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. Production Engineering)

(For admission in 2022-23 and onwards)

Course Structure and Scheme of Examination for M. Tech. - 2 Year Program Production 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	PET-301	Machining Science	3	1	0	4	50	100	150
3	PET-302	Industrial Tribology	3	1	0	4	50	100	150
4	PET-3XX	Professional Elective 1	3	0	0	3	50	100	150
5	PET-3XX	Professional Elective 2	3	0	0	3	50	100	150
6	PEP 301	Machining Science Lab	0	0	3	1	25	25	50
7	PEP 302	Industrial Tribology Lab	0	0	3	1	25	25	50
8	AHT-302	Research Methodology and IPR	2	0	0	2	50	50	100
9	AHT-303	Technical Writing and Presentation Skill	2	0	0	0	50	0	
		Total	**19**	**3**	**6**	**22**	**400**	**600**	**950**
10	PET-3XX	Open Elective (Optional)	3	0	0	3	50	100	150

Semester II (M. Tech. - 2 Year Program: Production Engineering)									
Sr. No.	**Course Type/Code**	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**	**External Marks**	**Total Marks**
			L	**T**	**P**				
1	PET-303	Advanced Welding Technology	3	1	0	4	50	100	150
2	PET-304	Computer Integrated Manufacturing	3	1	0	4	50	100	150
3	PET-3XX	Professional Elective 3	3	1	0	4	50	100	150
4	PET-3XX	Professional Elective 4	3	0	0	3	50	100	150
5	PET-3XX	Open Elective	3	0	0	3	50	100	150
6	PEP-303	Advanced Welding Technology Lab	0	0	3	1	25	25	50
7	PEP-304	Computer Integrated Manufacturing Lab	0	0	3	1	25	25	50
		Total	**15**	**3**	**6**	**20**	**300**	**550**	**850**
8	PET-3XX	Open Elective (Optional)	3	0	0	3	50	100	150

Semester III (M. Tech. - 2 Year Program: Production Engineering)											
Sr. No.	**Course Type/Code**	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**			**External Marks**	**Total Marks**
			L	**T**	**P**		**CT**	**TA**	**Total**		
1	PET-3XX	Open Elective	3	0	0	3	30	20	50	100	150
2	PEP-305	Seminar	0	0	4	2			100		100
3	PEP-306	Project	0	0	10	5			100	150	250
4	PEP-307	Dissertation	0	0	12	6			300		300
		Total	**3**	**0**	**22**	**16**			**550**	**250**	**800**

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

Course Structure and Scheme of Examination for B.Tech.-M. Tech. Dual 1 Year Program Production 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	PET-301	Machining Science	3	1	0	4	50	100	150
3	PET-3XX	Open Elective	3	0	0	3	50	100	150
4	AHT-302	Research Methodology and IPR	2	0	0	2	50	50	100
5	PEP-305	Seminar	0	0	4	2	100		100
6	PEP-306	Project	0	0	10	5	100	150	250
7	PEP-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- Production Engineering)									
Sr. No.	**Course Type/Code**	**Course Name**	**Teaching Scheme**			**Credits**	**Internal Marks**	**External Marks**	**Total Marks**
			L	T	P				
1	PET-303	Advanced Welding Technology	3	1	0	4	50	100	150
2	PET-3XX	Professional Elective1/2/4	3	0	0	3	50	100	150
3	PET-3XX	Open Elective	3	0	0	3	50	100	150
5	PEP-301	Machining Science Lab	0	0	3	1	25	25	50
4	PEP-303	Advanced Welding Technology Lab	0	0	3	1	25	25	50
6	PEP-308	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

Professional Electives 1

1. PET- 305 Modelling and Simulation
2. PET- 306 Rapid Prototyping and Tooling
3. PET- 307 Supply Chain Management
4. PET- 308 Automated Material Handling System

Professional Electives 2

1. PET- 309 Facility planning and Value Engineering
2. PET- 310 Materials Managements
3. PET- 311 Computer Aided Process Planning
4. PET- 312 Total Quality Management

Professional Electives 3

1. PET- 313 Computational Methods in Engineering
2. PET- 314 Finite Element Methods
3. PET- 315 Metrology and Inspection
4. PET- 316 Advanced Forming Processes

Professional Electives 4

1. PET- 317 Industrial Automation and Robotics
2. PET- 318 Material Characterization
3. PET- 319 Metal Casting
4. PET- 320 Machine Tool Design

Open Elective

1. PET- 331 Waste to Energy
2. PET- 332 Cost Management of Engineering Projects
3. PET- 333 Industrial Safety
4. PET- 334 Operations Research
5. PET- 335 Composite Materials
6. PET- 336 Industrial Design and Ergonomics

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

Syllabus

Machining Science (PET – 301)

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 machining.

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, modeling 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

Industrial Tribology (PET – 302)

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

Course objective

The impart knowledge on friction and methods to minimize wear of engineering components.

Unit 1

Introduction of tribology: Definition and Scope of tribology, Nature of metallic surface, surface geometry, measurement of surface topography, quantifying surface roughness, contact between surfaces Friction, the laws of friction, measurement of friction, origin of friction, theories of friction adhesion- theory, extension of the adhesion theory.

Unit 2

Wear: Types of wear, adhesive wear, Archard's law, abrasive wear, erosion wear, factors affecting corrosive wear, wear map, various wear testing methods- pin on disc, pin on drum, slurry wear, air jet and water jet erosion as per ASTM standards.

Unit 3

Introduction of lubrication and Tribological properties of solid materials: Introduction of lubrication and need of lubrication, properties of lubrications, Hardness, strength, ductility and work hardening rate, effect of crystal structure, effect of microstructure, mutual solubility of rubbing pairs and effect of temperature.

Unit 4

Surface treatments to reduce wear: Surface treatments with or without change of composition, surface coating- welding, flame, spraying, plasma spraying, electroplating and electroless coating, chemical vapour deposition (CVD) and physical vapour deposition (PVD), super hard coatings.

Unit 5

Applications: Application of tribology in manufacturing processes, Metal machining, Metal cutting, Tool wear, Action of lubricants, Friction welding, Extrusion process.

References

1. Engineering Tribology P Sahoo Prentice Hall of India
2. Principles and Applications of Tribology D.F. Moore Pergamon Press
3. Fundamentals of Tribology Basu, Sengupta&Ahuja Prentice Hall of India
4. Tribology Handbook M.J. Neele.

Course outcomes

CO1: Ability to understand the laws of friction.

CO2: Ability to understand different types of wear.

CO3: Capability to analyses tribological properties of solid materials.

CO4: Knowledge of basic principal of Coating.

CO5: Ability to understand the application of tribology.

Syllabus
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

Machining Science Lab(PEP – 301)

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

Course objective

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

Particulars

List of Experiments:

1. Study of the morphology of chips produced from different materials and 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. Determination of cutting forces in turning.
7. Truing and dressing of the grinding wheel.
8. Study the micro-drilling and micro-milling operations.

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.

Course outcomes

CO1: To be able to understand the morphology of chips produced.

CO2: To be able to understand the effect of tool geometry and chip thickness ratio.

CO3: Understand the measurement of tool face temperature and machined surface roughness.

CO4: To be able to understand the determination of cutting forces.

CO5: Understand the truing and dressing of grinding wheel, hands on operation on micro drilling.

Syllabus

Industrial Tribology Lab (PEP – 302)

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

Course objective

The impart knowledge on friction and methods to minimize wear of engineering components.

Particulars

List of experiments

1. Study of wear characteristics of machine components.
2. To determine sliding wear rate of given sample.
3. To determine of abrasive wear rate of given sample
4. To Study of surface characterization of wear components.
5. To determine the hardness of given sample.
6. To study of D-GUN spray coating technique.
7. To study of HVOF spray coating technique.
8. To study of cold spray coating technique.
9. To study of application of industrial tribology.
10. To Study of air jet and water jet erosion.

References

1. Engineering Tribology P Sahoo Prentice Hall of India.
2. Principles and Applications of Tribology D.F. Moore Pergamon Press.
3. Fundamentals of Tribology Basu, Sengupta&Ahuja Prentice Hall of India.
4. Tribology Handbook M.J. Neele.

Course outcomes

CO1: Ability to understand the wear characteristics of machine components.

CO2: Ability to understand different types of wear.

CO3: Capability to analyses different coating techniques.

CO4: Knowledge of basic principle of erosion.

CO5: Ability to understand the application of industrial tribology.

Syllabus

Advanced Welding Technology(PET – 303)

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

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

Computer Integrated Manufacturing(PET – 304)

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

Course objective

The course provides an overview of computer integrated manufacturing.

Particulars

Unit 1:

Introduction: Introduction to manufacturing system and their analysis. CIM-Basic concepts, Evolution of CIM Manufacturing Automation protocol.

Unit 2:

Numerical Control: Introduction- Fundamentals of N. C. Technology, Computer Numerical Controls, Distributed Numerical Control, Application of N.C., Engineering analysis of NC positioning system, N.C. part programming, part programming with APT.

Unit 3:

Group Technology: Introduction, Basic layout, process layout, product layout, comparison. Designing process layout. Coding system.

Flexible manufacturing System: Introduction, elements of FMS, Cell technology and FMS, optimization of FMS.

Unit 4:

Material Handling & Storage: Overview of material handling equipment, automated material handling equipment- A.G.V, features, function, types and safety consideration of AGV, Conveyers.

Analysis of material storage system: ASRS and caroused storage, Analysis of storage system.

Unit 5:

Manufacturing Support Functions: Introduction to computer aided process planning (CAPP), Just-in-time and Lean Production, MRP I&II, Concurrent engineering.

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.

Course Outcomes

CO1: Able to understand the manufacturing system and their analysis.

CO2: Able to understand the concepts of numerical control.

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

CO4: Able to understand the concepts of material handling and material storage system.

CO5: Able to understand the concepts of manufacturing support functions.

Syllabus

Advanced Welding Technology Lab(PEP – 303)

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

Course objective

To impart practical exposure about Fusion welding (Gas Welding, Resistance spot welding, GTAW welding and GMAW welding) practices applied in industries. Moreover, the practical knowledge about the metal spraying and the changes in hardness and wear properties of coated-film also covered. At more outset, the practical knowledge about various non-destructive testing (Dye-Penetrant, Magnetic Particle, Ultrasonic, eddy current) of defects occurred in weldments also explored.

Particulars

List of Experiments

A minimum of 08 experiments from the following:

1. Experiment on Gas Welding to find out the mechanical properties of metals
2. Experiment on Resistance Spot Welding to find out the mechanical properties of metals
3. Experiments on GTAW (TIG) welding to find out the mechanical properties of metals
4. Experiments on GMAW (MIG) welding to find out the mechanical properties of metals
5. Experiments on Friction Stir Welding to find out the mechanical properties of metals
6. Experiment on Metal Spraying and to study the tribological properties of coated film
7. Experiment on Metal Spraying and study the hardness of coated film
8. Dye-Penetrant Testing of weldments
9. Magnetic Particle Inspection of weldments
10. Ultrasonic testing of weldments
11. Eddy current testing of weldments
12. Thermo-mechanical design and stress analysis using any FEM package

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

At the end of this course, student is able to

CO1: Understand the working principle of Gas and Resistance spot welding along with the hand on experience.

CO2: Understand the working principle of MIG and TIG welding and also have hand on experience of these welding techniques.

CO3: Understand the working principle of friction stir welding.

CO4: Understand the concept for metal spraying.

CO5: Understand and apply the testing methods of welding.

Syllabus

Computer Integrated Manufacturing Lab(PEP – 304)

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

Course objective

The course provides an overview of CNC part programming skill for turning and milling operations.

Particulars

List of Experiments (Minimum 8 of the following)

1. To write a program to obtain the facing cycle in the CNC lathe.
2. To write a program to obtain the turning cycle in the CNC lathe.
3. To write a program to obtain the step turning cycle in the CNC lathe.
4. To write a program to obtain the taper turning cycle in the CNC lathe.
5. To write a program to obtain the Circular Interpolation in the CNC lathe.
6. To write a program to obtain the Drilling Cycle in the CNC lathe.
7. To write a program to obtain the Threading Cycle in the CNC lathe.
8. To write a program to obtain the Grooving Cycle in the CNC lathe.
9. To write a program to obtain linear and circular interpolation on the given work piece.
10. To write a program to engrave the letters “(college name)” on the given work piece.
11. To write a program to perform the mirroring operation.
12. To write a program to perform the Rotation operation on the given work piece.
13. To write a program to perform the Circular pocketing operation on the given work piece.
14. To write a program to perform the rectangular pocketing operation on the given work piece.

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.

Course Outcomes

CO1: Able to demonstrate the working with different equipment to test the basic concepts in NC technology for applications in industry.

CO2: Able to apply the concepts in NC technology for milling operation to solve complex industrial problems.

CO3: Able to apply the concepts in NC technology for turning operation to solve complex industrial problems.

CO4: Able to design the different types of critical programs as a group to execute the projects related to CIM.

CO5: Able to improve their programming skills.

Syllabus

Modeling and Simulation(PET – 305)

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

Course objective

To understand the concept of modeling and simulation. To classify and use various modeling and simulation methods.

Particulars

Unit 1: Introduction to modeling

Concept of system, continuous and discrete systems; Types of models and simulation; Discrete event simulation: Time advance mechanisms, components and organization of simulation model, steps in simulation study.

Unit 2: Statistical models in simulation

Discrete, continuous, Poisson and empirical distributions, output data analysis for a single system, comparing alternative system configurations, statistical procedures for comparing real world observations with simulation output data, generation of arriving processes, verification and validation of simulation models.

Unit 3: Stochastic simulation

Random number generation: Properties of random numbers, techniques of generating random numbers, generation of random varieties, Monte Carlo simulation and its applications in queuing models and inventory models.

Unit 4: Simulation of manufacturing and material handling systems

Models of manufacturing systems, models of material handling systems, goals and performance measures; Issues in manufacturing and material handling simulation: Modeling downtime failures, trace driven models.

Unit 5: Case studies on simulation packages

Simulation of queuing system (bank/job shop), simulation of manufacturing and material handling systems.

References

1. Banks, J., Nelson, B.L., Carson, J. S., and Nicol, D., "Discrete Event System Simulation", Pearson Education
2. Law, A.M., and Kelton, W.D., "Simulation Modeling and Analysis", McGraw-Hill
3. Schwarzenbach, J., and Gill, K.F., "System Modeling and Control", Butterworth-Heinemann
4. Carrie, A., "Simulation of Manufacturing Systems", John Wiley & Sons
5. Viswanadham, N., and Narahari, Y., "Performance Modeling of Automated Manufacturing System", Prentice-Hall of India.

Course outcomes

CO1: To be able to understand the types of modeling and simulation.

CO2: To be able to understand the static model in simulation.

CO3: Understand the concept of stochastic simulation.

CO4: To be able to understand the simulation of manufacturing and material handling systems.

CO5: Understand the case studies on simulation packages.

Syllabus

Rapid Prototyping and Tooling(PET – 306)

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

Course objective

The objective of rapid prototyping is how a part will designand development of a new product,In present era it is highly essential to be able to prepare final product or its prototype at the earliest. This is desirable to ensure that all the expected requirement of product are addressed and if required, its performance is also assessed from the prototype. Rapid prototyping offers a convenient option for manufacturing of product or its prototype from the CAD model.

Particulars

Unit 1

Introduction: Historical developments, Fundamentals of RP Systems and its Classification, Rapid prototyping process chains, 3D modeling and mesh generation, Data conversion and transmission.

Unit 2

RP Systems: Liquid polymer based rapid prototyping systems, Teijin Seiki's solid form and other similar commercial RP systems, Solid input materials based rapid prototyping systems, laminated object manufacturing (LOM) and fused deposition modelling systems etc.

Unit 3

Power based rapid prototyping systems, selective Laser sintering, SoligenDiren's shell production casting (DSPC), Fraunhofer's multiphase jet solidification (MJS) and MIT's 3D printing (3DP) etc.

Unit 4

RP Database: Rapid prototyping data formats, STL format, STL file problems, STL file repair, Network based operations, Digital inspection, Data warehousing and learning from process data.

Unit 5

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

RP Applications: Development of dies for molding, RP applications in developing prototypes of products, application in medical fields, Development of bone replacements and tissues etc., RP materials and their biological acceptability.

References:

1. Rapid Prototyping of Digital Systems: A Tutorial Approach by Hamblen James O Kluwer.
2. Rapid Prototyping: Principles and Applications by Kai Chua Chee, World Science.
3. Rapid System Prototyping: Accelerating the Design Process by R C Cofer.
4. Rapid Prototyping of Digital Systems by James O Hamblen Springer.

Course outcomes

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

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

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

CO3: Demonstrate solid ground curing principle and process

CO4: Discuss Rapid prototyping data formats, STL format, Digital inspection and Data warehousing.

CO5: Use appropriate tooling for rapid prototyping process and point out the application of RP System in medical field.

Syllabus

Supply Chain Management(PET – 307)

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

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

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

Automated Material Handling System(PET – 308)

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

Course objective

To introduce various automated material handling equipment and their utilization.

Particulars

Unit 1: Introduction of Material Handling

Overview of MHE, consideration in MHS design, twenty principles of material handling. The unit load concept.

Unit 2: Material Transport Systems

Industrial trucks, automated guided vehicle systems, monorails and other rail guided vehicles, conveyor systems, cranes and hoists.

Unit 3: Evaluation and Selection of Material Handling Layout

Design of bins and hoppers – flow patterns, measurement of flow properties, design methods, feeders, dischargers, silos, chutes and gates; Bulk material sampling and weighing systems, blending of bulk materials.

Unit 4: Analysis of Material Transport Systems

Rate of deliveries, required number of vehicles, economics of material handling systems.

Unit 5: Automated Storage & Retrieval Systems (AS/RS)

Functions of AS/RS, operations of AS/RS, AS/RS components, types of AS/RS, design of an AS/RS, system throughput, size parameters determination of AS/RS.

References

1. Allegri, T. H., “Material Handling Principles and Practice”, Krieger Publishing Company.
2. Meyers, F. E. and Stephens, M. P. “Manufacturing Facilities Design and Material Handling”, Prentice Hall.
3. Adam, N. D., Brown, T. W., Rowland, V. D. and Misenheimer, F.P., “Warehouse & Distribution Automation Handbook”, McGraw-Hill.
4. Sule, D. R., “Manufacturing Facilities-Location, Planning, and Design”, 3rd Ed., CRC Press

Course Outcomes

CO1: Ability to understand the material handling.

CO2: Ability to understand different types handling devices.

CO3: Knowledge of basic principle of material handling layout.

CO4: Capability to analyses economic aspect of material handling.

CO5: Ability to understand the material storage.

Syllabus

Facility Planning and Value Engineering(PET – 309)

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 of various 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

Materials Management(PET – 310)

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

Course objective

To expose the students to the different components and functions of material management.
Identify and use various search and matching techniques used in material management.

Particulars

Unit 1: Introduction to material management

Materials objectives, Policy manual: UNIDO Recommendations, Purchase policy, Purchasing cycle, purchase order, Materials Intelligence, Specification and standardization in Materials Management, Make or buy decision, buying process.

Unit 2: Materials planning and control

Material forecasting, Selection inventory control, Spare parts management, Inventory systems, Lead time analysis, administrative lead time, Supplier lead time, Transport lead time and Inspection lead time, Flow charting techniques to reduce various types of lead Time, Materials requirement planning, Aggregate inventory management.

Unit 3: Storage and distribution management

Codification of materials, Storage design, Stores layout, Storage systems and equipment, Stores preservation, Stores procedures, Stock valuation and verification ware housing, Distribution management.

Unit 4: Purchase policies and purchasing

Purchasing policies and procedures, Legal aspects of purchasing, Selection of sources of supply, Vendor evaluation and rating, Vendor development, Cost analysis.

Unit 5: Materials management and budgeting

Ethical buying, Performance indicators, Materials management controls, Budgetary control, Computer in materials management, Computer revolution, Software and hardware, Materials information system, Reports and information needs, Application and limitations of computers.

References

1. Gopalakrishnan.P, “Purchasing and Materials Management”, Tata McGraw Hill, 1990.
2. Learnerr Lee Jr. and Donald.M.Dobbler, "Purchasing and Material Management”, Tata McGraw Hill, 1996.
3. Camer Lee and Donald M Dubbler, “Purchasing and Materials Management, Text and cases”, Tata McGraw Hill, 1997.
4. Mark.J.V, “Operations Management”, McGraw Hill Publishers, 1984.
5. Westing.J.K, Fine, E.V. and Zone.C.T, “Purchasing Management Principles”, John Wiley & Sons, New York, 1986.

Course Outcome

CO1: To be able to understand the specification and standardization in Materials Management.

CO2: To be able to understand the Material forecasting, Selection inventory control, Spare parts management, Inventory systems.

CO3: Understand the concept of storage and distribution management.

CO4: To be able to understand the purchasing and purchase policies.

CO5: Understand the importance of materials management and budgeting.

Syllabus

Computer Aided Process Planning(PET – 311)

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

Course objective

The course provides an overview of computer aided process planning.

Particulars

Unit 1:

Introduction: Traditional process planning, product design evaluation, various steps in process planning.

Unit 2:

Group Technology: Introduction, advantages, part families, classification and coding systems, production flow analysis, design of machine cells.

Unit 3:

Concepts Related to Process Planning: Machinability data system, cutting condition optimization.

Unit 4:

Automated Process Planning: Advantages of automated process planning, various approaches to process planning; Variant process planning, its features and different stages, different variant systems; Generative and semi-generative process planning, its features, design strategies, planning, modeling and coding scheme, decision mechanisms; Process capability analysis, intelligent process planning system; Artificial intelligence -- overview and application in process planning; Various recent process planning systems; Case studies.

Unit 5:

Interfaces of Process Planning: Integrating with loading, scheduling, MRP II, and capacity planning and other shop floor functions.

References

1. Chang, T. C. and Wysk, R. A, "An Introduction to Automated Process Planning", Prentice-Hall.
2. Gallagher, C. C and Knight, W. A., "Group Technology: Production Method in Manufacturing", Ellis Horewood.
3. Nilsson, N. J., "Principles of Artificial Intelligence", Springer Verlag.
4. Cornelius, L.T, "Computer Aided and Integrated Manufacturing Systems: Manufacturing Processes", World Scientific Publishing Company.

Course Outcomes

At the end of this course, student is

CO1: Able to understand the basics of process planning.

CO2: Able to understand the concepts of group technology

CO3: Able to understand the concepts related to machinability data system and cutting condition optimization.

CO4: Able to understand the automated process planning and artificial intelligence.

CO5: Able to understand the interfaces of process planning.

Syllabus

Total Quality Management(PET – 312)

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

Course objective

To provide knowledge and understanding about the Total Quality Management (TQM), its concepts, tools and techniques.

Particulars

Unit 1:

Introduction: The concept of TQM, Quality and Business performance, attitude andinvolvement of top management, communication, culture and management systems. Management ofProcess Quality: Definition of quality, Quality Control, a brief history, Product Inspection vs, ProcessControl, Statistical Quality Control, Control Charts and Acceptance Sampling.

Unit 2:

Customer focus and satisfaction: The importance of customer satisfaction and loyaltyCratingsatisfied customers, Understanding the customer needs, Process Vs. Customer, internalcustomer conflict, quality focus, Customer Satisfaction, role of Marketing and Sales, Buyer – Supplier relationships. Benchmarking: Evolution of Benchmarking, meaning of Benchmarking, benefits of benchmarking, the bench marking process, pitfalls of bench marking.

Unit 3:

Organizing for TQM: The systems approach, Organizing for quality implementation, makingthe transition from a traditional to a TQM organizing, Quality Circles. Productivity, Quality andReengineering: The leverage of Productivity and Quality, Management systems Vs. Technology,Measuring Productivity, Improving Productivity Re-engineering.

Unit 4:

The cost of Quality: Definition of the Cost of Quality, Quality Costs, Measuring QualityCosts, use of Quality Cost Information, Accounting Systems and Quality Management.

Unit 5:

ISO9000: Universal Standards of Quality: ISO around the world, The ISO9000 ANSI/ASQCQ-90.Series Standards, benefits of ISO9000 certification, the third party audit, Documentation ISO9000and services, the cost of certification implementing the system.

References

1. Joel E. Ross, Susan Perry, "Total Quality Management: Text, Cases, and Readings", CRC Press, 3rd Edition, 1999.
2. Besterfield D. H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
3. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
4. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
5. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
6. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
7. Zeiri, "Total Quality Management for Engineers", Wood Head Publishers, 1991.
8. Poornima M Charantimath, "Total Quality Management", Pearson Education, 2nd Edition, 2011.

Course Outcomes

CO1: Students will be able to gain knowledge and understanding of the philosophies which have enabled the development of organizational quality improvement programs.

CO2: Students will be able to pursue the customer focus and satisfaction methodology.

CO3: Students will gain knowledge about the organization structure for TQM.

CO4: Students will understand the cost of quality.

CO5: Students will gain knowledge about ISO 9000.

Syllabus

Computational Methods in Engineering(PET – 313)

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

Course objective

The primary goal is to provide engineering majors with a basic knowledge of computational methods including: root-finding, elementary numerical linear algebra, integration, interpolation, solving systems of linear equations, and numerical solution to ordinary differential equations. The computational methods learned in this course enable students to work with mathematical models of technology and systems.

Particulars

Unit 1: Solution of Algebraic and Transcendental Equation

Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method, Multiple roots by Newton's method, Graeffe's root squaring method, Comparison of iterative methods.

Unit 2: Interpolation and Approximation

Finite differences, Newton forward and backward interpolation formula for finite differences, Gauss's forward and backward interpolation formula, Stirling's formula, Bessel's formula, Laplace-Everett's formula, Lagrange's interpolation formula, Newton's divided difference formula, Cubic spline.

Unit 3: Solution of Linear Simultaneous Equations

Cholesky's method, Crout's method, Jacobi's iteration method, Gauss-Seidel iteration method, Relaxation method, Eigen values and eigen vectors, Power method.

Unit 4: Numerical Differentiation and Integration

Numerical differentiation using difference operators, Newton-Cotes quadrature formula, Trapezoidal Rule, Simpson's one third rule, Simpson's three eighth rule, Boole's rule, Weddle's rule.

Unit 5: Solution of Differential Equations

Euler's Method, Modified Euler's method, Runge-Kutta method: second order, third order and fourth order, Milne's Predictor-Corrector method, Solution of simultaneous first order differential equations: Picard's method and Runge-Kutta method, Finite Difference method, Solution of Laplace equation by Liebman's method.

References

1. Numerical Methods by SukhenduDey and Shishir Gupta, Mc-Graw Hill
2. Numerical Methods by B.S. Grewal, Khanna Publications
3. Numerical Method for Scientific and Engineering Computation by M.K. Jain, S.R.K. Iyenger and R.K. Jain, Wiley Eastern Ltd.
4. Numerical Methods by A.D. Booth, Academic Press, NY
5. An Introduction to Numerical Analysis by K.E. Atkinson, John Wiley & Sons, NY
6. Introduction Methods of Numerical Analysis by S.S. Sastry, Prentice Hall of India
7. Elementary Numerical Analysis by S.D. Conte, McGraw Hill
8. Numerical Methods for Engineers by S.K. Gupta, Wiley Eastern Ltd.

Course Outcomes

CO1: To assess the approximation techniques to formulate and apply appropriate strategy to solve real world problems.

CO2: To find numerical solutions to system of linear equations and transcendental equations.

CO3: To find numerical solutions of integration, differentiations, linear equations, ordinary differential equations, interpolations.

CO4: To use numerical methods in modern scientific computing.

CO5: To understand the finite precision computation.

Syllabus

Finite Elements Methods(PET – 314)

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

Metrology and Inspection(PET – 315)

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

Course objective

To learn various concepts of instrumentation, metrology & computer assisted inspection.

Particulars

Unit 1

Significance of Measurement and Instrumentation:

Introduction; generalized configuration and functional stages of measuring systems. The transducerand its environment; an overview; sensing process and physical laws. Types of measurementproblems, Transducer classification and their modeling; Information, Energy and IncrementalModels; Characteristics of instruments, design and selection of components of a measuring system.

Dynamic Response of Instruments:

Mathematical model of a measuring system, response of general form of instruments to various testinputs; time-domain and frequency domain analysis. Elementary transfer functions and Bode plots ofgeneral transfer functions.

Unit 2

Errors in Measurement and its Analysis:

Causes and types of experimental errors; systematic and random errors. Uncertainty analysis;computation of overall uncertainty; estimation for design and selection for alternative test methods.

Transducers and Transduction Principles:

Developments in sensors, detectors and transducer technology; displacement transducers; force,torque and motion sensors; piezoelectric transducers; capacitive type transducers; Strain gagetransducers; accelerometers, pressure transducers based on elastic effect of volume and connectingtubing.

Unit 3

Metrology and Techniques:

Standards in metrology-definition, Traceability, Characteristics Length & Angular measurementsReviewof standard instruments, GD and tolerance procedure-Review of dimension & form toleranceand methods of measurement, Tolerance analysis.

Surface and form metrology:

flatness, roughness, waviness cylindricity, etc., Methods of improving accuracy & surface finish,Influence of forced vibration on accuracy, Dimensional wear of cutting tools and its influences onaccuracy.

Unit 4

Standards for length measurement standards and their calibration:

Light interference - Method of coincidence - Measurement errors. Various tolerances and theirspecifications, gauging assembly, comparators. Angular measurements - principles and measuringinstruments.

Laser Applications in Metrology:

LASER light source, LASER interferometer, LASER alignment telescope, LASER micrometer, Onlineand in-process measurements of diameter, Roundness and surface roughness using LASER,Micro holes and topography measurements, straightness and flatness measurement.

Unit 5

Special Measuring Instruments and Techniques:

Optoelectronic devices, contact and non-contact types, Applications in on-line and in-process monitoring systems, Tool wear measurement, Surface measurement, Machine vision, shape identification, Edge detection techniques, Normalization, gray scale correlation, Template Techniques, Surface roughness using vision system, Interfacing robot and image processing system.

Sensors in Inspection:

Manufacturing applications of photo detectors, deflection methods-beam detection, Reflex detection,& Proximity detection, Applications of Inductive and Capacitive proximity sensors, Understanding microwave sensing applications laser sensors and limit switches. Advanced sensor technology-Barcode systems, Principles and applications of Colour sensors, electro-magnetic identifier, Tactilesensors, Ultrasonic sensors, Odour sensors.

References

1. Fundamentals of dimensional Metrology T. Busch and R. Harlow Delmar, 3e.
2. Engineering Metrology G. Thomas and G. Butter Worth PUB.
3. Sensors and Control systems in Manufacturing SabneSoloman McGraw Hill Book.
4. Measurement systems: Applications & Design Doebelin International Student Edition.
5. Optoelectronics for Technology and Engineering Robert G. Seippel Prentice Hall India.

6. Interface Technology for Computer Controlled Ulrich-Rembold, Armbruster Marcel Dekker.
7. Publications, Manufacturing processes and Ulzmann NY.
8. Study manual on tolerance stacks, vol.1 Second edition ASME. 1994.
9. Dimensioning and tolerancing of mass Spotts Prentice Hall, 1983.

Course outcomes

At the end of the course

CO1: Students are able to understand the significance of measurement and instrumentation.

CO2: Students are able to have an eye view of errors in measurement and its analysis.

CO3: Students are able to understand the metrology techniques.

CO4: Students are able to understand the measurement standards, their calibration and laser application in metrology.

CO5: Students are able to know the advanced measuring instrumentation and techniques.

Syllabus

Advanced Forming Process(PET – 316)

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

Course objective

Understanding the mechanism of deformation for different metal forming processes and develop analytical relation between input and output parameters of process, the concept of yield criteria applicable to different material deformation processes. Apply theoretical and experimental techniques for measurement of important outcomes of metal forming processes. To understand the different lubrication mechanisms, lubricants and other valuable affecting the metal forming processes under different working conditions & the different types of defects, causes and apply their remedial measures in metal forming processes.

Particulars

Unit 1

Introduction: Stress/strain/strain-rate characteristics of materials, Yield criteria, classification of metal working processes, Formability and theory of sheet metal working, Friction and lubrication in metal working operation, Theories of friction and lubrication, Assessment of friction at interface.

Unit 2

Process Analysis: Introduction to metal forming, Cold and hot working processes, failure criterion, Various methods of analyzing the metal working processes (slip-line field theory, Upper bound Solution, stab methods).**Rolling**: Determination of rolling pressure, roll separating force, driving torque and power, Power loss in bearings.

