NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

Estd. Under Jharkhand State Private University Act, 2018 Approved by AICTE, PCI, BCI, NCTE, INC & JNRC

EVALUATION SCHEME & SYLLABUS FOR MASTER OF TECHNOLOGY IN Production Engineering

(M. TECH-PE)

On Choice Based Credit System
(Effective from the Session: 2025-26)

Netaji Subhas University

Pokhari, Near Bhilai Pahadi, Jamshedpur, Jharkhand

VISION

To strive for excellence in education, research, and entrepreneurship, with the ultimate goal of becoming a global hub for innovation. Committed to advancing scientific and technological services, we aim to contribute meaningfully to society.

MISSION

- To provide high-quality education that nurtures innovation, entrepreneurship, and ethical values, shaping future professionals equipped for a globally competitive landscape.
- To collaborate with stakeholders by sharing institutional expertise in education and knowledge, fostering mutual growth in technical learning.
- To cultivate an environment that encourages fresh ideas, groundbreaking research, and academic excellence, paving the way for future leaders, innovators, and entrepreneurs.
- To drive socio-economic progress by offering impactful scientific and technological solutions to society.

ESTD NSU 2018 JAMSHEDPUR 2018

PROGRAMME EDUCATION OBJECTIVES (PEOs):

PEO1: Postgraduates will develop advanced theoretical and practical knowledge in thermal engineering to solve real-world and research-oriented problems.

PEO2: Postgraduates will engage in high-quality research, innovation, and development of new thermals engg. processes and technologies.

PEO3: Postgraduates will demonstrate professionalism, ethical responsibility, and leadership in academic, industrial, and research organizations.

PEO4: Postgraduates will pursue doctoral studies, postdoctoral research, or continuous professional development to stay updated with emerging trends.

PEO5: Postgraduates will apply their skills to contribute meaningfully to sustainable development and address societal and environmental challenges.

PROGRAMME OUTCOMES (POs):

PO1: An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: Apply knowledge of advanced manufacturing processes, material science, and production systems to solve complex engineering problems.

PO3: Identify, formulate, and analyze problems in production and manufacturing systems using advanced mathematical and engineering principles.

PO4: Design and optimize production processes, tools, and systems considering quality, cost-effectiveness, safety, and sustainability.

PO5: Conduct independent research, analyze technical literature, and apply modern tools to investigate and solve complex production engineering problems.

PO6: Use modern engineering tools, CAD/CAM/CAE software, simulation tools, and manufacturing technologies for product and process design.

PO7: Demonstrate knowledge of engineering and management principles to lead and manage projects in multidisciplinary environments.

PO8: Function effectively in teams and communicate technical information clearly and concisely in both oral and written forms.

PO9: Recognize the need for and engage in independent, lifelong learning to keep pace with rapid technological changes in production engineering.

P10: Apply ethical principles and commit to professional ethics and responsibilities in manufacturing practices and research.

P11: Understand the impact of manufacturing processes on society and the environment, and design sustainable and eco-friendly systems.

P12: An ability to handle techno-scientific challenges of the society.

***

M.TECH - PRODUCTION ENGINEERING

COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Code	Group	Subject	L	P	Credits
MTPE101		Theory of Metal Cutting	3	-	3
MTPE102		Advanced Metal Forming	3	-	3
MTPE103		Advanced Casting and Welding Technologies	3	-	3
MTPE104		Advanced CAD	3	-	3
MTPE105	Elective –I	Machine Tool Design	3	-	3
		Advanced Manufacturing Processes			
		Composite Materials			
MTPE106	Elective –II	Computer Aided Manufacturing	3	-	3
		Quality Engineering in Manufacturing			
		Production & Operations Management			
MTPE107L	Lab	Production Engineering Lab	-	3	2
MTPE108		Seminar	-	-	2
		Total Credits	**18**	**3**	**22**

I Year II Semester

Code	Group	Subject	L	P	Credits
MTPE201		Precision Engineering	3	-	3
MTPE202		Rapid Prototyping Technologies	3	-	3
MTPE203		Optimization Techniques and Applications	3	-	3
MTPE204		Automation in Manufacturing	3	-	3
MTPE205	Elective -III	Intelligent Manufacturing Systems	3	-	3
		Finite Element Techniques			
		Design and Manufacture of MEMS & Micro systems			
MTPE206	Elective -IV	Mechatronics	3	-	3
		Industrial Robotics			
		Design for Manufacture & Assembly			
MTPE207L	Lab	Computer Aided Engineering Lab	-	3	2
MTPE208		Seminar	-	-	2
		Total Credits	**18**	**3**	**22**

II Year - I Semester

Code	Group	Subject	L	P	Credits
MTPE301		Comprehensive Viva	-	-	2
MTPE302		Project Seminar	-	3	2
MTPE303		Project work	-	-	18
		Total Credits	**-**	**3**	**22**

II Year - II Semester

Code	Group	Subject	L	P	Credits
MTPE401		Project work and Seminar	-	-	22
		Total Credits	**-**	**-**	**22**

M. Tech – I Year – I Sem.

THEORY OF METAL CUTTING (MTPE101)

Subject Code	**MTPE101**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objective:

The objective of this course is to provide students with a comprehensive understanding of the fundamental principles and mechanisms involved in metal cutting processes. The course aims to:

1. Explain the mechanics of chip formation and material removal in various cutting operations.
2. Analyse cutting tool geometry and its impact on cutting performance.
3. Understand the concepts of tool wear, tool life, and cutting fluids.
4. Evaluate cutting forces, temperature, and surface finish in machining operations.
5. Apply theoretical knowledge to select tools, optimize machining parameters, and improve process efficiency in real-world manufacturing applications.

NSU ESTD JAMSHEDPUR 2018

Unit -I

Mechanics of Metal Cutting: Geometry of Metal Cutting Process, Chip formation, Chip thickness ratio, radius of chip curvature, cutting speed, feed and depth of cut – Types of chips chip breakers.

Orthogonal and Oblique cutting processes – definition, Forces and energy calculations (Merchant’s Analysis) – Power consumed – MRR- Effect of Cutting variables on Forces, Force measurement using Dynamometers.

Unit II

Single Point Cutting Tool: Various systems of specifications, single point cutting tool geometry and their inter-relation. Theories of formation of built-up edge and their effect, design of single point contact tools throwaway inserts.

Unit III

Multipoint Cutting Tool: Drill geometry, design of drills, Rake& Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, milling cutters, cutting speed &feed machining time- design – from cutters.

Grinding: Specifications of grinding of grinding wheel, mechanics of grinding, Effect of Grinding conditions on wheel wear and grinding ratio. Depth of cut, speed, machining time, temperature power.

Unit IV

Tool Life and Tool Wear: Theories of tool wear – adhesion, abrasive and diffusion wear mechanisms, forms of wear, Tool life criteria and machinability index.

Types of sliding contact, real area of contact, laws of friction and nature of frictional force in metal cutting. Effect Tool angle, Economics, cost analysis, mean co-effect of friction.

Unit V

Cutting Temperature: Sources of heat in metal cutting, influence of metal conditions, Temperature distribution, zones, experimental techniques, analytical approach. Use of tool- work thermocouple for determination of temperature. Temperature distribution in Metal Cutting.

Cutting fluids: Functions of cutting fluids, types of cutting fluids, properties, selection of cutting fluids**.**

Cutting tool materials: Historical developments, essential properties of cutting tool materials, types, composition and application of various cutting tool materials, selection of cutting tool materials.

Program Outcomes (POs):

Upon successful completion of this course, students will be able to:

1. **PO1 –**Apply principles of mechanics and materials science to understand and analyse metal cutting processes.
2. **PO2 –**Identify, formulate, and solve problems related to tool wear, force estimation, and machining efficiency using analytical and empirical methods.
3. **PO3 –**Design appropriate cutting tools and processes to meet desired manufacturing outcomes within realistic constraints.
4. **PO4 –**Perform experiments and simulations to investigate the effects of cutting parameters on tool life, surface finish, and machining forces.
5. **PO5 –**Use modern tools and software for modelling and analysis of metal cutting processes and tool design.
6. **PO6 –**Understand the societal and environmental impacts of manufacturing processes and implement sustainable machining practices.
7. **PO7 –**Apply knowledge of cutting fluids and tool materials to reduce environmental impact and energy consumption.

Course Outcome No	Statement	Knowledge Level (K)
CO1	**Engineering Knowledge:** Apply principles of mechanics and materials science to understand and analyse metal cutting processes.	K1
CO2	**Problem Analysis:** Identify, formulate, and solve problems related to tool wear, force estimation, and machining efficiency using analytical and empirical methods.	K3
CO3	**Design/Development of Solutions:** Design appropriate cutting tools and processes to meet desired manufacturing outcomes within realistic constraints.	K6
CO4	**Conduct Investigations:** Perform experiments and simulations to investigate the effects of cutting parameters on tool life, surface finish, and machining forces.	K2
CO5	**Modern Tool Usage:** Use modern tools and software for modelling and analysis of metal cutting processes and tool design.	K3
CO6	**The Engineer and Society:** Understand the societal and environmental impacts of manufacturing processes and implement sustainable machining practices.	K5

CO7	**Environment and Sustainability:** Apply knowledge of cutting fluids and tool materials to reduce environmental impact and energy consumption	K1

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO7												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOKS:

1. Metal Cutting Principles/ MC Shaw / Oxford and IBH Publications, New Delhi, 1969.
2. Fundamentals of Machining /Boothryd/ Edward Amold publishers Ltd 1975.
3. 'Tool Design' by David Son / Lacain/ Goud, Tata Me Graw Hill.
4. Fundamentals of Tool Design by Wilson fw , ASTME PHI 2010.

