2	2
CO5	3	2	2	2	2	3	3	3	3	2	3	3	3	2

UNIT 1:	INTRODUCTION	9
Need for Sustainable Manufacturing Introduction to the environmental issues pertaining to the manufacturing sector–pressure to reduce costs–processes that minimize negative environmental impacts – environmental legislation and energy costs – acceptable practice in society – adoption of low carbon technologies– need to reduce the carbon footprint of manufacturing operations.		
UNIT 2:	ACCOUNTING AND ESTIMATION	9
Techniques for non-market valuation Cost and income based approaches, demand estimation methods – expressed and revealed preference, choice modeling – Multi-criteria analysis-Stake holder analysis – Environmental accounting at sector and national levels		
UNIT 3:	DESIGN APPROACHES	9
Strategies and Design Approaches Concepts of Competitive Strategy and Manufacturing Strategies and development of a strategic improvement programme – Manufacturing strategy in business - success Strategy formation and formulation – Structured strategy formulation –Sustainable manufacturing system design options – Approaches to strategy formulation –Realization of new strategies/system designs		
UNIT 4:	CHALLENGES AND OPPORTUNITIES	9
Challenges in logistics and supply chain – developing the right supply chain strategy for the products– need to align the supply network around the strategy– Tools that can be used systematically to identify areas for improvement in supply chains –Specific challenges and new thinking in the plan, source and delivering of sub-processes.		
UNIT 5:	SUSTAINABLE OPERATIONS	9
Principles of sustainable operations 7 hours Life cycle assessment Manufacturing and service activities–Influence of product design on operations–Process analysis–Capacity management–Quality management–Inventory management–Just-In-Time systems–Resource efficient design–Consumerism and sustainable well-being. Lean manufacturing, concepts. Primary Tools of Lean manufacturing: 5-S, Workplace organization, Total Productive Maintenance, Process mapping/ Value stream mapping, Work cell- Just-In-Time systems		
		45 HOURS

SUGGESTED READINGS

1.	Seliger,G,(2012), Sustainable Manufacturing: Shaping Global Value Creation, Springer
2.	Dornfeld,David.(2012),Green Manufacturing, Springer-Verlag, NewYork
3.	Davim,J.P.(2017),Sustainable Manufacturing, JohnWiley&Sons.
4.	Gupta, S.M. and Lambert, A.J.D.(2021), Environment Conscious Manufacturing, CRCPress.

INTELLIGENT MANUFACTURING SYSTEMS**3H-3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objectives**

Cos	Course Objectives	Blooms Level
CO1	Construct a the fundamentals and architecture of intelligent manufacturing systems	Remember
CO2	Execute artificial intelligence and data-driven techniques in manufacturing environments	Apply
CO3	Assemble smart manufacturing components such as sensors, robotics, and cyber-physical systems	Analyze
CO4	Implement the design intelligent manufacturing systems integrating IoT and automation technologies	Create
CO5	Demonstrate the performance and sustainability of intelligent manufacturing systems	Evaluate

Course Outcomes (COs)**At the completion of the course the student will be able to**

Cos	Course Outcomes	Blooms Level
CO1	Construct the key concepts and architecture of intelligent manufacturing systems	Remember
CO2	Execute the AI, machine learning, and data analytics in manufacturing applications	Apply
CO3	Assemble the role of robotics, sensors, and cyber-physical systems in smart manufacturing	Analyze
CO4	Implement the Design and implement IoT-enabled intelligent manufacturing solutions	Create
CO5	Demonstrate the system performance, flexibility, and sustainability in intelligent manufacturing	Evaluate

CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	2	1	2	2	2	1	3	2	2	2	1	3	2
CO2	3	3	2	2	1	2	3	2	3	2	3	3	3	3
CO3	2	2	1	2	3	2	2	1	2	1	2	3	2	3
CO4	2	2	2	2	1	2	2	2	3	2	2	2	2	2
CO5	1	2	2	2	2	1	3	3	2	2	3	3	1	2

UNIT 1:	INTRODUCTION TO INTELLIGENT MANUFACTURING	9
Evolution of manufacturing systems, Conventional vs intelligent manufacturing, Concepts of Industry 4.0, Smart factories and digital manufacturing, Architecture of intelligent manufacturing systems, Components: sensors, controllers, communication networks.		
UNIT 2:	ARTIFICIAL INTELLIGENCE IN MANUFACTURING	9
Introduction to Artificial Intelligence, Machine Learning in manufacturing, Expert systems and knowledge-based systems, Neural networks and fuzzy logic applications, Predictive maintenance using AI, Decision support systems.		
UNIT 3:	CYBER-PHYSICAL SYSTEMS & IoT	9
Cyber-Physical Systems (CPS) in manufacturing, Industrial Internet of Things (IIoT), Smart sensors and data acquisition systems, Cloud manufacturing, Big data analytics in manufacturing, Digital twin concept.		
UNIT 4:	ROBOTICS & AUTOMATION	9
Industrial robotics in intelligent manufacturing, Robot programming and control, Flexible Manufacturing Systems (FMS), Automated Guided Vehicles (AGVs), Human-robot collaboration, Smart automation and adaptive control.		
UNIT 5:	INTEGRATION, OPTIMIZATION & APPLICATIONS	9
Computer Integrated Manufacturing (CIM), System integration and interoperability, Real-time monitoring and control, Optimization techniques in manufacturing, Smart supply chain integration, Sustainable and intelligent manufacturing practices.		
		45 HOURS

