

MASTER OF TECHNOLOGY
IN
PRODUCTION ENGINEERING

(Applicable from the academic session 2018-2019)

MAULANA ABUL KALAM AZAD
UNIVERSITY OF TECHNOLOGY,
WEST BENGAL



Maulana Abul Kalam Azad University of Technology, West Bengal
(Formerly West Bengal University of Technology)
Haringhata-741249, Nadia, West Bengal, INDIA

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

Curriculum Structure

Semester-I							
Sl No.	Category	Subject Code	Subject Name	Total Number of contact hours			Credits
				L	T	P	
Theory							
1	Program Core I	PEM101	Advances in Forming and Joining Processes	3	0	0	3
2	Program Core II	PIEM102	Theory of Machining and Grinding	3	0	0	3
3	Program Elective-I	PEM103 A/B/C	Program Elective-I	3	0	0	3
4	Program Elective-II	PEM104 A/B/C/D/E	Program Elective-II	3	0	0	3
5	Mandatory Learning Course	MLC101	Research Methodology and IPR	2	0	0	2
6	Audit Course	AC101A/B/C/D/E/F	Audit Course 1	2	0	0	0
<i>Total Theory</i>				16	0	0	14
Practical							
1	Laboratory I	PEM191	Manufacturing Process Laboratory	0	0	4	2
2	Laboratory II	PEM192	Computational Laboratory	0	0	4	2
<i>Total Practical</i>				0	0	8	4
Total of Semester-I				16	0	8	18
Semester-II							
Theory							
1	Program Core III	PEM201	Automation in Manufacturing	3	0	0	3
2	Program Core IV	PEM202	Modern Machining Processes	3	0	0	3
3	Program Elective-III	PEM203 A/B/C	Program Elective-III	3	0	0	3
4	Program Elective-IV	PEM204 A/B/C/D/E	Program Elective-IV	3	0	0	3
5	Audit Course	AC201A/B/C/D/E/F	Audit Course 2	2	0	0	0
<i>Total Theory</i>				14	0	0	12
Practical							
1	Laboratory III	PEM291	Manufacturing Process and Systems Laboratory	0	0	4	2
2	Laboratory IV	PEM292	Design Laboratory	0	0	4	2
<i>Total Practical</i>				0	0	8	4
Sessional							
1	Mini Project	PEM281	Mini Project with Seminar	2	0	0	2
Total of Semester-II				16	0	8	18
Semester-III							
Theory*							
1	Program Elective-V	PEM301 A/B/C/D/E	Program Elective-V	3	0	0	3
2	Open Elective	OE301A/B/C/E/F/G/H	Open Elective	3	0	0	3
<i>Total Theory</i>				6	0	0	6
Sessional							
1	Major Project	PEM381	Dissertation –I((Progress)	0	0	20	10
Total of Semester-III				6	0	20	16
Semester-IV							
Sessional							
1	Major Project	PEM481	Dissertation -II(Completion)	0	0	32	16
Total of Semester-IV				0	0	32	16
Total Credits for the programme							68

*Students going to Industry full time for doing their Project & Thesis work (Dissertation) may opt for completion of these courses through Massive Open Online Courses (MOOCs).

MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME
Curriculum Structure

List of Program Electives

❖ **Program Elective - I**

1. Operations Management (PEM103A)
2. Advanced Engineering Mathematics (PEM103B)
3. Introduction to Finite Element Methods in Engineering (PEM103C)

❖ **Program Elective - II**

1. Planning and Control of Production Systems (PEM104A)
2. Project Engineering and Management (PEM104B)
3. Materials Management (PEM104C)
4. Industrial Ergonomics (PEM104D)
5. Environmental Degradation of Materials (PEM104E)
6. Computational Fluid Dynamics (PEM104F)

❖ **Program Elective - III**

1. Machine Tools Engineering (PEM203A)
2. Micro and Precision Manufacturing Systems (PEM203B)
3. Mechatronic Systems Design and Applications (PEM203C)

❖ **Program Elective - IV**

1. Quality management (PEM204A)
2. CAD-CAM Systems (PEM204B)
3. Design of Experiments (PEM204C)
4. Advanced Welding Technology (PEM204D)
5. Product Design and Development (PEM204E)

❖ **Program Elective - V**

1. Logistics and Supply Chain Management (PEM301A)
2. Introduction to Management Information Systems (PEM301B)
3. Robotics and Robot Applications (PEM301C)
4. Tribology and Terotechnology (PEM301D)
5. Design and Manufacture of Cutting Tool, Moulds and Dies (PEM301E)

List of Open Electives

1. Business Analytics (OE301A)
2. Operations Research (OE301B)
3. Cost Management of Engineering Projects (OE301C)
4. Industrial Safety (OE301D)
5. Composite Materials (OE301E)
6. Waste to Energy (OE301F)

Audit course 1 & 2

1. English for Research Paper Writing (AC101A / AC201A)
2. Pedagogy Studies (AC101B/ AC201B)
3. Constitution of India (AC101C/ AC201C)
4. Disaster Management (AC101D/ AC201D)
5. Value Education (AC101E/ AC201E)
6. Stress Management by Yoga (AC101F /AC201F)
7. Personality Development through Life Enlightenment Skills (AC101G/ AC201G)
8. Sanskrit for Technical Knowledge (AC101H/ AC201H)

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

SEMESTER - I

THEORY

PROGRAM CORE – I

PEM 101 : Advances in Forming and Joining Processes

Structure : 3-0-0

Credit : 3

Review of Theory of Elasticity: Stress and Strain tensor, stress and strain transformation, differential equation of equilibrium, Mohr's circles (three dimensional stress situation), Plane stress and Plane strain.

Review of theory of Plasticity: Stress space, Yield criterion, Von-Mises, Tresca's yield criterion, Yield Surface, Slip Line Field theory, Stress-Strain relationships - treatment involving differential equation, Upper and Lower bound theorem.

Metal forming processes and analysis: Drawing and extrusion, rolling, forging, bending, High Energy density metal forming Processes, Powder metallurgical processes.

Advanced Casting Processes: Evaporation casting process, vacuum sealed process, shell mould casting, Rapid Prototyping and Tooling.

Review of Basic welding process and classification, power sources, arc and electrode characteristics, electrode selection, Critical and Precision welding processes like: PAW, LBW, EBW, USW etc.

Welding of Ceramics, Plastics, Composites, Welding Metallurgy, HAZ, Weldability of Plain Carbon Steels, Stainless Steel, Cast Iron, Aluminium and its alloys, Residual stresses and distortion, testing of welding joints.

References:

1. "Introduction to the Theory of Theoretical and Experimental Analysis of Stress and Strain" - Durelli, Phillip's and Tsao, McGraw Hill Book Co.
2. "Theory of Elasticity" - Timoshenko and Goodier, McGraw Hill Book Co.
3. "Engineering Plasticity" - Johnson and Mellur, Van Nostrand-Reinhold Co.
4. "Introduction to the Theory of Plasticity - Metal Forming Applications" - O. Hoffman and G. Sachs, McGraw Hill Book Co.
5. "Introduction to Theory of Plasticity" - Mendelson.
6. "Principles of Metal Casting" - Heine, Loper and Rosenthal, TMH Publication
7. "Principles of Foundry Technology" - P.L. Jail, TMH Publications
8. "Welding for Engineers" - Udin, Funk and Wulf, John Wiley and Sons.
9. "Welding Process and Procedures" - J.L. Morris.
10. "A Text Book of Welding Technology" - O.P. Khanna, Dhanpat Rai & Sons
11. "Modern Arc Welding Technology" - S.V. Nadkarni, Oxford & IBH Publishing Co. Pvt. Ltd./ Advani-Oerlikon Ltd.
12. "Processes and Design for Manufacturing" - S.D.EI Wakil, PWS Publishing.

Date of Revision: July 2018

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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PROGRAM CORE – II**

PEM 102 : Theory of Machining and Grinding

Structure : 3-0-0

Credit : 3

Machining, definition and objectives. Geometry of cutting tools; turning, milling and drilling - in different reference systems like machine reference system, tool reference system and work reference system. Sharpening and re-sharpening of cutting tools.

Mechanism of chip formation by single point tools, drills and milling cutters. Types of chips and their characteristics. Effective rake.

Mechanics of machining, theoretical estimation and experimental determination of cutting forces and power consumption. Dynamometers; types, design, construction and use.

Thermodynamics of machining, sources of heat generation, cutting temperature modeling, measurement of cutting temperature. Cutting fluids; purpose, essential characteristics, selection and methods of application.

Cutting tools; methods of failure, mechanics of tool wear, essential properties, assessment of tool life and cutting tool materials.

Economics of machining; principal objectives, main parameters and their role on cutting forces, cutting temperature, tool life and surface quality, selection of optimum combination of parameters.

Causes of vibration and chatter in machining, and their remedy.

Mechanics of grinding, characteristics, specification and selection of grinding wheels. Process and wheel parameters in grinding. Grinding forces, grinding fluid applications, grinding ratios and surface integrity. High speed grinding and modern grinding wheels.

References:

1. "Metal Cutting : Theory and Practice" - A. Bhattacharyya , Central Book Publishers, Kolkata
2. "Metal Cutting Principles" - M.C. Shaw, Oxford University Press CBS
3. "Fundamentals of Metal Machining & Machine Tools" - G. Boothroyd, McGraw Hill
4. "Introduction to Machining Science" - G.K. Lal ,New Age International Pub., New Delhi
5. "Machining and Machine Tools" - A.B. Chattopadhyay, Wiley India, New Delhi
6. "Metal Cutting Theory and Cutting Tool Design" - V. Arshinov and G. Alekseev Mir Publishers, Moscow
7. "Manufacturing Science" - A. Ghosh and A.K. Mallik, Affiliated East-West Press Pvt. Ltd., New Delhi
8. "Metal Cutting" - E.M. Trent and P.K. Wright, Butterworth Heinemann Publication
9. "Metal Cutting Mechanics" - N.N. Zorev, Pergamon Press.
10. "Grindings Technology: Theory and Application of Machining with abrasives" – S. