Study Scheme & Syllabus of

M. Tech. Mechanical
(Manufacturing Engineering and Automation)

Batch 2021 onwards

(For Main Campus only)

By

Department of Academics
IK Gujral Punjab Technical University

Study Scheme of M. Tech. Mechanical
(Manufacturing Engineering and Automation)

(Batch 2021 Onwards)

SEMESTER 1st		Contact Hours/Week			Maximum Marks			Credits
Subject Code	**Subject Name**	**L**	**T***	**P**	**Int.**	**Ext.**	**Total**	
MTME-101	Advanced Engineering Materials	4	0	0	50	100	150	4
MTME-102	Modern Manufacturing Processes	4	0	0	50	100	150	4
MTME-103	Advanced Casting Processes	4	0	0	50	100	150	4
MTME-104	Operations Management	4	0	0	50	100	150	4
MTME-105	Metal Forming	4	0	0	50	100	150	4
	Total	**20**	**0**	**0**	**250**	**500**	**750**	**20**
Total Contact Hours/Week = 20								
* Tutorials involve problems solving sessions including practice on relevant software								

SEMESTER 2nd		Contact Hours/Week			Maximum Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MTME-201	Research Methodology	3	1*	0	50	100	150	4
MTME-202	Advanced Welding Technology	4	0	0	50	100	150	4
MTME-203	Corrosion Science	4	0	0	50	100	150	4
MTME-204	Advanced Material Characterization Techniques	3	1*	0	50	100	150	4
MTME-XXX	Elective –I	4	0	0	50	100	150	4
	Total	18	2	0	250	500	750	20
Total Contact Hours/Week = 20								
* Tutorials involve problems solving sessions including practice on relevant software								

SEMESTER 3rd		Contact Hours/Week			Maximum Marks			Credits
Subject Code	**Subject Name**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MTME-301	Industrial Automation	3	0	0	50	100	150	3
MTME-YYY	Elective-II	4	0	0	50	100	150	4
MTME-ZZZ	Elective-III	4	0	0	50	100	150	4
MTME-302	Mechatronics and IoT lab			2	30	20	50	1
MTME-303	Thesis (Dissertation Part-I)	-	-	6	50	50	100	3
MTME-304	Seminar	-	-	2	100	--	100	1
	Total	11	0	10	330	370	700	16
Total Contact Hours/Week = 16								

SEMESTER 4th		Contact Hours/Wee			Evaluation Criteria	Credits
Subject Code	**Subject Name**	**L**	**T**	**P**		
MTME-401	Thesis (Dissertation part-II	0	0	28	Satisfactory/Unsatisfactory	**14**
Total Contact Hours/Week = 28						

Total Credits for the Programme: 70

List of Elective Subjects for M. Tech. Mechanical (Manufacturing Engineering and Automation)

List of Electives (Manufacturing Engineering and Automation)

1.	MTME-205	Tribology
2.	MTME-206	Industrial Robotics
3.	MTME-207	Plastics Engineering
4.	MTME-208	Rapid Prototyping
5.	MTME-209	Advanced Metal Cutting
6.	MTME-210	Computer Aided Design & Manufacturing
7.	MTME-211	Maintenance and Reliability Engineering
8.	MTME-212	Supply Chain Management
9.	MTME-213	Production Planning and Control
10.	MTME-214	Product Design and Development
11.	MTME-215	Entrepreneurship
12.	MTME-216	Work System Design and Ergonomics
13.	MTME-217	Metrology & Industrial Inspection
14.	MTME-218	Finite Element Analysis
15.	MTME-219	Low cost Automation

Note:

(A) Student can opt Elective I, II & III subjects from the entire list of electives as above.

MTME-101 ADVANCED ENGINEERING MATERIALS

L	T	P
4	0	0

Classification and Selection of Materials

Classifications of materials, properties required in Engineering materials, selection of materials, Requirements/ needs of advance materials.

Composite Materials

Fiber reinforced, laminated and dispersed materials with metallic matrix of aluminium, copper and Titanium alloys and with non-metallic matrix of unsaturated polyesters and epoxy resins. Development, Important properties and applications of these materials.

Ceramics and Glasses - Bio-ceramics

Nearly inert ceramics, bio-reactive glasses and glass ceramics, porous ceramics; Calcium phosphate ceramics: grafts, coatings Physico-chemical surface modification of materials used in medicine.

Low & High Temperature Materials

Properties required for low temperature applications, Materials available for low temperature applications, Requirements of materials for high temperature applications, Materials available for high temperature applications, Applications of low and high temperature materials.

Smart Materials

Shape Memory Alloys, Varistors and Intelligent materials for bio-medical applications, Polymers and Plastics from industry. Development, important properties and applications of these materials.

Nanomaterials

Definition, Types of nanomaterials including carbon nanotubes and nanocomposites, Physical and mechanical properties, Applications of nanomaterials.

Books Recommended:

1. Engineering Material Technology by James A. Jacobs & Thomas F. Kilduff. Prentice Hall.
2. Materials Science and Engineering by WD. Callister Jr., Wiley India Pvt. Ltd., 2010
3. Engineering Design: A Materials and Processing Approach by G.E. Dieter, McGraw Hill, 1991.
4. Materials Selection in Mechanical Design by M.F. Ashby, Pergamon Press, 1992.
5. Introduction to Engineering Materials & Manufacturing Processes by NIIT, Prentice Hall of India.
6. Engineering Materials Properties and Selection by Kenneth G. Budinski, Prentice Hall of India.
7. Selection of Engineering Materials by Gladius Lewis, Prentice-Hall, New Jersey, US.

MTME-102 MODERN MANUFACTURING PROCESSES.

L T P
4 0 0

Introduction
Introduction to different advanced processes, importance and applications of advanced manufacturing processes. Overview: non-conventional machining Processes

Mechanical Machining Processes
Abrasive jet machining, Ultrasonic machining, Abrasive flow finishing, Magnetic abrasive finishing, Water jet cutting, Abrasive water jet machining process: working principle, theory of material removal, process variables and parametric analysis, process performance, determination of material removal rate and surface finish.

Thermodynamic Machining Processes
Electrical discharge machining (EDM), Electrical discharge grinding (EDG), WEDM, LBM, PAM, EBM: working principle, theory of material removal, process variables and parametric analysis, process performance, determination of material removal rate and surface finish.

Electrochemical and Chemical Machining Processes
Chemical machining (ChM), ECM, ECG, electrochemical stream drilling (ESD), electrochemical deburring (ECDe), shaped tube electrolytic machining (STEM): working principle, theory of material removal, process variables and parametric analysis, process performance, determination of material removal rate and surface finish

Powder Metallurgy
Important characteristics and methods of producing powders, Different techniques to form the miniature product from metal power, Extruding, Isostatic molding, Fibre metal process, Sintering Hot pressing.

Special Manufacturing Processes
Physical vapor deposition, chemical vapor deposition, thermal metal spraying and Additive manufacturing such as 3-D printing.

Books Recommended:
1. Advanced Manufacturing Processes by G.F. Benidict, Marcel Deker publisher.
2. Non-conventional Machining Processes by P.K. Mishra, Narosa Publication.
3. Manufacturing Processes by B.H. Amsteal, Philip F. Ostwald & Myron L. Bengeman, John Wiley & Sons, eighth edition
4. Manufacturing Analysis by N. Cook.
5. Modern Machining Processes by P.C. Pandey and H.S. Shan, Tata McGraw-Hill Education
6. Advanced Machining Processes by V.K.Jain

MTME – 103 ADVANCED CASTING PROCESSES

L	T	P
4	0	0

Introduction

Ferrous and non-ferrous materials and their properties, Pattern materials, types and allowances, Characteristics, Ingredients and additives of moulding sand, core sands, Structure of silica and different types of clays, bonding mechanism of silica-water-clay system, Swelling of clays, sintering adhesion and colloidal clay, silica grain shape and size distribution, standard permeability A.F.S. clay, Special sandadditives

Solidification of Metals

Nucleation and growth in metals and alloys, Free energy concept, Critical radius of nucleus, Segregation, Progressive and directional solidification, Constitutional super cooling, Columnar equiacquiesced and dendritic structures, Freezing of alloys, Centreline feeding resistance, Rate and time of solidification, mould constant, Fluidity of metals, Volumes redistribution, Solidification simulation, Analysis of the process.

Gate and Riser Design

Various elements of gating system, gating-system design for ferrous and non-ferrous materials, Top, bottom and inside gating, Different methods for riser design, Riser design shape, size and placement, Effect of appendages on risering, Effective feeding distances for simple and complex shapes, Use of chills, Aspiration of gases, Directional solidification stresses in castings, Metal mould reactions, Expansion scale and metal penetration, Analysis of the process

Advanced Casting Processes

Investment casting, Shell mould casting, Full mould casting, Vacuum casting, Die casting, Permanent mould casting, Continuous casting, Centrifugal casting, Squeeze casting, Slush casting

Casting Defects, Heat-Treatment of Castings and Moulding Sand Testing

Casting defects, causes and remedies; Heat treatment of steel, iron and stainless-steel castings; Moulding sand testing and control, Repair and salvage of castings, Quality control in foundries.

