VEER MADHO SINGH BHANDARI UTTARAKHAND TECHNICAL UNIVERSITY

(Formerly Uttarakhand Technical University, Dehradun Established by Uttarakhand State Govt. wide Act no. 415 of 2005)

Suddhowala, PO-Chandanwadi, Premnagar, Dehradun, Uttarakhand (Website- www.uktech.ac.in)

SYLLABUS

For

Master of Engineering Programmes

(M.Tech. Manufacturing Science & Engineering)

(For admission in 2022-23 and onwards)

Course Structure and Scheme of Examination for M. Tech. - 2 Year Program
Manufacturing Science and Engineering

Semester I									
Sr. No.	Course Type/Code	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**	**External Marks**	**Total Marks**
			L	T	P				
1	AHT – 301	Advanced Mathematics	3	1	0	4	50	100	150
2	MST – 301	Metal Forming Techniques	3	1	0	4	50	100	150
3	MST – 302	Manufacturing Management	3	1	0	4	50	100	150
4	MST-3XX	Professional Elective 1	3	0	0	3	50	100	150
5	MST-3XX	Professional Elective 2	3	0	0	3	50	100	150
6	MSP – 301	Advanced Manufacturing Laboratory – I	0	0	3	1	25	25	50
7	MSP – 302	Manufacturing Simulation Lab	0	0	3	1	25	25	50
8	AHT – 302	Research Methodology & IPR	2	0	0	2	50	50	100
9	AHT – 303	Technical Writing & Presentation Skill	2	0	0	0	50	0	
		Total	**19**	**3**	**6**	**22**	**400**	**600**	**950**
10	MST-3XX	Open Elective (Optional)	3	0	0	3	50	100	150

Semester II (M. Tech. - 2 Year Program: Manufacturing Science & Engineering)									
Sr. No.	Course Type/Code	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**	**External Marks**	**Total Marks**
			L	T	P				
1	MST – 303	Automated & Computer Integrated Manufacturing	3	1	0	4	50	100	150
2	MST – 304	Finite Element Method	3	1	0	4	50	100	150
3	MST-3XX	Professional Elective 3	3	1	0	4	50	100	150
4	MST-3XX	Professional Elective 4	3	0	0	3	50	100	150
5	MST-3XX	Open Elective	3	0	0	3	50	100	150
6	MSP – 303	Automation Lab	0	0	3	1	25	25	50
7	MSP – 304	Advanced Manufacturing Laboratory – II	0	0	3	1	25	25	50
		Total	**15**	**3**	**6**	**20**	**300**	**550**	**850**
8	MST-3XX	Open Elective (Optional)	3	0	0	3	50	100	150

Semester III (M. Tech. - 2 Year Program: Manufacturing Science & Engineering)									
Sr. No.	Course Type/Code	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**	**External Marks**	**Total Marks**
			L	T	P				
1	MSP-3XX	Open Elective	3	0	0	3	50	100	150
2	MSP – 305	Seminar	0	0	4	2	100		100
3	MSP – 306	Project	0	0	10	5	100	150	250
4	MSP – 307	Dissertation	0	0	12	6	300		300
		Total	**3**	**0**	**26**	**16**	**550**	**250**	**800**

Semester IV (M. Tech. - 2 Year Program: Manufacturing Science & Engineering)									
Sr. No.	Course Type/Code	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**	**External Marks**	**Total Marks**
			L	T	P				
1	MSP – 308	Dissertation	0	0	28	14	250	450	700
		Total	**0**	**0**	**28**	**14**	**250**	**450**	**700**

Abbreviations: L-No. of Lecture hours per week, T-No. of Tutorial hours per week, P-No. of Practical hours per week, CT-Class Test Marks, TA-Marks of teacher's assessment including student's class performance and attendance,

1 Hr Lecture	1 Hr Tutorial	2 or 3 Hr Practical
1 Credit	1 Credit	1 Credit

Course Structure and Scheme of Examination for B.Tech.-M. Tech. Dual 1 Year Program Manufacturing Science and Engineering									
Semester III									
Sr. No.	Course Type/Code	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**	**External Marks**	**Total Marks**
			L	T	P				
1	AHT – 301	Advanced Mathematics	3	1	0	4	50	100	150
2	MST – 301	Metal Forming Techniques	3	1	0	4	50	100	150
3	MST-3XX	Open Elective	3	0	0	3	50	100	150
4	AHT – 302	Research Methodology & IPR	2	0	0	2	50	50	100
5	MSP – 305	Seminar	0	0	4	2	100		100
6	MSP – 306	Project	0	0	10	5	100	150	250
7	MSP – 307	Dissertation	0	0	12	6	300		300
		Total	**11**	**2**	**26**	**26**	**700**	**500**	**1200**

Semester IV (B.Tech.-M. Tech. Dual 1 Year Program: Manufacturing Science & Engineering)									
Sr. No.	Course Type/Code	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**	**External Marks**	**Total Marks**
			L	T	P				
1	MST – 303	Automated & Computer Integrated Manufacturing	3	1	0	4	50	100	150
2	MST-3XX	Professional Elective 1/2/4	3	0	0	3	50	100	150
3	MST-3XX	Open Elective	3	0	0	3	50	100	150
4	MSP – 302	Manufacturing Simulation Lab	0	0	3	1	25	25	50
5	MSP – 303	Automation Lab	0	0	3	1	25	25	50
6	Dissertation	Dissertation	0	0	28	14	250	450	700
		Total	**9**	**1**	**34**	**26**	**450**	**800**	**1250**

Abbreviations: L-No. of Lecture hours per week, T-No. of Tutorial hours per week, P-No. of Practical hours per week, CT-Class Test Marks, TA-Marks of teacher's assessment including student's class performance and attendance,

1 Hr Lecture	1 Hr Tutorial	2 or 3 Hr Practical
1 Credit	1 Credit	1 Credit

Professionals Electives			
Program Elective 1		**Program Elective 3**	
Applied Material Engineering	MST – 305	Theory of Metal Forming	MST – 313
Advanced Welding Technology	MST – 306	Supply Chain and Logistics Management	MST – 314
Micro and Nano Manufacturing	MST – 307	Machine Tool Design Techniques	MST – 315
Modern Machining Processes	MST – 308	Precision Engineering	MST – 316
Program Elective 2		**Program Elective 4**	
Modern Manufacturing Processes	MST – 309	Advanced Materials Characterization Techniques	MST – 317
Lean Manufacturing System and Implementation	MST – 310	Additive Manufacturing Technology	MST – 318
Robotics& Automation	MST - 311	Manufacturing System Simulation	MST – 319
MEMS	MST - 312	Modern Concepts of Engineering Design	MST – 320

List of Open Electives

Sr. No.	Course Code	Course Title
1.	MST-331	Facility planning and value engineering
2.	MST-332	Quality management
3.	MST-333	Reliability and maintenance engineering
4.	MST-334	Entrepreneurship development
5.	MST-335	Product Engineering
6.	MST-336	Six Sigma

Syllabus

Advanced Mathematics (AHT-301)

L:T:P:: 3:1:0 **Credits-4**

Course objectives:

From this course, students will be able to:

1. learn distinct methods of solving simultaneous equations.
2. well-versed with partial differential equations and their solutions and applications.
3. acquire the knowledge of transformation to ease the complex problems.
4. acquaintance with basics of random variables and their distribution for dealing with events by chance.
5. study different mathematical domains to deal with real-time engineering problems.

Learning outcomes:

1. Comprehend with engineering problems in different mathematical realm.
2. Learn analytical and numerical methods to deal with mathematical problems.
3. Understand how to model the engineering problems and their solutions.
4. Implement the solutions to real-time complex engineering problems.
5. Apprehend with mathematical methodology.

Course content:

Unit I: Solution of linear simultaneous equations: (8 hours)

Consistency, Iterative method, Convergence, Cholesky's (Crout's) method, Gauss-Jordan method, Gauss-Seidel iteration and relaxation methods, Solution of Eigenvalue problems, Smallest, largest, and intermediate Eigen values

Computer based algorithm and programme for these methods (non-evaluative)

Unit II: Partial differential equation and its applications: (10 hours)

Introduction and classification of partial differential equation, Four standard forms of non-linear partial differential equations and their solutions, linear equations with constant coefficients. Applications of partial differential equationsone and two-dimensional wave equation, one and two-dimensional heat equation, Two-dimensional Laplace's equation.

Unit III: Transform calculus-I: (8 hours)

Laplace transform, Properties of Laplace transform, Inverse Laplace transform,Applications of Laplace transform, Fourier integral theorem, Fourier transforms, Application of Fourier transform

Unit IV: Transform calculus-II: (8 hours)

Z-transform, Properties of Z-transform, Shifting theorems, Initial and final value theorem, Convolution theorems, Inverse Z-transform, Application of Z-transform

Unit V: Basic probability theory: (8 hours)

Concept and laws of probability,Discrete and continuous random variable and their distributions; Some special distributions such as Binomial, Poisson, Negative Binomial, Geometric, Continuous uniform, Normal, Exponential, Weibull, Moments,Moment generating functions, Expectation and variance

Practical demo with statistical software like R, SPSS, SAS, etc. (non-evaluative)

Text Books / References:

1. B.S. Grewal, Engineering Mathematics, Khanna Publications, 44th edition.
2. F.B. Hilderbrand, Method of Applied Mathematics, PHI Publications, 2nd edition.
3. M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand Publication, 20th edition.
4. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathmematical Statistics, S. Chand Publication, 4th edition.
5. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th edition.

S. Ross, A First Course in Probability, Pearson Education, 8th edition

Syllabus

Metal Forming Techniques (MST – 301)

L T P: 3 1 0 **Credits-4**

Course Objective:

- To understand the behavior of materials during forming
- To learn the various metal forming process and their applications
- To study about powder metallurgy and modern forming process
- To learn various surface treatment processes

UNIT I: THEORY OF PLASTICITY

Theory of plastic deformation - Yield criteria - Teresa and Von-misses - Distortion energy - Stress-strain relation - Mohr's circle representation of a state of stress - cylindrical and spherical co-ordinate system - upper and lower bound solution methods - Overview of FEM applications in Metal Forming analysis.

UNIT II THEORY AND PRACTICE OF BULK FORMING PROCESSES

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing - Effect of friction - calculation of forces, work done - Process parameters, equipment used - Defects - applications - Recent advances in Forging, Rolling, Extrusion and Drawing processes - Design consideration in forming.

UNIT III SHEET METAL FORMING

Formability studies - Conventional processes - H E R F techniques – Super plastic forming techniques - Hydro forming - Stretch forming - Water hammer forming - Principles and process parameters - Advantages, Limitations and applications

UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES

Overview of Powder Metallurgy technique - Advantages - applications - Powder perform forging - powder rolling - Tooling, process parameters and applications. - Orbital forging - Isothermal forging - Hot and cold is ostatic pressing - High speed extrusion - Rubber pad forming - Fine blanking - LASER beam forming

UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS

Experiment techniques of evaluation of friction in metal forming selection - influence of temperature and gliding velocity - Friction heat generation - Friction

Between metallic layers - Lubrication carrier layer - Surface treatment for drawing, sheet metal forming, Extrusion and hot and cold forging.