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – I Sem. (Production Engg.)

ADVANCED METAL FORMING (MTPE102)

Subject Code	MTPE102	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	60	CREDITS	04

Course Objective:

The objective of this course is to impart advanced knowledge of metal forming processes with an emphasis on the mechanics, material behaviour, and process design.

Specific aims include:

1. To study the principles of plastic deformation and metal flow in forming operations.
2. To analyse stress-strain behaviour and forming limits of materials.
3. To understand and compare various advanced forming processes such as hydroforming, high-energy rate forming, and incremental forming.
4. To apply theoretical and numerical approaches in modelling forming processes.
5. To address process defects, formability issues, and strategies for process improvement.

UNIT - I

Fundamentals of Metal Forming: Classification of forming processes, mechanisms of metal forming: slab method, Upper and lower bound analysis, Deformation energy method and finite element method temperature of metal working, hot working, cold working, friction and lubricants.

UNIT - II

Rolling of metals: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations, Problems.

UNIT - III

Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed- die forging, forging defects, and powder metallurgy forging. Problems on flow stress, true strain and forging load.

Press tool design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming and drawing dies.

UNIT - IV

Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, and production of seamless pipes. Problems on extrusion load.

Drawing: Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process, analysis of wire, deep drawing and tube drawing .Problems on draw force.

UNIT - V

Sheet Metal forming: Forming methods, Bending, stretch forming, spinning and Advanced techniques of Sheet Metal Forming, Forming limit criteria, defect in formed parts.

Advanced Metal forming processes: HERF, Electromagnetic forming, residual stresses, in-process heat treatment and computer applications in metal forming. Problems on Blanking force, Blank diagram in Cup Diagram, Maximum considering shear.

Program Outcomes (POs):

Upon successful completion of the **Advanced Metal Forming** course, students will be able to:

1. **PO1 – Engineering Knowledge:** Apply advanced concepts of material science and plasticity theory to metal forming processes.
2. **PO2 – Problem Analysis:** Identify and analyse complex problems in forming operations related to formability, stress distribution, and process parameters.
3. **PO3 – Design/Development of Solutions:** Design forming processes and dies for specific materials and applications, considering constraints like stress, strain, and material behaviour.
4. **PO4 – Conduct Investigations:** Use analytical and simulation tools (like FEM) to study deformation behaviour and optimize forming processes.
5. **PO5 – Modern Tool Usage:** Utilize modern CAD/CAM tools and finite element software for process simulation and tool design in forming.
6. **PO6 – The Engineer and Society:** Understand the impact of forming processes on productivity, safety, and societal manufacturing needs.
7. **PO7 – Environment and Sustainability:** Integrate sustainable practices in metal forming by minimizing material waste, energy consumption, and environmental effects.

Course Outcome No	Statement	Knowledge Level (K)
CO1	**Engineering Knowledge:** Apply advanced concepts of material science and plasticity theory to metal forming processes.	K1
CO2	**Problem Analysis:** Identify and analyse complex problems in forming operations related to formability, stress distribution, and process parameters.	K3
CO3	**Design/Development of Solutions:** Design forming processes and dies for specific materials and applications, considering constraints like stress, strain, and material behaviour.	K6
CO4	**Conduct Investigations:** Use analytical and simulation tools (like FEM) to study deformation behaviour and optimize forming processes.	K2
CO5	**Modern Tool Usage:** Utilize modern CAD/CAM tools and finite element software for process simulation and tool design in forming.	K3
CO6	**The Engineer and Society:** Understand the impact of forming processes on productivity, safety, and societal manufacturing needs.	K5
CO7	**Environment and Sustainability:** Integrate sustainable practices in metal forming by minimizing material waste, energy consumption, and environmental effects.	K1

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO7												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

Text Book:

1. Fundamentals of Metal Forming Processes – B.L.Juneja.

References:

1. Principles of Metal Working processes - G.W. Rowe.
2. ASM Metal Forming Hand book.

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – I Sem. (Production Engg.)

ADVANCED CASTING AND WELDING TECHNOLOGIES (MTPE103)

Subject Code	MTPE103	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	60	CREDITS	04

Course Objectives:

1. **To impart in-depth knowledge** of advanced casting processes and welding techniques used in modern manufacturing industries.
2. **To analyse the influence** of process parameters on product quality and performance in casting and welding.
3. **To develop skills** for selection and design of suitable casting and welding methods for complex engineering applications.
4. **To introduce modern advancements** such as vacuum casting, squeeze casting, laser welding, and friction stir welding.
5. **To enable students to evaluate defects** in casting and welding and understand non-destructive testing (NDT) methods for quality assurance.

Unit I

Laser Beam Welding: Types of lasers, equipment, power calculation, applications, dual laser beam welding, use of fiber optics in LBW.

Friction Stir Welding; Details of process and process parameters, specific applications.

Electron Beam Welding; The interaction of electron beam with matter, mode of heat generation, mode of energy losses, details of the equipment, product design for EBW, case studies.

Ultrasonic Welding; Propagation of ultrasonic waves in matter, mode of joint formation, joint types and design of product for ultrasonic welding, details of equipment and case studies cutting and gauging, flame cutting plasma arc welding, laser assisted cutting.

Unit II

Heat flow in Welding: Significance, theory of heat flow cooling rate determination, selection of welding parameters based on heat flow analysis, residual stresses and distortion. Joint design, analysis of fracture and fatigue of welded joints. Automated welding systems.

Unit III

Investment casting, shell moulding, squeeze casting, vacuum casting, counter-gravity flow-pressure casting, and directional and monocrystal solidification, squeeze casting, semisolid metal casting, rheocasting.

Unit IV

Solidification Gating and Risering, Nucleation and grain growth, solidification of pure metals, short and long freezing range alloys. Gating and risering design calculations, Fluidity and its measurement.

Unit V

CAE of Welding and Casting: Design of weldment, application of finite element method in welding – determination of distortion in weldments, modeling of temperature distribution – case studies. Design for casting, application of finite element method in casting- determination of hot spots, location of turbulence and other defects, modeling of flow in molds, modeling of heat transfer in castings- case studies.

Program Outcomes (POs) Contribution:

Upon successful completion of the course, students will be able to:

1. **PO1 – Apply knowledge of science and engineering** principles to analyse and solve problems in casting and welding technologies.
2. **PO2 – Identify, formulate, and analyse** defects and their causes in advanced casting and welding processes.
3. **PO3 – Design and select appropriate techniques**, materials, and equipment for specific casting and welding applications.
4. **PO4 – Use modern tools and software** to simulate and optimize casting and welding processes.
5. **PO5 – Assess environmental and safety aspects** associated with casting and welding operations.
6. **PO6 – Function effectively as an individual and as a team member** in practical lab work and industrial projects.
7. **PO7 – Communicate effectively** about technical aspects of advanced casting and welding through reports and presentations.

Course Outcome No	Statement	Knowledge Level (K)
CO1	**Apply knowledge of science and engineering** principles to analyse and solve problems in casting and welding technologies.	K1
CO2	**Identify, formulate, and analyse** defects and their causes in advanced casting and welding processes.	K3
CO3	**Design and select appropriate techniques**, materials, and equipment for specific casting and welding applications.	K6
CO4	**Use modern tools and software** to simulate and optimize casting and welding processes.	K2
CO5	**Assess environmental and safety aspects** associated with casting and welding operations.	K3
CO6	**Function effectively as an individual and as a team member** in practical lab work and industrial projects.	K5
CO7	**Communicate effectively** about technical aspects of advanced casting and welding through reports and presentations.	K1

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO7												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOKS:

1. Ravi B, "Metal Casting: Computer Aided Design and Analysis" Prentice Hall, 2005.
2. Richard L Little, "Welding and Welding Technology" Tata McGraw Hill, 2004.

REFERANCE BOOKS:

1. John Campbell, "Casting Practice" Elsevier Science Publishing C0.,2004
2. Larry Jeffus, " Welding Principles and Applications" Delmar Publishers, 2004.
3. John Campbell " Casting Butterworth Heinemann, 2003.
4. Klas Weman, :Welding Processes Handbook", 2003.
5. Howard B Cary, " Modern Welding Technology" Prentice Hall, 2002.
6. Larry Jeffus, " Welding for Collision Repair ", Delmar Publishers, 1999.
7. ASM Hand Book " Casting", ASM International 1998.

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – I Sem. (Production Engg.)

ADVANCED CAD (MTPE104)

Subject Code	**MTPE104**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives:

By the end of this course, students will be able to:

1. Understand and apply the principles of geometric modelling and parametric design.
2. Develop 2D and 3D CAD models using industry-standard software.
3. Analyse and interpret design constraints using advanced CAD tools and features.
4. Utilize computer-aided techniques for design optimization and simulation.
5. Integrate CAD with manufacturing processes like CAM and CNC programming.

UNIT I

Introduction to CAD: Definition of Cad, Design Criteria, Design Tool, Cad Tools, Design Analysis, Functional Areas CAD, and CAD Software’s and their efficient use.

Geometric Modelling: Interpolation and Extrapolation of Curves, Properties of Splines, Wire Frame Modeling: Wire Frame Entities and Modeling.

Synthetic Curves: Hermite, Bezier and B-spline Curves and their properties.

UNIT II

Surface Modeling: Analytic and Synthetic surfaces. Planar rule, surface of revolution, Tabulated cylinder.

