OP Jindal University

Raigarh-Chhattisgarh

Scheme and Syllabus

of

M.Tech

School of Engineering

Session- 2022-23

M.Tech (Manufacturing Technology and Automation)

Program Outcomes for Engineering Post Graduate Program

PO1: Disciplinary knowledge: Accomplish vertical expertise in chosen discipline and enhance ability to function in multidisciplinary domains.

PO2: Research aptitude: Ability and aptitude to exercise research intelligence in investigations/ innovations and to communicate the findings in a clear, concise manner.

PO3: Project management: Develop and apply knowledge of engineering and management principles to manage a project in a multidisciplinary environment.

PO4: Ethics: Gain knowledge of ethical principles and commit to professional ethics

PO5: Self-directed lifelong learning: Ability to identify appropriate resources and learn independently for projects, research etc. using online resources.

Programme Specific Outcomes for M.Tech in Manufacturing Technology and Automation

PSO 1: An ability to apply knowledge and skill of various latest approaches in manufacturing technology and automation.

PSO 2: The research based knowledge and research methods including design of experiments, analysis and interpretation of data and IT tools in manufacturing.

PSO 3: An ability to automate a mechanical system or a process to meet desired needs within realistic constraints such as health, safety and manufacturability.

OP JINDAL UNIVERSITY

OP Jindal Knowledge Park, Punjipatra, Raigarh-496109

Department of Mechanical Engineering

OPJU
UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

MTech in Manufacturing Technology and Automation
Semester I

SN	Subject Code	Subject	Periods per Week			Scheme of Examination		Total Marks	Credit L+(T+P)/2
						Theory / Practical			
			L	T	P	ESE	TA		
1	SOE-M-MTA101	Computational Methods and Optimization Techniques	4	0	0	50	50	100	4
2	SOE-M-MTA102	Advanced Manufacturing Processes (Technologies)	4	0	0	50	50	100	4
3	SOE-M-MTA103	Advanced Materials and Processing (Process Technology)	4	0	0	50	50	100	4
4	SOE-M-MTA104	Industrial Automation and Robotics	4	0	0	50	50	100	4
5	SOE-M-MTA105 **(1-5)**	Program Elective I **(Annexure -I)**	4	0	0	50	50	100	4
6	SOE-M-MTA106	Advanced Manufacturing and Processing Lab	0	0	4	50	50	100	2
7	SOE-M-MTA107	Computational Methods and Optimization Techniques Lab	0	0	4	50	50	100	2
8	SOE-M-MTA108	Scientific Paper Writing & Seminar	1	0	1	25	25	50	2
Total			**21**	**0**	**10**	**375**	**375**	**750**	**26**

Program Elective I (Annexure - I)

Sr. No.	Subject Code	Name of the Courses
1	SOE-M- MTA105 (1)	Micro and Nano Machining
2	SOE-M- MTA105 (2)	Design and Metallurgy of Welded Joint
3	SOE-M- MTA105 (3)	Manufacturing Management
4	SOE-M- MTA105 (4)	Quantitative Decision Making
5	SOE-M- MTA105 (5)	Finite Element Analysis in Manufacturing

MTech in Power Plant Engineering & Energy Management
Semester II

SN	Subject Code	Subject	Periods per Week			Scheme of Examination		Total Marks	Credit L+(T+P)/2
						Theory / Practical			
			L	T	P	ESE	TA		
1	SOE-M-MTA201	Industrial Instrumentation and Control	4	0	0	50	50	100	4
2	SOE-M-MTA202	Digital Manufacturing	4	0	0	50	50	100	4
3	SOE-M-MTA203	Flexible Manufacturing Systems	4	0	0	50	50	100	4
4	SOE-M-MTA204	Quality Engineering in Manufacturing	4	0	0	50	50	100	4
5	SOE-M-MTA205 **(1-5)**	Professional Elective -II **(Annexure -II)**	4	0	0	50	50	100	4
6	SOE-M-MTA206	Advanced Welding Lab	0	0	4	50	50	100	2
7	SOE-M-MTA207	CAD/CAM/CIM Lab	0	0	4	50	50	100	2
8	SOE-M-MTA208	Project report writing and Seminar	1	0	1	25	25	50	2
Total			**21**	**0**	**10**	**375**	**375**	**750**	**26**

Program Elective II (Annexure - II)

Sr. No.	Subject Code	Name of the Courses
1	SOE-M- MTA205 (1)	Product Design and Development
2	SOE-M- MTA205 (2)	Mechatronics Product Design
3	SOE-M- MTA205 (3)	Product Analysis and Cost Optimization
4	SOE-M- MTA205 (4)	Expert system and A.I. in Manufacturing / IoT and IT in Manufacturing
5	SOE-M- MTA205 (5)	Lean Manufacturing

MTech in Power Plant Engineering & Energy Management
Semester III

SN	Subject Code	Subject	Periods per Week			Scheme of Examination Theory / Practical		Total Marks	Credit L+(T+P)/2
			L	T	P	ESE	TA		
1	SOE-M-MTA301	Plant Maintenance & Safety	4	0	0	50	50	100	4
2	SOE-M-MTA302	Industrial Training	0	0	8	100	100	200	4
3	SOE-M-MTA303	Research Seminar	0	0	4	25	25	50	2
4	SOE-M-MTA304	Dissertation – I	0	0	24	125	125	250	10
Total			**4**	**0**	**36**	**300**	**300**	**600**	**20**

MTech in Power Plant Engineering & Energy Management

Semester IV

SN	Subject Code	Subject	Periods per Week			Scheme of Examination		Total Marks	Credit L+(T+P)/2
						Theory / Practical			
			L	T	P	ESE	TA		
1	SOE-M-MTA401	Dissertation – II	0	0	28	200	200	400	14
Total			**0**	**0**	**28**	**200**	**200**	**400**	**14**

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Programme : M.Tech. **Semester :** I Sem

Name of the Course: Computational Methods and Optimization Techniques **Course Code:** SOE-M-MTA102

Credits : 4 **No of Hours :** 4 hours/week

Max Marks: 100

Course Description:

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcome
CO1	
CO2	
CO3	
CO4	
CO5	

Syllabus

Unit I: Statistics:

Frequency Distribution – Characteristics of Distributions: Central tendency and dispersion. methods of least square and regression, multiple regression, Solutions of regression analysis problems Analysis of Variance.

Unit II: Probability:

Concept of probability, Random Variables, Binomial, Poisson and Normal distribution – applications, Chi-squared test, F-test, t-test.

Unit III: Optimization:

Concept, need, importance and applications related to environmental engineering, Single and multivariable optimization without and with constraints. Linear programming – standard form of problems, pivotal reduction of equations. Solutions of linear programming problems, Simplex method – single and two phase methods, Concept of Dual Linear Programming and conversion of primal to Dual.

Unit IV: Non-Linear Programming:

Numerical search methods nonlinear problems-Dichotomous. Fibonacci and Golden section methods. Quadratic and cubic interpolation methods.

Unit V: Numerical Methods:

Newton – Raphson method for solution of algebraic and transcendental equations, Numerical solutions of partial differential equations – finite difference, solution of elliptic, parabolic and hyperbolic equations.