Books Recommended:

1. Flimm, Fundamentals of Metals Casting, Addison Wesley
2. P. N. Rao, Manufacturing Technology - Foundry, Forming and Welding, Tata McGraw Hill
3. Heine Loper and Resenthal, Principles of Metal Casting, McGraw Hill
4. Salman &Simans, Foundry Practice, Issac Pitman
5. Richard W. Heine, Principles of Metal Casting Processes, McGraw Hill
6. P. L. Jain, Principles of Foundry Technology, Tata McGraw Hill
7. Metals Handbook - Metal Casting, ASME

MTME-104 OPERATIONS MANAGEMENT

L	T	P
4	0	0

Introduction

Basic concepts of operations and production management, Types of manufacturingsystems and their characteristics, scope of operations management.

Product and Process Design

System planning and design, long-range planning, product and process design and technological considerations, MACRO and MICRO process design.

Demand Forecasting

Role of demand forecasting in operations decisions; various demand patterns, qualitative and quantitative techniques of demand forecasting, introduction to standard software used in demand forecasting.

Production Planning and Scheduling

Aggregate production planning, operation scheduling, various scheduling criteria, lot sizing, job shop control; Mutli-stage manufacturing systems, their scheduling and management, capacity planning, introduction to standard software used for Production Planning and Scheduling.

Materials Planning

Details of material requirement planning (MRP), manufacturing resource planning (MRP-II) and enterprisewide resource planning (ERP) with their various techniques, JIT and JIT-II concepts.

Facilities Planning

Plant design, types and considerations in the plant location, plant layout types, design, evaluation, principles and types of material flow, optimum plant layout.

Books Recommended:

1. Modern Production/Operations Management by Buffa, E. S. and Sarin, R. K, John Wiley & Sons.
2. Production Operations Management by Adam, E., Jr. and Ebert, R. E., Pearson Education.
3. Operations Management: Policy, Practice, and Performance Improvement by Brown, S., Blackmon, K., Cousins, P. and Maylor H., Butterworth-Heinemann.
4. Operations Management by Dervitsiotis, K. N., McGraw Hill.
5. Production and Operations Management by Starr M. K.,Thomson Business Information.
6. Operations Management: Processes & Supply Chains by Karjewski, L. J, Ritzman, L. P. and Malhotra, M. K., Pearson Education.
7. Operations Management by S. Anil Kumar & N. Suresh, New Age International Publishers.

MTME-105 METAL FORMING

L	T	P
4	0	0

Plasticity – True stress and true strain, true stress-strain curves, selection of stress-strain curves for cold and hot working, yield of isotropic plastic material, yield criteria. Tresca maximum sheer-strainenergy criterion, plastic incompressibility, Poisson's ratio for plastic deformation flow rule, strain hardening function, heat generation and heat transfer in metal forming processes, temperatures in Quasi continuous forming operations. Examination of Metal forming processes. (12 Hours)

Drawing: Prediction of working loads and maximum deformation analysis of the processes of wire drawing/tube drawing, strip drawing and extrusion. various parameters/variables affecting the processes of wire drawing, tube drawing, strip drawing and extrusion; various methods of tube drawing and their comparison. Working loads for plain strain forging of strip and disc under conditions of well lubrications and sticking of material with die and under mixed conditions, prediction of working loads under above approach (simple plain strain and axis symmetric problems) (8 Hours)

Theory of Lubrication: Lubrication in metal forming processes, principles and mechanism of lubrications, hydrodynamic and their film lubrication, boundary and extreme pressure lubricants, solid lubricants, lubricants used for rolling and cold drawing, forging, extrusion and deep drawing processes; defects in various metal forming processes like rolling, forging, extrusion, wire drawing and deep drawing and their causes and remedial measures. (8 Hours)

Forming: Theory and deep drawing of circular blanks, analysis of the process, prediction of radial stress and punch load, ironing, wrinkling, blank holding and various parameters/variables affecting the deep drawing process. (6 Hours)

Rolling: Classification of rolling mills, analysis of the process. Prediction of roll pressure for flat strip rolling in the leading and lagging zones, roll separating forces, torque on the roll, effect of front and back tensions, effect of support rolls, various factors which affect rolling force. (6 Hours)

Books: An Introduction to the Principles of Metal working by Rowe, Arnold.

Metal forming analysis by Avitzer, Mcgraw hill.

Plasticity for mechanical Engineering by Johnson & Merlore; Van Northand.

High Velocity working Metals by ASME; EEE

MTME-201 RESEARCH METHODOLGY

L	T	P
3	1	0

Course Objective:

The objective of the course is to enable the students to study the planning of research, strategies, tools and research ethics.

Course Outcomes:

After completing the course, the students will be able to:
CO1: Formulate the research problem
CO2: Carry out the different experimental designs and their analysis.
CO3: Apply different statistical tools for the research analysis
CO4: Follow research ethics.

Introduction to Research and Review Process

Nature and objective of research, Research topic, Literature review, Formulation of problem, Research design, Sampling techniques, Data collection, Statistical and sensitive analysis of data, Interpretation of result and report writing.

Introduction to Design of Experiment

Basic principles, Error analysis in experiments, Classification of experimental designs, Design and analysis of one, 2k and 3k factors experiments, completely randomized and randomized complete block designs

Taguchi Design and ANOVA

Taguchi method, Design of Experiments with the help of orthogonal arrays, Selection of parameters and Taguchi's Robust parameter design, Analysis of Variance, Main effects and interactions, Two-factor and three factors interaction and analysis of variance, Noise factors, Tolerance on control factors. Formation and analysis of Signal-to-Noise Ratio.

Response Surface Method and Other Approaches to Process Optimize

Introduction to response surface methodology, analysis of second order response surface, blocking in response surface design, the response surface approach to robust design, problem solution.

Statistical Software

Application of Statistical Softwares like SPSS, MS Excel, Mini Tab or MATLAB Software in Data Analysis

Research Ethics

Plagiarism tools, reproducibility and accountability.

Recommended Books:

1. Numerical Methods with Applications by Autar K Kaw, Egwu E Kalu, And Duc Nguyen
2. Design and Analysis of Experiments, Douglas C. Montgomery, John Wiley & Sons (Asia) Pvt Ltd.
3. Numerical Methods for Engineers, Chapra and Canale, 4th edition, 2005, Tata Mc Graw Hill.
4. Engineering Optimization, S.S.Rao, 3rd edition, 2000, New Age.
5. Probability and Statistics for Engineers and scientists, Walpole, Myers, Myers and Ye, 7th Edition, 2002, Pearson Education.
6. Statistics in Research, Bernand Ostle and Richard N.Mensing 3rd ed, 1975, Oxford & IBH Pub Co.
7. Research Methodology: Methods and Techniques by C.R. Kothari, Gaurav Garg , New Age international Publishers.

MTME –202 ADVANCED WELDING TECHNOLOGY

L	T	P
4	0	0

Course Objectives:

1. To impart knowledge regarding various advanced welding practices in industries.
2. To understand the different types of zones formed during welding.
3. To understand the various parameters and requirements for welding processes.
4. To know the comparative merits and demerits of various welding processes.
5. To impart knowledge of welding consumables and welding power sources.

Course Outcomes:

At the end of the course, students will demonstrate their ability to:

CO1: Describe metal transfer mechanism and classify different type of welding process on the basis of heat sources.

CO2: Analyze the mechanism of modern welding process and their Parameters and control.

CO3: Explain the influence of heat input and temperature distribution across a welded structure based on weld geometry.

CO4: Illustrate the consumables and welding power sources used for welding.

DETAILED SYLLABUS

Introduction

Classification of welding processes, weldability, welding defects, causes and remedies, weld thermal cycle, metallurgy of fusion welds, solidification mechanism and micro-structural products in weld metal, epitaxial, cellular and dendritic solidification, metallurgical changes in weld metal, phase transformation during cooling of weld metal in carbon and low alloy steel, prediction of microstructures and properties of weld metal. Heat affected zone, re- crystallization and grain growth of HAZ, gas metal reaction, effects of alloying elements on welding of ferrous metals. Welding symbols, safety and hazards in welding.

Welding Arc

Arc efficiency, temperature distribution in the arc, arc forces, arc blow, electrical characteristics of an arc, mechanism of arc initiation and maintenance, role of electrode polarity on arc behaviour and arc stability, analysis of the arc; Effects of voltage/current, polarity, welding speed on bead geometry and mechanical properties of weld.

Welding Consumables and Welding Power Sources

Classification and selection of welding electrodes and filler rods, Welding fluxes, Role of flux ingredients and shielding gases, Electrode coatings, Arc welding power sources, Basic characteristics of power sources for various arc welding processes, duty cycles, AC, DC welding power source, DC rectifiers, thyristor controlled rectifiers, transistorized units, inverter systems, Arc length regulation in mechanized welding processes.

Metal Transfer and Melting Rate

Mechanism and types of metal transfer, forces affecting metal transfer, modes of metal transfer, metal

transfer in various welding processes, effective of polarity on metal transfer and melting rate.

Advanced Welding Processes

Selection of suitable welding process, Theory, principle, technique, advantages, applications, limitations and analysis of advanced welding processes such as Electro-Slag welding, Thermit welding, Ultrasonic welding, Plasma arc welding, Electron Beam welding, Laser Beam welding, Friction welding, Friction stir welding, Forge welding, Diffusion welding, Explosive welding, Atomic hydrogen welding, Microwave welding, Hybrid welding; Resistance welding processes namely Spot, Seam, Projection, Up-set, Flash welding; Other basic welding processes such as Oxy-fuel gas welding, MIG welding, TIG welding, Submerged arc welding and Allied welding processes viz. Brazing, Braze welding, Soldering.

Recommended Books:

1. R. S. Parmar, Welding Engineering and Technology, Khanna Publishers
2. P. N. Rao, Manufacturing Technology, Foundry, Forming and Welding, Tata McGraw Hill
3. Jean Cornu, Advanced Welding Systems, IFS
4. Richard L Little, Welding and Welding Technology, Tata McGraw Hill
5. Rossi, Welding Technology, McGraw Hill
6. Koenigsberger and Adaer, Welding Technology, Macmillan

MTME –203 CORROSION SCIENCE

L	T	P
4	0	0

Course Objective

The purpose of this course is to introduce the underlying science of corrosion and the fundamentals of corrosion engineering. This course will examine the general mechanisms of corrosion and relate these specific engineering issues and methods being used to reduce the cost of corrosion.

Course Outcomes:

After completing the course, the students will be able to:

CO1. Theoretical knowledge of electrochemistry and its association with corrosion.

CO2. The student is trained in distinguishing between the different corrosion forms and in proposing proper measures of prevention, right design and treatment.

CO3. The student acquires knowledge about the main corrosion forms of major alloy families, the respective routes of corrosion prevention, protection and management.

CO4. The student acquires knowledge of the effect of various environments on corrosion

DETAILED SYLLABUS

Introduction
Definition of Corrosion, Cost of corrosion, Corrosive environments, Corrosion Damage, Types of Corrosion

Corrosion Principles
Introduction, Corrosion Rate Expression, Electrochemical Aspects-Electrochemical Reactions, Polarization, Passivity, Environmental Effects-Effect of Oxygen and oxidizers, Effect of Velocity, temperature, corrosive concentration and effect of galvanic coupling

Corrosion Types-Basic Principles and Mechanisms
Uniform Corrosion, Crevice Corrosion, Pitting, Intergranular Corrosion, Selective Leaching, Erosion-Corrosion, Stress Corrosion, Hydrogen Damage

Corrosion Testing
Introduction, General Classification, Purpose of testing, Materials and Specimens, Surface preparation, Measuring & Weighing, Exposure techniques, Duration, Planned-interval tests, Aeration, Cleaning Specimens after Exposure, Standard Expression for Corrosion Rate

Corrosion Protection Methods
Classification of protection techniques, by changing physical, chemical and mechanical properties of materials, by modification of environmental parameters, cathodic and anodic protection, special coatings: metallic and nonmetallic coatings

Tutorials: Problems relevant to the topics covered in the course

Recommended Books:

1. Corrosion Engineering by Mars G. Fontana and Norbert D. Greene, Mc-Graw Hill Book Company
2. Material science and Engineering by V. Raghvan, PHI
3. Corrosion-understanding the basics by J. R. Davis, ASM Publishers
4. Engineering Coatings by Stan Grainger and Jane Blunt, Abington Publishing
5. Corrosion Testing Procedures by F. A. Champion, Chapman and Hall, London Publishers
6. Corrosion Hand Book by Herbert H. Uhlig, John-Willy Sons.

MTME – 204 ADVANCED MATERIAL CHARACTERIZATION TECHNIQUES

L	T	P
4	0	0

Course objective:

1. To provide an introduction to materials characterization and its importance.
2. To discuss different types of characterization techniques and their uses.
3. To describe the principle, operation and analysis of various advanced material characterization techniques.
4. To study the procedure of sample preparation required for various advanced material characterization techniques.
5. To discuss the application and limitations of material characterization techniques.

Course Outcomes:

At the end of the course the student will be able to:

CO1: Understand various materials characterization techniques.

CO2: Comprehend the principle and operation of characterization equipment

CO3: Decide the characterization tool for specific application

CO4: Compare the principle and operation of different characterization tools such as optical microscope, Scanning electron microscopes and transmission electron microscope

CO5: Interpret the results of various characterization techniques

DETAILED SYLLABUS

Introduction

Materials characterization - definition; importance and application. Principles and general methods of compositional, structural and defect characterization.

Diffraction Techniques

X-ray diffraction: Introduction, principles, Instrumentation, Specimen preparation, Types of analysis, Data collection for analysis, Applications, Limitations applications and limitations.

Microscopy

Optical, electron (TEM & SEM) and electron microprobe analysis, scanning probe methods (STM, AFM, EFM, MFM etc.): Introduction, principles, Instrumentation, Specimen preparation, imaging modes, applications and limitations.

Optical Spectroscopy

UV, visible, IR and Raman spectroscopy: Introduction, principles, Instrumentation, Specimen preparation, imaging modes, applications and limitations.

Electron Spectroscopy

Auger and photoelectron spectroscopy: Introduction, principles, Instrumentation, Specimen preparation, imaging modes, applications and limitations.

Thermal Methods

DTA, TGA, DSC, TMA and DMA: Basic principles, Instrumentation, working principles, Applications, Limitations.

Recommended Books:

1. Materials Characterization Techniques- Sam Zhang, Lin Li, Ashok Kumar
2. Materials Characterization-Yang Lang
3. Auger and X-ray photoelectron spectroscopy- D. Briggs and M. P. Seah
4. An Introduction to Material Characterization- P. R. Khangaonkar
5. Materials Characterization, ASM Hand Book Vol. 10, Edited by: ASM International Handbook

MTME-301 INDUSTRIAL AUTOMATION

Course Learning Objectives:

The basic objective of the subject is:

1. To introduce the importance of automation techniques manufacturing and process industries.
2. To impart the role of PLC in industry automation.
3. To expose to various control techniques employed in process automation.
4. To develop automation system for manufacturing and process industries.

Course Outcomes

After successful completion of this course, the students will be able to

CO1 familiar with various automation technologies in manufacturing and process industries.

CO2 understand various automation tools and methods in manufacturing industry.

CO3 implement various control and automation method in process industries.

CO4 familiar with various communication technologies in manufacturing and process industries.

DETAILED SYLLABUS

Automation in Manufacturing Industries: - Introduction- Automation in production system, Principles and strategies of automation, Basic elements of an automated system, Advanced automation functions, Levels of automations, Automated flow lines and transfer mechanisms, Analysis of transfer lines without storage, Automated flow lines with storage buffers.

Material Handling and Identification Technologies: - Overview of material handling systems, Types of material handling equipment, Design of the system, Conveyor system, Automated guided vehicle system, Automated storage systems, Interfacing handling and storage with manufacturing, Overview of Automatic Identification Methods.

Automated Manufacturing Systems:- Components, Classification and overview of manufacturing systems, Cellular manufacturing, Flexible manufacturing system(FMS), FMS and its planning and implementation, Automated assembly system – design and types of automated assembly systems, Analysis of multi station and single station assembly machine.

Automation in Process Industries:- Introduction to computer based industrial automation- Direct Digital Control (DDC), Distributed Control System (DCS) and supervisory control and data acquisition (SCADA) based architectures. SCADA for process industries includes understanding of RTUs, Pumping stations, Evacuation processes, Mass Flow Meters and other flow meters, Leak-flow studies of pipelines, Transport Automation.

Programmable Logic Controller (PLC):- Block diagram of PLC, Programming languages of PLC, Basic instruction sets, Design of alarm and interlocks, Networking of PLC, Overview of safety of PLC with case studies. Process Safety Automation: Levels of process safety through use of PLCs, Integrating Process safety PLC and DCS, Application of international standards in process safety control.

Distributed Control System:- Local Control Unit (LCU) architecture, LCU Process Interfacing Issues, Block diagram and Overview of different LCU security design approaches, Networking of DCS. Introduction to communication protocols- Profibus, Field bus, HART protocols. Data gathering, Data analytics, Real-time analysis of data stream from DCS, Historian build, Integration of business inputs with process data, Leveraging RTU (as different from PLCs and DCS).

Reference Books:

1. M.P.Groover,"Automation, Production Systems and Computer Integrated Manufacturing", 5 th Edition, Pearson Education, 2009.
2. John W. Webb and Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications", 5th Edition, Prentice Hall Inc., New Jersey, 2003.
3. Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011.
4. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw- Hill, New York, 2016.
5. Curtis D. Johnson, "Process Control Instrumentation Technology", 8th Edition, Pearson New International, 2013
6. Lukas M.P, " Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986

MTME-302 MECHATRONICS & IOT

Course Learning Objectives:

The basic objective of the subject is:

1. To understand basic concept of Mechatronics and IOT.
2. To understand function of basic IOT components, cloud platform and interfacing with real time applications.
3. To impart knowledge on tools and techniques used for developing IOT based products

Course Outcomes

After successful completion of this course, the students will be able to

1. Ability to develop IOT application using controller, sensors, actuators etc.
2. Ability to develop application using cloud and data analytics.
3. Ability to develop IOT mobile application

List of Practicals

1. Study and demonstration of Mechatronics and IOT-based components.
2. Demonstration of microcontroller and microprocessor for various applications.
3. To carry out Interfacing of I/O devices.
4. Demonstration of integration of hardware and software with IoT cloud.
5. Car reverse assistant system
6. Home Automation by Voice Control & Remote Control
7. Smart Agriculture using remote monitoring and control for Soil condition and pump operation
8. IOT application using cloud platform and Data Analytics
9. To carry out the project based on IoT i.e., turn your smartphone into an IoT device using the IoT Platform cloud-hosted service.

MTME-205 TRIBOLOGY

L	T	P
4	0	0

Course Objective:

The basic objective of the subject is:

1. To provide the knowledge and importance of Tribology in Design, friction, wear and lubrication aspects of machine components.
2. To understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.

Course Outcomes:

After successful completion of this class, students will be able to

CO1. Apply the basic theories of friction, wear and lubrication to predictions about the frictional behavior of commonly encountered sliding interfaces.

CO2. Characterize features of rough surface and liquid lubricants as they pertain to interface sliding.

CO3. Interpret the latest research on new topics in tribology including its application to nanoscale devices and biological systems

DETAILED SYLLABUS

Introduction

Background, Meaning of tribology, Cost of friction and wear, Types of contacts, Types of motions, Types of deformations, Surface energy and flash temperature theory, Interdisciplinary approach.

Friction and Wear

Topography of engineering surfaces, Material properties influencing friction, Cause/source of friction, Laws of friction, Friction characteristics, Friction of metals, non-metals, lamellar solids, ceramics and polymers, Energy dissipation mechanism, Stick-lip motion, Measurement of friction, Types of wear: abrasive, erosive, cavitation and adhesive wear , Wear mechanism, Theories of wear, Friction effecting wear, Wear of metals and non-metals, ceramics and polymers, Wear measurements in dry and wet environments and Wear equipment.

Lubrication

Importance, Types and mechanism of lubrication, squeeze film, hydro-static, hydrodynamic, elasto-hydrodynamic and plasto-hydrodynamic lubrication, Solution of Reynold's equation in two and three dimensions, Pressure distribution, load carrying capacity and friction forces in oil films, Coefficient of friction in Journal bearing, A brief introduction of solid lubricants and their applications.

Tribology of Bearings

Principle, Operations and Selection Criteria: : hydrodynamic bearing, hydrodynamic journal bearing, hydrostatic bearing, rolling element, ball bearing, roller bearing, needle roller bearing, Design of bearing/journal bearing, Clearance in journal bearing, Minimum film thickness,

Sommar-field number, Heat generation and cooling.

Industrial Applications of Tribology

In metal working: effect of friction, Classification of plastic deformation in rolling, drawing, extrusion, forging, sheet-metal, metal removaland metal finishing, Lube share in metal working process, In Mining: Tools and cutters, Tribology in excavation, loading, haulage and hoisting, In paper and glass fibre industry.

Recommended Books:

1. Prasanta Sahoo, Engineering Tribology, PHI Learning Private Limited
2. Sushil Kumar Srivastava, Tribology in Industries, S. Chand and Company Limited
3. B. S. Prabhu, Industrial Tribology, Tribological Failure and Their Analysis
4. Gwidon W. Stachowiak and Andrew W. Batchelor, Engineering Tribology

MTME – 206 INDUSTRIAL ROBOTICS

L	T	P
4	0	0

Course Objective

The objective of this course is to introduce the basic concepts in Robotics, robot kinematics, sensors, effectors, control systems.

Course Outcomes

The students would be able to:

CO1 Interpret terminologies related to Robotics technology.
CO2 Understand various grippers and sensors for robotics.
CO3 Apply logic for selection of robotic sub systems and systems
CO4 Analyze basics of principles of robot system integration.
CO5 Integrate knowledge of AI techniques in the area of robotic technology.

DETAILED SYLLABUS

Introduction to robotics : Brief History, Basic Concepts of Robotics such as Definition , Three laws, Elements of Robotic Systems i.e. Robot anatomy, DOF, Misunderstood devices etc., Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc., Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device etc., Introduction to Principles & Strategies of Automation, Types & Levels of Automations, Need of automation, Industrial applications of robot.

Grippers and Sensors for Robotics:
Grippers for Robotics - Types of Grippers, Guidelines for design for robotic gripper, Force analysis for various basic gripper system. Sensors for Robots - Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control

Drives and Control for Robotics:
Drive - Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers,

Programming and Languages for Robotics: Robot Programming: Methods of robot programming,WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of Robotic Languages, Introduction to various types such as VAL, RAIL, AML, Python, ROS etc., Development of languages since WAVE till ROS.

Related Topics in Robotics: Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need andapplication of AI, New trends & recent updates in robotics**.**

Recommended Books:

1. Robotics by Appuu Kuttan K. K., I K Internationals.
2. Introduction to Robotics by S K Saha , New York, Mc Graw Hill
3. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006).
4. Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House, (2019).
5. R. K. Mittal, I. J. Nagrath, Robotics and Control, TATA McGraw Hill Publishing Co Ltd, New Delhi (2003).

MTME-207 PLASTIC ENGINEERING

L	T	P
4	0	0

Course Objective

1. To evaluate the properties and processing methods for commercial plastic materials.
2. To evaluate the different methods of processing plastics in terms of their fundamental advantages and disadvantages from a product design perspective.
3. To evaluate the effect various additives have on changing the performance of a commercial resins.
4. To provide an appreciation of the environmental, life cycle and recycling issues related to the use of plastics.

Course Outcomes

After completing the course students will be able to:

1. Knowledge of variety of methods used to process commercial plastic resins, including limitations.
2. Knowledge of the basic tooling requirements for various plastic processing methods.
3. Ability to write professionally formatted summaries of plastic processing experiments.
4. Articulate the roll of additives in changing the performance of commercial resin systems.

DETAILED SYLLABUS

Overview of the Plastics Industry

Major processes and products, Classification methods of commercial resins, Net-shaped manufacturing

Process Selection

Extrusion, Injection Molding (and variations) – with in-depth analysis of process physics, Thermoforming, Blow Molding (Injection and Extrusion), Rotational Molding, Compression Molding and Filament Winding (reinforced thermosets), Tooling requirements for each process

Plastics Material Selection

Classification based on cost, resistance to chemicals, performance under loads and heat
Commodities: HDPE, LDPE, PP, PS, and PVC (low cost thermoplastics)
Roll of additives in modifying resin performance. Plastics combinations of Polymers and Additives (for performance, protection, esthetics)
Engineering: PC, PMMA, PA, POM (higher cost and performance thermoplastics)
High temperature: PTFE, PEI, PSU, PPS (very high temperature thermoplastics)
Elastomers (partial cross-linking): PUR and SI
Thermosets: PF, MF, UP, and EP (much cross-linking)
Bio-based: PLA; renewable feedstock vs. compostable products

Life Cycle Analysis and Recycling

Role of plastics in sustainable living, End of life options for commercial resins

Recommended Books:

1. Osswald and Menges, Materials Science of Polymers for Engineers, Hanser (1995) (introductory material science)
2. Pötsch and Michaeli, Injection Molding an Introduction, Hanser (1995) (practical and theory

based reference)
3. Osswald, Polymer Processing Fundamentals, Hanser (1998) (introductory processing overview)
4. Avery, Injection Molding Alternatives, Hanser (1998) (comprehensive treatment of alternatives to molding)
5. Progelhof and Throne, Polymer Engineering Principles, Hanser (1993) (deep, theoretical treatment of processing/design)
6. Ehrenstein, Polymeric Materials, Hanser (2001) (excellent foundational treatment of polymeric materials)

MTME – 208 RAPID PROTOTYPING

L	T	P
4	0	0

Course Objective

To provide knowledge on different types of Rapid Prototyping systems and its applications in various fields.

Course Outcomes

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

CO1: Describe product development, conceptual design and classify rapid prototyping systems; Explain stereo lithography process and applications.

CO2: Explain direct metal laser sintering, LOM and fusion deposition modeling processes

CO3: Demonstrate solid ground curing principle and process

DETAILED SYLLABUS

Introduction to Rapid Prototyping

Classification of Manufacturing Processes, Introduction to Rapid Prototyping, Rapid Prototyping and its Impact, Engineering design process, Product development, Product Prototyping and Product Development, Need of Product Prototyping, Prototype Planning and Management, Product and Prototype Cost Estimation, Prototype Design Methods and tools.

Materials Selections and Product Prototyping

Geometrical Modelling Techniques, Wireframe Modelling, Surface Modelling and solid modelling, Prototyping Materials, Modelling of Material Properties, Modelling and Design of Materials and Structures.

Rapid Prototyping Processes

Rapid Prototyping Overview, Rapid Prototyping Procedure, Liquid-Based RP Processes, Solid-Based RP Processes, Powder-Based RP Processes.

Direct Digital Prototyping and Manufacturing

Solid Models and Prototype Representation, Reverse Engineering for Digital Representation, Prototyping and Manufacturing Using CNC Machining, Fully Automated Digital Prototyping and Manufacturing.

Direct Methods for Rapid Tool Production

Classification of Direct Rapid Tool Methods, Direct ACESTM Injection Moulds, Laminated Object Manufactured (LaM) Tools, DTM Rapid Tool, Sand Form, EOS Direct Tool Process, Direct Metal Tooling using 3Dp. applications of Rapid Prototyping: Functional Models, Pattern for Investment and Vacuum Casting, Medical Model, and Art Models, Engineering Analysis Models

Indirect Methods for Rapid Tool Production

Metal Deposition Tools, RTV Tools, Epoxy Tools, Ceramic Tools, Cast Metal Tools, Investment Casting, Fusible Metallic Core, Sand Casting, Keltool Process

Recommended Books:

- Rapid prototyping and engineering applications by Frank W. Liou, CRC press publications.
- Rapid manufacturing by DT Pham & SS Dimov, Springer
- Product design by Kevin otto &, kristin wood, Pearson publication

MTME – 209 ADVANCED METAL CUTTING

L	T	P
4	0	0

Course Objectives:

1. The course provides students with fundamental knowledge and principles in material removal processes.
2. In this course, the students apply the fundamentals and principles of metal cutting to practical applications through multiple labs using lathes, milling machines, grinding machines, and drill presses, Computer Numerical Control etc.
3. To demonstrate the fundamentals of machining processes.
4. To develop knowledge and importance of metal cutting parameters.
5. To develop fundamental knowledge on tool materials, cutting fluids and tool wear mechanisms.
6. To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes.

Course Outcomes:

After studying this course, students shall be able to:

CO1.Overview of the principles of metal cutting
CO2. Describe the methods of metal cutting
CO3. Describe the cutting forces involved and their measurements
CO4. Describe the parameters effecting tool forces
CO5. Describe the theory/methods to find tool life.

DETAILED SYLLABUS

Introduction

Machining fundamentals: work-tool contact, machinable surface, Kinematics of work tool interaction, kinematic elements involved in metal cutting action during different processes, Steriometry of cutting tools: basic shape of cutting tool, tool in hand and system of Tool Nomenclature, standards, Tool Geometry, tool point reference system. Method of master line for rake angle, vector method for rake angle inter relationship.

Oblique Cutting

Normal chip reduction coefficient under oblique cutting, True shear angle, effective rake, influx reg on consideration for deformation, Direction of maximum elongation, effect of cutting variables on chip reduction coefficient, Forces system in oblique cutting, effect of wear land on force system. Force system in milling, effect of helix angle, vulf's method, spaan's model for oblique cutting.

Mechanism of Chip Formation

Deformation of uncut layer in shear, Methods for frozen chip samples, classification of chips, mechanics of chip curl, factors involved in chip formation analysis, Dynamic shearing strain in chip formation, Effect of nose radius, effect of cutting variables on chip reduction coefficient.

Cutting Forces and Dynamometer

Measurement of forces, basic requirement in force measuring techniques, transducers for force measurement, design requirement of dynamometers, different types of force measuring instruments, dynamics of dynamometers, dynamometers for measurement of forces during turning, drilling and milling. Effect of cutting variables on cutting forces. Theoretical determination of cutting forces: Ernst and Merchants upper bond solution, Merchant's second solution and machining constant.

Fundamental Factors Which Effect Tool Forces

Correlation of standard mechanized test. (Abuladze-relation), nature of contact and stagnant phenomena, Rates of strains, shear strain and normal strains distribution, Kinetic coefficient of friction analysis, Built up edge phenomena, Effect of cutting variables on BUL and BUE.

Failure of Cutting Tools

Tool materials, tool failure, analysis of plastic failure (Form stability criterion), Analyzing failure by brittle fracture, wear of cutting tools, criterion, Flank and creature wear analysis, optimum tool life, tool life equations (Taylor's, woxen etc.) Tool life test, machining optimization predominant types of wear: flank, crater, abrasive, adhesive, diffusion wear models, wear measurements techniques, Theory of tool wear, oxidative, Mathematical modeling for wear, Test of machinability and influence of metallurgy on machinability.

Economics of Machining

Economic tool life; Gilbert's Model, Optimal cutting speed for Maximum production; Maximum profit cutting speed, objective criteria for optimization, selection of optimum cutting parameters under various restrictive conditions, Brewer and Reuda;s optimization for maximum power constraint and maximum feed, Bjrcke's Generalized Model, Sensitivity analysis in Machining economics, Economy based on Non Taylorian Tool life laws; Economics of multipass cutting.

Advance Metal Machining

Composite cutting, ceramic and super alloys cutting, cutting tool selection, process parameters and geometry effect on machinability during cutting of composite, ceramics and super alloys.

Surface Integrity and Finishes

Surface metallurgy and topography, factors affecting the surface quality, the numerical assessment of the machined surface, ISO recommendation for assessment of machined surface, super finishing processes, and kinematics of super finishing. Mechanics of lapping and honing, three body abrasion.

Books Recommended:

1. Metal cutting theory and practice by A. Bhattacharyya, Central book, Publisher, Calcutta-9
2. Metal cutting by M. Shaw
3. Manufacturing Science by Amitava Ghosh, and Asok kumar Mallik, Affiliated East-West Press Private Limited, New Delhi

MTME-210 COMPUTER AIDED DESIGN & MANUFACTURING

L	T	P
3	1	0

Course Objectives:
To review and train in CAD/CAM modeling by introducing the concepts of geometric & solid modeling techniques, automated CNC machining, and process control

Course Outcomes:
At the end of the course the student will be able to:
CO1 Understand the basic fundamentals of computer aided design and manufacturing
CO2 To learn 2D & 3D transformations of the basic entities like line, circle, ellipse etc.
CO3 To understand the different geometric modelling techniques like solid modelling, surface modelling, feature based modelling etc. and to visualize how the components look like before its manufacturing or fabrication
CO4 To learn the part programming, importance of group technology, computer aided process planning, computer aided quality control
CO5 To learn the overall configuration and elements of computer integrated manufacturing systems.

DETAILED SYLLABUS

CAD

Introduction
Definitions, Historical Development. Nameable and Unnamable shapes, Explicit and Implicit Equations, Intrinsic Equations, Parametric Equations, Coordinate Systems.

Curves
Algebraic and Geometric Forms, Parametric space of a curve, Blending functions, Re-parametrization, Truncating, Extending and subdividing, Space curve, Four point form, Straight lines, Spline Curves, Bezier Curves, B-spline Curves, Rational Polynomials, introduction to NURBS.

Geometric Transformation and Projection
Transformations: Translation, Rotation, Scaling Symmetry and Reflection, Homogeneous Transformations. Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformation.

Surfaces
Algebraic and Geometric form, Tangent and Twist Vectors, Normal, Parametric space of a surface, Blending Functions, Re-parametrization of a surface patch, subdividing, Sixteen Point form, 16 Four Curve Form, Plane surface, Cylindrical Surface, Ruled surface, Surface of Revolution. Bezier Surface, B-Spline Surface.

CAM
Introduction to Computer Aided Design (CAD), Computer Aided Process Planning (CAPP), Computer Aided Manufacturing (CAM), Computer Integrated Manufacturing (CIM), product cycle and automation in CAD/CAM, Need of CAD/CAM.

Process Planning
Basic concepts of process planning, computer aided process planning (CAPP), Retrieval or variant and generative approach of CAPP, Implementation consideration of CAPP.

Numerical control of Machine tools
Principles of Numerical control (NC), Computer Numerical control (CNC), Direct Numerical control (DNC), comparison between conventional and CNC systems, Classification of CNC system, NC coordinate system, positional control, system devices; drives, ball screws, transducers, feedback devices, counting devices, signal converters, interpolators, adaptive control system.

NC Part programming
Concept, format, codes, preparatory and miscellaneous coded, manual part programming, APT

programming, macros, fixed cycles.

Group Technology (GT)

Introduction, needs of GT, part families, classification and coding systems, GT machine cells, benefits of GT.

CIM and FMS

Introduction, hierarchical computer system, components of CIM, types of manufacturing systems, transfer lines, flexible manufacturing system (FMS), The manufacturing cell, tool management and workpiece handling system, benefits of CIM.

Books Recommended:

1. Michael E. Mortenson, Geometric Modelling: John Wiley.
2. Roger and Adams, Mathematical Elements of Computer Graphics: McGraw Hill.
3. I. Zeid, CAD CAM Theory and Practice: McGraw Hill.
4. Groover Automation, Production systems and computer integrated manufacturing PHI.
5. Groover and Zimmer CAD/CAM PHI Chang, Wysk & Wang, Computer Aided Manufacturing: PHI.
6. Yoram Koren, Computer control of manufacturing system: McGraw Hill Book Co.
7. B.L. Jones, Computer Numerical Control: John Wiley and Sons.
8. Rao, Tiwari & Kunda, Computer Aided Manufacturing: Tata Mc.Graw Hill.
9. Vajpayee, Principles of Computer Integrated Manufacturing: PHI.
10. Radhakrishna Subramanyan & Raju, CAD/CAM/CIM: New Age International (P) Ltd., Publishers.
11. Sharma, Fundamentals of Computer aided Manufacturing: S.K. Kataria and Sons.

MTME – 211 MAINTENANCE AND RELIABILITY ENGINEERING

L	T	P
4	0	0

Course Objectives:

This course is designed to introduce basic concepts of maintenance and reliability to the students, to introduce various methods of reliability analysis with real time problems with constraints and to make understanding the applications of Reliability and Maintenance analysis in different types of systems.

Course Outcomes:

After studying this course, students shall be able to:

CO1. Understand the concepts of Maintenance, Reliability and Availability.

CO2. Establish maintenance strategies according to system characteristics and design transition programs to implement these strategies.

CO3. Develop fault trees for a system and apply various reliability models on fault analysis.

CO4. Develop hazard rate models to know the behaviour of components.

CO5. Manage the manufacturing organisation with highest possible availability.

DETAILED SYLLABUS

Introduction

Concept of maintenance and terotechnology, objective and importance of maintenance engineering, functions and classification, types of maintenance: corrective, renovative, preventive, breakdown, planned, proactive, predictive etc.

Maintenance Planning and Control

Basic requirements of maintenance systems, responsibilities of maintenance engineering department, control and coordination in maintenance, Maintenance planning, Daily/monthly/annually maintenance schedule, Format/preparation of equipment history, failure analysis report, daily maintenance progress report, Total productive maintenance (TPM)

Safety and House Keeping in Maintenance

Hazards: classification, important factors of hazards and causes of accidents, categories of hazards and measurement, procedure of minimizing hazard, different safety devices, their applications and safety checklist. Factors governing housekeeping, housekeeping maintenance and inspection.

Reliability and Hazard Rates

Reliability, maintainability, failure, hazard rate concept, availability, Reliability structure and optimum design configuration of series, parallel, combination of series and parallel, redundancy structure. Mean time to failure (MTTF), mean time between failures (MTBF), mean time to repair (MTTR). Breakdown time distribution. 5-WHY concept for root cause.

Reliability Prediction and Analysis

Quantitative estimation of reliability: Kuder-Richardson formula, Statistical estimation of reliability. ReliaSoft's Lambda hybrid automated reliability predictor. Reliability prediction

based on exponential distribution, system reliability analysis – block diagram method, fault tree and success tree methods, event tree method, failure model, failure mechanism.

Reliability Design

Design for reliability, design process, assessment methodology, reliability allocation, reliability improvement, selection of components to improve system reliability.

Recommended Books:

1. Industrial Engineering and Management Khanna O.P Dhanpat Rai & Sons 1994
2. A textbook of Reliability and Maintenance Engineering by Dr. Alakesh Manna, I K International.
3. Maintenance Planning and Control, Kelly A Buttersworth & Co. 1984
4. Maintenance and Spare parts Management, Krishnan G. Prentice Hall 1991
5. Reliability Engineering and Technology, Gupta, A.K Macmillan India Ltd. 1996
6. Introduction to Reliability Engineering Lewis E.E John Willey & Sons
7. Reliability Engineering, Srinath L.S., East West Press 1991

MTME – 212 SUPPLY CHAIN MANAGEMENT

L	T	P
4	0	0

Course Objectives

1. To develop an understanding of basic concepts and role of Logistics and supply chain management in business.
2. To understand how supply chain drivers play an important role in redefining value chain excellence of Firms.
3. To develop analytical and critical understanding & skills for planning, designing and operations of supply chain.
4. To understand, appraise and integrate various supply chain strategies.

Course Outcomes:

At the end of the course, students will demonstrate their ability to:

CO1 Explain the fundamentals of elements and functions of supply chain, role of drivers and demand forecasting. To understand how supply chain drivers play an important role in redefining value chain excellence of Firms.

CO2 Apply various techniques of inventory management and their practical situations.

CO3 Analyze how supply chain decisions related to facility location can be applied to various industries and designing the supply chain.

CO4 How various warehousing management system and transportation can be practiced in various industries?

CO5 How supply chain performance can be measured using various models?

DETAILED SYLLABUS

Supply Chain Drivers and Obstacles

Four drivers of supply chain inventory transportation, facilities, and information, a framework for structuring drivers, role of each driver in supply chain, obstacles to achieve strategic fit.

Supply Chain Performance

Objectives of supply chain, stages of supply chain, supply chain process cycles, customer order cycle, replenishment cycle, manufacturing cycle, procurement cycle, push/pull view of supply chain processes, importance of supply chain flows, examples of supply chain, supply chain strategies, achieving strategic fit, product life cycle, the minimize local cost view, the minimize functional cost view, the maximize company profit view, the maximize supply chain surplus view.

Managing Economies of Scale in A Supply Chain

Role of cycle inventory in a supply chain, economies of scale to exploit fixed costs, economies of scale to exploit quantity discounts, short term discounting, estimating cycle inventory related costs, determining appropriate level of safety inventory.

Transportation in A Supply Chain

Facilities affecting transportation decisions, modes of transportation and their performance

characteristics, design options for a transport network, trade-offs in transportation decision, tailored transportation, routing and scheduling in transportation, making transportation decisions in practice.

Logistics and Competitive Strategy

Competitive advantage, gaining competitive advantage, advantage through logistics, mission of logistics management, supply chain and competitive performance, changing logistics environment.

Measuring Logistics Costs and Performance

The concept of total cost analysis, principles of logistics costing, logistics and the bottom line, logistics and share holder value, customer profitability analysis, cost drivers and activity based costing.

Benchmarking the Supply Chain

Benchmarking the logistics process, mapping supply chain processes, supplier and distributor benchmarking, identifying logistics performance indicators, setting benchmarking priorities.

Coordination in A Supply Chain

Lack of supply chain coordination and the Bullwhip effect, effect of lack of coordination on performance, obstacles to coordination, managerial levers to achieve coordination, achieving coordination in practice.

Recommended Books:

1. Logistics and Supply Chain Management by Martin Christopher, Pearson Education Asia (2002).
2. Supply Chain Management–Strategy, planning and operation‘s, by Peter Meindl Pearson Education, Asia.
3. Marketing logistics: A Supply Chain Approach, by KK Kapoor & P Kansal Pearson Education Asia.
4. Production and operation Management by Alan Muhlemann, John Oakland & Keith Lockyer Macmillan India Publications (2000).
5. Production and Operations Management by K. Aswathappa, & K.S.Bhat, Himalaya Publishing House, Mumbai (2000).
6. Production and operations Management by R. Panneerselvan, Prentice Hall of India, Delhi.
7. Essentials of Supply Chain Management by S.G. Deshmukh.

MTME-213 PRODUCTION PLANNING AND CONTROL

L	T	P
4	0	0

Course Objective

The objective of the course is to enable the students to study basic strategies of production planning and its controlling methods. It also includes resource planning, shop floor planning

Course Outcomes

After completing the course students will be able to:

CO1: Forecast the appropriate requirement of resources for various production processes and other shop floor activities.

CO2: Design an appropriate strategy for resource planning through appropriate MRP tool

CO3: Improve the productivity of shop floor through design of appropriate production systems such as mass production, batch production etc. within existing conditions.

CO4: Apply scientific tools such as MRP, JIT optimizing production systems.

DETAILED SYLLABUS

Introduction: Manufacturing function; Elements of production systems; Types of production systems, objectives and functions of production planning and control, concept of production and productivity.

Product Design: Identification of product ideas and selection, product development and design; Product analysis: Marketing aspects, product characteristics, economic analysis, profitability and competitiveness, production aspects.

Process Design: Systems approach to process planning and design, linkage, distinction between process planning and facilities planning, types of process design, product mix, process planning aids. Forecasting: Concepts and applications, demand forecasting, principle of forecasting;

Forecasting techniques: Quantitative and qualitative

Aggregate Planning: Concept, strategies for aggregate planning: three pure planning strategies, master production scheduling (MPS), and procedure for developing MPS

.

Capacity Planning and Facility Design: Importance of Capacity and Location decisions, Measuring Capacity, Capacity Strategy, Capacity Planning and Evaluation Methods. Facility location factors, evaluation of alternatives, Types of plant layout, evaluation, Computer aided layout, Assembly line balancing

Shop floor planning and control: Phases in production planning and control, operations planning and scheduling, scheduling techniques for job shop, stages in scheduling, load charts, Sequencing concept-job machine problems

Lean Production System: Kanban and Pull system, Implementation of JIT Production

Resource Requirements Planning: MRP-I, MRP-II, MRP Computational procedure, issues in MRP, evaluation of MRP, Introduction to ERP.

Inventory: functions, costs, classifications, deterministic and probabilistic inventory models, quantity discount; perpetual and periodic inventory control systems.

Recommended Books:

1. Buffa, E.S., and Sarin, R.K., "Modern Production / Operations Management", John Wiley & Sons,1994
2. Mukhopadhyaya, S.K., "Production Planning and Control – Text and Cases", PrenticeHall of India,2004
3. Adam, Jr., E.E., and Ebert, R.J., "Production and Operations Management: Concept, Models and Behavior", 5th Ed., Prentice-Hall of India, 2001
4. Vollman, T.E., Berry, W.L., and Why bark, D.C., "Manufacturing Planning and Control Systems" 4th Ed., McGraw-Hill, 1997
5. Sipper, D., and Buffin, R.L., "Production: Planning, Control and Integration", McGrawHill, 1997

ONLINE RESOURSES 1. nptel.ac.in/courses/112107143/

MTME – 214 PRODUCT DESIGN AND DEVELOPMENT

L	T	P
4	0	0

Course Objectives:

The focus of Product Design and Development is integration of the marketing, design, and manufacturing functions of the firm in creating a new product. The course is intended to provide you with the following benefits:

1. Competence with a set of tools and methods for product design and development.
2. Confidence in your own abilities to create a new product.
3. Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
4. Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective.
5. Reinforcement of specific knowledge from other courses through practice and reflection in an action-oriented setting.
6. Enhanced team working skills.

Course Outcomes:

After studying this course, students shall be able to:

CO1. Learn the importance of product design in industry and principal requirements of good product design.

CO2. Learn the knowledge about the ergonomic factor in product design and product design methodology and techniques.

CO3. Learn the knowledge about the basic elements and concepts of visual design.

CO4. Learn the importance of product graphics, product development and packaging of materials.

CO5. Learn how the product design helps in to reduce the time to launch product in market.

DETAILED SYLLABUS

Creative Thinking and Organizing for Product Innovation

The product design function, locating ideas for new products, selecting the right product, Qualifications of the product design engineer, Creative thinking, Curiosity and imagination, Ideas generate ideas, taking time to think, Using a systematic producer for product innovation, Setting responsibilities for new product development, Structural units for new product development, Functions of the new product development unit, Opportunities for the product design engineer.

Criteria for Product Success

Areas to be studied preparatory to design, Principles of values and laws of appearance, Incorporating quality and reliability into the design, Man-machine consideration, Designing for case of maintenance.

Cost and Product Development

Source of funds for development cost product costs, Estimating the product cost, Kinds of cost procedures, Cost reduction.

Integrated Approach to Product Development

Diffusion of innovation. Generation, screening and development of new product ideas, Product life cycle and new product development, Economic analysis-evaluation of new product ideas/concepts, Value analysis, Test marketing of new product launch.

Recommended Books:

1. Product design and Manufacturing by Chitale and Gupta, Prentice Hall 1997.
2. Taguchi Methods Explained by Bagchi, Prentice Hall 1997 (Practical steps to robust design).
3. Product design and process Engineering by Nible & Drper, Mc Graw Hill.
4. Design and Marketing of new products by Urban G.L & Houser, Prentice Hall 1980
5. Marketing management by Kotler Phillips, Prentice Hall 1990
6. New product Development by Mascarenhas Oxford, 1987 (it is Marketing Research & Managerial Calculate)
7. Product Management by Kaushal O.P & Lalvani Pub. House, 1967
8. The Management of Innovation Burns & Stalk Tasstoch Publication, 1961

MTME-215 ENTREPRENEURSHIP

L	T	P
4	0	0

Course Objectives

The purpose of this subject is to prepare a ground where the students view Entrepreneurship as a desirable and feasible career option. In particular, the paper seeks to build the necessary competencies and motivation for a career in Entrepreneurship

Course Outcomes

After studying this course, students shall be able to:

CO1 Gain knowledge of discovering opportunities and basic entrepreneurial issues.

CO2 Develop critical thinking skills on developing a career as entrepreneurs and define the concept of entrepreneurship.

CO3 Understand strategic decisions that entrepreneurs need to make and the ability to engage in strategic planning.

CO4 Develop the ability to solve real life entrepreneurship issue and Small/ Medium Business problems.

DETAILED SYLLABUS

Foundations of Entrepreneurship: Entrepreneurship and Intrapreneurship- similarities and variance, India's start up Revolution: Trends, Imperatives, Characteristics and types of entrepreneurs, Business vs. Enterprise, different forms of ownership, Business incubators- Rural Entrepreneurship, Social entrepreneurship, Women Entrepreneurship- The Entrepreneurial mind set. Key attributes of an entrepreneur, Desirable and acquirable attitudes and behaviours- Readiness- The right time, right age and right conditions- Myths & realities of Entrepreneurship.

Entrepreneurship Composition/Development: Entrepreneurial Stress. Composition of Entrepreneurship, Different life stages of entrepreneur, relative importance – Disagreements between Entrepreneurs, idea entrepreneur and where do ideas come from. Scarcity, Choice and Trade off- Identity paying customer, developing market understanding- Narrowing focus- End user profiling and Persona- Market Segmentation, Market sizing. Institution and schemes offered to promote entrepreneurship in India.

Enterprise Scalability/ Legal Structures and Matters: Small & Medium Business, Scalability, Defensibility, Venture feasibility analysis- Pitching Legal Matters- Organizational Form Partnership, Sole Proprietorship. Corporation, Intellectual Property- Copyright, trademarks - Tax, Personal Law.

Start Ups: Ideation, feasibility study - technical and financial feasibility, business plan and DPR preparation, Concept of Business Plan**,** Scope and Value, Writing the business plan, Using and implementing business plan.

Recommended Books:

1. Entrepreneurship development programme in India and its relevance to developing countries by VG Patel; EDI- India; Ahmedabad (1987)
2. Developing of New Entrepreneurship by EDI India; Ahmedabad (1987)
3. Self –made Impact making Entrepreneurship by G.R. Jain and M.A. Ansari; by EDI India; Ahmedabad (1988)
4. Vasant Desai Management of small scale industries, Himalaya Publishing
5. Angadi, Cheema, Das, Entrepreneurship, Growth, and Economic Integration, Himalaya Publication
6. Roy Entrepreneurship Oxford University Press 4) Dr. R.K Gupta & Lipika k.Guliani Fundamen

MTME-216 WORK SYSTEM DESIGN AND ERGONOMICS

L	T	P
4	0	0

Course Objective

The basic objective of this course is:

1. To provide basic understanding to the students about the concept and significance of work study and ergonomics.
2. To impart thorough knowledge to the students about various techniques of work-study for improving the productivity of an organization.
3. To inculcate the skill among the students for analyzing and improving existing methods of working on the shop floor of an organization.
4. To impart through knowledge and skills to students with respect to allowances, rating, calculation of basic and standard time for manual operations in an organization.

Course Outcomes

After studying this course, students shall be able to:

CO1: Students will be able to calculate the basic work content of a specific job for employees of an organization. Thereby they will be able to calculate the production capacity of man power of an organization.

CO2: Students will be able to analyze and calculate the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems.

CO3: Students will be able to rate a worker engaged on a live job and calculate basic, allowed and standard time for the same

DETAILED SYLLABUS

Work System Design: Introduction and concept of productivity, measurement of productivity, productivity measures, productivity measurement models, factors influencing productivity, causes of low productivity, productivity measurement models, productivity improvement techniques, numerical problems on productivity, case study on productivity.

Work Study: Basic concept, steps involved in work study, concept of work content, techniques of work study, human aspects of work study. method study: basic concept, steps involved in method study, recording techniques, operation process charts, operation process charts: examples. flow process charts, flow process charts: examples, two-handed-process charts, multiple activity charts, flow diagrams. string diagrams, principles of motion economy, micro-motion study, therbligs, simo charts memo-motion study, cycle graph and chrono-cycle graph, critical examination techniques, development and selection of new method, installation and maintenance of improved methods.