Synthetic Surface: Bi cubic, Bezier, B-spline and NURBS Surfaces.

UNIT III

Advanced Surfaces: Coons, Blending, Sculptured Surfaces. Surface Manipulation, Displaying Segmentation, Trimming, intersection.

Transformations: 2-D and 3-D Transformations, Homogeneous Transformation and Concatenation.

UNIT IV

3-D Modelling: B-Rep, C-Rep, Cell Decomposition, Spatial occupancy and Enumeration, Primitive Instancing.

Graphics Standards: IGES, STEP, ACIS and DXF.

Design Applications: Mechanical Tolerances, Mass Properties, Mechanical Assembly, Finite Element Modeling (Mesh).

UNIT V

Collaborative Engineering: Collaborative Design, Mockup Design, Morphology, Behavioral and Feature Based Modeling and Analysis, Sensitivity analysis, Conceptual, Bottom up and Top down Design Approach.

Upon successful completion of the Advanced CAD course, students will be able to:

1. **CO1**: Apply knowledge of mathematics, science, and engineering in the creation of complex CAD models.
2. **CO2**: Identify, formulate, and analyse complex design problems using modern CAD tools.
3. **CO3**: Design components/systems that meet desired needs within realistic constraints using advanced modelling software.
4. **CO4**: Demonstrate proficiency in using current CAD technologies and tools for engineering practice.
5. **CO5**: Recognize the need for and engage in continuous learning of evolving CAD tools and techniques.
6. **CO6**: Understand project management principles while handling collaborative CAD projects.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply knowledge of mathematics, science, and engineering in the creation of complex CAD models.	K1
CO2	Identify, formulate, and analyze complex design problems using modern CAD tools.	K3
CO3	Design components/systems that meet desired needs within realistic constraints using advanced modelling software.	K6
CO4	Demonstrate proficiency in using current CAD technologies and tools for engineering practice.	K2
CO5	Recognize the need for and engage in continuous learning of evolving CAD tools and techniques.	K3
CO6	Understand project management principles while handling collaborative CAD projects.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOK:

1. CAD/CAM Theory and Practice - lbrahim Zeid, 2^{nd} Edition, Mc Graw Hill international.

REFERENCE BOOKS:

1. Mathematical Elements For Computer Graphics – David Rosers, 2^{nd} Edition Tata Mc Graw Hill 2002.
2. CAD/CAM, Principles and Applications, 3^{rd} Edition Tata Mc Graw Hill 2010.
3. Computer Graphics – Steven Hamington, 2^{nd} Edition Tata Mc Graw Hill 1987.

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – I Sem. (Production Engg.)

MACHINE TOOL DESIGN (MTPE105)

(Elective-I)

Subject Code	**MTPE105**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives (COs):

1. **CO1**: Understand the basic principles and classification of machine tools and their mechanisms.
2. **CO2**: Analyse the design aspects of machine tool structures, guide ways, and spindles.
3. **CO3**: Design various components of machine tools considering dynamic and static loads.
4. **CO4**: Evaluate machine tool drives and control systems for performance and efficiency.
5. **CO5**: Apply design standards and safety considerations in machine tool design projects.

UNIT –I

Kinematics of Machine Tools:- shaping of geometrical and real surfaces, Developing and designing of kinematic schemes of machine tools, kinematics structures of lathe, drilling, milling, grinding, gear shaping and gear hobbing machines. Kinematic design of speed and feed boxes. Productivity loss. Stepped and stepless regulation, clutched drive.

UNIT – II

Strengths and Rigidity of Machine tool Structures: Basic principles of design for strength. Different types of structures. Overall compliance of machine tools. Design of beds, bases, columns, tables, cross rail for various machines. Various types of guide ways, their relative advantages. Materials for machine tool components including plastic guide way (PTFE)

UNIT – III

Analysis of Spindles, Bearings, and Power Screws: Design of spindles subjected to combined bending and torsion. Layout of bearings. Pre-loading. Anti-friction slide ways. Rolling contact hydrodynamic, hydrostatic, Hydrodynamic design of Journal bearings, Magneto bearings.

Machine Tool Vibrations: Effect of vibrations on machine tool. Free and Forced vibrations. Machine tool chatter.

UNIT – IV

Computer- Aided Programming: General information, APT programming, Examples apt programming probkms (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors introduction to CAD/CAM software, automatic Tool Path generation.

UNIT V

Tooling for CNC Machines: Interchangeable tooling system, present and qualifies tools, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC Systems and Adaptive Control; Introduction, type of DNC systems, advantages arid disadvantages of DNC, adaptive control with optimization, Adaptive control with constrains, Adaptive control of machining processes like turning, grinding.

Course Outcomes (COs):

1. **CO1**: Apply engineering knowledge to design machine tools and components for specific applications.
2. **CO2**: Analyse and solve complex engineering problems using the principles of mechanics and design.
3. **CO3**: Design machine tool components/systems that meet desired needs considering function, cost, and manufacturability.
4. **CO4**: Use modern design and simulation tools to create and analyse machine tool systems.
5. **CO5**: Demonstrate awareness of professional ethics and safety standards in machine design.
6. **CO6**: Engage in independent and lifelong learning in the context of evolving machine tool technologies.

Course Outcome	**Statement**	**Knowledge Level (K)**
CO1	Apply engineering knowledge to design machine tools and components for specific applications.	K1
CO2	Analyse and solve complex engineering problems using the principles of mechanics and design.	K3
CO3	Design machine tool components/systems that meet desired needs considering function, cost, and manufacturability.	K6
CO4	Use modern design and simulation tools to create and analyse machine tool systems.	K2
CO5	Demonstrate awareness of professional ethics and safety standards in machine design.	K3
CO6	Engage in independent and lifelong learning in the context of evolving machine tool technologies.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOK:

1. N.K. Mehta, Machine Tool Design and Numerical Control, Tata McGraw Hill, 1997.

REFERANCE BOOKS:

1. Sen and Battacharya, Principles of Machine Tools, Central book publishers, Calcutta 1995.
2. SK BASU " Machine Tool Design".
3. McGraw "CAD/CAM".
4. Yorenkoren "Computer Control " Manufacturing Systems".

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – I Sem. (Production Engg.)

ADVANCED MANUFACTURING PROCESSES (MTPE105)

(Elective – I)

Subject Code	**MTPE105**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives (COs):

1. **CO1**: Understand the principles and applications of advanced manufacturing techniques such as EDM, ECM, LBM, and ultrasonic machining.
2. **CO2**: Analyse the process parameters and material removal mechanisms in non-traditional machining processes.
3. **CO3**: Explore additive manufacturing technologies and their role in modern production environments.
4. **CO4**: Evaluate hybrid manufacturing processes and their industrial relevance.
5. **CO5**: Integrate advanced manufacturing methods into conventional systems for improved productivity and precision.

Unit I

Surface treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating, Electro forming, Chemical vapour deposition, thermal spraying, lon implantation, diffusion coating, Diamond coating and cladding.

Unit II

Non-Traditional Machining: Introduction, need AJM, Parametric Analysis, Process capabilities, USM- Mechanics of Cutting, models, Parametric Analysis, WJM – principles, equipment, generators, analysis of R-C circuits, MRR, Surface finish, WEDM.

Unit III

Laser Beam Machining – Principles of working, equipment, Material removal rate, Process parameters, performance characterization, applications.

Plasma Arc Machining – Principles of working, equipment, Material removal rate, Process Parameters, performance characterization, applications

Electron Beam Machining – Principle of working equipment, Material removal rate, Process performance characterization, applications

Electro Chemical Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, applications

Unit IV

Processing of ceramics: Applications characteristics, classification Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

Unit V

Fabrication of Microelectronics devices: Crystal growth and wafer preparation, Film deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuits economics.

E-Manufacturing, nanotechnology, and micromachining, High speed Machining

Course Outcomes (POs):

1. **CO1**: Apply knowledge of science and engineering to understand advanced manufacturing techniques and their industrial applications.
2. **CO2**: Identify, formulate, and solve engineering problems related to non-traditional and hybrid manufacturing processes.
3. **CO3**: Design and develop efficient and sustainable manufacturing processes considering technical, economic, and environmental aspects.
4. **CO4**: Use modern engineering tools and simulation software to analyse and optimize manufacturing techniques.
5. **CO5**: Demonstrate awareness of recent technological advancements in manufacturing and commit to lifelong learning.
6. **CO6**: Understand the societal and ethical implications of advanced manufacturing processes, including waste reduction and resource utilization.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply knowledge of science and engineering to understand advanced manufacturing techniques and their industrial applications.	K1
CO2	Identify, formulate, and solve engineering problems related to non-traditional and hybrid manufacturing processes.	K3
CO3	Design and develop efficient and sustainable manufacturing processes considering technical, economic, and environmental aspects.	K6
CO4	Use modern engineering tools and simulation software to analyse and optimize manufacturing techniques.	K2
CO5	Demonstrate awareness of recent technological advancements in manufacturing and commit to lifelong learning.	K3
CO6	Understand the societal and ethical implications of advanced manufacturing processes, including waste reduction and resource utilization.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			

CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOKS:

1. Manufacturing Engineering and Technology, Kalpakijian, Adisson Wesley 1995.
2. Process and Materials of Manufacturing RA Lindburg 4th edition PHI 1990.
3. Foundation of MEMS/Chang Liu/ Pearson, 2012.
4. Advanced Machining Processes VKJin, Allied Publications.
5. Introduction to Manufacturing Processes, John A Schey, Mc Graw Hill.

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – I Sem. (Production Engg.)