Text Books:

References Books:

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	2	3	4	5	1	2	3
CO1								
CO2								
CO3								
CO4								
CO5								

Note: 1: Low 2: Moderate 3: High

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Programme :	M.Tech.	**Semester :**	I Sem
Name of the Course:	Advanced Manufacturing Processes	**Course Code:**	SOE-M-MTA105 (1)
Credits :	4	**No of Hours :**	4 hours/week
Max Marks:	100		

Course Description:

The aim of this course is to provide students with an understanding of specific laser-based and metal processing technologies and skills relating to the implementation of these technologies in modern manufacturing industry within both global and local contexts.

Course Outcomes: at the end of the course the students will be able to

CO Number	Course Outcomes
CO1	Student will be able to select appropriate manufacturing processes for advanced and difficult-to-machine materials.
CO2	Student will be able to understand selection of latest chemical-based manufacturing processes.
CO3	Students will be able to describe the application of different types of electro-thermal machining techniques and the operating principles of related processes.
CO4	Students will be able to apply the knowledge of thermal based machining processes for research and development.
CO5	Students will be able to combine & develop novel hybrid techniques from the state of art techniques available.

Syllabus:

Unit 1: Introduction: Introduction, Need for non-traditional machining processes.
Abrasive Jet Machining: Principles-parameters of the process applications-advantages and advantages.
Ultrasonic Machining - Definition-Mechanism of metal elements of the process- Tool feed mechanism. Theories of mechanics of causing effect of parameter applications.

Unit 2:
Chemical Machining: Introduction-fundamental principle types of chemical machining Maskants- Etchants- Advantages and disadvantages-applications.
Electrochemical Machining: Electro chemical machining (ECM) Classification ECM process-principle of Material removal in ECM, determination of the metal removal rate, advantages, disadvantages and applications. Electro Chemical Grinding.

Unit 3:

Electric discharge machining: Principle of operation – mechanism of metal removal, basic EDM circuitry, relaxation type circuit, material removal rate in relaxation.

Plasma arc Machining: Introduction-Plasma-Generation of Plasma and equipment Mechanism of metals removal,

Unit 4:

Electron Beam Machining (EBM): Introduction-Equipment for production of Electron beam - Theory of electron beam machining Thermal & Non thermal types of characteristics - applications.

Laser Beam Machining (LBM): Introduction-principle of generation of lasers Equipment and Machining procedure- Types of Lasers-Process characteristics-advantages and limitations applications.

Unit 5:

High Velocity Forming Process: Explosive forming processes, Electrohydrolic forming, Electromagnetic forming, Pneumatic/mechanical forming, Formability criteria.

Hybrid Machining: Introduction, Hybrid chemical and electrochemical processes, Hybrid thermal machining

Textbooks:

1. Benedict G.F., Non-Traditional Manufacturing Processes, Marcel Dekker
2. Ghosh, A., Mallik, A. K. (1986). Manufacturing Science. United Kingdom: Ellis Horwood.
3. New technology Institution of Engineers - Bhattacharya -India
4. Production Technology - HMT - Tata McGraw Hill.
5. Modern Machining Process - P.C Pandy & H.S. Shan - Tata McGraw Hill.

References Books:

1. Metals Handbook - ASM -Vol-3.
2. Modern Manufacturing Method - Adithan- New Age International (p) Limited.
3. Modern Machining Processes - P.K. Mishra - Narosa Publishing House, New Delhi - 1997.

CO, PO & PSO Correlation

Course Outcome	Program Outcome						PSO	
	1	2	3	4	5	1	2	3
CO1	3	3	2	-	-	3	3	3
CO2	3	3	1	-	-	3	3	3
CO3	3	3	2	-	-	3	3	3
CO4	3	3	-	-	-	3	3	3
CO5	3	3	-	-	-	3	3	3

Programme :	M.Tech.	**Semester :**	I Sem
Name of the Course:	Advanced Materials & Processing	**Course Code:**	SOE-M-MTA104
Credits:	4	**No of Hours :**	4 hours/week
Max Marks:	100		

Course Description:

Course Outcomes: at the end of the course the students will be able to

CO Number	Course Outcomes
CO1	
CO2	
CO3	
CO4	
CO5	

Syllabus:

Unit 1: Classification and characteristics: Metals, Ceramics, Polymers and composites. General properties and structure: Atoms, molecules bonds in solids, Crystalline - Defects in Metallic structure, Dislocations and plastic deformation - Strengthening mechanism - grain size, dislocation - Cold work, precipitation hardening, dispersion hardening - phase reactions, fatigue and Creep behavior.

Unit 2: Ferrous Alloys: iron carbon equilibrium diagrams - Steels and cast irons - properties, structure, composition and applications transformation hardening in steels - TIT diagrams - Heat treatment processes - Effect of alloying elements - High alloy

steels, Stainless steel types, tool Steels, Manganese steels, heat resistant steels, HSLA, Maraging steels.

Unit 3: Non Ferrous alloys: Alloys of copper, Aluminum, nickel, magnesium, titanium, lead, tin, Zinc - composition, heat treatment, structure, properties and application.

Unit 4: Polymers and polymerizations: Structure and properties of thermoplastics and thermo sets – Engineering Applications - property modifications - Mechanical and thermal behavior – processing methods. Ceramics : Nature and structure of Ceramics - Refractory Abrasives glasses - glass ceramics - Advanced ceramics processing methods.

Unit 5: Composites: Definition - classification and characteristics of composite materials - Volume fraction - laminated composites particulate composites, fibrous composites - Types of reinforcements, their shape and size - production and properties of fiber reinforced plastics, Metal Matrix composites and ceramic matrix composites - Applications. Processing of Polymers: composites, ceramics - thermal spraying - Ion beam machining diamond coating techniques-tribological Applications.

Text books:

1. Engineering Metallurgy - Raymond and Higgens - ELBS/EA
2. Introduction to Material Science and Engineering - James.F.Shackleford - McMillan, NY - 7th edition.

References Books:

1. Powder Metallurgy-Metals Hand Book -ASM, USA - Vol.7, 1974.
2. Composite Materials - Science and Engineering - Chawla K.K. ,Springer - Verlag, Newyork - 2nd edition, 1998.
3. Cast Metal Matrix Composites ASM Metals Hand Book - P.K. Rohagti - VI5.
4. Elements of Material science and Engineering - Van Vlack L.H. - Addison Wesley, NY - 1989.

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	2	3	4	5	1	2	3
CO1								
CO2								
CO3								
CO4								
CO5								

Note: 1: Low 2: Moderate 3: High

Programme :	**M.Tech.**	**Semester :**	**I Sem**
Name of the Course:	**Industrial Automation and Robotics**	**Course Code:**	**SOE-M-PPE107**
Credits :	**2**	**No of Hours :**	**4 hours/week**
Max Marks:	**100**		

Objectives:

1. To develop the student's knowledge in various robot structures and their workspace.

2. To develop student's skills in performing spatial transformations associated with rigid body motions and robot systems.

3. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.

4. To provide the student with some knowledge and analysis skills associated with trajectory planning and robot control

Course Outcomes:

1. Students will demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics.

2. Students will demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.

3. Students will demonstrate an ability to solve inverse kinematics of simple robot manipulators.

4. Students will demonstrate an ability to obtain the Jacobian matrix and use it to identify singularities

Detailed Contents:

1. Introduction: Concept and scope of automation: Socio economic impacts of automation, Types of Automation, Low Cost Automation

2. Fluid Power: Fluid power control elements, Standard graphical symbols, Fluid power generators, Hydraulic and pneumatic Cylinders - construction, design and mounting; Hydraulic and pneumatic Valves for pressure, flow and direction control.

3. Basic hydraulic and pneumatic circuits: Direct and Indirect Control of Single/Double Acting Cylinders, designing of logic circuits for a given time displacement diagram & sequence ofoperations, Hydraulic & Pneumatic Circuits using Time Delay Valve & Quick Exhaust Valve, Memory Circuit & Speed Control of a Cylinder, Troubleshooting and "Causes & Effects of Malfunctions" Basics of Control Chain, Circuit Layouts, Designation of specific Elements in a Circuit.

4. Fluidics: Boolean algebra, Truth Tables, Logic Gates, Coanda effect.

5. Electrical and Electronic Controls: Basics of Programmable logic controllers (PLC), Architecture & Components of PLC, Ladder Logic Diagrams

6. Transfer Devices and feeders: Classification, Constructional details and Applications of Transfer devices, Vibratory bowl feeders, Reciprocating tube, Centrifugal hopper feeders

7. Robotics: Introduction, Classification based on geometry, control and path movement,Robot Specifications, Robot Performance Parameters, Robot Programming, Machine Vision, Teach pendants, Industrial Applications of Robots

Suggested Readings/Books:

1. Anthony Esposito, Fluid Power with applications, Pearson

2. S. R Majumdar, Pneumatic Control, McGraw Hill

3. S. R Deb, Robotic Technology and Flexible Automation, Tata Mc Hill

4. Saeed B. Niku Introduction to Robotics, Wiley India

5. Ashitava Ghosal, Robotics, Oxford

Programme :	**M.Tech.**	**Semester :**	**I Sem**
Name of the Course:	**Scientific paper writing & Seminar**	**Course Code:**	**SOE-M-PPE108**
Credits :	**2**	**No of Hours :**	**4 hours/week**
Max Marks:	**50**		

Course Description

This subject is related the techniques of scientific study and understanding related research mobility and how to express in a scientific framework. The area of the subject may be particular topic/subject/area/live project/case study and identifies the key areas and express in a paper mode for the scientific audiences.

Course Outcomes

After completion of the course, students will be able to

CO Number	Course Outcomes
CO1	Understanding the research methods
CO2	Acquire the perfection in journal reading
CO3	Perform skills for research publication/write up.
CO4	Effective presentation and improve soft skills.
CO5	Make use of new and recent technology (e.g. Latex) for creating technical reports

Syllabus:

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas.

The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic

2. Stating an objective.

3. Collecting the relevant bibliography (at least 15 journal papers)

4. Preparing a working outline.

5. Studying the papers and understanding the authors contributions and critically analyzing each paper.

6. Preparing a working outline

7. Linking the papers and preparing a draft of the paper.

8. Preparing conclusions based on the reading of all the papers.

9. Writing the Final Paper and giving final Presentation

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	2	3	4	5	1	2	3
CO1	1	3	1	1	-	2	1	3
CO2	2	2	-	1	2	2	1	-
CO3	-	2	2	-	1	2	1	1
CO4	-	-	2	1	2	2	1	2
CO5	-	-	2	1	2	-	-	3

Note: 1: Low 2: Moderate 3: High

Programme :	**M.Tech.**	**Semester :**	**I Sem**
Name of the Course:	Micro and Nano machining	**Course Code:**	**SOE-M-PPE107**
Credits :	**2**	**No of Hours :**	**4 hours/week**
Max Marks:	**100**		

Course Description:

With the advancement of technology, miniaturization of equipment is increasing. Material and hence equipment behavior at such a small scale is different. New technologies are required to manufacture at such a small scale. The course intends to introduce technologies used for manufacturing of products at micro and Nano scale

Course Objective:

- To give awareness of different techniques used in micro and nano machining/manufacturing.
- To give in-depth idea of the conventional techniques used in micro machining/manufacturing.
- To introduce Non-conventional micro-nano manufacturing and finishing approaches
- To introduce Micro and Nanofabrication Techniques and other processing routes in Micro and nano machining/manufacturing

Course Outcomes:

After completion of the course, students will be able to

CO Number	Course Outcomes
CO1	The student can identify different areas of Micro and Nano Machining
CO2	Can find the applications of all the areas in Industries.
CO3	Learn various techniques used for manufacturing and inspection.
CO4	Analyze and apply process parameters for micro manufacturing techniques
CO5	Understand and apply fundamentals of Nano manufacturing

Syllabus:

UNIT – I:

Introduction:

Introduction, Basic elements of molecular dynamics modelling, Design and requirements for state-of-the-art MD cutting process simulations, Capabilities of MD for nanoscale material removal process analysis, Advances and recent developments in material removal process simulation, Summary. **Ductile Mode Cutting of Brittle Materials** The mechanism of ductile mode cutting of brittle materials, The chip formation in cutting of brittle materials, Machined surfaces in relation to chip formation mode **Diamond Tools in Micromachining** Diamond technology, Preparation of substrate, Modified HFCVD process, Nucleation and diamond growth, Deposition on complex substrates, Diamond micromachining

UNIT – II: **Conventional Processes: Micro-turning, Micro-drilling and Micro-milling** Introduction, Micro-turning, Micro-drilling, Micro-milling, Product quality in micromachining

Micro-grinding and Ultra-precision Processes Introduction, Micro and nanogrinding, Nanogrinding tools

UNIT – III: **Non-Conventional Processes**: **Laser Micromachining** Introduction, Fundamentals of lasers, Laser microfabrication, Laser nanofabrication.

Evaluation of Subsurface Damage in Nano and Micromachining Destructive evaluation technologies, Non-destructive evaluation technologies

UNIT – IV: **Micro and Nano Finishing Processes** Need for Nano finishing, Magnetic abrasive Finishing, Magnetorheological Finish, Elastic Emission Finishing, Magnetic Float Polishing, Ion Beam finishing

UNIT V: **Micro Joining** Challenges, Micro Resistance welding, Ultrasonic welding, Micro TIG, Applications.

Applications of Nano and Micromachining in Industry Typical machining methods, Applications in optical manufacturing, Semiconductor and electronics related applications.

Text Book:

1. J. Paulo Davim, Mark J. Jackson Nano and Micromachining,John Wiley & Sons, 2013.
2. Mark. J. Jackson, Micro and Nano-manufacturing, Springer, 2006
3. Mark. J. Jackson, Micro-fabrication and Nano-manufacturing - Pulsed water drop micromachining CRC Press 2006.

References Books

1. Nitaigour Premchand Mahalik, Micro-manufacturing and Nanotechnology, 2006
2. V.K.Jain, Micro-manufacturing Processes, CRC Press, 2012
3. Yi Qin, Micro-manufacturing Engineering and Technology, William Andrew, 2015
4. Kapil Gupta, Micro and Precision Manufacturing, Springer, 2017

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	2	3	4	5	1	2	3
CO1	2	2	2	1	2	1	2	3
CO2	2	2	1	-	2	1	1	2
CO3	1	2	2	1	2	2	1	3
CO4	3	2	1	3	1	-	2	3
CO5	2	2	3	1	3	2	1	3

Note: 1: Low 2: Moderate 3: High

Programme :	**M.Tech.**	**Semester :**	**I Sem**
Name of the Course:	Design And Metallurgy Of Welded Joints	**Course Code:**	**SOE-M-PPE107**
Credits :	**2**	**No of Hours :**	**4 hours/week**
Max Marks:	**100**		

Course Description:

Welding is one most the most commonly used fabrication techniques. For successful application of welding to produced sound weld joints, it is utmost important to understand the science and technology behind the welding. This course is aimed at familiarizing the students with the fundamentals weld joint design, metallurgical aspects in welding of steel, and assessing the quality and suitability of weld joints. Topics related with weldability of metals shall also be covered to equip the student's technological input for handling the problems in welding of selected metals and alloys.

Course Outcomes:

After completion of the course, students will be able to

CO Number	Course Outcomes
CO1	Understand the concept of static design of joints.
CO2	Design of welded joints and static and dynamic loading.
CO3	Evaluate the metallurgical and thermal aspects of welding joints of metals acquire
CO4	knowledge about the cooling transformation curves of welded joints
CO5	acquire knowledge about destructive and non-destructive tests of weldments

Syllabus:

UNIT – I:
Introduction: Welded joints, symbols, welded defects; Design considerations; Joint efficiency; Factor of safety, Types of loading; Permissible stress; Computation of stresses in welds; Weld size calculation; Code requirement for statically loaded welded structures

UNIT – II: Dynamic Behaviour of Welded Joints and Failure Theories: Design for fluctuating and impact loading; Dynamic behavior of welded joints; Stress Concentrations; Fatigue analysis; Fatigue improvement techniques; Permissible stress-life prediction; Concept of stress intensity factors - LEFM and EPFM concepts; Brittle fracture; Transition temperature approach, Application of fracture mechanics to fatigue.

UNIT – III: Welding Metallurgy: Thermal effect of welding on parent metal; Structure of fusion welds; Effect of cooling rate; Weld metal solidification and heat affected zone; Heat flow - temperature distribution cooling rates; Influence of heat input; Joint geometry; Plate thickness; Preheat; Significance of thermal severity number; Epitaxial growth - weld metal solidification - columnar structures and growth morphology effect of welding parameters; Absorption of gases - gas/metal and slag/metal reactions.

UNIT – IV: Phase Transformations: Weld CCT diagrams - carbon equivalent-preheating and post heating weldability of low alloy steels; Welding of stainless steels use of Schaffler and Delong diagrams;

UNIT V: Weldability testing: Types of weldability test, Varestraint test, Cast pin tear test, hot ductility test, Strain to fracture test, reheat cracking test, tests for Hydrogen induced cracking.

Text Book:

1. Design of Weldments; W. B. Omer; James. F. Lincoln; Arc Welding Foundation; 1991.
2. Deformation and Fracture of Mechanics of Engineering Materials; R. W. Hertzberg; John Wiley;1996.
3. Welding Metallurgy; Volume I and II; 4th Edition; G. E. Linnert; AWS; 1994.
4. The Metallurgy of Welding, 6th Edition , Lancaster, William Andrew Publishing, NY.

References Books

1. Rational Welding Design; T. G. E. Gray; Butterworths; 1982.
2. Mechanical Metallurgy; G. Dieter; Tata McGraw Hill; 1988.
3. Weldment Design; M. Bhattacharya; Association of Engineers;1991.
4. Fundamentals of Welding Metallurgy; H. Granjon; Jaico Publishing House; 1994.

5. Introduction to Physical Metallurgy of Welding; 2nd Edition; Easterling Kenneth; Butterworth Heinmann; 1992.

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	2	3	4	5	1	2	3
CO1								
CO2								
CO3								
CO4								
CO5								

Note: 1: Low 2: Moderate 3: High

Programme :	**M.Tech.**	**Semester :**	**I Sem**
Name of the Course:	Manufacturing management	**Course Code:**	**SOE-M-PPE107**
Credits :	**2**	**No of Hours :**	**4 hours/week**
Max Marks:	**100**		

Course Description:

Manufacturing management is intended to introduce the new domains of operations management. In today's competitive business environment, mangers in the manufacturing sector are faced with unique leadership challenges which is further compounded by a shortage of people with competency essentials to high growth industries.

Course Outcomes:

After completion of the course, students will be able to

CO Number	Course Outcomes
CO1	Understand the elements of competitive manufacturing strategy
CO2	Design the processing system for product/service

CO3	Prepare capacity and material plans
CO4	Understand the elements of Just in time manufacturing
CO5	Locate lay out facilities and understands the elements of lean and agile manufacturing

Syllabus:

UNIT – I:
Manufacturing strategy – competitiveness, strategy and productivity – Strategy formulation process – strategic options – SWOT Analysis – world class manufacturing practices – Operations strategy in global economy.

UNIT – II: System design – product and service design – process design issues – strategic capacity planning for products and services – facility location – factors affecting location.

UNIT – III: Planning and control of operations – strategies for aggregate production planning – resources planning – materials requirements planning – MRP System – Capacity requirements planning – manufacturing resources planning (MRP II) – Enterprise resources planning.

UNIT – IV: Just in time and lean operations – Elements of JIT manufacturing – Lot size reduction – Kanban production information system - push and pull scheduling – JIT as a business philosophy.

UNIT V: Layout – demerits of products and process layout – cellular manufacturing –flexible manufacturing. Elements of lean production-Introduction to agile manufacturing.

Text Book:

1. William J Stevenson, Operations management, Tata McGraw Hill
2. Nicholas, J.M., Competitive Manufacturing Management, Tata McGraw Hill Education Private Limited, New Delhi, 2007.
3. Mahadevan, B., Operations Management, Theory and Practice, second edition, Pearson Education, 2010.

References Books

1. S N chary, Production and Operations Management, Tata McGraw-Hill.
2. R Panneerselvam, Production and Operations Management, PHI Learning pvt Ltd.
3. Norman Gaither, Greg Frazier, Operations management, South Western, CNGAGE Leaning.
4. Lee Krajewsky etal., Operations Management, Processes and Value chains, Prentice Hall of India.

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	2	3	4	5	1	2	3
CO1	2	2	2	1	2	1	2	3
CO2	2	2	1	-	2	1	1	2
CO3	1	2	2	1	2	2	1	3
CO4	3	2	1	3	1	-	2	3
CO5	2	2	3	1	3	2	1	3

Note: 1: Low 2: Moderate 3: High

Programme :		**Semester:**	**I Sem**
Name of the Course:	Quantitative Decision Making	**Course Code:**	
Credits:		**No of Hours:**	**4 hours/week**
Max Marks:			

Course Description

The main objectives of the course are to learn Numerical optimization techniques for single variable and multi variable non- linear optimization problems. Sensitivity analysis on LPP queuing, Simulation of annexing problem & inventory problem, Geometry cutting plane method & branch bound method for linear IPP. Meaning of stochastic programming problem simple problems for finding mean variance of random variables chance constrained algorithm. Formulation of GP model and solving it using arithmetic geometric inequality theorem. State of art nontraditional optimization technique, namely genetic algorithm simulated annealing & particle swarm optimization.

Course Outcomes

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

1. To understand the role of optimization in various engineering applications.
2. To formulate the real-life problem in optimization problem.
3. To solve single and multivariable optimization problem.
4. To solve integer programming problems
5. To apply the recent optimization tools to solve the real-life problems.

UNIT-I: Introduction to Optimization Techniques and Single Variable Non-Linear Unconstrained Optimization: Introduction to Optimization and Its Engineering applications Optimality criteria, Classical optimization techniques, Kuhn-Tucker (KT) optimality conditions, Interior and exterior penalty function method, Convergence, and divergence of optimization algorithms. Uni-Model function and its importance, Fibonacci method & Golden section method. Interpolation methods: Quadratic & Cubic interpolation methods.

UNIT-II: Multi variable non-linear unconstrained optimization: Direct search methods – Univariant method, Pattern search methods – Powell's, Hook -Jeeves,

Rosenbrock search methods. Gradient methods: Gradient of function & its importance, Steepest descent method, Conjugate direction methods: Fletcher-Reeves method & variable metric method.

UNIT-III: Linear Programming: Formulation, Simplex method & Artificial variable optimization techniques: Big M & Two-phase methods. Sensitivity analysis: Changes in the objective coefficients, constants& coefficients of the constraints. Addition of variables, constraints. Simulation – Introduction – Types - steps – applications: inventory & queuing – Advantages and disadvantages.

UNIT-IV: Integer Programming: Introduction to Integer programming, mathematical formulation, Geometry 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 programming: Chance constrained algorithm.

UNIT-V: Non-Traditional Optimization Algorithms: Modern Methods in Optimization: Genetic Algorithm - Simulated Annealing - Particle Swarm Optimization - Neural Network based optimization - Optimization of Fuzzy systems – multi-Objective optimization - Design of experiment-based optimization - Data Analytics and optimization using Machine learning approach.

TEXTBOOKS:

1. Optimization for Engineering Design by Kalyanmoy Deb, PHI
2. Operation Research by H. A. Taha, TMH

REFERENCE Book:

1 Engineering Optimization Theory and Practice, by Rao, S. S, New Age International, 2013.
2 Introduction to Optimum Design, by J. S. Arora, Academic press
3 Manufacturing Optimization through Intelligent Techniques by Saravanan. R., Taylor & Fransis, CRC Press

Course Outcome	Program Outcome					PSO		
	1	2	3	4	5	1	2	3
CO1	2	1			2			
CO2	1	2			2			
CO3	2	2	2		1			

CO4	2	2	1		1			
CO5	2	3	2		3			

Programme :	**M.Tech.**	**Semester :**	**I Sem**
Name of the Course:	Finite Element Analysis In Manufacturing	**Course Code:**	**SOE-M-PPE107**
Credits :	**2**	**No of Hours :**	**4 hours/week**
Max Marks:	**100**		

Course Description:

Manufacturing management is intended to introduce the new domains of operations management. In today's competitive business environment, mangers in the manufacturing sector are faced with unique leadership challenges which is further compounded by a shortage of people with competency essentials to high growth industries.

Course Outcomes:

After completion of the course, students will be able to

CO Number	Course Outcomes
CO1	
CO2	
CO3	
CO4	
CO5	

Syllabus:

UNIT – I:

FEM – elements and coordinate system – interpolation polynomials – element and global matrices – local and natural coordinate systems.

UNIT – II: FEA - discretization - selecting the proper elements - elements, nodes, degree of freedom – preprocessing - executing the model – postprocessing -design optimization - Fundamentals of Applied finite element analysis – hardware requirements for doing FEA.

UNIT – III: Finite Element Analysis in production design - Minimising the product design cycle by interfacing CAD and FEA – FEA of maximum fatigue life and minimum weight – vehicles aerodynamics studies.

UNIT – IV: Application in metal casting, cutting, metal forming and welding, moulds and dies.

UNIT V: FEA in automotive industries - Finite element Models –Finite Element Analysis Results and Discussions.

Text Book:

1. Larry J Segerlind,, "Applied Finite Element Analysis", John Wiley, 1984..
2. Bathe KJ, "Finite Element Procedures", Prentice Hall, 1996.
3. J.N. Reddy, "An Introduction to the Finite Element Method", Second Edition, McGraw Hill, New York, 1993.

References Books

1. Edward R Champion Jr,, "Finite Element Analysis in Manufacturing Engineering", Mc Graw Hill, 1992.
2. K.J. Bathe and Wilson E L., "Finite Element Procedures", Prentice Hall, 1994.
3. Huebner K H & Thornton E A, "The Finite Elment Methods for Engineers", John Wiley,1982.

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	2	3	4	5	1	2	3
CO1	2	2	2	1	2	1	2	3
CO2	2	2	1	-	2	1	1	2
CO3	1	2	2	1	2	2	1	3
CO4	3	2	1	3	1	-	2	3
CO5	2	2	3	1	3	2	1	3

Note: 1: Low 2: Moderate 3: High

OBJECTIVES:

- To acquire knowledge on process planning and scheduling manufacturing system.
- To learn about automated material handling system in industries.
- To apply the knowledge of group technology and FMS for the automation of industrial processes.

UNIT I PLANNING, SCHEDULING AND CONTROL OF FMS Introduction To FMS– Development of Manufacturing Systems – Benefits – Major Elements – Types of Flexibility – FMS Application and Flexibility –Single Product, Single Batch, N – Batch Scheduling Problem – Knowledge Based Scheduling System.

UNIT II COMPUTER CONTROL AND SOFTWARE FOR FMS Introduction – Composition of FMS– Hierarchy of Computer Control –Computer Control of Work Centre and Assembly Lines – FMS Supervisory Computer Control – Types of Software Specification and Selection – Trends. "

UNIT III FMS SIMULATION AND DATA BASE

Application of Simulation – Model of FMS– Simulation Software – Limitation – Manufacturing Data Systems – Data Flow – FMS Database Systems – Planning for FMS Database.

UNIT IV GROUP TECHNOLOGY AND JUSTIFICATION OF FMS Introduction – Matrix Formulation – Mathematical Programming Formulation –Graph Formulation – Knowledge Based System for Group Technology – Economic Justification Of FMS- Application of Possibility Distributions in FMS Systems Justification.

UNIT V APPLICATIONS OF FMS AND FACTORY OF THE FUTURE FMS Application in Machining and Fabrication, Prismatic Component Production, Material handling – AGV- RGV– Aerospace Application – FMS Development Towards Factories of The Future – Artificial Intelligence and Expert Systems in FMS – Design Philosophy and Characteristics for Future.

OUTCOMES: Students will

1. Apply the concepts of PPC and GT to the development of FMS.
2. Be able to discuss the planning and scheduling methods used in manufacturing systems.
3. Identify various workstations, system support equipment.
4. Be able to identify hardware and software components of FMS.

5. Summarize the concepts of modern manufacturing such as JIT, supply chain management and lean manufacturing etc.

REFERENCES:

1. Jha N.K "Handbook of Flexible Manufacturing Systems", Academic Press Inc., 2006.

2. Radhakrishnan P and Subramanyan S, "CAD/CAM/CIM", Wiley Eastern Ltd., New Age International Ltd., 2001.

3. Raouf A. and Ben-Daya M, Editors, "Flexible Manufacturing Systems: Recent Development", Elsevier Science, 2000.

4. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt., New Delhi, 1996.

5. Kalpakjian, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Co., 1995.

6. Taiichi Ohno, "Toyota Production System: Beyond Large-Scale Production", Productivity Press (India) Pvt. Ltd. 1992.

WEB RESOURCES: 1. http://www.ignou.ac.in/upload/UNIT6-55.pdf

IOT/IT IN MANUFACTURING

Course Description: This course exposes the students on diversity of Digital -controlled manufacturing processes and information systems developments. Use of information technology in manufacturing applications in the organizations.

Course Objectives

- To understand the concepts of Digital manufacturing system.
- To study the importance of organization and management information systems
- To understand the concepts of Information Technology Infrastructure
- To understand the techniques of product life cycle management.
- To Illustrate the application of digital manufacturing using information technology

Unit-I Manufacturing organizations, management, and the networked enterprises, Globalization challenges and opportunities, Dimensions of Information systems, Approaches to study information system, Technical and Behavioral approach. Introduction to Digital Manufacturing: Definition of digital manufacturing, Operation Mode and Architecture of Digital Manufacturing System. manufacturing systems.

Learning outcomes: At the end of this unit, the student will be able to
- understand the manufacturing information systems [L1]
- comprehend the concept of digital manufacturing [L2]

Unit-II Organizations, management, and the networked enterprise: Information systems in global business today, Global e-business: Use of information systems in manufacturing functions, information system, organizations, and strategy, ethical and social issue in information systems

Learning outcomes: At the end of this unit, the student will be able to
- understand the organizational information system[L1]
- understand the e-business concepts using information system [L1]

Unit-III Information Technology Infrastructure: IT Infrastructure and Emerging Technologies, Foundations of Business Intelligence: Databases and Information Management, Telecommunications, the Internet, and Wireless Technology, Securing Information Systems, Shop floor communications.
Learning outcomes: At the end of this unit, the student will be able to
- understand the IT Infrastructure and Emerging Technologies [L1]
- comprehend the concept of Information technology infrastructure [L2]

Unit-IV PRODUCT LIFE CYCLE MANAGEMENT: Introduction, Types of Product Data, PLM systems, Features of PLM System, System architecture, Product information models, Functionality of the PLM Systems.

Learning outcomes: At the end of this unit, the student will be able to
- Understand the concepts of Product life cycle [L1]
- analyze the functionality of the PLM Systems. [L4]

Unit-V Key System Applications: Achieving Operational Excellence and Customer Intimacy: Enterprise Applications, E - Commerce: Digital Markets, Digital Goods, Managing Knowledge and Collaboration, Enhancing Decision Making.

Learning outcomes: At the end of this unit, the student will be able to
- identify different areas of Digital and Smart Manufacturing and its applications [L4]

Text Books:

1. K. Laudon and J. Laudon, Management Information Systems, 14th edition, Pearson Higher Education, 2016, ISBN: 9780136093688.

2. F. Cecelja, Manufacturing Information and Data Systems, 1st edition, Butterworth - Heinemann, 2002, ISBN: 97 81857180312.

References

1. T. O. Boucher and A. Yalçin, Design of Industrial Information Systems, 1st edition, Elsevier, 2006, ISBN: 9780123704924.

2. K. E. Kurbel, Enterprise Resource Planning and Supply Chain Management: Functions, Business Processes and Software for Manufacturing Companies, 1st edition, Springer, 2013, ISBN: 9783662509869.

3. Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer, 2004.

4. M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing. 3rd edition, Pearson Education, 2015. ISBN: 978-9332549814.

5. Scrope Kalpakjian,, “Manufacturing processes for Engineering Materials”, Addision Wesley, 1997.

6. M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2010, ISBN-10: 0123748992

Course Outcomes: At the completion of the course, the students should able to

1. understand the concepts of Digital manufacturing information system [L1].

2. understand the information systems in manufacturing functions [L1].

3. apply knowledge on IT Infrastructure and Emerging Technologies [L3]..

4. analyze the functionality of the PLM Systems[L4].

5. Understand the application of Digital and Smart Manufacturing [L1]

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Department of Mechanical Engineering

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Programme :	**M.Tech.**	**Semester :**	**I Sem**
Name of the Course:	IOT/IT in Manufacturing	**Course Code:**	**SOE-M-PPE107**
Credits :	**2**	**No of Hours :**	**4 hours/week**
Max Marks:	**100**		

Course Description:

This course exposes the students on diversity of Digital -controlled manufacturing processes and information systems developments. Use of information technology in manufacturing applications in the organizations.

Course Outcomes:

After completion of the course, students will be able to

CO Number	Course Outcomes
CO1	understand the concepts of Digital manufacturing information system
CO2	understand the information systems in manufacturing functions
CO3	apply knowledge on IT Infrastructure and Emerging Technologies
CO4	analyze the functionality of the PLM Systems
CO5	Understand the application of Digital and Smart Manufacturing

Syllabus:

UNIT – I: Manufacturing organizations, management, and the networked enterprises, Globalization challenges and opportunities, Dimensions of Information systems, Approaches to study information system, Technical and Behavioral approach. Introduction to Digital Manufacturing: Definition of digital manufacturing, Operation Mode and Architecture of Digital Manufacturing System. manufacturing systems.

UNIT – II: Organizations, management, and the networked enterprise: Information systems in global business today, Global e-business: Use of information systems in manufacturing functions, information system, organizations, and strategy, ethical and social issue in information systems

UNIT – III: Information Technology Infrastructure: IT Infrastructure and Emerging Technologies, Foundations of Business Intelligence: Databases and Information Management, Telecommunications, the Internet, and Wireless Technology, Securing Information Systems, Shop floor communications.

UNIT – IV: PRODUCT LIFE CYCLE MANAGEMENT: Introduction, Types of Product Data, PLM systems, Features of PLM System, System architecture, Product information models, Functionality of the PLM Systems.

UNIT V: Key System Applications: Achieving Operational Excellence and Customer Intimacy: Enterprise Applications, E - Commerce: Digital Markets, Digital Goods, Managing Knowledge and Collaboration, Enhancing Decision Making.

Text Book:

1. K. Laudon and J. Laudon, Management Information Systems, 14th edition, Pearson Higher Education, 2016.
2. F. Cecelja, Manufacturing Information and Data Systems, 1st edition, Butterworth - Heinemann, 2002.

References Books

1. T. O. Boucher and A. Yalçin, Design of Industrial Information Systems, 1st edition, Elsevier, 2006.
2. K. E. Kurbel, Enterprise Resource Planning and Supply Chain Management: Functions, Business Processes and Software for Manufacturing Companies, 1st edition, Springer, 2013.
3. Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer, 2004.
4. M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing. 3rd edition, Pearson Education, 2015.
5. Scrope Kalpakjian,, “Manufacturing processes for Engineering Materials”, Addision Wesley, 1997.
6. M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2010.

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	2	3	4	5	1	2	3
CO1								
CO2								
CO3								
CO4								
CO5								

Note: 1: Low 2: Moderate 3: High

Programme :	**M.Tech.**	**Semester :**	**I Sem**
Name of the Course:	**Digital Manufacturing**	**Course Code:**	**SOE-M-PPE107**
Credits :	**2**	**No of Hours :**	**4 hours/week**
Max Marks:	**100**		

Course Description:

Digital Manufacturing (DM) is the fastest and easiest way to transform a concept into a reality. DM belongs to a much larger trend known as the Fourth Industrial Revolution, which combines CAD design, digital manufacturing, robotics, sensors & data and analytics to redefine industrial production. This subject concentrates on providing the fundamental theoretical and practical knowledge to understand the additive manufacturing concept, a range of technologies that are capable of joining materials to make objects from 3D model data, usually layer upon layer, in a quick and easy process. The additive, freeform nature of the technology, coupled with improvements in materials, processing speed, accuracy and surface finish, open up an array of manufacturing options that before were impossible with conventional technologies.

Course Outcomes:

After completion of the course, students will be able to

CO Number	Course Outcomes
CO1	transform product ideas into viable products
CO2	fundamental engineering design principles and procedures
CO3	design, analysis and optimization of parts using CADCAMCAE technologies
CO4	Implementation of additive manufacturing; and reverse engineering complete processes.
CO5	Know the new manufacturing technologies, as well as its potential industrial application.

Syllabus:

Unit 1. Conception and development of products

Design processes and methods. CAD/CAM/CAE technologies and product lifecycle management (PLM). Concepts generation and embodiment. Expression of product design ideas using 2D sketches.

Unit 2. Computer Aided Design (CAD)

3D modeling. Parametric design. Assembly modeling. Render the appearance of a product. CAD and additive manufacturing.

Unit 3. Computer Aided Engineering (CAE)

Finite Element Analysis (FEA) to validate functional performance: general stages of the process, solid and FEA models, materials definition, loading (loads, displacements constraints…), post-processing, results and verifications. Topology optimization in additive manufacturing.

Unit 4. Reverse engineering

General methodology: point clouds, meshes (.stl), NURBS surface models and parametric CAD models. Digitizing methods and main technologies: applications and selection of reverse engineering systems. Hardware and software involved. Reverse engineering and additive manufacturing.

Unit 5. Additive manufacturing

General methodology, stages and components of the process. Main technologies, principles and applications. Strengths, weaknesses, challenges, and limitations of additive manufacturing technologies. Main brands and suppliers available. Design for Additive Manufacturing (DFAM). Design for functionality and 3D printability. Planning and slicing additive manufacturing software.

Text Book:

1. Slides prepared by the lecturer (available in Moodlerooms).
2. K. T. Ulrich and S. D. Eppinger, *Product Design and Development*, 6th Ed., McGraw-Hill Education, 2015.
3. Parametric Technology Corporation (PTC), *Simulation using Creo Parametric user guides*.
4. V. Raja and K. J. Fernandes (eds.), *Reverse Engineering. An Industrial Perspective*, 1st Ed., Springer-Verlag London, 2008.
5. N. Hopkinson, R. J. M. Hague and P. M. Dickens (eds.), *Rapid Manufacturing: An Industrial Revolution for the Digital Age*, 1st Ed., John Wiley & Sons, 2005.

References Books

1. K. Otto and K. Wood, *Product Design: Techniques in Reverse Engineering and New Product Development*, 1st Ed., Prentice Hall, 2000.

2. Z. Zhou, S. Xie, and D. Chen, *Fundamentals of Digital Manufacturing Science*, 1st Ed., Springer-Verlag London, 2012.

3. I. Gibson, D. W. Rosen, and B. Stucker, *Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing*. Springer-Verlag Boston, 2010.

4. C. K. Chua, K. F. Leong, and C. S. Lim, *Rapid Prototyping: Principles and Applications*, 3rd Ed., World Scientific, 2010.

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1	2	2	2	1	2	1	2	3
CO2	2	2	1	-	2	1	1	2
CO3	1	2	2	1	2	2	1	3
CO4	3	2	1	3	1	-	2	3
CO5	2	2	3	1	3	2	1	3

Note: 1: Low 2: Moderate 3: High

Programme :	**M.Tech.**	**Semester :**	**I Sem**
Name of the Course:	Quality Engineering in Manufacturing	**Course Code:**	**SOE-M-PPE107**
Credits :	**2**	**No of Hours :**	**4 hours/week**
Max Marks:	**100**		

Course Description:

This course provides students with the analytical and management tools necessary to solve manufacturing quality problems and implement effective quality systems. Topics include voice of the customer analysis, the Six Sigma problem solving methodology, process capability analysis, measurement system analysis, design of experiments, statistical process control, failure mode and effects analysis, quality function deployment, and reliability analysis.

Course Outcomes:

After completion of the course, students will be able to

CO Number	Course Outcomes
CO1	transform product ideas into viable products

CO2	fundamental engineering design principles and procedures
CO3	design, analysis and optimization of parts using CADCAMCAE technologies
CO4	Implementation of additive manufacturing; and reverse engineering complete processes.
CO5	Know the new manufacturing technologies, as well as its potential industrial application.

Syllabus:

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 Ftest, 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.

Text Book:

1. Quality Control & Application by B. L. Hanson & P. M. Ghare, Prentice Hall of India.
2. Quality Management by Kanishka Bedi.
3. Statistical Quality Control by M. Mahajan, Dhanpat Rai & Co. (P) Ltd.

References Books

1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill, Intl. II Edition, 1995.
2. Quality Engineering in Production systems I G. Taguchi, A. Elsayed et al / Mc.Graw Hill Intl. Edition, 1989.

3. Taguchi Methods explained: Practical steps to Robust Design / Papan P. Bagchil Prentice Hall md. Pvt. Ltd., New Delhi.
4. Design of Experiments using the Taguchi Approach/Ranjit K. Roy, John wiley& sons. Inc. 2001

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	2	3	4	5	1	2	3
CO1	2	2	2	1	2	1	2	3
CO2	2	2	1	-	2	1	1	2
CO3	1	2	2	1	2	2	1	3
CO4	3	2	1	3	1	-	2	3
CO5	2	2	3	1	3	2	1	3

Note: 1: Low 2: Moderate 3: High

PRODUCT ANALYSIS AND COST OPTIMISATION

New product strategy, market definition - idea generation - design process - forecasting sales potential - product engineering, manufacturing planning - selection of economical process - standardisation - implification – specialization - break even analysis.

Value engineering – evaluation of function determining function - classifying function - evaluation of costs - evaluation of worth - determining worth - evaluation of value - value engineering.

Job plan information phase - speculation phase - analysis phase - development phase - presentation phase - implementation phase - follow up phase - fast diagramming - cost models - life cycle costs

Cost accounting - cost estimation

Cost calculations for machined components, welding, casting and forging components - calculation of selling price - activity based cost analysis.

REFERENCES

1. Samual Eilon, “Elements of Production Planning and Control”,Universal Book Co, 1984

2. Miles L.D, “Techniques of Value Engineering and Analysis”, McGrawHill, 1972. 3. Narang, C.B.S and Kumar V, “Production and Costing”, Khanna publishers ,1983.

OPTIMIZATION TECHNIQUES IN ENGINEERING

Introduction to Optimization - Engineering applications - Statement of an optimization problem - Classification - Optimal problem formulation: Problems involving design and manufacturing - Optimality criteria - Classical optimization techniques - Kuhn-Tucker (KT) optimality conditions. Non-linear programming: One dimensional minimization methods - Unconstrained optimization techniques - Constrained optimization techniques - Transformation methods - Interior and exterior penalty function method - Convergence and divergence of optimization algorithms - Complexity of algorithms.

Modern Methods in Optimization: Genetic Algorithm - Simulated Annealing - Particle Swarm Optimization - Neural Network based optimization - Optimization of Fuzzy systems - MultiObjective optimization - Design of experiment based optimization - Data Analytics and optimization using Machine learning approach.

Implementing optimization algorithm using Matlab / Programming: Design optimization - Robust design - Optimization in manufacturing / machining – Multi objective optimization - Structural optimization - Shape optimization - Optimization in production planning and control.

TEXT BOOKS/ REFERENCES:

1. Kalyanmoy Deb, “Optimization for Engineering Design Algorithms and Examples”, Prentice Hall, Second Edition, 2012.

2. Rao, S. S., “Engineering Optimization Theory and Practice”, Fourth Edition, New Age International, 2013.

3. J. S. Arora, “Introduction to Optimum Design, Academic press”, 4th Edition, 2017.

4. Saravanan. R., “Manufacturing Optimization through Intelligent Techniques”, Taylor & Fransis, CRC Press, 2006.

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Department of Mechanical Engineering

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UNIVERSITY OF STEEL TECHNOLOGY AND MANAGEMENT

Programme :	M.Tech.	**Semester :**	I Sem
Name of the Course:	Product Design and Development	**Course Code:**	SOE-M-MTA103
Credits :	4	**No of Hours :**	4 hours/week
Max Marks:	100		

Course Description:

Course Outcomes:

After Completion of the course Students will be able to:

CO Number	Course Outcomes
CO1	
CO2	
CO3	
CO4	

Syllabus:

Unit -1: Introduction: Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development. Development Processes and Organizations: A generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization. Product Planning: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources and plan timing, complete pre project planning, reflect all the results and the process.

Unit 2: Identifying Customer Needs: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process. Product Specifications: What are specifications, when are specifications established, establishing target specifications, setting the final specifications. Concept Generation: The activity of concept generation, clarifies the problem, search externally, search internally, explore systematically, reflect on the results and the process.

Unit 3: Concept Selection: Overview of methodology, concept screening, and concept scoring, Concept Testing: Define the purpose of concept test, choose a survey

population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process. Product Architecture: What is product architecture, implications of the architecture, establishing the architecture, variety and supply chain considerations, platform planning, related system level design issues.

Unit 4: Industrial design: Assessing the need for industrial design, the impact of industrial design, industrial design process, managing the industrial design process, assessing the quality of industrial design. Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors. Prototyping: Prototyping basics, principles of prototyping, technologies, planning for prototypes.

Unit 5: Product Development Economics: Elements of economic analysis, base case financial mode,. Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis. Managing Projects: Understanding and representing task, baseline project planning, accelerating projects, project execution, postmortem project evaluation.

Text Books:

1. Product Design and Development - Karl.T.Ulrich, Steven D Eppinger - Irwin McGrawHill - 2000.

Reference Books

1. Product Design and Manufacturing - A C Chitale and R C Gupta, PH1, - 3rd Edition, 2003.
2. New Product Development - Timjones. Butterworth Heinmann -Oxford. UCI -1997.
3. Product Design for Manufacture and Assembly - GeofferyBoothroyd, Peter Dewhurst and Winston Knight – 2002.

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	2	3	4	5	1	2	3
CO1								
CO2								
CO3								
CO4								

Note: 1: Low 2: Moderate 3: High

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Department of Mechanical Engineering

OPJU

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Programme :	**M.Tech.**	**Semester :**	**I Sem**
Name of the Course:	**Lean Manufacturing**	**Course Code:**	**SOE-M-PPE107**
Credits :	**2**	**No of Hours :**	**4 hours/week**
Max Marks:	**100**		

Course Description:

The objective of the lab work is to familiarize you with implementation of numerical methods using Matlab. Knowledge of Matlab is not a prerequesite of the course, and all the relevant features of Matlab will be explained in the text of the labs. Because of the focus on numerical methods, neither the toolboxes nor many capabilities of Matlab will be covered. Instead, numerical methods will be implemented and tested using Matlab functions and scripts.

Course Outcomes:

After completion of the course, students will be able to

CO Number	Course Outcomes
CO1	Apply the transform methods for the solution of differential equations arising in the modeling of real world problems.
CO2	Implement the algorithms for the computation of inverse of Discrete Fourier and Wavelet Transforms.
CO3	Solve the system of algebraic equations arising in solution of PDEs by Finite Difference and Finite Element Methods, by matrix methods and by iterative methods.
CO4	Apply and analyze the finite difference schemes for the numerical solution of parabolic, hyperbolic and elliptic partial differential equations in one and two dimensions.
CO5	Implement the finite element technique for the solution of one and two dimensional equations, particularly arising in the study of heat transfer and fluid mechanics.

Syllabus:

Unit-1

Just in time production system. JIT Logic -Pull system Japanese approach to production elimination of waste - JIT implementation requirements JIT application for job shops, Case studies

Unit-2

Kanban system:-Kanban rules supplier Kanban and sequence schedule used by supplier. Monthly information & daily information. Later replenish system by Kanban sequenced withdrawal P system by sequence schedule table - problems & counter measures in applying Kanban system to subcontractors - Supplier Kanban circulation in the paternal manufacturer - structure of supplier Kanban sorting office.

Unit-3

The rise of lean production: - Birth place, concrete example, company as community, Final assembly plant, product development and engineering. Changing customer demand, dealing with the customer, future of lean production. Shortening of production lead times: reduction of setup times, practical procedures for reducing setup time

Unit-4

Standardization of operations: Machine layout, multi function workers and job rotation. Improvement activities to reduce work force and increase worker morale -foundation for improvements. Elements of lean production viz G M Framingharn: Toyota Takaoka Mass Production V /s lean production, diffusing lean production

Unit-5

Managing lean enterprise:- Finance, Career ladders, geographic spread and advantages of global enterprise. Prospects for catching up. Simplicity in the natural state: institutional factors -life time employment -educational commodities -quality & productivity in full circle.

Text Book:

1. I.N Sneddon, Fourier Transform
2. E. Kreszing, Advance Engineering Mathematics
3. S.C. Chapra Applied Numerical Methods with MATLAB

References Books

1. S.S. Sastry, Introductory method of Numerical Analysis
2. Buchanan, Finite Element Analysis (Schaum's Outline Series)
3. Krishnamurthy, Finite Element Analysis
4. J.N. Reddy, An Introduction to Finite Element Method
5. B.V. Ramana, Higher Engineering Mathematics

Recommended Text Books

1. Erwin Kreyszig, Advanced Engineering Mathematics (8th edition) – John Wiley & Sons.
2. B. V. Rammana, Higher Engineering Mathematics -Tata Mc Graw Hill.
3. R.K. Jain & S.R.K. Iyengar, Advanced Engineering Mathematics– Narosa Publishing House.
4. R. R. Greenberg, Advance Engineering Mathematics - Pearson Publication.
5. S.C. Chapra, Applied Numerical Methods with MATLAB - Tata Mc Graw Hill.
6. J.N. Reddy, An Introduction to Finite Element Method -Tata Mc Graw Hill.
7. Krishnamurthy, Finite Element Analysis:

8. Jichun Li & Yi-Tung, Computational Partial Differential Equations Using MATLAB, Chen – CRC Press.

CO, PO & PSO Correlation

Course Outcome	Program Outcome					PSO		
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**
CO1	2	2	2	1	2	1	2	3
CO2	2	2	1	-	2	1	1	2
CO3	1	2	2	1	2	2	1	3
CO4	3	2	1	3	1	-	2	3
CO5	2	2	3	1	3	2	1	3

Note: 1: Low 2: Moderate 3: High