SUGGESTED READINGS

1.	D. T. Pham & E. E. Eldukhri, Intelligent Production Machines and Systems, Elsevier
2.	Kusiak, A., Intelligent Manufacturing Systems, Prentice Hall
3.	Lee, J., Cyber Physical Systems and Smart Manufacturing, Springer
4.	Mikell P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, Pearson
5.	Kagermann, H., Industry 4.0: Smart Manufacturing for the Future, Springer

Open Elective

Industry 4.0 Concepts**3H – 3C****Instruction Hours / week: L: 3 T: 0 P: 0****Marks: Internal: 40****External: 60****Total: 100****End Semester Exam: 3 Hours****Course Objectives**

Cos	Course Objectives	Blooms Level
CO1	Construct the fundamental concepts and evolution of industrial revolutions leading to Industry 4.0.	Remember
CO2	Execute the key technologies such as IoT, Cyber-Physical Systems, and Big Data in modern industries.	Apply
CO3	Assemble knowledge of familiarize students with smart manufacturing systems and digital transformation.	Analyze
CO4	Implement appropriate role of automation, robotics, and artificial intelligence in Industry 4.0.	Create
CO5	Demonstrate the explore real-world applications, challenges, and future trends of Industry 4.0.	Evaluate

Course Outcomes (COs)**At the completion of the course the student will be able to**

Cos	Course Outcomes	Blooms Level
CO1	Construct the principles and evolution of Industry 4.0.	Remember
CO2	Execute the core technologies enabling Industry 4.0.	Apply
CO3	Assemble basic concepts of smart manufacturing and automation.	Analyze
CO4	Implement the industrial applications using Industry 4.0 technologies.	Create
CO5	Demonstrate the challenges, benefits, and future opportunities in digital industries.	Evaluate

CO-PO Mapping

CO / PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2	1	2	2	1	2	1	2	2	1	2	2	2
CO2	2	1	2	2	2	2	3	2	1	2	3	3	2	3
CO3	1	2	1	1	1	1	2	2	2	1	1	1	3	2
CO4	2	1	2	2	2	2	2	2	3	2	2	2	2	1
CO5	1	2	2	2	2	3	1	3	2	2	3	3	1	2

UNIT 1:	INTRODUCTION TO INDUSTRY 4.0	9
Industrial Revolutions (1.0 to 4.0) , Definition and scope of Industry 4.0 , Key drivers and components , Smart factories and digital transformation, Benefits and challenges, Third Industrial Revolution (Automation, computers, electronics) , Fourth Industrial Revolution (Digital transformation, cyber integration) , Comparative analysis of Industry 1.0–4.0		
UNIT 2:	CORE TECHNOLOGIES OF INDUSTRY 4.0	9
Internet of Things (IoT) in manufacturing, Cyber-Physical Systems (CPS) , Cloud Computing and Edge Computing, Big Data and Analytics , Artificial Intelligence basics, IoT architecture (sensors, gateways, cloud) , Industrial IoT (IIoT) applications , Smart devices and connected systems , Use cases in predictive maintenance.		
UNIT 3:	SMART MANUFACTURING & AUTOMATION	9
Smart manufacturing systems , Advanced robotics and automation , Additive Manufacturing (3D Printing) , Human-machine interaction , Digital Twin concept , Principles and processes (FDM, SLA, SLS) , Materials used in 3D printing , Advantages and limitations , Applications in prototyping and production, Human-Machine Interface (HMI) , Augmented Reality (AR) and Virtual Reality (VR)		
UNIT 4:	DATA, COMMUNICATION & INTEGRATION	9
Industrial communication systems , Machine-to-Machine (M2M) communication , Data acquisition and monitoring , System integration (Horizontal & Vertical) , Cybersecurity in Industry 4.0, Types of cyber threats in industrial systems , Security frameworks and standards , Data protection and encryption techniques , Risk assessment and mitigation strategies.		
UNIT 5:	APPLICATIONS, CASE STUDIES & FUTURE TRENDS	9
Industry 4.0 in automotive, healthcare, and logistics , Smart supply chain and logistics, Real-time industrial applications , Challenges: skills gap, cost, security , Future trends: Industry 5.0, sustainability, Automotive manufacturing (smart assembly lines) , Healthcare (smart diagnostics, telemedicine) , Logistics (automated warehouses, tracking systems).		
		45 HOURS

SUGGESTED READINGS

1.	Klaus Schwab – The Fourth Industrial Revolution, 2020.
2.	Alasdair Gilchrist – Industry 4.0: The Industrial Internet of Things, 2022.
3.	Vijay Madiseti & Arshdeep Bahga – Internet of Things: A Hands-On Approach, 2023.
4.	Radziwon, Bilberg et al. – Smart Manufacturing Systems, 2024.