COMPOSITE MATERIALS (MTPE105)

Subject Code	**MTPE105**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives (COs):

1. **CO1**: Understand the fundamentals, classifications, and advantages of composite materials.
2. **CO2**: Analyse the mechanical behaviour of composite materials under different loading conditions.
3. **CO3**: Study manufacturing techniques and processing methods for various composite systems.
4. **CO4**: Evaluate the performance, failure mechanisms, and design aspects of fiber-reinforced composites.
5. **CO5**: Apply composite material concepts in real-world engineering design and structural applications.

UNIT –I

INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II

REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications.

Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering.

Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT –IV

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Course Outcomes (POs):

1. **CO1**: Apply knowledge of materials science and engineering mechanics to solve problems involving composite materials.
2. **CO2**: Analyse composite structures using theoretical and computational methods to predict mechanical performance.
3. **CO3**: Design engineering components using composite materials with consideration of weight, strength, and cost.
4. **CO4**: Use modern tools, including FEA and CAD, to simulate and analyse the behaviour of composites.
5. **CO5**: Demonstrate awareness of sustainable manufacturing practices and environmental impacts in composite usage.
6. **CO6**: Engage in continuous learning to keep pace with advancements in composite material technologies and their applications.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply knowledge of materials science and engineering mechanics to solve problems involving composite materials.	K1
CO2	Analyse composite structures using theoretical and computational methods to predict mechanical performance.	K3
CO3	Design engineering components using composite materials with consideration of weight, strength, and cost.	K6
CO4	Use modern tools, including FEA and CAD, to simulate and analyse the behaviour of composites.	K2
CO5	Demonstrate awareness of sustainable manufacturing practices and environmental impacts in composite usage.	K3
CO6	Engage in continuous learning to keep pace with advancements in composite material technologies and their applications.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOKS

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

REFERENCES

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – I Sem. (Production Engg.)

COMPUTER AIDED MANUFACTURING (MTPE106)

Elective II

Subject Code	MTPE106	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	60	CREDITS	04

Course Objectives (COs):

1. **CO1**: Understand the fundamentals and scope of computer-aided manufacturing in modern industry.
2. **CO2**: Analyse and apply numerical control (NC/CNC) programming techniques for machining operations.
3. **CO3**: Study various computer-integrated manufacturing systems and automation strategies.
4. **CO4**: Explore the application of robotics, group technology, and flexible manufacturing systems (FMS).
5. **CO5**: Integrate CAD/CAM tools to develop complete digital manufacturing workflows.

UNIT I

Compute-Aided Programming: General information, APT programming, Examples Apt programming probkms (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors .Introduction to CAD/CAM software, Automatic Tool Path generation.

UNIT II

Tooling for CNC Machines: Interchangeable tooling system, preset and qualified toois, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages arid disadvantages of DNC, adaptive control with optimization, Adaptive control with constrains, Adaptive control of machining processes like turning, grinding.

UNIT III

Post Processors for CNC: Introduction to Post Processors: The necessity of a Post Processor, the general structure of a Post Processor, the functions of a Post Processor, DAPP — based- Post Processor: Communication channels and major variables in the DAPP — based Post Processor, th creation of a DAPP — Based Post Processor.

UNIT IV

Micro Controllers: Introduction, Hardware components, I/O pins, ports, external memory:, counters, timers and serial data I/O interrupts. Selection of Micro Controllers Embedded Controllers, Applications and Programming of Micro Controllers. Programming Logic Controllers (PLC' s): Introduction, Hardware components of PLC, System, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC

Machines.

UNIT V

Computer Aided Process Planning, Hybrid CAAP System, Computer Aided Inspection and quality control, Coordinate Measuring Machine, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods, Artificial Intelligence and expert system: Artificial Neural Networks, Artificial Intelligence in CAD, Experts systems and its structures.

Course Outcomes (POs) Addressed

1. **CO1**: Apply knowledge of engineering fundamentals to understand and implement CAM systems.
2. **CO2**: Formulate and analyse machining processes using NC/CNC programming.
3. **CO3**: Design automated manufacturing solutions using CAM software and techniques.
4. **CO4**: Use modern engineering tools such as CAM software, CNC simulators, and digital twin platforms.
5. **CO5**: Understand and apply principles of smart manufacturing, including Industry 4.0 concepts.
6. **CO6**: Commit to lifelong learning in emerging areas of computer-aided manufacturing and industrial automation.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply knowledge of engineering fundamentals to understand and implement CAM systems.	K1
CO2	Formulate and analyse machining processes using NC/CNC programming.	K3
CO3	Design automated manufacturing solutions using CAM software and techniques.	K6
CO4	Use modern engineering tools such as CAM software, CNC simulators, and digital twin platforms.	K2
CO5	Understand and apply principles of smart manufacturing, including Industry 4.0 concepts.	K3
CO6	Commit to lifelong learning in emerging areas of computer-aided manufacturing and industrial automation.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

Text Books:

1. Computer Control of Manufacturing Systems / Yoram Koren / Mc Graw Hill. 1983.
2. Computer Aided Design Manufacturing – K. Lalit Narayan, K. Mallikarjuna Rao and M.M.M. Sarcar, PHI, 2008.

Reference Books:

1. Systems approach to Computer Integrated Design and Manufacturing – Nana Singh, John Wiley, 1996.
2. Computer Aided Manufacturing – Tien Chien Chang, Richrad A. Wysk and Hsu-Pin Wang, Pearson Third Editon, 2012.
3. Computer Numerical Control, Operations and Programming – Jon Stenerson, Kelly Cuman, PHI.

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – I Sem. (Production Engg.)

QUALITY ENGINEERING IN MANUFACTURING (MTPE106)

(Elective II)

Subject Code	**MTPE106**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives (COs):

1. **CO1**: Understand the fundamental concepts and principles of quality control and quality assurance in manufacturing.
2. **CO2**: Apply statistical quality control (SQC) tools such as control charts and process capability analysis.
3. **CO3**: Analyse product and process quality using Six Sigma, DOE, and other quality improvement methods.
4. **CO4**: Utilize quality standards and frameworks like ISO, TQM, and Kaizen in industrial practices.
5. **CO5**: Develop strategies for continuous improvement and customer satisfaction in manufacturing environments.

UNIT I

Quality Value and Engineering: An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances.(N-type,S-type and L-type)

UNIT II

Tolerance Design and Tolerancing: Functional limits, tolerance design for N-type. L-type and S-type characteristics, tolerance allocation fbr multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

UNIT III

Analysis of Variance (ANOVA): NO-way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT IV

Orthogonal Arrays: Typical test strategies, better test strategies, efficient test strategies, steps in designing, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.

UNIT V

IS[)-9000 Quality System, BDRE, 6.-sigma, Bench making, Quality circles Brain Storming —

Fishbone diagram — problem analysis.

Course Outcomes (COs) Addressed

1. **CO1**: Apply knowledge of mathematics, statistics, and engineering to solve quality-related problems in manufacturing.
2. **CO2**: Analyse and interpret manufacturing data using SQC tools to improve process control and reliability.
3. **CO3**: Design effective quality systems for products and processes that meet international standards and customer expectations.
4. **CO4**: Use modern quality engineering tools and software for analysis, monitoring, and improvement.
5. **CO5**: Demonstrate professional ethics and responsibility in promoting sustainable quality practices.
6. **CO6**: Engage in lifelong learning to stay updated with evolving quality frameworks and technologies.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply knowledge of engineering fundamentals to understand and implement CAM systems.	K1
CO2	Formulate and analyse machining processes using NC/CNC programming.	K3
CO3	Design automated manufacturing solutions using CAM software and techniques.	K6
CO4	Use modern engineering tools such as CAM software, CNC simulators, and digital twin platforms.	K2
CO5	Understand and apply principles of smart manufacturing, including Industry 4.0 concepts.	K3
CO6	Commit to lifelong learning in emerging areas of computer-aided manufacturing and industrial automation.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

Text Book:

1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill, Intl. II Edition, 1995.

Reference Books:

1. Quality Engineering in Production systems *I* G. Taguchi, A. Elsayed et al / Mc.Graw Hill Intl. Edition, 1989.
2. Taguchi Methods explained: Practical steps to Robust Design / Papan P. Bagchi *I* Prentice Hall md. Pvt. Ltd., New Delhi.
3. Design of Experiments using the Taguchi Approach/Ranjit K. Roy, John wiley & sons. Inc. 2001.

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – I Sem. (Production Engg.)

PRODUCTION AND OPERATIONS MANAGEMENT (MTPE106)

(Elective II)

Subject Code	**MTPE106**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives (COs):

1. **CO1**: Understand the principles, functions, and scope of production and operations management in manufacturing and service sectors.
2. **CO2**: Analyse and apply forecasting, capacity planning, and facility layout strategies.
3. **CO3**: Learn methods for efficient resource planning, inventory management, and scheduling.
4. **CO4**: Evaluate productivity, quality, and lean operations for process improvement.
5. **CO5**: Develop decision-making skills using quantitative models and operational strategies.

UNIT -1

Operation Management – Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management.

Product design – Requirements of good product design – product development – approaches – concepts in product development – standardization – simplification – Speed to market – Introduction to concurrent engineering.

UNIT II

Alue engineering – objective – types of values – function & cost – product life cycle- steps in value engineering – methodology in value engineers – FAST Diagram – Matrix Method.

Location – Facility location and layout – Factors considerations in Plant location- Comparative Study of rural and urban sites – Methods of selection plant layout – objective of good layout – Principles – Types of layout – line balancing.

UNIT III

Aggregate Planning – definition – Different Strategies – Various models of Aggregate Planning – Transportation and graphical models.

Advance inventory control systems push systems – Material Requirement – Terminology – types of demands – inputs to MRP- techniques of MRP – Lot sizing methods – benefits and drawbacks of MRP – Manufacturing Resources Planning (MRP –II), Pull systems – Vs Push system – Just in time (JIT) philosophy Kanban System – Calculation of number of Kanbans Requirements for implementation JIT – JIT Production process – benefits of JIT.

UNIT IV

Scheduling – Policies – Types of scheduling – Forward and Backward Scheduling – Grant Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – job shop Scheduling – 2 jobs and n machines – Line of Balance.

UNIT V

Project Management – Programming Evaluation Review Techniques (PERT) – three times estimation – critical path – probability of completion of project – critical path method – crashing of simple nature.

Course Outcomes (COs):

1. **CO1**: Apply knowledge of engineering and management principles to solve production and operations problems.
2. **CO2**: Analyse and optimize processes related to planning, scheduling, and resource allocation.
3. **CO3**: Design and manage effective production systems that meet performance, quality, and cost criteria.
4. **CO4**: Use modern tools and software for operations planning, forecasting, and process control.
5. **CO5**: Demonstrate awareness of professional ethics, sustainability, and safety in operations management.
6. **CO6**: Engage in continuous learning to adopt evolving trends in production and operations practices.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply knowledge of engineering and management principles to solve production and operations problems.	K1
CO2	Analyse and optimize processes related to planning, scheduling, and resource allocation.	K3
CO3	Design and manage effective production systems that meet performance, quality, and cost criteria.	K6
CO4	Use modern tools and software for operations planning, forecasting, and process control.	K2
CO5	Demonstrate awareness of professional ethics, sustainability, and safety in operations management.	K3
CO6	Engage in continuous learning to adopt evolving trends in production and operations practices.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOK:

1 "Operations Management'' by E.S. Buffs.

REFERANCE BOOKS:

1. Operations Management Theory and Problems - Joseph G. Monks.
2. Production Systems Management - James I. Riggs.
3. Production and Operations Management - Chary.
4. Operations Management - Chase.
5. Production and Operation Management - Panner Selvam.
6. Production and Operation Analysis - Nahima.

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – I Sem. (Production Engg.)

PRODUCTION ENGINEERING LAB (MTPE107)

List of Experiments:

1 Study of the morphology of chips produced from different materials sand machining processes.

2 Effect of tool geometry on chip flow direction in simulated orthogonal cutting conditions.

3 Study of cutting ratio/chip thickness ratio in simulated orthogonal cutting with different materials and tool geometry.

4. Evaluations of tool face temperature with thermocouple method.

5. Roughness of machined surface. Influence of tool geometry and feed rate.

6 Study of the construction and operating parameters of metal spinning Lathe.

7 Study of the water hammer equipment and hydrostatic extrusion setup.

8. Extrusion of cylindrical billets through dies of different included angles and exit diameters and their effect on extrusion pressure.

9. Practice and study of blanking and punching process and their characteristic features on mechanical press with existing dies.

10 Experiments on TIG and MIG welding to find out the mechanical properties of metals.

11 Hydraulic and Pneumatic circuits.

12 Study of operation of tool and cutter grinder, twist drill grinder, Centre less grinder.

13 Determination of cutting forces in turning.

14 Inspection of parts using tool maker's microscope, roughness and form tester.

15 Studies on PLC programming.

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – II Sem. (Production Engg.)

PRECISION ENGINEERING (MTPE201)

Subject Code	**MTPE201**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives (COs):

1. **CO1**: Understand the fundamentals and significance of precision engineering in high-accuracy manufacturing.
2. **CO2**: Study sources of error and factors affecting precision such as thermal, geometric, and dynamic influences.
3. **CO3**: Analyse the design and performance of precision machine elements and systems.
4. **CO4**: Explore metrology systems, interferometry, and Nano metrology techniques for precision measurements.
5. **CO5**: Apply precision engineering principles in the design and evaluation of advanced manufacturing and assembly processes.

UNIT-I

Concepts of Accuracy : Introduction-Concepts of Accuracy of Machine Tools-Spindle and Displacement Accuracies-Accuracy of Numerical Control Systems-Errors due to Numerical Interpolation Displacement Measurement System and Velocity Lags.

UNIT-II

Geometric Dimensioning and Tolerancing : Tolerance Zone Conversions-Surfaces, Features of Size, Datum features-Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datum's- Datum Feature of Representation-Form Controls, Orientation Controls-Logical Approach to Tolerancing.

UNIT-III

Datum Systems: Design of Freedom, Grouped Datum systems-Different types, Two and Three mutually perpendicular grouped datum planes, Grouped Datum System with spigot and recess, pin and hole, Grouped Datum System with spigot and recess pair and Tongue-Slot Pair-Computation of Transnational and Rotational accuracy, Geometric Analysis and Application.

UNIT-IV

Tolerance Analysis: Process Capability, Mean, Variance, Skewness, Kurtosis, Process Capability Metrics, Cp, Cpk, Cost Aspects, Feature Tolerances, Geometric Tolerances.

Surface Finish, Review of relationship between attainable tolerance grades and different Machining Process. Cumulative effect of Tolerances sure fit law, normal law and truncated normal law.

UNIT-V

Tolerance Charting Techniques: Operation Sequence for typical shaft type of components, Preparation of Process drawings for different Operations, Tolerance Worksheets and centrally analysis, Examples. Design features to facilitate Machining: Datum Features-functional and Manufacturing. Components design- Machining considerations, Redesign for Manufactured Examples.

Course Outcomes (COs) Addressed

1. **CO1**: Apply foundational knowledge of engineering science to solve problems in precision engineering applications.
2. **CO2**: Analyse and mitigate error sources to improve manufacturing accuracy and repeatability.
3. **CO3**: Design high-precision systems and components considering thermal, mechanical, and dynamic stability.
4. **CO4**: Use modern metrology tools, sensors, and simulation software for precision measurement and control.
5. **CO5**: Demonstrate awareness of the importance of precision in critical industries such as aerospace, biomedical, and electronics.
6. **CO6**: Engage in lifelong learning to stay updated on emerging tools, techniques, and standards in precision engineering.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply foundational knowledge of engineering science to solve problems in precision engineering applications.	K1
CO2	Analyse and mitigate error sources to improve manufacturing accuracy and repeatability.	K3
CO3	Design high-precision systems and components considering thermal, mechanical, and dynamic stability.	K6
CO4	Use modern metrology tools, sensors, and simulation software for precision measurement and control.	K2
CO5	Demonstrate awareness of the importance of precision in critical industries such as aerospace, biomedical, and electronics.	K3
CO6	Engage in lifelong learning to stay updated on emerging tools, techniques, and standards in precision engineering.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOK:

1. Precision Engineering in Manufacturing – Murthy R.L., New Age International (p) Limited, 1996.

REFERENCE BOOKS:

1. Geometric Dimensioning and Tolerancing – James D. Meadows, Marcel Dekker Inc. 1995.
2. Precision Manufacturing – David Dorifield, Dae Eur Lee, Springer Publishers, 2008.

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – II Sem. (Production Engg.)

RAPID PROTOTYPING TECHNOLOGIES (MTPE202)

Subject Code	MTPE202	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	60	CREDITS	04

Course Objectives (COs):

1. **CO1**: Understand the fundamentals, importance, and applications of rapid prototyping (RP) in product development.
2. **CO2**: Study various RP processes such as SLA, SLS, FDM, and 3DP, along with their working principles.
3. **CO3**: Evaluate the advantages, limitations, and material compatibility of different RP technologies.
4. **CO4**: Learn about data preparation, CAD modeling, and STL file generation for additive manufacturing.
5. **CO5**: Apply rapid prototyping techniques in real-world product design, testing, and customization.

UNIT – I

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.

UNIT – II

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

UNIT-III

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs. RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

UNIT – IV

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magic's, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.

UNIT –V

RP Applications: Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

Course Outcomes (COs):

1. **CO1**: Apply engineering knowledge to understand and utilize rapid prototyping technologies effectively.
2. **CO2**: Identify and analyse the suitability of different RP processes for various engineering applications.
3. **CO3**: Design and develop product prototypes considering time, cost, material, and functional constraints.
4. **CO4**: Use modern tools and software such as CAD and slicing programs for RP data preparation and process control.
5. **CO5**: Understand the role of RP in innovation, customization, and accelerating time-to-market.
6. **CO6**: Pursue lifelong learning to keep pace with emerging trends in additive manufacturing and digital fabrication.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply engineering knowledge to understand and utilize rapid prototyping technologies effectively.	K1
CO2	Identify and analyse the suitability of different RP processes for various engineering applications.	K3
CO3	Design and develop product prototypes considering time, cost, material, and functional constraints.	K6
CO4	Use modern tools and software such as CAD and slicing programs for RP data preparation and process control.	K2
CO5	Understand the role of RP in innovation, customization, and accelerating time-to-market.	K3
CO6	Pursue lifelong learning to keep pace with emerging trends in additive manufacturing and digital fabrication.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			

CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOK:

1 Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications , Third Edition, 2010.

REFERANCE BOOKS:

1. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer, 2001.
2. Whalers Report 2000 – Terry Wohlers, Wohlers Associates, 2000 Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press, 1996.

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – II Sem. (Production Engg.)

OPTIMIZATION TECHNIQUES AND APPLICATIONS (MTPE203)

Subject Code	MTPE203	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	60	CREDITS	04

Course Objectives (COs):

1. **CO1**: Understand the fundamentals and classifications of optimization problems and methods.
2. **CO2**: Formulate linear, nonlinear, and dynamic optimization problems for engineering applications.
3. **CO3**: Apply classical and numerical optimization techniques to solve constrained and unconstrained problems.
4. **CO4**: Use advanced methods such as genetic algorithms, particle swarm optimization, and simulated annealing.
5. **CO5**: Implement optimization models using mathematical tools and software for real-world engineering systems.

UNIT- I

Single Variable Non-Linear Unconstrained Optimization: One dimensional Optimization methods:- Uni-modal function, elimination methods, Fibonacci method, golden section method, interpolation methods – quadratic & cubic interpolation methods.

UNIT- II

Multi variable non-linear unconstrained optimization: Direct search method – Univariant method - pattern search methods – Powell's- Hook -Jeeves, Rosenbrock search methods- gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

UNIT- III

Linear Programming – Formulation – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints.

Simulation – Introduction – Types- steps – application – inventory – queuing – thermal system

UNIT- IV

Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method

Stochastic Programming: Basic concepts of probability theory, random variables- distributions-mean, variance, correlation, co variance, joint probability distribution- stochastic linear, dynamic programming.

UNIT- V

Geometric Programming: Posynomials – arithmetic - geometric inequality – unconstrained G.P- constrained G.P

Non Traditional Optimization Algorithms: Genetics Algorithm-Working Principles, Similarities and Differences between Genetic Algorithm & Traditional Methods. Simulated Annealing- Working Principle- Simple Problems.

Course Outcomes (COs):

1. **CO1**: Apply mathematical and engineering knowledge to formulate and solve optimization problems.
2. **CO2**: Analyse engineering systems to identify opportunities for performance enhancement through optimization.
3. **CO3**: Design optimal solutions for engineering problems under multiple constraints and criteria.
4. **CO4**: Use modern computational tools and algorithms to implement and simulate optimization models.
5. **CO5**: Demonstrate a multidisciplinary approach to solving complex problems in design, manufacturing, logistics, and control.
6. **CO6**: Commit to continuous learning in advanced optimization techniques and their evolving applications in engineering.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply mathematical and engineering knowledge to formulate and solve optimization problems.	K1
CO2	Analyse engineering systems to identify opportunities for performance enhancement through optimization.	K3
CO3	Design optimal solutions for engineering problems under multiple constraints and criteria.	K6
CO4	Use modern computational tools and algorithms to implement and simulate optimization models.	K2
CO5	Demonstrate a multidisciplinary approach to solving complex problems in design, manufacturing, logistics, and control.	K3
CO6	Commit to continuous learning in advanced optimization techniques and their evolving applications in engineering.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOKS:

1. Optimization theory & Applications / S.S.Rao / New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI

REFERENCE BOOKS:

1) S.D.Sharma / Operations Research
2) Operation Research / H.A.Taha /TMH
3) Optimization in operations research / R.LRardin
4) Optimization Techniques /Benugundu & Chandraputla / Pearson Asia.
5) Optimization Techniques theory and practice / M.C.Joshi, K.M.Moudgalya/ Narosa Publications.

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – II Sem. (Production Engg.)

AUTOMATION IN MANUFACTURING (MTPE204)

Subject Code	**MTPE204**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives (COs):

1. **CO1**: Understand the fundamentals, scope, and benefits of automation in manufacturing systems.
2. **CO2**: Study various hardware and software components used in industrial automation, including sensors, actuators, PLCs, and controllers.
3. **CO3**: Analyse the principles and design of automated material handling and assembly systems.
4. **CO4**: Explore flexible manufacturing systems (FMS), robotics, and computer-integrated manufacturing (CIM).
5. **CO5**: Apply automation technologies to improve productivity, quality, and safety in manufacturing environments.

UNIT-I

Introduction to Automation: Automation in Production Systems-Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.

UNIT-II

Introduction to Material Handling, Overview of Material Handling Equipment, Considerations in Material Handling System Design, The 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code technology, other ADC technologies.

UNIT -III

Manual Assembly Lines - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design.

UNIT-IV

Transfer lines, Fundamentals of Automated Production Lines, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.

UNIT-V

Automated Assembly Systems, Fundamentals of Automated Assembly Systems, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines, And Partial Automation.

Course Outcomes (COs):

1. **CO1**: Apply engineering fundamentals to understand and implement automation in manufacturing processes.
2. **CO2**: Analyse and solve problems related to control, productivity, and integration in automated systems.
3. **CO3**: Design automated manufacturing systems considering real-time control, flexibility, and system efficiency.
4. **CO4**: Use modern tools like PLC programming, SCADA, HMI, and robotics simulators for automation tasks.
5. **CO5**: Demonstrate awareness of industrial trends, including smart manufacturing and Industry 4.0.
6. **CO6**: Engage in lifelong learning to adapt to emerging automation technologies and digital transformation in industry.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply engineering fundamentals to understand and implement automation in manufacturing processes.	K1
CO2	Analyse and solve problems related to control, productivity, and integration in automated systems.	K3
CO3	Design automated manufacturing systems considering real-time control, flexibility, and system efficiency.	K6
CO4	Use modern tools like PLC programming, SCADA, HMI, and robotics simulators for automation tasks.	K2
CO5	Demonstrate awareness of industrial trends, including smart manufacturing and Industry 4.0.	K3
CO6	Engage in lifelong learning to adapt to emerging automation technologies and digital transformation in industry.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOK:

1. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover/ Pearson Eduction.

REFERENCE BOOKS:

1. CAD CAM : Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE).
2. Automation, Buckinghsm W, Haper & Row Publishers, New York, 1961.
3. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – II Sem. (Production Engg.)

INTELLIGENT MANUFACTURING SYSTEMS (MTPE205)

(Elective – III)

Subject Code	**MTPE205**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives (COs):

1. **CO1**: Understand the principles and components of intelligent manufacturing systems (IMS) and their relevance in Industry 4.0.
2. **CO2**: Analyse the role of artificial intelligence, machine learning, and data analytics in enhancing manufacturing processes.
3. **CO3**: Study the integration of smart sensors, IoT, cyber-physical systems, and cloud computing in manufacturing environments.
4. **CO4**: Explore decision support systems, real-time monitoring, and adaptive control in smart factories.
5. **CO5**: Apply intelligent manufacturing frameworks to improve efficiency, flexibility, and sustainability in production systems.

UNIT - I

Computer Integrated Manufacturing Systems – Structure and functional areas of CIM system - CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM.

Manufacturing Communication Systems – MAP/TOP, OSI Model, Data Redundancy, Top-down and Bottom- up Approach, Volume of Information. Intelligent Manufacturing – System Components, System Architecture and Data Flow, System Operation.

UNIT - II

Components of Knowledge Based Systems – Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

UNIT - III

Machine Learning – Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing

UNIT - IV

Automated Process Planning – Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning

Knowledge Based System for Equipment Selection (KBSES) – Manufacturing system design, Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KBSES.

UNIT - V

Group Technology: Models and Algorithms – Visual Method, Coding Method, Cluster Analysis Method, Matrix Formation – Similarity Coefficient Method, Sorting-based Algorithms, Bond Energy Algorithm, Cost Based method, Cluster Identification Method, Extended CI Method. Knowledge Based Group Technology - Group Technology in Automated Manufacturing System, Structure of Knowledge based system for group technology (KBSGT) – Data Baswe, Knowledge Base, Clustering Algorithm.

Course Outcomes (COs):

1. **CO1**: Apply interdisciplinary knowledge to develop and implement intelligent solutions in manufacturing systems.
2. **CO2**: Analyse complex manufacturing problems using AI-driven models, simulations, and data analytics.
3. **CO3**: Design smart, flexible, and adaptive production systems with integrated cyber-physical capabilities.
4. **CO4**: Use modern tools such as digital twins, IoT platforms, and AI/ML frameworks in intelligent manufacturing.
5. **CO5**: Demonstrate understanding of the societal, ethical, and sustainability aspects of smart manufacturing systems.
6. **CO6**: Engage in lifelong learning to adapt to advancements in intelligent automation and digital transformation technologies.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply interdisciplinary knowledge to develop and implement intelligent solutions in manufacturing systems.	K1
CO2	Analyse complex manufacturing problems using AI-driven models, simulations, and data analytics.	K3
CO3	Design smart, flexible, and adaptive production systems with integrated cyber-physical capabilities.	K6
CO4	Use modern tools such as digital twins, IoT platforms, and AI/ML frameworks in intelligent manufacturing.	K2
CO5	Demonstrate understanding of the societal, ethical, and sustainability aspects of smart manufacturing systems.	K3
CO6	Engage in lifelong learning to adapt to advancements in intelligent automation and digital transformation technologies.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOKS:

1. Intelligent Manufacturing Systems, Andre Kusaic.
2. Artificial Neural Networks, Yagna Narayana.
3. Automation, Production Systems and CIM, Groover M.P.
4. Neural Networks, Wassarman.

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – II Sem. (Production Engg.)

FINITE ELEMENT TECHNIQUES (MTPE205)

(Elective III)

Subject Code	**MTPE205**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives (COs):

1. **CO1**: Understand the basic concepts and formulation methods used in the finite element method (FEM).
2. **CO2**: Apply FEM to solve structural, thermal, and fluid mechanics problems in engineering.
3. **CO3**: Develop element stiffness matrices and assemble global matrices for various boundary value problems.
4. **CO4**: Utilize software tools for modeling, meshing, and solving real-world engineering problems using FEM.
5. **CO5**: Analyse the accuracy, convergence, and limitations of finite element solutions.

UNIT-I

Introduction to Finite Element Method of solving field problems. Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations.

One Dimensional Problem: Finite element modeling. Local, natural and global coordinates and shape functions. Potential Energy approach: Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions.

UNIT-II

Analysis of trusses and frames: Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node. Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element.

UNIT-III

Finite element modeling of two dimensional stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements.

Convergence requirements and geometric isotropy.

UNIT-IV

Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional conduction analysis of thin plate.

Time dependent field problems: Application to one dimensional heat flow in a rod.

Dynamic analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors.

Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

UNIT-V

Finite element formulation of three dimensional problems in stress analysis.

Finite Element formulation of an incompressible fluid. Potential flow problems

Bending of elastic plates. Introduction to non-linear problems and Finite Element analysis software.

Course Outcomes (COs):

1. **CO1**: Apply foundational knowledge of mathematics and mechanics to develop FEM formulations.
2. **CO2**: Identify, model, and solve engineering problems using finite element analysis (FEA).
3. **CO3**: Design and analyse engineering components and systems using FEM tools under realistic boundary conditions.
4. **CO4**: Use modern FEA software (like ANSYS, Abaqus, or COMSOL) for simulation, validation, and decision-making.
5. **CO5**: Understand the role of FEM in product design, development, and performance prediction across industries.
6. **CO6**: Engage in lifelong learning to stay current with advancements in computational mechanics and FEA tools.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply foundational knowledge of mathematics and mechanics to develop FEM formulations.	K1
CO2	Identify, model, and solve engineering problems using finite element analysis (FEA).	K3
CO3	Design and analyse engineering components and systems using FEM tools under realistic boundary conditions.	K6
CO4	Use modern FEA software (like ANSYS, Abaqus, or COMSOL) for simulation, validation, and decision-making.	K2
CO5	Understand the role of FEM in product design, development, and performance prediction across industries.	K3
CO6	Engage in lifelong learning to stay current with advancements in computational mechanics and FEA tools.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOKS:

1 Tirupathi R Chandraputla and Ashok. D. Belegundu, Introduction of Finite Element in Engineering, Prentice Hal of India, 1997.

2 Rao S.S., The Finite Element Methods in Engineering, Pergamon Press, 1989.

3 Segerland. L.J., Applied Finite Element Analysis, Wiley Publication, 1984.

4 Reddy J.N., An Introduction to Finite Element Methods, Mc Graw Hil Company, 1984.

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – II Sem. (Production Engg.)

DESIGN AND MANUFACTURING OF MEMS AND MICRO SYSTEMS (MTPE205)

(Elective-III)

Subject Code	MTPE205	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	60	CREDITS	04

Course Objectives (COs):

1. **CO1**: Understand the basic concepts, evolution, and applications of Micro-Electro-Mechanical Systems (MEMS) and Microsystems.
2. **CO2**: Study materials, design considerations, and micro fabrication techniques used in MEMS.
3. **CO3**: Analyse various transduction mechanisms like piezoelectric, thermal, and electrostatic in MEMS devices.
4. **CO4**: Explore micro machining methods such as bulk micromachining, surface micromachining, and LIGA process.
5. **CO5**: Apply MEMS design principles using CAD tools and assess reliability, packaging, and integration challenges.

UNIT - I

Overview and working principles of MEMS and Microsystems: MEMS & Microsystems, Evolution of Micro fabrication, Microsystems & Microelectronics, Microsystems & miniaturization, Applications of MEMs in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidics

UNIT - II

Engineering Science for Microsystems Design and Fabrication: Atomic structure of Matter, Ions and Ionization, Molecular Theory of Matter and Intermolecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics.

UNIT - III

Engineering Mechanics for Microsystems Design: Static Bending of Thin plates, Mechanical Vibration, Thermo mechanics, Fracture Mechanics, Thin- Film Mechanics, Overview of Finite Element Stress Analysis

UNIT - IV

Thermo Fluid Engineering & Microsystems Design: Overview of Basics of Fluid Mechanics in Macro and Mesoscales, Basic equations in Continum Fluid Dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid flow in Sub micrometer and Nano scale, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in sub micrometer scale, Design Considerations, Process Design Mechanical Design, Mechanical design using FEM, Design of a Silicon Die for a Micro pressure sensor.

UNIT V

Materials for MEMS & Microsystems and their fabrication: Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, Chemical and Physical vapor deposition, etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process.

Course Outcomes (COs):

1. **CO1**: Apply interdisciplinary knowledge of mechanics, electronics, and materials science to analyse and design MEMS devices.
2. **CO2**: Formulate and solve microsystem design problems considering fabrication constraints and performance criteria.
3. **CO3**: Design MEMS components with appropriate modeling and simulation using specialized CAD/CAE tools.
4. **CO4**: Use modern micro fabrication and characterization tools for MEMS development and testing.
5. **CO5**: Demonstrate awareness of emerging trends, sustainability, and challenges in miniaturized systems for industrial and biomedical applications.
6. **CO6**: Engage in lifelong learning to explore innovations in micro scale sensors, actuators, and integrated microsystems.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply interdisciplinary knowledge of mechanics, electronics, and materials science to analyse and design MEMS devices.	K1
CO2	Formulate and solve microsystem design problems considering fabrication constraints and performance criteria.	K3
CO3	Design MEMS components with appropriate modeling and simulation using specialized CAD/CAE tools.	K6
CO4	Use modern micro fabrication and characterization tools for MEMS development and testing.	K2
CO5	Demonstrate awareness of emerging trends, sustainability, and challenges in miniaturized systems for industrial and biomedical applications.	K3
CO6	Engage in lifelong learning to explore innovations in micro scale sensors, actuators, and integrated microsystems.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOKS:

1. Tia-Ran Hsu, MEMS & Microsystems. Design & Manufacturing, TMH 2002.
2. Foundation of MEMS/ Chang Liu/Pearson, 2012.

REFERENCES:

1. Maluf, M., "An Introduction to Microelectromechanical Systems Engineering". Artech House, Boston 2000.
2. Trimmer, W.S.N., "Micro robots and Micromechnaical Systems", Sensors & Actuators, Vol 19, 1989.
3. Trim., D.W., "Applied Partial Differential Equations"., PWS-Kent Publishing, Boston, 1990.

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – II Sem. (Production Engg.)

MECHATRONICS (MTPE206)

(Elective – IV)

Subject Code	MTPE206	IA Marks	30
Number of Lecture Hours/Week	04	Term End Exam Marks	70
Total Number of Lecture Hours	60	CREDITS	04

Course Objectives (COs):

1. **CO1**: Understand the fundamentals of mechatronic systems and their interdisciplinary nature.
2. **CO2**: Study the working principles and integration of sensors, actuators, and microcontrollers in automated systems.
3. **CO3**: Analyse system dynamics and control strategies used in mechatronic applications.
4. **CO4**: Develop programming skills for interfacing hardware and implementing embedded control systems.
5. **CO5**: Design and simulate integrated mechatronic systems using appropriate tools and software.

Unit - I

Introduction: Definition of Mechatronics products, Design Considerations and Tradeoffs. Overview of Mechatronic products. Intelligent Machine vs Automatic. Machine Economic and Social Justification.

Actuators and Motion Control: Characteristics of Mechanical, electrical, Hydraulic and pneumatic actuators and their limitations. Control parameters and system objectives. Mechanical configurations. Popular control system configurations. S-curve, Motor/Load inertia matching. 1)esign with linear slides.

Unit-Il

Motion Control Algorithms: significance of feed forward control loops, shortfalls, Fundamental concepts of adaptive and fuzzy control. Fuzzy logic compensatory control of transformation and deformation non-Z linearity.

Unit-Ill

Architecture of Intelligent Machines: Introduction to Microprocessor and programmable logic controllers and identification of system, System design Classification. Motion control aspects in Design.

UNIT-IV

Manufacturing Data Bases: Data Base management system, CAD/CAM Data bases, Graphic Data Base, Introduction to object oriented concepts, objects oriented model language interface, procedures and methods in creation, edition and manipulation of Data.

Unit-V

Sensor Interfacing: Analog and Digital Sensors for Motion Measurement, Digital Transducers, Human — Machine and Machine — Machine Interfacing devices and strategy.

Machine Vision: Feature and Pattern Recognition methods, concepts of perception and cognition in decision making.

Course Outcomes (COs):

1. **CO1**: Apply knowledge of mechanics, electronics, and control systems to design intelligent products and processes.
2. **CO2**: Analyse dynamic systems and implement appropriate control strategies using sensors and actuators.
3. **CO3**: Design mechatronic systems that integrate hardware and software for real-world engineering problems.
4. **CO4**: Use modern tools like MATLAB/Simulink, Lab VIEW, and microcontroller platforms for simulation and implementation.
5. **CO5**: Demonstrate understanding of automation, smart systems, and their applications in advanced manufacturing and robotics.
6. **CO6**: Engage in lifelong learning to keep pace with technological advancements in mechatronic system design and control.