Processing of thin Al tapes - Cladding of Al alloys - Duplex and triplex steel rolling - Thermo mechanical regimes of Ti and Al alloys during deformation - Formability of welded blank laser structured steel sheet Formability of laminated sheet.

References

1. An Introduction to the Principles of Metal Working by Rowe Arnold.
2. Metal Forming Analysis by Avitzur, McGraw Hill
3. Mathematical Simulation and Computer analysis of Thin Strip Rolling Mill by Polukhin, MIR Publications
4. Plasticity for Mechanical Engineers by Johnson &Mellore Van Nostrand
5. High Velocity Working of Metals, ASTME EEE
6. Manufacturing Science by Ghosh & Mallik, Affiliated East-West
7. Technology of Metal Forming Processes by S. Kumar, Prentice Hall of India

Course Outcomes

CO1: Able to understand the concept of theory of plasticity.

CO2: Able to understand and analyse the concept of yield criteria applicable to different material deformation processes.

CO3: Able to apply theoretical and experimental techniques for measurement of important outcomes of metal forming processes.

CO4: Able to understand the different powder metallurgy techniques.

CO5: Able to understand the different experimental techniques of evaluation of friction in metal forming selection.

Syllabus

Manufacturing Management (MST – 302)

L T P: 3 1 0 **Credits-4**

Course objectives:

To understand the concepts of manufacturing management and its various functions

Unit I: Plant engineering

Plant location - factors affecting plant location - techniques - plant layout - principles - types - comparison of layouts - materials handling - principles - factors affecting selection of materials handling system - types of materials handling systems - techniques.

Unit II: Work study

Principles of motion economy - steps in method study - tool and techniques - work measurement - purpose - stop watch time study - production studies - work sampling - ergonomics - value analysis.

Unit III: Process planning and forecasting

Process planning - aims of process planning - steps to prepare the detailed work sheets for manufacturing a given component - break even analysis - forecasting - purpose of forecasting - methods of forecasting - time series - regression and correlation - exponential smoothing - forecast errors.

Unit IV Scheduling and project management

Scheduling - priority rules scheduling - sequencing - Johnson's algorithm for job sequencing - n job m machine problems - project network analysis - pert/ cpm - critical path -floats - resource leveling - queuing analysis.

Unit V Personnel and marketing management

Principles of management - functions of personnel management - recruitment - training - motivation - communication - conflicts - industrial relations - trade union - functions of marketing - sales promotion methods - advertising - product packaging - distribution channels - market research and techniques.

References:

1. R-panneerselvam "production and operation management" prentice hall of india.
2. Martund t. Telsang "production management" s chand&company.
3. Thomas e mortan "production and operation management" vikash publication.
4. Hiller & Lieberman, Introduction to Operations Research
5. Hira D. S. &Gupt P. K., Operations Research, S. Chand & Co. 1995.
6. Vohra N.D, Quantitative Techniques in Management, Tata McGraw Hill, 1995.
7. Sharma J. K., Operation Research Theory and Applications, 2nd Ed., Macmillan, 2003.
8. Kasana H. S., Kumar K. D., Introductory Operations Research Theory and Applications, Springer, 2003.

9. En R. P., Operations Research Algorithm and Applications, PHI, New Delhi.
10. Shah N. H., Gor R. M., Soni H., Operations Research, PHI, New Delhi, 2007.

Course Outcomes

CO1: Able to understand the plant engineering.

CO2: Able to understand and work study problems.

CO3: Able to understand process planning and forecasting.

CO4: Able to understand and analyse PERT and CPM techniques.

CO5: Able to understand the marketing management.

Research Methodology and IPR (AHT-302)

L:T:P:: 2:0:0 **Credits-2**

Course Objectives: Students will be able to:

1. To understand the fundaments of research in today's world controlled by technology, ideas, concept, and creativity.
2. To understand different methods of research designing and data collections.
3. To understand the methods of report writing and its different methods of interpretations.
4. To understand research ethics and methods of research publications
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and inturn brings about, economic growth and social benefits.

Course Outcomes:

1. To understand research problem formulation.
2. To study research design and method of data collections.
3. To study methods of report writing.
4. To follow research ethics.
5. To enhance student's competence to discover new inventions.

Syllabus Contents:

UNIT I: FUNDAMENTAL OF RESEARCH

Meaning of research; objectives of research; basic steps of research; criteria of good research; Research methods vs. Methodology. Types of research –criteria of good research; Meaning of research problem; selection of research problem; Approaches of investigation of solutions for research problem, Errors in selecting a research problem, Scope and objectives of research problem, Review of related literature- Meaning, necessity and sources.

Unit 2: RESEARCH DESIGN AND DATA COLLECTION

Research design: Types of research design- exploratory, descriptive, diagnostic and experimental;Variables- Meaning and types; Hypothesis- Meaning, function and types of hypothesis; Null/Alternative hypothesis; Sampling- Meaning and types of sampling; Probability and Non-Probability; Tools and techniques of data collection- questionnaire, schedule, interview, observation, case study, survey etc.

Unit 3:REPORT WRITING AND ITS INTERPRETATION

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

Unit 4:RESEARCH ETHICS AND SCHOLARY PUBLISHING

Ethics-ethical issues, ethical committees (human & animal); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism and its concept and importance for scholar.

Unit 5: INTELLECTUAL PROPERTY RIGHT (IPR)

IPR- intellectual property rights and patent law, commercialization, New developments in IPR; copy right, royalty, trade related aspects of intellectual property rights (TRIPS); Process of Patenting and Development; Procedure for grants of patents, Patenting under PCT;Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases.

Reference Books:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science &engineeringstudents'"
2. WayneGoddardandStuartMelville,"ResearchMethodology:AnIntroduction"
3. RanjitKumar,2ndEdition,"ResearchMethodology:AStepbyStepGuideforbeginners"
4. Halbert,"ResistingIntellectualProperty",Taylor&FrancisLtd,2007.
5. Mayall,"IndustrialDesign",McGrawHill,1992.
6. Niebel,"ProductDesign",McGrawHill,1974.
7. Asimov,"IntroductiontoDesign",PrenticeHall,1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age",2016.
9. T.Ramappa,"IntellectualPropertyRightsUnderWTO",S.Chand,2008

Syllabus

Advanced Manufacturing Laboratory I (MSP – 301)

L T P: 0 0 3 **Credits-1**

List of Experiments:

1. Study of the morphology of chips produced from different materials sand machining processes.
2. Effect of tool geometry on chip flow direction in simulated orthogonal cutting conditions.
3. Study of cutting ratio/chip thickness ratio in simulated orthogonal cutting with different materials and tool geometry.
4. Evaluations of tool face temperature with thermocouple method.
5. Roughness of machined surface. Influence of tool geometry and feed rate.
6. Extrusion of cylindrical billets through dies of different included angles and exit diameters and their effect on extrusion pressure.
7. Practice and study of blanking and punching process and their characteristic features mechanical press with existing dies.
8. Study of operation of tool and cutter grinder, twist drill grinder, Centreless grinder
9. Determination of cutting forces in turning
10. Inspection of parts using tool makers microscope, roughness and form tester

Syllabus

Manufacturing Simulation Lab(MSP – 302)

L T P: 0 0 3 **Credits-1**

A. MANUFACTURING SIMULATION

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

1. Auto MOD Software.
2. PROMODEL
3. SLAM-II
4. CAFIMS
5. Flexsim

They also learn how to write sub routines in C-language and interlinking with the above packages. Problems for modelling and simulation experiments:

1. AGV planning

2. ASRS simulation and performance evaluation

3. Machines, AGVs and AS/RS integrated problems

4. JIT system

5. Kanban flow

6. Material handling systems

7. M.R.P. Problems

8. Shop floor scheduling etc.

B. PRECISION ENGINEERING

1. Hydraulic and Pneumatic circuits

2. Closed loop control systems

3. Study of the chip formation in turning process

4. Study of operation of tool and cutter grinder, twist drill grinder, Centreless grinder

5. Determination of cutting forces in turning

6. Experiments in unconventional manufacturing processes-AJM and study of USM, EDM, Laser Machining and Plasma spraying

7. Inspection of parts using tool makers microscope, roughness and form tester

8. Study of micro-controllers, programming on various CNC machine tools and also controllers

9. Studies on PLC programming

10. Study and programming of robots

11. Condition monitoring in machining process using acoustic emission.

Syllabus

Applied Material Engineering (MST – 305)

L T P: 3 0 0 **Credits-3**

Course objective

- To study the elastic, plastic and fracture behavior of engineering materials.
- To study the various modern materials , properties and their applications
- To understand the selection of metallic and non-metallic materials for various engineering applications.

Particulars

Unit I Elastic and plastic behavior

Elasticity in metals and polymers An elastic and visco-elastic behavior - Mechanism of plastic deformation and non metallic shear strength of perfect and real crystals - Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behavior - Super plasticity - Deformation of non crystalline materials.

Unit II fracture behaviour

Griffith's theory, stress intensity factor and fracture toughness - Toughening mechanisms - Ductile, brittle transition in steel - High temperature fracture, creep - Larson Miller parameter - Deformation and fracture mechanism maps - Fatigue, low and high cycle fatigue test, cracks initiation and propagation mechanisms and Paris law. Effect of surface and metallurgical parameters on fatigue - Fracture of non metallic materials - Failure analysis, sources of failure, procedure of failure analysis.

Unit IIISelection of materials

Motivation for selection, cost basis and service requirements - Selection for mechanical properties, strength, toughness, fatigue and creep - Selection for surface durability corrosion and wear resistance - Relationship between materials selection and processing - Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications - Computer aided materials selection.

Unit IV Modern metallic materials

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel - Intermetallics, Ni and Ti aluminides - smart materials, shape memory alloys - Metallic glass and nano crystalline materials.

Unit V Non metallic materials

Polymeric materials - Formation of polymer structure - Production techniques of fibers, foams, adhesives and coating - structure, properties and applications of engineering polymers

- Advanced structural ceramics, WC, TIC, Tac, Al_2O_3, Sic, Si3N4 CBN and diamond - properties, processing and applications.

References

1. Vlack V. Elements of Material Science And Engineering, 2nd ed., Pearson Education India, 2014.
2. KodgireV.D. ,Material science and Metallurgy, Everest Publishing House.
3. Askeland D. R. and Phule P. P., The Science and Engineering of Materials, 3rd ed., Thomson Publication,1996.
4. GEORGE E, DIETER, Mechanical METALLURGY, MC Graw HILL, 1998
5. THOMAS H COURTNEY, mechanical behavior of materials (2 EDITION) Mc Graw HILL, 1998

Course Outcomes

At the end of this course, the student is able to

CO1: Differentiate between elastic and plastic behaviour of materials.

CO2: Understand the fracture mechanism.

CO3: Suggest materials for low and high temperature applications.

CO4: Integrate knowledge of different types of advanced engineering materials.

CO5: Analyse problem and find appropriate solution for use of non-metallic materials.

Syllabus

Advanced Welding Technology (MST – 306)

L T P: 3 0 0 **Credits-3**

Course objective

To impart knowledge regarding various Fusion welding practices in industries. Moreover, this course also provides knowledge about the heat flow and chemical reactions and their influence on weld properties. The aspects about the metallurgical changes and weldability of different materials and their effects on weld properties also covered in this course.

Particulars

Unit 1

Fusion Welding Processes: Principle, Working and Application of fusion welding processes such as Gas welding, Gas Tungsten Arc welding, Gas Metal Arc Welding, Submerged Arc Welding, Resistance welding. Electroslag Welding, Electron beam welding, Plasma arc welding, Laser welding.

Unit 2

Non-Fusion Welding Processes: Principle, Working and Application of non-fusion welding processes such as such as Forge Welding, Friction Stir welding, Explosive welding, Diffusion welding, Ultrasonic welding,

Unit 3

Heat flow and Chemical Reactions in welding

Heat Flow: Heat Source Efficiency, Heat Source Efficiencies in Various Welding Processes, Melting Efficiency, Temperature distribution due to heat flow in Arc Welding, Metallurgical effects of Heat flow in welding, Time-Temperature-Transformation Diagrams (TTT Curves), Continuous Cooling Transformation Diagrams (CCT Curves)

Gas-Metal Reactions, Slag-metal Reactions,

Unit 4

Welding Metallurgy and Weldability:

Heat affected zone and its properties; Heat treatment in fusion welding, Microstructural products in weldments, Effects of alloying elements on microstructure, Weld defects. Weldability of metals and alloys: weldability of steels, stainless steel, cast iron, and aluminum and titanium alloys.

Unit 5

Weld Design: Residual stresses (Causes, effects and remedies), Distortion (causes, effects and remedies), Fatigue (Mechanism, Fractography, S-N curve, Remedies), Non-destructive Testing of weldments, Weld design for static loading and fatigue loading.

References:

1. Welding Engineering and Technology-R. S. Parmer, Khanna Publishers
2. Welding Processes and Technology- R. S. Parmer, Khanna Publishers
3. Metallurgy of welding – J. F. Lancaster, George Alien &Unwin Publishers
4. Welding Metallurgy – Sindo Kou, John Wiley & Sons, Inc., Publication
5. ASM Handbook vol.6, welding Brazing & Soldering
6. Advanced Welding Processes-John Norrish, Woodhead Publishing Ltd Cambridge

Course Outcomes

CO1: Students are introduced to various fusion and non-fusion welding techniques which make them interested to choose a career in the field of welding.

CO2: Students will be familiar with various welding process parameters and techniques and capable to select most suitable welding procedure and consumables for a product/process.

CO3: Students will understand the advanced welding practices in Industries and their comparative merits and demerits.

CO5: Students are demonstrated to develop the knowledge and skills in advanced welding processes, weld design using the various thermal and metallurgical considerations against various defects and final quality testing of weldments to secure employments.

CO5: Students will be able to choose the choose appropriate welding processes, right kind of welding techniques, weld design to minimize the occurrence of various weld defects or distortion with the aim of maximizing process efficiency and weld quality.

Syllabus

Micro and Nano Manufacturing (MST – 307)

L T P: 3 0 0 **Credits-3**

Course objective

The objective of this course is to give awareness of different techniques used in micro and nano manufacturing and to introduce other processing routes. Moreover, different techniques used in micro joining and the metrology tools in micro and nano manufacturing also covered in this course.

Particulars

Unit 1: Introduction to Micro and Nano Engineering

Introduction to precision engineering, macro milling and micro drilling, Micro-electromechanical systems- merits and applications, Micro phenomenon in Electro-photography – applications.Introduction to bulk micromachining, Surface micromachining, Micro instrumentation, Micro Mechatronics, Nanofinishing.

Laser Technology in micro manufacturing- Practical Lasers, application of technology fundamentalsIntroduction to Micro-energy and Chemical system, e-Beam Nano lithography.Introduction to Nanotechnology. Carbon Nanotubes – properties and structures, Nano level Biosensors.

Unit 2: Conventional Micro Manufacturing Techniques

Introduction to mechanical micromachining, Micro drilling, Micro turning, Diamond Micro turning, Micro milling and Micro grinding. Micro Extrusion – process and applications, Micro bending with Laser, Nano plastic forming and Roller imprinting.

Unit 3: Unconventional Micro Nano Manufacturing Techniques

Introduction to unconventional micro nano manufacturing.Abrasive Jet and Water Jet Micro machining- Process, principle and applications.Micro EDM, Micro wire EDM, Micro EBM - Process, principle and applications.Micro ECM, Micro LBM - Process, principle and applications.Focused ion beams - Process, principle and applications.

Unit 4: Micro and Nano Finishing Processes

Introduction to Micro and Nano Finishing ProcessesMagneto Rheological Finishing (MRF) processes, Magneto Rheological Abrsive Flow Finishing processes (MRAFF) - Process, principle and applications.Elastic Emission Machining (EEM) – machine description, applications.Ion Beam Machining (IBM) – principle, mechanism of material removal, applications.Chemical Mechanical Polishing (CMP) – schematic diagram, principle and applications.

Unit 5: Micro Joining and Metrology Tools

Laser Micro welding, Electron Beam Micro welding – description and applications.Introduction to micro and nano measurement, defining the scale, uncertainty.Scanning white light Interferometry, – principle and application.Optical Microscopy, Scanning Probe Microscopy – description and application.Introduction to on machine metrology.

References

1. Mark J. Jackson, Micro and Nano-manufacturing, Spinger,2006.
2. Mark J. Jackson, Micro fabrication and Nano- manufacturing – Pulsed water drop micromachining CRC Press 2006.
3. V.K. Jain, Micro – manufacturing Processes, CRC Press, 2012.
4. Micro Machining Methods By J.A. Mc Geough, Champan and Hall, London.
5. Nitaigour Premchand Mahalik, Micro-manufacturing and Nano technology, 2006.

Course Outcomes

CO1: Get an awareness of different techniques used in micro and nano manufacturing.

CO2: get in-depth idea of the conventional techniques used in micro manufacturing.

CO3: Become aware about non-conventional micro-nano manufacturing and finishing approaches.

CO4: Get awareness on micro and nano finishing processes.

CO5: Know about different techniques used in micro joining and the metrology tools in micro and nano manufacturing.

Syllabus

Modern Machining Processes (MST – 308)

L T P: 3 0 0 **Credits-3**

Course Objective

To impart clear knowledge about modern machining processes and its latest developments to the students.

Particulars

Unit I

MECHANICAL ADVANCED MACHINING PROCESSES ABRASIVE JET MACHINING (AJM) Introduction - Abrasive Jet Machining Setup - Gas Propulsion System - Abrasive Feeder Machining Chamber - AJM Nozzle - Abrasives.

PARAMETRIC ANALYSIS - Stand-off-Distance Abrasive Flow Rate - Nozzle Pressure - Mixing Ratio.

PROCESS CAPABILITIES APPLICATIONS PROBLEMS

ULTRASONIC MACHINING (USM) INTRODUCTION ULTRASONIC MACHINING SYSTEM MACHINING SYSTEM MECHANICS OF CUTTING PARAMETRIC ANALYSIS PROCESS CAPABILITIES APPLICATIONS PROBLEMS

ABRASIVE FLOW FINISHING ABRASIVE FLOW FINISHING WORKING PRINCIPLE ABRASIVE FLOW MACHINING SYSTEM Machine - Tooling - Media. PROCESS VARIABLES PROCESS PERFORMANCE ANALYSIS AND MODELING OF ABRASIVE FLOW MACHINED SURFACES - Number of Active Grains - Wear of Abrasive Grains. APPLICATIONS - Aerospace - Dies and Molds.

Unit II

MAGNETIC ABRASIVE FINISHING (MAF) INTRODUCTION WORKING PRINCIPLE OF MAF MATERIAL REMOVAL (OR STOCK REMOVAL) AND SURFACE FINISH - Bonded and Unbonded Magnetic Abrasives - Machining Fluid- Magnetic Flux Density. ANALYSIS

WATER JET CUTTING (WJC) INTRODUCTION WJM MACHINE PROCESS CHARACTERISTICS PROCESS PERFORMANCE APPLICATIONS BIBLIOGRAPHY SELF TEST QUESTIONS REVIEW QUESTIONS

ABRASIVE WATER JET MACHINING (AWJM) WORKING PRINCIPLE AWJM MACHINE - Pumping System – Abrasive

Feed System - Abrasive Jet Nozzle - Catcher. PROCESS CHARACTERISTICS WATER - Water Jet Pressure During Slotting Water Flow Rate.ABRASIVES - Abrasive Flow Rate - Abrasive Particle Size - Abrasive Material.CUTTING PARAMETERS - Traverse Speed Number of Passes - Stand-off-Distance - Visual Examination. PROCESS CAPABILITIES APPLICATIONS

Unit III

THERMOELECTRIC ADVANCED MACHINING PROCESSES ELECTRIC DISCHARGE MACHINING (EDM) INTRODUCTION WORKING PRINCIPLE OF EDM R-C PULSE GENERATOR EDM MACHINE - Power Supply - Dielectric System - Electrodes - Servo system - Electrode Refeeding - Power Delivered to the Discharging Circuit. CNC-EDM ANALYSIS - Analysis of R-C Circuits - Current in discharging Circuit - Material Removal in RC Circuits - Surface Finish. PROCESS VARIABLES - Dielectric Pollution and its Effects.PROCESS CHARACTERISTICS - Gap Cleaning. APPLICATIONS

ELECTRIC DISCHARGE GRINDING (EDG) AND ELECTRIC DISCHARGE DIAMOND GRINDING (EDDG) ELECTRIC DISCHARGE GRINDING ELECTRICAL DISCHARGE DIAMOND GRINDING - Working Principle - Capabilities and Applications.

WIRE ELECTRIC DISCHARGE MACHINING WORKING PRINCIPLE WIRE EDM MACHINE - Power Supply System Dielectric System - Positioning System - Wire Drive System. ADVANCES IN WIRECUT STRATIFIED WIREPROCESS VARIABLES PROCESS CHARACTERISTICS APPLICATIONS PROBLEMS

Unit IV

LASER BEAM MACHINING PRODUCTION OF LASERS WORKING PRINCIPLE OF LASER BEAM MACHINING TYPES OF LASERS - Solid Lasers - Gas Lasers.PROCESS CHARACTERISTICS APPLICATIONS - Drilling - Cutting - Marking Miscellaneous Applications.

PLASMA ARC MACHINING WORKING PRINCIPLE PLASMA ARC CUTTING SYSTEM ELEMENTS OF A PLASMA ARC CUTTING SYSTEM PROCESS PERFORMANCE APPLICATIONS REVIEW QUESTIONS

ELECTRON BEAM MACHINING WORKING PRINCIPLE ELECTRON BEAM MACHINING SYSTEM Electron Beam Gun - Power Supply - Vacuum System and Machining Chamber. PROCESS PARAMETERS CHARACTERISTICS OF THE PROCESS APPLICATIONS

FOCUSSED ION BEAM MACHINING Working Principle - FIB machining system - Parametric analysis - Applications - Problems.