Unit 3

Mechanics of Forming Processes: Forging-Forces in strip forging and disc forging, Drawing-determination of force and power, Maximum allowable reduction, Deep drawing force analysis, Analysis of tube drawing process with fixed and moving mandrel, Tandem tube drawing, Bending- Determination of work load and spring back, Extrusion-Determination of work load from stress analysis and energy consideration, Power loss.

Unit 4

Hydrostatic Extrusion: Comparison with conventional extrusion, Pressure required to extrude, variables affecting the processes. Hydrostatic extrusion, Punching & Blanking-Mode of metal

deformation and failure, 2D deformation model and fracture analysis, Determination of work force.

Unit 5

High Speed Forming: Classification, Comparison of low and high-speed forming, operation problems in high-speed forming operation, Introduction to high forming process such as explosive forming, Electrical and Mechanical high-speed forming techniques. Defects in metal forming and applications of metal forming.

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 and apply the mechanism of deformation for different metal forming processes and develop analytical relation between input and output parameters of process.

CO2: Able to understand and analyze 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 lubrication mechanisms, lubricants and other valuable affecting the metal forming processes under different working conditions.

CO5: Able to understand the different types of defects, causes and apply their remedies.

Syllabus

Industrial Automation and Robotics(PET – 317)

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

Course objective

Graduates will be successful as engineers in the industry and provide solutions to problems faced in the multi-disciplinary field of Automation & Robotics. Graduates will have the ability to be an integral part of research programand involve in a process of lifelong learning. Graduates will address problems in the society in a professional & ethical manner with due attention to environmental issues.

Particulars

Unit 1

Introduction: Automation and Robotics, Historical Development, Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines.

Unit 2

Material handling and Identification Technologies: Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods.

Unit 3

Automated Manufacturing Systems: Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation.Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies.

Unit 4

Robotics: Robotics Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, Complete Classification of Robots, Fundamentals about Robot Technology, Factors related to use Robot Performance, Basic Robot Configurations and their Relative Merits and Demerits, the Wrist & Gripper Subassemblies. Concepts about Basic Control System, Control Loops of Robotic Systems, Different Types of Controllers-

Proportional, Integral, Differential, PID controllers.

Unit 5

Robot Sensing & Vision: Various Sensors and their Classification, Use of Sensors and SensorBased System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors.

Industrial Applications: Objectives, Automation in Manufacturing, Robot Application inIndustry, Task Programming, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges and Case Studies.

References

1. Automation, Production Systems and Computer Integrated Manufacturing-M.P.Groover, Pearson Education.5th edition.
2. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill.
3. Introduction to Robotics- John J. Craig, Addison Wesley Publishing, 3rd edition.
4. Computer Based Industrial Control- Krishna Kant, EEE-PHI,2nd edition.
5. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang &Richard A. Wysk
6. Performance Modeling of Automated Manufacturing Systems, -Viswanandham, PHI, 1st edition.
7. Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition.
8. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition.

Course Outcome

After the successful completion of this course, the student will be able:

CO1: To identify potential areas for automation and justify need for automation

CO2: To select suitable major control components required to automate a process or an activity

CO3: To translate and simulate a real time activity using modern tools and discuss the benefits of automation.

CO4: To explain the basic principles of Robotic technology, configurations, control and programming of Robots.

CO5: To choose the appropriate Sensor and Machine vision system for a given application.

Syllabus

Material Characterization(PET – 318)

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

Course objective

The course provides an overview of materials characterization.

Particulars

Unit 1:

Light Microscopy: Introduction, concept of resolution, Airy rings, numerical aperture, magnification, depth of field, depth of focus, lens defects and their corrections, principles of phase contrast – bright-field and dark-field contrast, polarized light microscopy, Quantitative microscopy, estimation of grain size, grain boundary area, relevance of light microscopy ideas to electron microscopy.

Unit 2:

X-ray Diffractometry: Introduction, crystal geometry, lattice directions and planes, zone axis, interplaner spacing and angle, Stereographic projection, Bragg's condition of diffraction, X-ray scattering, application of X-ray diffraction – phase identification, estimation of grain size, particle size, residual stress.

Unit 3:

Transmission electron microscopy (TEM): Principle, construction and operation of TEM, Interaction of electrons with specimen, reciprocal space and lattice, Ewald sphere, diffraction from finite crystal, preparation of specimens, bright and dark field imaging, selected area diffraction, indexing of diffraction patterns.

Unit 4:

Scanning electron microscopy (SEM): Principle, construction and operation of SEM, study of fractured surfaces, energy and wavelength dispersive spectroscopy.

Unit 5:

Thermal analysis techniques: Principles of differential scanning calorimetry (DSC), differential thermal analysis (DTA), Dilatometry, Thermogravimetric analysis (TGA).

Additional techniques: emission spectroscopy, Atomic Absorption Spectroscopy, Inductively Coupled Plasma - Mass Spectroscopy (ICP-MS), Vibrating Sample Magnometer (VSM), SQUID, four probe resistivity measurement.

References

1. Goodhew, P.J., Humphreys J. and Beanland, R., "Electron Microscopy and Analysis", Taylor and Francis.
2. Gifkins, R.C., "Optical Microscopy of Metals", Sir Isaac Pitman and Sons.
3. Cullity, B.D., "Elements of X-Ray Diffraction", Addison–Wesley Publishing Company.
4. Brown, M.E., "Introduction to Thermal Analysis: Techniques and Applications", Springer.
5. Speyer, R., "Thermal Analysis of Materials", 1st ed., CRC Press.

Course Outcomes

CO1: Able to understand basics of microscopy.

CO2: Able to understand basics of X-ray diffractometry.

CO3: Able to understand basics of transmission electron microscopy.

CO4: Able to understand basics of scanning electron microscopy.

CO5: Able to understand basics of thermal analysis techniques and additional techniques.

Syllabus

Metal Casting(PET – 319)

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

Course objective

To inculcate the principle, thermal and metallurgical aspect during solidification of metal and alloys. To impart knowledge about principles methods of casting with detail design of gating & riser system needed for casting, defects in cast object and requirements for achieving sound casting.

Particulars

Unit 1

Introduction: Features of Casting problems, Survey and Scope of Foundry Industries, Solidification of pure metals, Nucleation and growth in alloys, Solidification of actual casting, Progressive and directional solidification, Centreline feeding resistance, Rate of solidification, Chvorinov's rule, Electrical analog of solidification problems.

Unit 2

Gating and Risering Systems: Gating systems and their characteristics, Effects of gates on aspiration, Turbulence and dross trap, recent trends, Riser design, Risering curves, NRL method of riser design, Feeding distance, Risering of complex casting, Risering of alloys other than steel, Riser design by geometrical programming.

Unit 3

Moulding and Core Making: Review and critical comparison of various established processes, recent developments example low pressure and ferrous die casting, High pressure moulding, Full mould process, Flasklessmoulding, Hot and cold box moulding, Ceramic shell moulding, V-process, Continuous casting, Squeeze and pressed casting, Nishiyama process, Shaw process, Anitoch process.

Melting and Fluidity: Selection and control of melting furnaces; melting, refining and pouring; Coupla design, Measurement of fluidity, Effect of various parameters on fluidity, Methods of elimination and control of gases in casting.

Unit 4

Internal Stress, Defects and Surface Finish: Residual stresses, Hot tears and cracks in casting; Stress relief, defects and their causes and remedies; Parameters affecting surface finish and related defects e.g., Rough casting, bum-on sand bum-in metal penetration, Facing and washes; Mold wall movement; transport zones, Expansion scabbing etc.

Unit 5

Casting of Sand, Design Considerations: Recent developments, e.g., Mulling index; Mouldability index, Compatibility, deformability etc.

Foundry Practice: Casting of different Cast Irons, Steel, Aluminum, Zinc, Brass etc., Mechanization in Foundry, Use of Computers in foundry, Inspection and Quality Control-Review of X-ray and gamma ray radiography, Magnetic particle, Penetrant and Ultrasonic inspections, use of statistical quality control.

References

1. Bronze Sculpture Casting and Patination: Mud Fire Metal by Steve Hurst Schiffer, Publishing.
2. Fine Art Metal Casting by Richard Rome.
3. Casting Technology and Cast Alloys by Chakraborty, Prentice Hall of India.
4. Meta Casting: Principles and Practice by TV RammanaRao, New Age International.

Course Outcomes

CO1: Able to explainthe principle, thermal and metallurgical aspect during solidification of metal and alloys. **CO2**: Able to explainabout methods of casting with detail design of gating & riser system needed for casting.

CO3: Able to explain the different defects in cast object and requirements for achieving sound casting.

CO4: Able to explain the different recent trends in the metal casting.

CO5: Able to explain the casting of different materials like cast iron, iron alloys and other materials.

Syllabus

Machine Tool Design(PET – 320)

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

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

Waste to Energy(PET – 331)

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

Course objective

The course deals with the production of energy from different types of wastes through thermal, biological and chemical routes. It is intended to help the young scientist professionals to keep their knowledge upgraded with the current thoughts and newer technology options along with their advances in the field of the utilization of different types of wastes for energy production.

Particulars

Unit 1

Introduction to energy from waste: characterization and classification of waste as fuel – Agrobased, characterization of wastes, forest residues, industrial waste, Municipal solid waste.

Unit 2

Waste to energy options: Energy production form wastes through incineration, combustion (unprocessed and processed fuel), gasification, anaerobic digestion, fermentation, pyrolysis, Energy production from wastes through fermentation and transesterification.

Unit 3

Conversion devices: Combustors (Spreader Stokes, Moving grate type, fluidized bed), gasifier, digesters. Briqueting technology: Production of RDF and briquetted fuel. Properties of fuels derived from waste to energy technology: Producer gas, Biogas, Ethanol and Briquettes, Comparison of properties with conventional fuels.

Unit 4

Energy production from organic wastes through anaerobic digestion and fermentation, Introduction to microbial fuel cells, Densifications of solids, efficiency improvement of power plant and energy production from waste plastics.

Unit 5

Power generation using waste to energy technologies: Cl and Sl engines, IGCC and IPCC concepts, Landfills: Gas generation and collection in landfills, Environmental monitoring system for land fill gases, Environmental impacts; Measures to mitigate environmental effects due to incineration, Introduction to transfer stations.

References

1. M.M. EL-Halwagi, Biogas Technology- Transfer and diffusion, Elsevier Applied science Publisher, New York, 1984.
2. D.O Hall and R.P. Overeed, Biomass – regenerable energy, John Willy and Sons Ltd. New York. 1987.
3. Fay JA, Golomb DS. Energy and Environment, Oxford University Press (2002).
4. Brown RC and Stevens C, Thermo-chemical Processing of Biomass: Conversion into Fuels, Chemicals and Power, Wiley and Sons (2011).

Course Outcomes

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

CO1: Define and explain important concepts in the field of waste management, such as waste hierarchy, waste prevention, recirculation, municipal solid waste etc.

CO2: Suggest and describe suitable technical solutions for biological and thermal treatment of the waste. The student should also be able to discuss the drawbacks and prerequisites for a chosen solution.

CO3: Formulate protocol to convert agricultural waste into energy also discuss the various techniques to describe the waste to energy conversion system.

CO4: Discuss social aspects connected to handling and recirculation of waste from a local as well as global perspective.

CO5: Analyze and describe the potential as a secondary raw material, and thereby associated problems.

Syllabus

Cost Management of Engineering Projects(PET – 332)

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

Course objective

Students will be able to understand the tools of costing and managerial aspect to implement an engineering project.

Particulars

Unit 1: Introduction and Overview of the Strategic Cost Management Process, Cost concepts indecision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost.Objectives of a Costing System; Inventory valuation; Creation of a Database for operationalcontrol; Provision of data for Decision-Making.

Unit 2: Project: meaning, Different types, why to manage, cost overruns centres, various stagesof project execution: conception to commissioning. Project execution as conglomeration oftechnical and nontechnical activities. Detailed Engineering activities. Pre project execution mainclearances and documents Project team: Role of each member. Importance Project site: Datarequired with significance. Project contracts. Types and contents. Project execution Project costcontrol. Bar charts and Network diagram. Project commissioning: mechanical and process.

Unit 3: Cost Behavior and Profit Planning Marginal Costing; Distinction between MarginalCosting and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Variousdecision-making problems. Standard Costing and Variance Analysis. Pricing strategies: ParetoAnalysis. Target costing, Life Cycle Costing. Costing of service sector.

Unit 4: Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning,Total Quality Management and Theory of constraints. Activity-Based Cost Management, BenchMarking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets;Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricingdecisions including transfer pricing.

Unit 5: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi

2. Charles T. Horngren and George Foster, Advanced Management Accounting

3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher

5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Course Outcomes

At the end of this course, students will be able to

CO1: understand the aspect of costing aspects in decision making and inventory.

CO2: perceived knowledge of project execution.

CO3: understand the cost behaviour and profit planning marginal costing.

CO4: understand the aspect of MRP, ERP and TQM.

CO5: analyse the quantitative techniques for cost management.

Syllabus

Industrial Safety(PET – 333)

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

Course objective

Students will be able to recognize and evaluate occupational safety and health hazards in the workplace, and to determine appropriate hazard controls following the hierarchy of controls. Students will furthermore be able to analyze the effects of workplace exposures, injuries and illnesses, fatalities and the methods to prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.

Particulars

Unit 1

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit 2

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit 3

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit 4

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's

like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit 5

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

References

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Course Outcomes

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

CO1: Evaluate workplace to determine the existence of occupational safety and health hazards. Also describes the different safety considerations.

CO2: Identify the scope of maintenance engineering along with best practices that are applicable.

CO3: Understand the wear and corrosion analysis of different industrial equipment and various types of maintenance.

CO4: Analyse the fault tracing-concept and importance of decision tree concept. Also study about the different industrial equipment.

CO5: To understand the periodic and preventive maintenance to avoid the industrial hazards.

Syllabus

Operation Research (PET – 334)

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

Course objective

The course provides an overview of operation research.

Particulars

Unit 1

Introduction: Linear programming, Definition, scope of Operations Research (OR) approach and limitations of OR Models, Characteristics and phases of OR Mathematical formulation of L.P. Problems. Graphical solution methods.

Linear Programming Problems:The simplex method - slack, surplus and artificial variables. Concept of duality, Big-M method, Two-phase method, degeneracy, and procedure for resolving degenerate cases.

Unit 2

Nonlinear programming: Kuhn- Tucker conditions- quadratic programming- Wolfe's algorithm.

Decision Theory: Introduction, Decision under certainty, Decision under risk, Decision under uncertainty, Laplace criterion, MaxiMin criterion, MiniMax criterion, savage MiniMax regret criterion, hurwicz criterion, Decision tree.

Unit 3

Game Theory: Formulation of games, two person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property, mixed strategy (3x3 or higher games).

Introduction to optimization techniques, sequencing and scheduling, sensitivity analysis.

Unit 4

Dynamic Programming: Deterministic and stochastic example.

Goal Programming: Formulations Goal Programming Solutions Complexity of Simplex Algorithm.

Unit 5

PERT-CPM Techniques: Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion.

References

1. Hiller & Lieberman, Introduction to Operations Research
2. Hira D. S. &Gupt P. K., Operations Research, S. Chand & Co. 1995.
3. Taha H. A., Operation Research, 7th Ed., Prentice Hall of India, New Delhi, 2002.
4. Wagner H. M., Principles of Operation Research with Applications to Managerial Decisions, 2nd Ed., PHI, 2010.
5. Vohra N.D, Quantitative Techniques in Management, Tata McGraw Hill, 1995.
6. Sharma J. K., Operation Research Theory and Applications, 2nd Ed., Macmillan, 2003.
7. Kasana H. S., Kumar K. D., Introductory Operations Research Theory and Applications, Springer, 2003.
8. Wilkes F. M., Elements of Operational Research, McGraw Hill Co.
9. Levin R. et.al, Quantitative approaches to Mgmt, McGraw Hill Co.
10. Richard Broson, Govindasamy&Naachimuthu, Schaum's Outline of Theory and Problems of Operations Research, II Edition, Tata McGraw Hill , 2004.
11. En R. P., Operations Research Algorithm and Applications, PHI, New Delhi.
12. Shah N. H., Gor R. M., Soni H., Operations Research, PHI, New Delhi, 2007.

Course Outcomes

CO1: Able to understand the basics of OR and LPP.

CO2: Able to understand and solve the nonlinear programming problems and decision theory.

CO3: Able to understand and analyse game theory problems.

CO4: Able to understand and analyse dynamic and goal programming.

CO5: Able to understand and analyse PERT and CPM techniques.

Syllabus

Composite Materials(PET – 335)

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

Course objective

To learn about different types of composite materials and their applications. To understand the concept of composite fabrication and techniques. To evaluate the performance of various types of composite materials.

Unit 1: Introduction

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

Unit 2: Reinforcements

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

Unit 3: Manufacturing of Metal Matrix Composites

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

Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carboncomposites: Knitting, Braiding, Weaving. Properties and applications.

Unit 4: Manufacturing of Polymer Matrix Composites

Preparation of Moulding compounds andprepregs – hand layup method – Autoclave method – Filament winding method – Compressionmoulding – Reaction injection moulding. Properties and applications.

Unit 5: Strength

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

References

1. K.K. Chawla, Composite Materials – Science & Engineering, Springer-Verlag, New York, 1987.
2. F.L. Matthews and R.D. Rawlings, Composite Materials: Engineering and Science, Chapman & Hall, London, 1994.
3. DrNavin Chand, Tribology of Natural fiber Composites, Wood Head Publishing Limited, Eng.

Course Outcomes

CO1: To be able to understand the concept of composite materials and their classification.

CO2: To be able to understand the different types of reinforcements.

CO3: To be able to understand the various techniques of metal matrix composite fabrication techniques.

CO4: To be able to understand the various techniques of polymer composite fabrication techniques.

CO5: Understand the analysis of strength criteria of composites.

Syllabus

Industrial Design and Ergonomics(PET – 336)

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

Course objective
The aim of this course is to acquaint students with basics of industrial and ergonomics.

Particulars
Unit 1

Introduction to Ergonomics and Industrial Design: An approach to industrial design- elements ofdesign, Structure for industrial design in engineering; Application in modern manufacturing systems;General approach to the man-machine relationship, Work station design, Working position.

Unit 2

Control and Displays: Shapes and sizes of various controls and displays- Multiple displays and controlsituations; design of major controls in automobiles, machine tools etc.; Design of furniture; Redesign ofinstruments.

Unit 3

Ergonomics and Production: Ergonomics and product design, ergonomics in automated systems;Expert systems for ergonomic design; Anthropometrics data and its applications in ergonomic design;Limitations of anthropometric data, Use of computerized database; Case study.

Unit 4

Visual Effects of Line and Colour: The mechanics of seeing; Psychology of seeing; General influenceof line and form; Colour and light; Colour and objects; Colour and the eye; Colour consistency; Colourterms; Reaction to colour and colour continuation; Colour on engineering equipment's.

Unit 5:

Aesthetic Concepts: Concept of unity; Concept of order with variety; Concept of purpose style andenvironment; Aesthetic expressions; Style, Components of style; House style; Observation style incapital goods; Case study.

References

1. Industrial design for Engineers W.H. Mayall London Hiffee Books Ltd.
2. Introduction to Ergonomics R.C. Bridger McGraw Hill.
3. Human Factor Engineering Sanders &McComlick.

Course Outcomes

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

CO1: Understand the aspect and importance of industrial design and ergonomics.

CO2: Understand the importance of controls and displays.

CO3: Understand the importance of ergonomics in production system.

CO4: Understand the importance of visual effects of line and colour.

CO5: Understand the aesthetic concept.