Course Outcome No	**Statement**	**Knowledge Level (K)**
CO1	Apply knowledge of mechanics, electronics, and control systems to design intelligent products and processes.	K1
CO2	Analyse dynamic systems and implement appropriate control strategies using sensors and actuators.	K3
CO3	Design mechatronic systems that integrate hardware and software for real-world engineering problems.	K6
CO4	Use modern tools like MATLAB/Simulink, Lab VIEW, and microcontroller platforms for simulation and implementation.	K2
CO5	Demonstrate understanding of automation, smart systems, and their applications in advanced manufacturing and robotics.	K3
CO6	Engage in lifelong learning to keep pace with technological advancements in mechatronic system design and control.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

Text book:

1. **"Introduction to Mechatronics and Measurement Systems"**
   Authors: David G. Alciatore, Michael B. Histand
   Publisher: McGraw-Hill
   Edition: 5th Edition (or latest)
   Note: Balanced coverage of electrical, mechanical, and computer systems.
2. **"Mechatronics: A Multidisciplinary Approach"**
   Author: William Bolton
   Publisher: Pearson
   Note: Focuses on integration of systems and software.

Reference Book:

1. **"The Mechatronics Handbook"**
   Editor: Robert H. Bishop
   Publisher: CRC Press
   Note: Comprehensive handbook with detailed chapters on all major areas.
2. **"Mechatronics System Design"**
   Authors: Devdas Shetty, Richard A. Kolk
   Publisher: Cengage Learning

NSU JAMSHEDPUR ESTD 2018

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR
M. Tech – I Year – II Sem. (Production Engg.)
INDUSTRIAL ROBOTICS (MTPE206)
(Elective – IV)

Subject Code	**MTPE206**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives (COs):

1. **CO1**: Understand the fundamentals of robotics, including types, applications, and components of industrial robots.
2. **CO2**: Study kinematics, dynamics, and trajectory planning in robotic systems.
3. **CO3**: Analyse robot control techniques, programming methods, and integration with manufacturing systems.
4. **CO4**: Learn about sensors, actuators, and vision systems used in robotics for automation tasks.
5. **CO5**: Apply robotics knowledge to design, simulate, and implement industrial robotic applications.

UNIT: I

Introduction: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

Control System and Components: basic concept and modais controllers control system analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

UNIT: II

Motion Analysis And Control: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.

UNIT: III

End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics.

Machine Vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT: IV

Robot Programming: Lead through programming, Robot programming as a path in space, Motion interpolation, WAlT, SINONAL AND DELAY commands, Branching capabilities and Limitations.

Robot Languages: Textual robot Languages, Generation, Robot language structures, Elements in function.

UNIT: V

Robot Cell Design and Control: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work eel 1 controller.

Robot Application: Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application.

Course Outcomes (COs):

1. **CO1**: Apply engineering fundamentals to analyse and design industrial robotic systems.
2. **CO2**: Solve complex kinematic and dynamic problems in robotic arms and manipulators.
3. **CO3**: Design and develop robotic applications integrating control algorithms and sensor feedback.
4. **CO4**: Use modern tools and simulation software (e.g., MATLAB, ROS, RoboDK) for robot modeling and programming.
5. **CO5**: Demonstrate awareness of robotics in smart manufacturing, flexible automation, and human-robot collaboration.
6. **CO6**: Engage in lifelong learning to stay updated with evolving trends in robotics, AI integration, and Industry 4.0.

Course Outcome No	Statement	Knowledge Level (K)
CO1	Apply engineering fundamentals to analyse and design industrial robotic systems.	K1
CO2	Solve complex kinematic and dynamic problems in robotic arms and manipulators.	K3
CO3	Design and develop robotic applications integrating control algorithms and sensor feedback.	K6
CO4	Use modern tools and simulation software (e.g., MATLAB, ROS, RoboDK) for robot modeling and programming.	K2
CO5	Demonstrate awareness of robotics in smart manufacturing, flexible automation, and human-robot collaboration.	K3
CO6	Engage in lifelong learning to stay updated with evolving trends in robotics, AI integration, and Industry 4.0.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												
CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOKS:

I. Industrial robotics, Mikell P.Groover/McGraw Hill.

2. Robotics, K.S.Fu / McGraw Hill.

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – II Sem. (Production Engg.)

DESIGN FOR MANUFACTURING AND ASSEMBLY (MTPE206)

(Elective IV)

Subject Code	**MTPE206**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	60	**CREDITS**	04

Course Objectives (COs):

1. **CO1**: Understand the principles and importance of DFMA in product design and development.
2. **CO2**: Learn to evaluate and improve product designs based on manufacturability and ease of assembly.
3. **CO3**: Analyze the impact of material selection, process planning, and part geometry on manufacturing efficiency.
4. **CO4**: Apply DFMA guidelines to reduce product cost, complexity, and time-to-market.
5. **CO5**: Use DFMA software tools to assess design alternatives and optimize component integration.

NSU ESTD JAMSHEDPUR 2018

UNIT I

Introduction: Design philosophy steps in Design process — General Design rules for manufacturability — basic principles of design Ling for economical production — creativity in design. Materials: Selection of Materials for design Developments in Material technology — criteria for material selection — Material selection interrelationship with process selection process selection charts.

UNIT II

Machining Process: Overview of various machining processes — general design rules for machining - Dimensional tolerance and surface roughness — Design for machining — Ease — Redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

Metal Casting: Appraisal of various casting processes, selection of casting process, - general design considerations for casting — casting tolerances — use of solidification simulation in casting design — product design rules for sand casting.

UNIT III

Metal Joining: Appraisal of various welding processes, Factors in design of weidments — general design guidelines — pre and post treatment of welds — effects of thermal stresses in weld joints — design of brazed joints. Forging — Design factors for Forging — Closed die forging design — parting lines of die5 drop forging die design — general design recommendations. Extrusion & Sheet Metal Work: Design guidelines for extruded sections - design principles for Punching, Blanking, Bending, Deep Drawing — Keeler Goodman Forming Line Diagram — Component Design for Blanking.

UNIT-IV

Assemble Advantages: Development of the assemble process, choice of assemble method assemble advantages social effects of automation.

Automatic Assembly Transfer Systems: Continuous transfer, intermittent transfer, indexing mechanisms, and operator - paced free – transfer machine.

UNIT-V

Design Of Manual Assembly: Design for assembly fits in the design process, general design guidelines for manual assembly, development of the systematic DFA methodology, assembly efficiency, classification system for manual handling, classification system for manual insertion and fastening, effect of part symmetry on handling time, effect of part thickness and size on handling time, effect of weight on handling time, parts requiring two hands for manipulation, effects of combinations of factors, effect of symmetry effect of chamfer design on insertion operations, estimation of insertion time.

Course Outcomes (COs):

1. **CO1**: Apply knowledge of design and manufacturing principles to develop cost-effective, manufacturable products.
2. **CO2**: Analyse the relationship between design features and manufacturing/assembly challenges.
3. **CO3**: Design components and assemblies that meet functional requirements while simplifying production processes.
4. **CO4**: Use modern CAD and DFMA analysis tools to improve product performance and manufacturability.
5. **CO5**: Demonstrate awareness of sustainable design practices and lifecycle cost considerations.
6. **CO6**: Engage in lifelong learning to stay informed about new DFMA tools, techniques, and industrial standards.

7. **Course Outcome No**	**Statement**	**Knowledge Level (K)**
CO1	Apply engineering fundamentals to analyse and design industrial robotic systems.	K1
CO2	Solve complex kinematic and dynamic problems in robotic arms and manipulators.	K3
CO3	Design and develop robotic applications integrating control algorithms and sensor feedback.	K6
CO4	Use modern tools and simulation software (e.g., MATLAB, ROS, RoboDK) for robot modeling and programming.	K2
CO5	Demonstrate awareness of robotics in smart manufacturing, flexible automation, and human-robot collaboration.	K3
CO6	Engage in lifelong learning to stay updated with evolving trends in robotics, AI integration, and Industry 4.0.	K5

KL – Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1- Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5- Evaluate, K_6 – Create

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3			3				2	1			
CO2	2				1		1	3	3			
CO3	3		2	3				1	1			
CO4												
CO5												

CO6												
CO Average	2.66		2	3	1		1	2	1.66			

3 - High; 2 - Medium; 1 - Low

TEXT BOOKS:

1. Geoffrey Boothroyd, "Assembly Automation and Product Design", Marcel Dekker Inc., NY, 1992.
2. Engineering Design – Material & Processing Approach – George E. Deiter, McGraw Hill Intl. 2nd Ed. 2000.

REFERENCEBOOKS:

1. Geoffrey Boothroyd, "Hand Book of Product Design" Marcel and Dekken, N.Y. 1990.
2. A Delbainbre "Computer Aided Assembly London, 1992.

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

M. Tech – I Year – II Sem. (Production Engg.)

COMPUTER AIDED ENGINEERING LAB II (MTPE207L)

Features and selection of CNC turning and milling centers. Practice in part programming and operation of CNC turning machines, subroutine techniques and use of cycles. Practice in part programming and operating a machining center, tool planning and selection of sequences of operations, tool setting on machine, practice in APT based NC programming.

Geometric Modeling of 2D & 3D objects by using any CAD packages. Analysis of Objects by using any Analysis packages.

CAD Package References:

AUTO

CAD

PROEE

CATIA V5

UNIGRAPHICS

IRON CAD

ANALYSIS Package References:

ANSYS

The students will be given training on the use and application of the following software to manufacturing problems;

1) Auto MOD Software
2) PROMOD
3) SLAM – II
4) CAFIMS
5) Flexsim

They also learn how to write sub routines in C-language and interlinking with the above packages.

Problems for modeling and simulation experiments:

1) AGV planning
2) ASRS simulation and performance evaluation
3) Machines, AGVs and AS/RS integrated problems
4) JIT system
5) Kanban flow
6) Material handling systems
7) M.R.P. Problems
8) Shop floor scheduling etc.