Work Measurement: Basic concept, techniques of work measurement, steps involved in time study, steps and equipment of time study, performance rating. performance rating: examples, allowances, computation of standard time-i, computation of standard time-ii, case study work sampling: basics, procedure of work sampling study, numerical problems on work sampling, introduction to synthetic data and PMTS, introduction to MTM and MOST

Principles of workplace design, physical requirements in the workplace anthropometrics and communication considerations, social requirements of the workplace- personal and territoriality considerations. Workspace design; general principles, deciding position of control with respect to other controls, position of displays with respect to other displays, positioning of displays and controls, control display compatibility

Ergonomics: Ergonomics: Introduction, definition, objectives and scope, man-machine system and its components. Introduction to musculoskeletal system, respiratory and circulatory system, metabolism, measure of physiological functions- workload and energy consumption, Introduction to biomechanics, types of movements of body members, Design of lifting tasks using NIOSH lifting equation, Distal upper extremities risk factors, risk assessment tools; Strain Index, RULA, REBA. Introduction to anthropometry; work table and seat designing. Design of Visual displays and controls. Occupational exposure to; noise, whole body Vibrations, heat stress and dust. Effect of vibration/ noise, temperature, illumination and dust on human health and performance

Recommended Books:

1. Introduction to Work Study: International Labor Office (ILO), Geneva.
2. Motion and Time Study Design and Measurement of Work: Ralph M. Barnes, Wiley, The University of California.
3. Industrial Engineering and Production Management: M. Telsang, S. Chand and Company Ltd.
4. Lakhwinder P S, "Work Study and Ergonomics", Cambridge University Press, 2016.
5. Benjamin E Niebel and Freivalds Andris, "Methods Standards & Work Design", Mc Graw Hill, 1997.

MTME-217 METROLOGY AND INDUSTRIAL INSPECTION

L	T	P
4	0	0

Course Objective

1. To expose the students to various measurement techniques used for the measurement of physical variables in manufacturing industries
2. To expose to various control techniques employed in process automation and develop automation system for manufacturing and process industries.

Course Outcomes

After completing the course students will be able to:

1. Study the characteristics and specification of instruments.
2. Implement various control and automation method in process industries.

DETAILED SYLLABUS

Limits, Tolerance & Gauges – Types of Measurement, Error in Measurement, Limits, Tolerance-Dimensional & Geometrical, Allowance, Types of Fites, Hole and Shaft Basis Measurement, Gauges, Different Types of Limit Gauges, Snap Gauges, Taper Gauges, Ring Gauges. Methods & Measuring Equipments for Testing of Limit Gauges.

Linear, Angular & Circular Measurements - Gauges for the Linear Measurement, Determination of Taper of Ring Gauge by Precision Balls and Rollers, Sign Bar, Clinometers, Autocollimators, Roundness Measurement of Shaft by Dial Indicator Method, Optical Dividing Head.

Measurement – Temperature: Radiation pyrometers and thermal imaging. Pressure: Electro-mechanical and electronic pressure measuring instruments. Low pressure measurement.

Thread and Gear Measurement

Measurement of Major and Minor Diameter of External and Internal threads, Pitch Measurements, Angle and forms of Thread Measurement. Screw Head Gauges- Plug and Ring Gauge, Thread Caliper Gauge.

Measurement of Forms and Pitch of Gear Teeth by Parson's Gear Rolling Tester, Tooth Thickness Measurements- Constant Chord Method and Basic Tangent Method; Testing of Involutes and Cycloidal Form of Gear Teeth, Depth Measurement.

Measurement of Surface Texture

Waviness, Straightness and Roughness Measurement R_a. RMS, R_z, CLA Value; Fatness Measurement, Use of Optical Flats, Surface Plates, Straight Edge, Comparators- Optical, Mechanical, Pneumatic and Electronic.

Industrial Inspection:

Visual Inspection, Online and Offline Inspection, Inspection by variables and by Attributes, Automatic

Gauging, Coordinate Measuring Machine, Non-contact Inspection Methods, Post Process Metrology, Computer Aided Inspection Using Robot, Industrial Inspection Instruments and Their Calibrations.

Recommended Books:

1. Mechanical and Industrial Measurement, R.K. Jain, Khanna Publishers
2. Measurement Systems- Application and Design, Deobelin, E.O, Mc Graw Hill, New York
3. Handbook of Dimensional Measurement, Industrial Press, New York.
4. Engineering Metrology, R.K. Jain, Khanna Publishers.

MTME-218 FINITE ELEMENT ANALYSIS

L	T	P
3	1	0

Course Objective:
The objective of the course is to enable the students to understand the basic concepts of Finite Element Analysis, its methods and application for complex engineering problems.

Course Outcomes:

After completing the course, the students will be able:
CO1: To explain the concepts behind formulation methods in FEM.
CO2: To identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.
CO3: To develop element characteristic equation and generation of global equation.
CO4: To apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axi-symmetric and dynamic problems and solve them for displacements, stress and strains induced.

DETAILED SYLLABUS

Introduction to Finite Element Method
Basic concept, Historical background, engineering applications, general Description, comparison with other methods.

Formulations and Variation Methods
Need for weighted, integral forms, relevant mathematical concepts and formulae, weak formulation of boundary value problems, variational methods, Rayleigh –Ritz method and weighted residual approach.

Finite Element Techniques
Model boundary value problem, finite element discretization, element shapes, sizes And node locations, interpolation functions, derivation of element equations, connectivity, boundary conditions, FEM solution, post-processing, Compatibility and completeness requirements, convergence criteria, higher order and isoparametric elements, natural coordinates, Langrange and Hermit Polynomials.

Applications to Solid and Structural Mechanics Problems
External and internal equilibrium equations, one-dimensional stress-strain relations, plane stress and strain problems, axis symmetric and three dimensional stress-strain problems, strain displacement relations, boundary conditions compatibility equations, analysis of trusses, frames and solids of revolution, computer programs.

Application to Heat Transfer Problem
Variational approach, Galerkin approach, one-dimensional and two-dimensional steady state problems for conduction, convection and radiation, transient problems.

Application to Fluid Mechanics Problems

In viscid incompressible flow, potential function and stream function formulation, incompressible viscous flow, stream function, velocity-pressure and stream function-vorticity formulation, solution of incompressible and compressible fluid film lubrication problems.

Recommended Books:

1. Introductory Finite Element Method by Chandrakant S Desai, Tribikram Kundu
2. The Finite Element Method: Volume 2 by O C Zienkiewicz, R L Taylor
3. Building Better Products With Finite Element Analysis by Vince Adams, Abraham Askenazi
4. Finite Element Implementation by Y K Cheung
5. Finite Element Analysis With Personal Computers by Champion, J M Ensminger, Edward R Champion
6. Programming the Finite Element Method by Ian M. Smith, Vaughan Griffiths
7. The Finite Element Method for Engineers by Kenneth H. Huebner, Donald L. Dewhirst, Douglas E. Smith, Ted G. Byrom
8. The Finite Element Method and Its Reliability by Ivo Babuska, T Strouboulis

MTME-219 LOW COST AUTOMATION

L	T	P
3	1	0

Course Objective

1. To give basic knowledge about automation.
2. To understand the basic hydraulics and pneumatics systems for automation.
3. To understand the assembly automation.

Course Outcomes

After completing the course students will be able to:
CO1 Understand the types of automation and its various elements.
CO2 Select various components for low-cost automation systems.
CO3 Do some assembly automation

DETAILED SYLLABUS

Automation of Assembly Lines

Concept of automation - mechanization and automation - Concept of automation in industry - mechanization and automation - classification, balancing of assembly line using available algorithms - Transfer line-monitoring system (TLMS) using Line Status - Line efficiency - Buffer stock Simulation in assembly line.

Automation using Hydraulic Systems:

Design aspects of various elements of hydraulic systems such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc. - Selection of hydraulic fluid, practical case studied on hydraulic circuit design and performance analysis - Servo valves, electro hydraulic valves, proportional valves and their applications.

Automation using Pneumatic Systems:

Pneumatic fundamentals - control elements, position and pressure sensing -logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods – step counter method - compound circuit design - combination circuit design. Pneumatic equipment's - selection of components - design calculations -application - fault finding – hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation - Robotic circuits.

Automation using Electronic Systems

Introduction - various sensors – transducers - signal processing - servo systems - programming of microprocessors using 8085 instructions - programmable logic controllers

Assembly Automation

Types and configurations - Parts delivery at workstations - Various vibratory and non-vibratory devices for feeding - hopper feeders, rotary disc feeder, centrifugal and orientation - Product design for automated assembly.

Recommended Books:

1. Anthony Esposito, "Fluid Power with applications", Prentice Hall international, 2009.

2. Mikell P Groover, "Automation, Production System and Computer Integrated Manufacturing", Prentice Hall Publications, 2007.
3. Kuo. B.C, "Automatic control systems", Prentice Hall India, New Delhi, 2007.
4. Peter Rohner, "Industrial hydraulic control", Wiley Edition, 1995.
5. Mujumdar.S.R, "Pneumatic System", Tata McGraw Hill 2006.