ELECTROCHEMICAL AND CHEMICAL ADVANCED MACHINING PROCESSES ELECTROCHEMICAL MACHINING

Unit V

INTRODUCTION ELECTROLYSIS ELECTROCHEMICAL MACHINING (ECM) ECM MACHINE TOOL - Power Source Electrolyte Supply and Cleaning System - Tool and Tool Feed System - Workpiece and Work Holding Device. ADVANTAGES AND LIMITATIONS APPLICATIONS MECHANICAL PROPERTIES OF ECM'D PARTS THEORY OF ECM - Faraday's Laws of Electrolysis. ELECTROCHEMICAL EQUIVALENT OF ALLOYS - Material Removal Rate in ECM - Interelectrode Gap in ECM - Zero Feed Rate - Finite Feed Rate - Self Regulating Feature Generalized Equation for Inter-electrode Gap. MAXIMUM PERMISSIBLE FEED RATE IN ECM ELECTROLYTE CONDUCTIVITY (K) Temperature - Hydrogen Bubbles.

ELECTROCHEMICAL GRINDING INTRODUCTION ECG MACHINE TOOL PROCESS CHARACTERISTICS APPLICATIONS

ELECTROCHEMICAL DEBURRING INTRODUCTION - Definition of Burr - Types of Burrs - Basic Approach on Deburring.CLASSIFICATION OF DEBURRING PROCESSES ELECTROCHEMICAL DEBURRING (ECDe) Principle of Working. APPLICATIONS SPECIFIC FEATURES OF ECDe MACHINE

CHEMICAL MACHINING (ChM) INTRODUCTION MASKANTS - Cut And Peel - Screen Printing Photo-resist Mask-ant. ETCHANT ADVANTAGES AND LIMITATIONS

References

1. Advanced Machining Processes by V.K.Jain, Allied Publishers, New Delhi.

2. Modern Machining Processes by P.C.Pandey, Tata McGraw Hill, New Delhi.

3. Unconventional Machining Processes by P.K.Mishra

4. Advanced Machining Methods by JAMcGeough, Chapman and Halls, UK.

Course Outcomes

At the end of course, students will

CO1: Able to understand as well as demonstrate the knowledge and the basic techniques of ultrasonic machining processes.

CO2: Able to understand the abrasive jet machining.

CO3: Able to understand the applications of EDM & EDG.

CO4: Able to understand the applications of electrochemical and chemical advanced machining methods.

CO5: Able to understand the importance and criteria to apply ECM and chemical machining.

Syllabus

Modern Manufacturing Processes (MST – 309)

L T P: 3 0 0 **Credits-3**

Course objective

This course familiarizes students with the advanced manufacturing processes which includes surface treatment, non-traditional machining, laser beam, plasma arc, electron beam and electron chemical machining. This course also covers the processing of composites and fabrication of microelectronic devices.

Particulars

Unit 1

Surface treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, andceramic and organic methods of coating, economics of coating. Electro forming, Chemicalvapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coatingand cladding.

Unit 2

Non-Traditional Machining: Introduction, need,AJM, Parametric Analysis, Processcapabilities, USM –Mechanics of cutting, models, Parametric Analysis, WJM –principle,equipment,process characteristics, performance, EDM – principles, equipment, generators,analysis of R-C circuits, MRR, Surface finish, WEDM.

Unit 3

Laser Beam Machining: Principle of working, equipment, Material removal rate, Processparameters, performance characterization, Applications.

Plasma Arc Machining: Principle of working, equipment, Material removal rate, Processparameters, performance characterization, Applications.

Electron Beam Machining: Principle of working, equipment, Material removal rate, Processparameters, performance characterization, Applications.

Electro Chemical Machining: Principle of working, equipment, Material removal rate,Process parameters, performance characterization, Applications.

Unit 4

Processing of ceramics: Applications, characteristics, classification. Processing ofparticulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction,Area of application, finishing of ceramics.

Processing of Composites: Composite Layers, Particulate and fiber reinforced composites,Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

Unit 5

Fabrication of Microelectronic devices: Crystal growth and wafer preparation, FilmDeposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuitboards, computer aided design in microelectronics, surface mount technology, Integratedcircuit economics.E-Manufacturing, nanotechnology, and micromachining, High speed Machining.

References

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

Course Outcomes

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

CO1: Understand the methodology of surface treatment

CO2: Understand the working principle of non-traditional machining

CO3: Understand the working of Electron beam, laser beam and laser hybrid welding processes.

CO4: Understand different types of composite material characteristics, types ofmicro & macro machining processes

CO5: Understand the e-manufacturing & nano materials.

Syllabus

Lean Manufacturing System and Implementation (MST – 310)

L T P: 3 0 0 **Credits-3**

Course objective

- To introduce the concepts of lean manufacturing system
- To study the various tools for lean manufacturing and case studies

Unit I- Introduction to lean manufacturing

Conventional Manufacturing versus Lean Manufacturing - Principles of Lean Manufacturing - Basic elements of lean manufacturing - Introduction to LM Tools.

Unit II-Cellular manufacturing, JIT, TPM

Cellular Manufacturing - Types of Layout, Principles of Cell layout, Implementation. JIT - Principles of JIT and Implementation of Kanban. TPM - Pillars of TPM, Principles and implementation of TPM.

Unit III Set up time reduction, TQM, 5S, VSM

Set up time reduction - Definition, philosophies and reduction approaches. TQM - Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

Unit IV Six sigma

Six Sigma - Definition, statistical considerations, variability reduction, design of experiments - Six Sigma implementation

Unit V Case studies

Various case studies of implementation of lean manufacturing in industries.

References

1. Ronald g. askin&jeffrey b gold berg design and analysis of lean production systemjohn wiley& sons.2003
2. Hopp W. J., Spearman M. L. and Irwin, “Factory Physics: Foundations of Manufacturing”, McGraw-Hill Inc.New York.
3. Sridhar Tayur, Ram Ganeshan and Michael Magazine (editors), “Quantitative Models for Supply Chain Management”, Kluwer Academic Publishers, UK.
4. Handfield R.B. and NocholsE.L.Jr., “Introduction to Supply Chain Management”, Prentice Hall Inc. Englewood- Cliff, New Jersey.
5. Viswanadham N. and Narahari Y., “Performance Modeling of Automated Manufacturing Systems”, Prentice Hall of India, New Delhi.
6. Viswanadham N., “Analysis of Manufacturing Enterprises”, Kluwer Academic Publishers, UK.

7. Chopra S. and Meindel P., "Supply Chain Management: Strategy, Planning, and Operation", Prentice Hall of India, New Delhi

Course outcomes

CO1: Able to understand the concept and principle of lean manufacturing system.

CO2: Able to define the principles of JIT & TPM.

CO3: Able to apply the principles of TQM, 5S.

CO4: Able to identify the principles of six sigma.

CO5: Able to apply case studies using quality tools.

Syllabus

Robotics and Automation (MST – 311)

L T P: 3 0 0 **Credits-3**

Course objective

To impart knowledge about the engineering aspects of Robots and their applications.

Particulars

Unit 1

Introduction: Brief history, robot terminology, classification, characteristic, physical configuration, structure of industrial robot. Robot and Effectors: Types, mechanical grippers, other types of gripper, tools as end effectors, Robot/end effector interface, design consideration.

Robot Motion Analysis & Control: Introduction to manipulator kinematics, robot dynamics, manipulator dynamics, robot control, task planning.

Unit 2

Sensors: Transducers and sensors, sensors in robotics, tedile sensors, proximity and range sensors, miscellaneous sensors and sensor-based systems, use of sensors in robotics, touch sensors, force-torque sensors.

Machine Vision: Introduction, sensing and digitizing function in machine vision, image processing and analysis, vision system robotic applications.

Unit 3

Programming: Basics of robot programming, languages, commands, communications and data processing. Applications: Welding, electro-plating, painting, spraying, assembling, material handling, inspection, Future applications. Introduction to design of robot in specific applications.

Unit 4

Fundamentals of Manufacturing Automation: Basic Principles of automation, types of automated systems, degrees of automation, Automated flow lines. Automation for machining operations Design and fabrication considerations.Analysis of multi station assembly.

Automated Material Handling: components, operation, types, design of automated guided vehicles and applications.Automated storage / retrieval systems - types, basic components and applications.

Unit 5

Group Technology: Part families, part classification and coding, machine Cell design, Benefits. Computer Aided Process Planning, benefits and limitations.

Automated Inspection and Testing: Automated inspection principles and methods sensors techniques for automated inspection-techniques for automated inspection-contact and noncontact inspection methods-in process gauging, CMM's, construction, types, inspection probes, types, and applications. Machine vision, LASER Micro meter and optical inspection methods.

References

1. Mikell P. Groover, "Industrial Robotics Technology Programming and Applications", McGraw Hill Co., Singapore, 2008.
2. Deb. S.R, "Robotics technology and flexible automation", Tata McGraw Hill publishing company limited, New Delhi, 2010.
3. Klafter R.D, Chmielewski T.A and Noggins, "Robot Engineering: An Integrated Approach", Prentice Hal of India Pvt. Ltd., New Delhi, 2010.
4. Fu K.S, Gonzalez, R.C., & Lee, C.S.G., "Robotics control, sensing, vision and intelligence", McGraw Hill Book Co., Singapore, Digitized 2007.
5. Craig. J. J, "Introduction to Robotics mechanics and control", Addison- Wesley, London, 2008.

Course Outcomes

At the end of course, student will able to

CO1: demonstrate the knowledge of relationship between mechanical structures of industrial robots and their operational workspace characteristics.

CO2: demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.

CO3: demonstrate an ability to solve inverse kinematics of simple robot manipulators.

CO4: apply localization and mapping aspects of mobile robotics.

CO5: demonstrate the self-learning capability.

Syllabus

Micro Electro Mechanical Systems (MST – 312)

L T P: 3 0 0 **Credits-3**

Course objective

To educate on the rudiments of micro fabrication techniques and to introduce different types of sensors and actuators. Moreover, the micro systems design are also explored.

Particulars

Unit 1

Overview of MEMS and Microsystems: MEMS and Microsystems, Microsystems and Microelectronics, Microsystems and miniaturization, Application of Microsystem. Working Principles of Microsystem: Microsensors- Acoustic wave sensors, biomedical sensors and bio sensors, chemical sensors, optical sensors, pressure sensors, thermal sensors.Micro actuation- actuation using thermal forces, actuation using shape-memory alloys, actuation using piezoelectric crystals, actuation using electrostatic forces.MEMS and Micro actuators- Micro grippers, micromotors, microvalves, micropumps, micro accelerometers, Microfluidics.

Unit 2

Materials for MEMS and Microsystems: substrates and wafers, active substrate materials, silicon as a substrate material- the ideal substrate for MEMS, single crystal silicon and wafers, crystal structure, the miller indices, mechanical properties of silicon. Silicon compounds- silicon dioxide, silicon carbide, silicon nitride, polycrystalline silicon piezo resistors, Gallium arsenide, polymers for MEMS and Microsystems, conductive polymer, the Langmuir-Blodgett film, packaging materials.

Unit 3

Microsystems Fabrication Processes: Photolithography-photo resists and application, light sources, photo resist development, photo resist removal and post baking. Ion implantation, diffusion, oxidation-thermal oxidation, silicon dioxide, thermal oxidation rates, oxide thickness by color; Chemical vapor deposition- working principle of CVD, chemical reaction s in CVD, rate of deposition, enhanced deposition; physical vapor deposition- sputtering; Deposition by epitaxy; Etching- Chemical etching, plasma etching.

Unit 4

Micro manufacturing: Bulk Manufacturing- overview of etching, isotropic and anisotropic etching, wet etchants; etch stop, dry etching, and comparison of wet versus dry etching. Surface micromachining- general description, process in general, mechanical problems associated with surface micromachining. The LIGA Process- general description of the LIGA process, materials for substrates and photo resists, electroplating.The SLIGA process.

Unit 5

Microsystems Design: Design Considerations- Design constraints, selection of materials, selection of manufacturing processes, selection of signal transduction, electromechanical system and packaging Process design- photolithography, thin film fabrications, geometry shaping, Mechanical design- thermo mechanical loading, thermo mechanical stress analysis, dynamic analysis, interfacial fracture analysis. Design of micro fluidic network systems- fluid resistance in microchannels, capillary electrophoresis network systems, mathematical modeling of capillary electrophoresis network systems

References

1. MEMS & Microsystems Design and Manufacture by Tai-Ran Hsu Tata McGraw-Hill
2. Pelesko, J.A., and Bernstein D.H., "Modeling MEMS and NEMS", 1st Ed., Chapman and Hall CRC
3. Beeby, S., Ensell, G., Kraft, M., and White N., "MEMS Mechanical Sensors", 1st Ed., Artech House, Inc.
4. Bao, M., "Analysis and Design Principles of MEMS Devices", 1st Ed., Elsevier B.V.
5. Mohamed Gad-el-Hak (Editor), "The MEMS Handbook", 2nd Ed., Taylor and Francis.
6. Adams, T.M., and Layton, R.A., "Introductory MEMS: Fabrication and Applications", Springer New York.

Course outcomes

At the end of course, student will able to

CO1: describe new applications and directions of modern engineering.

CO2: illustrate the techniques for building microdevices in silicon, polymer, metal and other materials.

CO3: demonstrate the physical, chemical, biological, and engineering principles involved in the design and operation of current and future microdevices.

CO4: critically analyze microsystems technology for technical feasibility as well as practicality.

CO5: outline the limitations and current challenges in microsystems technology.

Syllabus

Automated & Computer Integrated Manufacturing (MST – 303)

L T P: 3 1 0 **Credits-4**

Course Objective

- To understand basic concepts of CIM system
- To learn the various concepts of automated manufacturing system.
- To study the computer aided process planning and control and techniques.

UNIT IINTRODUCTION

Introduction to CAD/CAM and CIM - Evolution of CIM - CIM wheel and cycle - Production concepts - CIM hardware and software - Major elements of CIM system -Implementation of CIM -- Computer networks for manufacturing - The future automated factory - Management of CIM - Impact of CIM on personnel.

UNIT II AUTOMATED MANUFACTURING SYSTEMS

Automated production line -system configurations, work part transfer mechanisms - Fundamentals of Automated assembly system-System configuration, Part delivery at workstations - Design for automated assembly - Overview of material handling equipments -Consideration in material handling system design. Automated Guided Vehicle system - Automated storage/Retrieval system and Carousel storage system

UNIT III GROUP TECHNOLOGY AND FMS

Part families - Visual - Parts classification and coding - Production flow analysis - Grouping of parts and Machines by rank order clustering method - Benefits of GT - Case studies.

FMS -Components -workstations-FMS layout configurations - FMS planning and implementation issues - Architecture of FMS - flow chart showing various operations in FMS -FMS applications Benefits.

UNIT IV PROCESS PLANNING

Typical process sheet - case studies in Manual process planning. Computer Aided Process Planning - Process planning module and data base Variant process planning - Two stages in VPP - Generative process planning Flow chart showing various activities in generative PP - Semi generative process planning.

UNIT V TYPES OF PROCESS CONTROL AND AUTOMATIC DATA CAPTURE

Introduction to process model formulation -linear feedback control systems - Optimal control - Adaptive control -Sequence control and PLC. Computer process control - Computer process interface hardware - Computer process monitoring - Direct digital control and Supervisory computer control. Overview of Automatic identification methods - Bar code technology - Other Automatic data capture technologies.

References:

1. Groover M P, Automation, Production Systems, and Computer-Integrated Manufacturing, PHI Learning Pvt. Ltd.
2. Alavudeen A &Venkateshwaran N., Computer Integrated Manufacturing, PHI Learning Pvt. Ltd.
3. Cornelius,L.T, "Computer Aided and Integrated Manufacturing Systems: Manufacturing Processes", World Scientific Publishing Company.
4. Chang,T.-C., Wysk,R. A. and Wang, H.-P. "Computer Aided Manufacturing", 3rd Ed., Prentice Hall.
5. Rao,P. N., Tiwari,N. K. and Kundra,T.K., "Computer Aided Manufacturing", Tata McGraw Hill.
6. Sava,M. and Pusztai,J., "Computer Numerical Control Programming", Prentice Hall.
7. Automation, Production systems and computer integrated manufacturing by Mikel P. Groover, Pearson Education.
8. CAD CAM: Principles, Practice and Manufacturing Management by Chris Mc Mohan, Jimmie Browne, Pearson edu. (LPE)
9. Automation by Buckinghsm W, Haper&Row Publishers, New York, 1961
10. Automation for Productivity by Luke H.D, John Wiley & Sons, New York, 1972.

Course Outcomes

CO1: Able to understand the introduction of CAD/CAM

CO2: Able to understand the automated manufacturing system.

CO3: Able to understand the concepts of group technology and flexible manufacturing system.

CO4: Able to understand the concepts of process planning.

CO5: Able to understand the different types of process controls.

Syllabus

Finite Elements Methods (MST – 304)

L T P: 3 1 0 **Credits-4**

Course objective

To equip students with fundamentals of finite element principles. Moreover, physical and engineering problems with emphasis on structural and thermalengineering applications also covered in this course.

Particulars

Unit 1: Introduction to Finite Element Analysis and Finite Element Formulation Techniques

Introduction, Basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis.

Virtual Work and Variational Principle, Galerkin Method, Finite Element Method: Displacement Approach, Stiffness Matrix and Boundary Conditions.

Unit 2: Element Properties

Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Isoparametric Formulation, Stiffness Matrix of Isoparametric Elements, Numerical Integration: One Dimensional, Numerical Integration: Two and Three Dimensional, Worked out Examples.

Unit 3: Analysis of Frame Structures

Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame.

Unit 4: FEM for Two- and Three-Dimensional Solids

Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness Computation of Stresses, Geometric Nonlinearity and Static Condensation, Axisymmetric Element, Finite Element Formulation of Axisymmetric Element, Finite Element Formulation for 3 Dimensional Elements Worked out Examples.

Unit 5: Additional Applications of FEM

Finite Elements for Elastic Stability, Finite Elements in Fluid Mechanics, Dynamic Analysis.

References

1. Introduction to Finite Elements in Engineering by T. R. Chandrupatla and A. D. Belegundu, Pearson Eduction.
2. Finite Element Methods: Basic concepts and applications by Chennakesava R. Alavala, PHI publications.
3. A First Course in Finite Element Method by Daryl L. Logan, Cengage Publication.
4. Finite Element Analysis by C.S. Krishnamurthy Tata McGraw Hill

5. Concepts and Application of Finite Element Analysis by R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley
6. The Finite Element Method by O.C. Zienkiewicz and R.L. Taylor, McGraw Hill
7. Finite Element and Approximation by O.C. Zenkiewicy& Morgan
8. An Introduction to Finite Element Method by J. N. Reddy, McGraw Hill
9. Finite Element Procedure in Engineering Analysis by K.J. Bathe, McGraw Hill

Course Outcomes

CO1: Students should be able to understand the basic Concepts of Finite Element Analysis.

CO2: Students will be able to understand the Finite Element Formulation Techniques.

CO3: Students should have the knowledge about the Finite Element Properties

CO4: Students will be able to understand the analysis of Frame Structures

CO5: Student should have a knowledge about the applications of FEM.

Syllabus

Automation Lab(MSP – 303)

L T P: 0 0 3 **Credits-1**

To simulate the various hydraulics and pneumatics circuits

1. Study of Sensors and Transducers. Potentiometer, Strain gauge, Torque, LVDT, Hall-effect, speed, Vibration, Pressure.

2. Study of Temperature Transducer.

3. Study of optical Transducer.

4. Exercises on Operational amplifier circuits.

5. Study of Fiber optic sensors.

6. Electronic Power controls of DC and AC motors.

7. Study of Hydraulic and Pneumatic components.

8. Exercise on Hydraulic circuits.

9. Exercise on Electro hydraulic circuits.

10. Study of Electro Pneumatic Sequencing circuits.

11. Study of Hydraulic and Pneumatic Circuits using simulation software.

12. Exercise on Hydraulic and Pneumatic circuits using PLC.

Syllabus

Advanced Manufacturing Laboratory II (MSP – 304)

L T P: 0 0 3 **Credits-1**

List of experiments

1. Experimental Study of MRR on EDM
2. Experimental Study of TWR on EDM
3. Experimental Study of Surface Roughness on EDM
4. Experimental Study on ECM
5. Experimental Study on 3D Printing
6. Study of wear characteristics of machine components.
7. To determine sliding wear rate of given sample.
8. To determine of abrasive wear rate of given sample
9. To Study of surface characterization of wear components.
10. To determine the hardness of given sample.
11. Experiment on Metal Spraying and to study the tribological properties of coated film
12. Experiment on Metal Spraying and study the hardness of coated film
13. Dye-Penetrant Testing of weldments

Syllabus

Theory of Metal Cutting (MST – 313)

L T P: 3 1 0 **Credits-4**

Course objective

To expose the students to the different aspects of machining. Identify and use various methods and mechanism of metal cutting.

Particulars

Unit 1: Mechanics of metal cutting

Chip formation, Types of chips, tool geometry-effect of rake, lead and clearance angles; Mechanics of orthogonal and oblique cutting, Shear angle relations in orthogonal cutting, Shear angle and chip flow direction in oblique cutting, Chip control methods, Analysis of cutting process, Machining with rotary tools.

Unit 2: Thermal aspects in machining

Heat and temperature distribution, modelling of chip formation in metal cutting, machining characteristics in turning, milling, drilling, grinding, etc., measurement of cutting forces and cutting temperatures. Economics of metal machining.

Unit 3: Cutting tools

Tools materials analysis of plastic failure (from stability criterion), Analysis failure by brittle fracture, wear of cutting tools, criterion, flank and crater wear analysis, optimum tool life, tool life equations, machining optimization, predominant types of wear; abrasive, adhesive, diffusion wear models, wear measurements and techniques, theory of tool wear, test of machinability and influence of metallurgy on machinability.

Unit 4: Abrasive machining

Mechanics of grinding, cutting action of grit, maximum grit chip thickness, energy and grit force temperature during grinding, Theory of wheel wear, High speed grinding theory, Grinding of drills, form cutters etc., testing of grinding wheels, mechanics of lapping and honing, free body abrasion.

Unit 5: Micro milling

Micro-milling Tools, Process Results and Micro-milling Applications- micromechanically milled X-ray masks, micro-milled mask materials, Mask Absorption, Quantification, and Exposure Quantification. Microdrilling: Micro-drilling and Macro-drilling Techniques.

References

1. E. J. A. Armarego, R. H. Brown, “The Machining of Metals”, Prentice Hall Inc.
2. Kronenberg, “Machining Science and Applications”, Pergamon Press.

3. Geoffrey Boothroyd and W. A. Knight, "Fundamentals of Machining and Machine Tools",MarcelDekkel Inc.
4. J. A. McGeough, "Advanced Methods of Machining", Chapman and Hall.
5. P. L. B. Oxley, "The Mechanics of Machining", Ellis Horwood Ltd.
6. Gary F. Benedict, "Nontraditional Manufacturing Processes", Marcel Dekker Inc.
7. AmitabhaBattacharyya, "Metal Cutting, Theory and Practice", New Central Book Agency
8. Amitabh Ghosh and Asok Kumar Mallik, "Manufacturing Science", Affiliated East West Press Pvt. Ltd.
9. B. L. Juneja and G.S. Sekhon, "Fundamentals of Metal Cutting and Machine Tools", New Age, International (P) Ltd.
10. V. C. Vekatesh and H. Chandrasekharan, "Experimental Techniques in Metal cutting", Practice Hall of India Pvt. Ltd.
11. Introduction to Machining Science by GK Lal New Age International.

Course Outcome

CO1: To be able to understand the mechanism of metal cutting.

CO2: To be able to understand the thermal aspects in machining.

CO3: Understand the classification of various types of cutting tools and their geometry and design.

CO4: To be able to understand the concept of abrasive machining and free body abrasion.

CO5: Understand the importance of micro-milling and micro-drilling.

Syllabus

Supply Chain and Logistics Management (MST – 314)

L T P: 3 1 0 **Credits-4**

Course objective

This course aims to provide an introduction industry demand. Our Supply Chain Management program will prepare you to: Understand fundamental supply chain management concepts. Apply knowledge to evaluate and manage an effective supply chain.

Particulars

Unit 1

Introduction: Understanding supply chain, supply chain performance; supply chain drivers and obstacles.

Unit 2

Planning Demand and Supply in a Supply Chain: Demand forecasting in supply chain, aggregate planning in supply chain, planning supply and demand; managing predictable variability, Economic Order Quantity Models, Reorder Point Models, Multi-echelon Inventory Systems.

Unit 3

Planning and Managing inventories in a Supply Chain: Managing economies of supply chain, managing uncertainty in a supply chain, determining optimal levels of product availability.

Unit 4

Transportation, Network Design and Information Technology: Transportation aspects in a supply chain, facility Decision, Network design in a supply chain, Information technology and its use in supply chain.

Unit 5

Coordination in Supply Chain and effect of E- Business: Role of Coordination and E-business in a supply chain; financial evaluation in a supply chain.

References

1. Hopp W. J., Spearman M. L. and Irwin, “Factory Physics: Foundations of Manufacturing”, McGraw-Hill Inc. New York.
2. Sridhar Tayur, Ram Ganeshan and Michael Magazine (editors), “Quantitative Models for Supply Chain Management”, Kluwer Academic Publishers, UK.
3. Handfield R.B. and NocholsE.L.Jr., “Introduction to Supply Chain Management”, Prentice Hall Inc. Englewood- Cliff, New Jersey.

4. Viswanadham N. and Narahari Y., "Performance Modeling of Automated Manufacturing Systems", Prentice Hall of India, New Delhi.
5. Viswanadham N., "Analysis of Manufacturing Enterprises", Kluwer Academic Publishers, UK.
6. Chopra S. and Meindel P., "Supply Chain Management: Strategy, Planning, and Operation", Prentice Hall of India, New Delhi.

Course Outcomes

At the end of this course, students will be

CO1: Able to apply metrics in supply chains.
CO2: Able to define the principles of scheduling and planning in supply chain management.
CO3: Able to apply the principles of Strategic/Master planning of resource in supply chains.
CO4: Able to identify the principles of customer and supplier relationship management in supply chains.
CO5: Able to define the principles of quality and lean manufacturing.

Syllabus

Machine Tool Design Techniques(MST – 315)

L T P: 3 1 0 **Credits-4**

Course objective

To impart the clear knowledge about the machine tool design.

Particulars

Unit 1

Machine Tool Drive: working and auxiliary motion in machine, Machine tool drives, Hydraulic transmission, Mechanical transmission, General requirements of machine tool design, Layout of machine tools.

Unit 2

Regulation of Speed and Feed Rates: Aim of speed feed regulation, stepped regulation of speed, design of speed box, Design of feed box, Special cases of gear box design, Set stopped regulation of speed and feed rates.

Unit 3

Design of Machine Tool Structure: Fundamentals of machine tool structures and their requirements, Design criteria of machine tool structure, Static and dynamic stiffness, Design of beds and columns, Design of housing models, Techniques in design of machine tool structure.

Unit 4

Design of Guide-ways and power Screws: Function and type of guide-ways, design of slide-ways, protecting devices for slide-ways, Design of power screws.

Design of Spindles and Spindle Supports: Materials for spindles, Design of spindles, Antifriction bearings, Sliding bearings.

Unit 5

Dynamics of Machines Tools: General procedure of assessing dynamic stability of EES, Cutting processing, closed loop system, Dynamic characteristics of cutting process, Stability analysis.

References

1. N.K. Mehta, Machine Tool Design and Numerical Control, TMH, New Delhi, 2010.
2. G.C. Sen and A. Bhattacharya, Principles of Machine Tools, New Central Book Agency, 2009.
3. D. K Pal, S. K. Basu, “Design of Machine Tools”, 5th Edition. Oxford IBH, 2008.
4. N. S. Acherkhan, “Machine Tool Design”, Vol. I, II, III and IV, MIR publications, 1968.

Course Outcomes

CO1: The students will able to explain the Auxiliary motion, feed motion of different machine tool, layout of machine, and general requirement of machine tool.

CO2: The student will be able to design the speed box and feed box.

CO3: The student will be able to design various parts of machine tool like bed, column, housing, etc.

CO4: The student will be able to design guideways, spindle and spindles support of a machine tool.

CO5: The student will be able to assess dynamic stability of EES and Dynamic characteristics of cutting process, Stability analysis.

Syllabus

Precision Engineering (MST – 316)

L T P: 3 1 0 **Credits-4**

Course objective

- Understand the principal application of different measuring instruments.
- Summarize the application of latest manufacturing techniques (Nano).

UNIT I: Concepts of Accuracy:

Introduction – Concept of Accuracy of Machine Tools – Spindle ad Displacement Accuracies – Accuracy of numerical Control Systems – Errors due to Numerical Interpolation Displacement Measurement System and Velocity Lags. Geometric Dimensioning and Tolerancing: Tolerance Zone Conversions – Surfaces, Features, Features of Size, Datum Features – Datum Oddly Configured and Curved Surfaces as Datum Features, Equalizing Datums –Datum Feature of Representation – Form Controls, Orientation Controls – Logical Approach to Tolerancing.

UNIT II: Datum Systems:

Design of freedom, Grouped Datum Systems – different types, two and three mutually perpendicular grouped datum planes; Grouped datum system with spigot and recess, pin and hole; Grouped Datum system with spigot and recess pair and tongue – slot pair – Computation of Transnational and rotational accuracy, Geometric analysis and application.

UNIT III: Tolerance Analysis:

Process Capability, Mean, Variance, Skewness, Kurtosis, Process Capability Metrics, Cp, Cpk, Cost aspects, Feature Tolerances, Geometric Tolerances. Tolerance Charting Techniques-Operation Sequence for typical shaft type of components, Preparation of Process drawings for different operations, Tolerance worksheets and centrally analysis, Examples. Design features to facilitate machining; Datum Features – functional and manufacturing. Components design – Machining considerations, Redesign for manufactured, Examples

UNIT IV: Surface finish,

Review of relationship between attainable tolerance grades and different machining process. Cumulative effect of tolerances sure fit law, normal law and truncated normal law.

UNIT V: Fundamentals of Nanotechnology:

System of nanometer accuracies – Mechanism of metal Processing – Nano physical processing of atomic bit units. Nanotechnology and Electrochemical atomic bit processing. MEASURING SYSTEMS PROCESSING: In processing or in-situ measurement of position of processing point-Post process and on-machine measurement of dimensional features and surface-mechanical and optical measuring systems.

Reference books:

1. Nano Technology / Norio Taniguchi / Oxford University Press, 1996
2. Engineering Design – A systematic Approach / Matousek / Blackie & Son Ltd, London.
3. Precision Engineering in Manufacturing / Murthy R. L., / New Age International (P) limited, 1996.
4. Geometric Dimensioning and Tolerancing / James D. Meadows / Marcel Dekker Inc.1995.

Course Outcomes

At the end of course, students are able to

CO 1: describes the General concept of accuracy.
CO 2: Understand the datum system
CO 3: Understand the BIS code fits and tolerances for geometrical dimensioning and tolerance
CO 4: Understand the fundamental importance of surface finish and its measurement
CO 5: Explains Top down and bottom up approach, development of Nanotechnology, and precision.

Syllabus

Advanced Materials Characterization Techniques (MST – 317)

L T P: 3 0 0 **Credits-3**

Course objective

To introduce the students to the principles of optical and electron microscopy, X-ray diffraction and various spectroscopic techniques

Particulars

Unit I

Introduction: Need of materials characterization and available techniques. Optical Microscopy: Optical microscope - Basic principles and components, Different examination modes (Bright field illumination, Oblique illumination, Dark field illumination, Phase contrast, Polarised light, Hot stage, Interference techniques), Stereomicroscopy, Photomicroscopy, Colour metallography, Specimen preparation, Applications.

Unit II

Electron Microscopy: Interaction of electrons with solids, Scanning electron microscopy Transmission electron microscopy and specimen preparation techniques, Scanning transmission electron microscopy, Energy dispersive spectroscopy, Wavelength dispersive spectroscopy.

Unit III

Diffraction Methods: Fundamental crystallography, Generation and detection of X-rays, Diffraction of X-rays, X-ray diffraction techniques, Electron diffraction.

Unit IV

Surface Analysis: Atomic force microscopy, scanning tunneling microscopy, X-ray photoelectron spectroscopy. Spectroscopy: Atomic absorption spectroscopy, UV/Visible spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy.

Unit V

Thermal Analysis:Thermo gravimetric analysis, Differential thermal analysis, Differential Scanning calorimetry, Thermo mechanical analysis and dilatometry.

References

1. Li, Lin, Ashok Kumar Materials Characterization Techniques Sam Zhang; CRC Press, (2008).

2. Cullity, B.D., and Stock, R.S., "Elements of X-Ray Diffraction", Prentice-Hall, (2001).

3. Murphy, Douglas B, Fundamentals of Light Microscopy and Electronic Imaging, Wiley-Liss, Inc. USA, (2001).

4. Tyagi, A.K., Roy, Mainak, Kulshreshtha, S.K., and Banerjee, S., Advanced Techniques for Materials Characterization, Materials Science Foundations (monograph series), Volumes 49 – 51, (2009).

5. Wendlandt, W.W., Thermal Analysis, John Wiley & Sons, (1986).

6. Wachtman, J.B., Kalman, Z.H., Characterization of Materials, ButterworthHeinemann, (1993).

Course Outcomes

Students will have achieved the ability to:

CO1: Apply appropriate characterization techniques for microstructure examination at different magnification level and use them to understand the microstructure of various materials

CO2: Choose and appropriate electron microscopy techniques to investigate microstructure of materials at high resolution

CO3: Determine crystal structure of specimen and estimate its crystallite size and stress

CO4: Use appropriate spectroscopic technique to measure vibrational / electronic transitions to estimate parameters like energy band gap, elemental concentration, etc.

CO5: Apply thermal analysis techniques to determine thermal stability of and thermodynamic transitions of the specimen.

Syllabus

Additive Manufacturing Technology (MST – 318)

L T P: 3 0 0 **Credits-3**

Course objectives:

• To analyze and determine material fabrication processes.

• To use laboratory instrument doing routine metrological measurements

• To operate regular machine shop equipment such as grinders, drill presses, lathes, milling machines, shapers and etc.

• To recognize engine machine tool requirements and be selective in the choice of tools.

• To setup and operate machines, index and determine machine speeds, feeds, and depth of cut requirements.

• To identify with numerical control machining and computer programming.

• To determine costs and establish basic programs in machine shop economics.

UNIT - I:

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

UNIT - II:

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

UNIT - III:

Laser Beam Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Plasma Arc Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electron Beam Machining - Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications. Electro Chemical Machining – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, Applications.

UNIT - IV:

Processing of ceramics: Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying , sintering, Hot compaction, Area of application

, finishing of ceramics. Processing of Composites: Composite Layers, Particulate and fiber reinforced composites,
Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

UNIT - V:

Fabrication of Microelectronic devices: Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics. E-Manufacturing, nanotechnology, and micromachining, High speed Machining

References:

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

Course Outcomes

At the end of course, students are able to

CO1: Understand the principle of vapour deposition

CO2: Understand the aspects of non-traditional machining

CO3: Understand the principle of laser beam and electron beam machining

CO4: Demonstrate the knowledge about processing ceramics

CO5: Demonstrate the knowledge for fabrication of microelectronic devices

Syllabus

Manufacturing System Simulation (MST – 319)

L T P: 3 0 0 **Credits-3**

Course objectives

To acquaint the student with the various methods of modelling and analysis of manufacturing systems.

Particulars

Unit I

Manufacturing Systems and Models

Introduction to manufacturing models- types and principles of manufacturing system, manufacturing models - types and uses- physical models, mathematical models, model uses, model building

Unit II

Assembly Lines, Scheduling

Introduction- line balancing algorithms- COMSOL Random sequence generation, Ranked positional weight heuristics, optimal solutions- practical issues - mixed models – sequencing- unpaced lines-

Shop scheduling with many products, Order release, flow shop sequencing – single and two machine flow shops- job shop scheduling- Dispatching rules and Schedule generation

Unit III

Flexible Manufacturing Systems

Introduction - Components of FMS – Machines, Part movement system, work stations, system controller. Planning and control hierarchy- System design, system set up, scheduling and control. Flexible assembly system.- Group technology – principles, coding schemes, assign machines to groups- production flow analysis, binary ordering algorithm. Assigning parts to machines

Unit IV

Material Handling and AGV systems

Introduction- types, principles of material handling – Equipment selection, conveyor analysis, closed loop conveyor- AGV systems – Design and operation of AGV, vehicle requirements analysis- pallet sizing and loading

Unit V

Ware Housing – Storage and Retrieval Systems

Introduction – ware house components – ware house design, stacking pattern, location in ware houses – dedicated storage, open storage, class base storage, storing complementary items- Order picking – forming pick list, pick sequencing

References

1. Ronald G. Askin and Charles R. Standridge, "Modeling and analysis of manufacturing systems" John Wiley & Sons, Inc. 2000

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

3. Jha, N.K., "Handbook of Flexible Manufacturing Systems", Academic Press Inc., 1991.

4. Kalpakjian, "Manufacturing Engineering and Technology", Addison-Wesley Publishing Co., 1995.
5. Taiichi Ohno, Toyota, "Production System Beyond Large-Scale production", Productivity Press (India) Pvt.Ltd., 1992.

Course outcomes

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

CO1 Understand types and models of manufacturing systems

CO2 Apply line balancing algorithms

CO3 Design flexible manufacturing systems

CO4 Design of material handling systems

CO5 Design ware house systems

Syllabus

Modern Concepts of Engineering Design (MST – 320)

L T P: 3 0 0 **Credits-3**

Course Objectives

- Widen students' knowledge on design process
- Enable Students to attain knowledge on tools used in Design Methods
- Create an understanding on the process of material selection and design
- Develop in depth knowledge on Engineering statistics and reliability
- Create awareness on legal and ethical issues in Design a Quality Engineering

UNIT I

DESIGN PROCESS: The design process – Morphology of Design – Design Drawings – Computer Aided Engineering – Designing of standards – Concurrent Engineering – Product life cycle – Technological Forecasting – Market Identification– Competition Bench marking – Systems Engineering – Life Cycle Engineering – Human Factors in Design – Industrial Design.

UNIT II

DESIGN METHODS: Creativity and Problem Solving – Product Design Specifications– Conceptual design – Decision Theory – Decision Tree – Embodiment Design – Detail Design – Mathematical Modeling – Simulation – Geometric Modeling – Finite Element Modeling – Optimization – Search Methods – Geometric Programming – Structural and Shape Optimization.

UNIT III

MATERIAL SELECTION PROCESSING AND DESIGN: Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classificationof Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

UNIT IV

ENGINEERING STATISTICS AND RELIABILITY: Probability – Distributions – Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Reliability centered Maintenance.

UNIT V

LEGAL AND ETHICAL ISSUES IN DESIGN AND QUALITY ENGINEERING: Introduction – The origin of laws – Contracts – Liability – Tort law – Product liability – Protecting intellectual

property – Legal and ethical domains – Codes of ethics – Solving ethical conflicts– case studies Total Quality Concept – Quality Assurance – Statistics Process Control – Taguchi Methods – Robust Design – Failure Model Effect Analysis.

References

1. Pahl, G. and Beitz, W. (1984) Engineering Design. Springer - Verlag

2. Karl Ulrich, T. and Eppinger Steven, D. (2000) Product Design and Development. McGraw Hill Edition

3. Dieter George, E. (1991) Engineering Design - A Materials and Processing Approach. McGraw Hill, 4. International Editions, Mechanical Engineering Series

5. Suh, N.P. (1990) The principles of Design. Oxford University Press 6.Ray, M.S. (1985) Elements of Engg.Design. Prentice Hall Inc

Course Outcomes:

1. Get clear understanding on CAE / concurrent engineering and systems engineering
2. Attain problem solving skills through modeling/simulation and optimize design
3. Ability to do material selection based on economy and value analysis. Develop understanding on DFM/DFA
4. Have good understanding on DOE, Reliability theory and reliability centred maintenance
5. Exposed to laws, codes of ethics, Quality concepts and FMEA

Syllabus

Facility Planning and Value Engineering (MST – 331)

L T P: 3 0 0 **Credits-3**

Course objective

Provide students with the ability to apply plant layout design procedure to design a new facility and ability to select a suitable location for new facility with the use of different techniques.

Particulars

Unit 1

Plant layout, material handling and their interrelationship, objectives of a good plant layout, principles of a good layout, classical types of layouts, special types and practical layouts. Factors affecting plant layout: man, material, machine, movement, waiting, service, building and change, features and considerations of each factor, procedure of plant layout, data collection for layout design, layout visualization using templates and 3D models.

Unit 2

Various theories/models of site location like equal weights, variable weights, weight cum rating, composite model and Bridgemannn's model, Weber index, and various subjective techniques, evaluation of layout, computerized layout, flowcharts of various Programmes like CRAFT, ALDEP AND CORELAP.

Unit 3

Principles, factors affecting material handling, objectives, material handling equation, selection of material handling systems and equipments, cranes, conveyors, hoists and industrial trucks, installation of new facilities in the existing setup using median model and gravity model.

Unit 4

Methodology of value engineering, unnecessary costs, use and prestige value, estimation of product quality or performance.Types of functions functional cost and functional worth.Effect of value improvement on profitability, tests for poor value.

Unit 5

Aims and objectives of value engineering, systematic approach.Value engineering, job plan- study ofvarious phases of the job plan.Selection of projects for value analysis. Primary and secondary functions work and sell functions, determining and evaluating functions, assigning equivalence, function-cost matrix evaluation. Function (FAST).Reporting, implementation & follow up.

References

1. Tompkins, J. A., White, J. A., Bozer, Y.A. and Tanchoco, J.M.A., Facilities Planning, John Wiley (2003).
2. Muther, R., Practical Plant Layout, McGraw Hill Book Company (1995).
3. Anil Kumar Mukhopadhyaya, "Value Engineering: Concepts Techniques and applications", SAGE Publications 2010.

Course Outcomes

At the end of this course, student is able

CO1: To select a suitable location amongst the available locations for setting up a new facility.
CO2: To decide about the particular production process flow strategy.
CO3: To design a layout for the new facility to suit the company's production process structure.
CO4: To select proper type of equipment for storage and movement of material.
CO5: To create the value engineering team and discuss the value engineering case studies.

Syllabus

Quality Management (MST – 332)

L T P: 3 0 0 **Credits-3**

Course Objective

The objectives of this course is to introduce the main principles of business and social excellence, to generate knowledge and skills of students to use models and quality management methodology for the implementation of total quality management in any sphere of business and public sector.

Particulars

Unit 1

Quality Concepts: Evolution of Quality Control, concept change, TQM Modern concept, Quality concept in design, Review of design, Evolution of proto type.

Control on Purchased Product: Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality: Methods and techniques for manufacture, inspection and control of product, quality in sales and services, guarantee, analysis of claims.

Unit 2

Quality Management: Organization structure and design, quality function, decentralization, designing and fitting, organization for different type products and company, economics of quality value and contribution, quality cost, optimizing quality cost, seduction program.

Human Factor in quality: Attitude of top management, cooperation of groups, operators attitude, responsibility, causes of apparatus error and corrective methods.

Unit 3

Control Charts: Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts.

Attributes of Control Chart: Defects, construction and analysis of charts, improvement by control chart, variable sample size, construction and analysis of C charts.

Unit 4

Defects diagnosis and prevention defect study, identification and analysis of defects, correcting measure, factors affecting reliability, MTTF, calculation of reliability, building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

Unit 5

ISO-9000 and its concept of Quality Management ISO 9000 series, Taguchi method, JIT in some details.

References

1. Lt. Gen. H. Lal, "Total Quality Management", Eastern Limited, 1990.
2. Greg Bounds, "Beyond Total Quality Management", McGraw Hill, 1994.
3. Menon, H.G, "TQM in New Product manufacturing", McGraw Hill 1992.

Course Outcomes

At the end of this course, student will demonstrate the ability to

CO1: Explain the different meanings of the quality concept and its influence.

CO2: Recognize the contributions of world's leading experts on quality management and through this, develop the intellectual skills.

CO3:Understand the importance of control chart.

CO4:Understand the concept of reliability.

CO5:To apply the concept of Quality Management ISO 9000 series and Taguchi method.

Syllabus

Reliability and Maintenance Engineering (MST – 333)

L T P: 3 0 0 **Credits-3**

Course objective

To apply the concept to reliability, concept of maintainability, concept of replacement planning & to apply the concept of maintenance management.

Particulars

Unit1

Reliability: Introduction and definition about reliability, Probabilistic nature of failures. Mean failure rate and meantime between failures (MTBF) of component/system: Problems Hazard rate and Hazard models Problems Weibull model for reliability of components/systems. Reliability of components in Series configuration.Reliability of components in Parallel configuration. Redundant and Mixed configurations System reliability improvement. Case studies in reliability of system.

Unit 2

Maintainability: Introduction and definition of maintainability, availability. Choice of maintenance strategy. Factors contributing to Mean Down Time (MDT): Problems Mean time to repair (MTTR):Problems Fault diagnosis, and routine testing forum revealed faults. Factors contributing to Mean Maintenance Time (MMT): Problems Types of maintenance Economics of maintenance.

Unit 3

Maintenance Strategies: Break down maintenance, planned maintenance, strategies, preventive maintenance, design out maintenance, planned lubrication, total productive maintenance, zero break down, preventive inspection of equipment used in emergency.

Unit 4

Replacement planning maintain or replace decision, replacement of items that deteriorate identical equipment, replacement of items that fail without deterioration individual, group replacement, replacement in anticipation of failure. Break down maintenance planning.

Unit 5

Maintenance Management, production maintenance system, objectives and functions, forms, policy, planning, organization, economics of maintenance, manpower planning, materials planning, spare parts planning and control, evaluation of maintenance management.

References

1. Industrial Safety Handbook: William Handley.
2. Introduction to Safety Engineering: David S Gloss & Miriam Gayle Wardle.
3. Industrial Safety: Roland P Blake.
4. Industrial Hazard & Safety Handbook: Ralph King & John Magid.

Course Outcomes

At the end of this course, the student is

CO1: Able to explain the concept to reliability.

CO2: Able to explain the concept of maintainability of a system.

CO3: Able to explain the concept of maintenance strategies.

CO4: Able to explain the concept of replacement planning.

CO5: Able to explain the concept of maintenance management.

Syllabus

Entrepreneurship Development (MST – 334)

L T P: 3 0 0 **Credits-3**

Course objective

To motivate the development of new entrepreneurs for new India.

Particulars

Unit 1

Foundation of Entrepreneurship Development: Concept and need of entrepreneurship; Characteristics and Types of Entrepreneurship; Entrepreneurship as a career; Entrepreneurship as a style of Management; The changing role of the entrepreneur; Entrepreneurial traits, factors affecting entrepreneur.

Unit 2

Theories of Entrepreneurship: Influences on entrepreneurship development; External influences on entrepreneurship development; Socio-cultural, Political, economical, personal entrepreneurial success and failure: reasons and remedies; Women entrepreneurs: Challenges and achievements of women entrepreneurs.

Unit 3

Business Planning Process: The business plan as an entrepreneurial tool; Elements of business planning; Objectives; Market analysis; development of Product/ idea; Marketing, Finance, Organization and management; Ownership; Critical risk contingencies of the proposal; Scheduling and milestones.

Unit 4

Project Planning for Entrepreneurs: Technical, Financial, Marketing, Personnel, and management feasibility reports; Financial schemes offered by various financial institution, Like Commercial Banks, IDBI, ICICI, SIDBI, SFCs, Foreign currency, Financing; Estimation of Financial requirements.

Unit 5

Entrepreneurship Development and Government: Role of Central Government and State Government in promoting entrepreneurship with various incentives, subsidies, grants, programmed, schemes and challenges. Government initiatives and inclusive entrepreneurial Growth.

References

1. Khanna, S.S., Entrepreneurial Development, S. Chand, New Delhi.
2. Hisrich D. Robert, Michael P. Peters, Dean A. Sheperd, Entrepreneurship, McGraw-Hill, 6th ed.
3. Zimmerer W. Thomas, Norman M. Scarborough, Essentials of Entrepreneurship and Small Business Management, PHI, 4th ed.
4. Holt H. David, Entrepreneurship: New Venture Creation, Prentice- Hall of India, New Delhi, Latest edition.
5. Kuratko, F. Donald, Richard M. Hodgetts, Entrepreneurship: Theory, Process, Practice, Thomson, 7th ed.
6. Desai, Vasant, Dynamics of Entrepreneurship: New Venture Creation, Prentice-Hall of India, New Delhi, Latest edition.
7. Patel, V.G., The Seven Business Crises and How to Beat Them, Tata McGraw-Hill, New Delhi, 1995.
8. Roberts, Edward B.(ed.), Innovation: Driving Product, Process, and Market Change, San Francisco: Jossey Bass, 2002.
9. SIDBI Report on Small Scale Industries Sector, Latest edition.

Course Outcomes

At the end of course, students will able to understand

CO1: the basic requirements for entrepreneurship.

CO2: the influence of entrepreneurship on socio-cultural, political and economical regime.

CO3: the entrepreneurial tool.

CO4: the aspects of project planning for entrepreneurs.

CO5: the schemes raised by central and state Government for promoting entrepreneurship.

Syllabus

Product Engineering (MST – 335)

L T P: 3 0 0 **Credits-3**

Course Objectives: 1. Gain an understanding and appreciation of the breadth and depth of the field of Product design and manufacturing. 2. Understand the various basics of Product design phases, design morphology, considerations in different manufacturing processes and value engineering. 3. Learn how to apply optimization, ergonomics and anthropometry for product design and manufacturing. 4. Learn to design, develop and manufacturing of a product.

Unit 1

Introduction to Product Design

Asimow's Model: Definition of Product Design, Design by Evolution, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production-consumption Cycle, The Morphology of Design (The sever phases), Primary Design Phases and flowcharting, Role of Allowance Process Capability, and. Tolerance in Detailed Design and Assembly.

Unit 2

Product Design Practice and Industry

Introduction, Product Strategies Time to Market, Analysis of the Product, The Three S's, Standardization Renard Series (Preferred Numbers), Simplification, The Designer and it’s Role, The Designer: Myth and Reality, The Industrial Design Organization Basic Design Considerations, Problems faced by Industrial Designer. Procedure adopted by Industrial Designers, Types of Models designed by Industrial Designers, What the Designer contributes, Role of Aesthetics in Product Design, Functional Design Practice.

Review of Strength, Stiffness and Rigidity Considerations in Product Design Principal Stress Trajectories (Force - Flow Lines), Balanced Design, Criteria and Objectives of Design, Material Toughness: Resilience, Designing for Uniform Strength, Tension vis-à-vis Compression.

Unit 3

Design for Production - Metal Parts

Producibility Requirements in the Design of Machine Components, Forging Design, Pressed Components Design, Casting Design, Design for Machining Ease, The Role of Process Engineer, Ease of Location and Clamping, Some Additional Aspects of Production Design, Die Casting and Special Castings, Design for Powder Metallurgical Parts, Expanded Metals and Wire Forms. Designing with Plastics, Rubber, Ceramics and Wood Approach to Design with Plastics, Plastic Bush Bearings, Gears in Plastic, Fasteners in Plastic, Rubber Parts, Design Recommendations for Rubber Parts, Distortion in Rubber, Dimensional Effects, Tolerances, Ceramics and Glass Parts, Production Design Factors for Ceramic Parts, Special Considerations for Design of Glass Parts, Dimensional Factors and Tolerances, Wood. Design for assembly and disassembly.

Unit 4

Economic Factors Influencing Design Product Value, Design for Safety, Reliability and Environmental Considerations, Manufacturing Operations in relation to Design, Economic Analysis, Profit and Competitiveness, Break- even Analysis, Economics of a New Product Design (Samuel Eilon Model).

Human Engineering Considerations in Product Design Introduction, Human being as Applicator of Forces, Anthropometry: Man as Occupant of Space, The Design of Controls, The Design of Displays, Man/Machine Information Exchange.

Unit 5

Value Engineering and Product Design Introduction, Historical& Perspective, What is Value? Nature and Measurement of Value, Maximum Value, Normal Degree of Value, Importance of Value, The Value Analysis, Job Plan, Creativity, Steps to Problem-solving and Value Analysis, Value Analysis Tests, Value Engineering Idea Generation Cheek-list, Cost Reduction through Value Engineering Case Study on Tap Switch Control Assembly, Material and Process Selection in Value Engineering.

Modern Approaches to Product Design

Concurrent Design, Quality Function Deployment (QFD) for design.

Text Books:

- A.C. Chitale and R.C. Gupta, Product Design and Manufacturing by PHI.
- Karl T. Ulrich & Steven D., Product Design & Development Eppinger Tata McGraw Hill, 3rd Edition, 2003

Reference Books:

- Tim Jones, Butterworth Heinmann, New Product Development by Oxford, TAC- 1997.
- Roland Engene Y.,Inetoviez, New Product Development: Design & Analysis, John Wiley and Sons Inc., N.Y. 1990.
- GeofferryBoothroyd, Peter Dewhurst and Winston Knight. Product Design forManufacture and Assembly, Amherst, 1983.
- Bill Hollins, Stwout Pugh, Butterworth, Successful Product Design by London 1990.
- Boothroyod&DewburstP.,Design for Assembly, a Designer's Hand book, University of Massachusets, Amherst, 1983.
- Keyinotto&Kristini Wood, Product Design Pearson Education 2004.

Course Outcomes:

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

1. Learn basics of product design process and morphology of design.

2. Students are exposed to Concept design, detail design, manufacturing, marketing, Introductionstrategy of new product. Students learn about process of design for production of metalcomponents.

3. Understand producibility requirements in the Design of Machine Components.

4. To prepare a brief presentation on design morphology of at least one product as well as assignmentsis given to students to evaluate manufacturability and design for production.

5. At the end of course students should aware of different stages of product design

Syllabus

Six Sigma (MST – 336)

L T P: 3 0 0 **Credits-3**

Unit-I

Quality Perception: Quality in Manufacturing, Quality in Service Sector; Differences between Conventional and Six Sigma concept of quality; Six Sigma success stories. Statistical foundation and methods of quality improvement.

Descriptive statistics: Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis.

Probability Distribution: Normal, Binomial, Poisson Distribution.

Unit-II

Basics of Six Sigma: Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S, Customer focus, Six Sigma for manufacturing, Six Sigma for service. Z score, Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts.

Unit-III

Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects.

Unit-IV

Six Sigma Tools: Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments.

Unit-V

Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to softwares for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.

References:

1. Six Sigma: SPC and TQM in manufacturing and service, Geoff Tennant, Gower Publishing Co.
2. Six Sigma for managers, Greg Brue, TMH
3. What is Six Sigma, Pete Pande, TMH
4. The Six Sigma Way, Peter S. Pande, TMH Team Field book
5. The Six Sigma way, Peter S. Pande, TMH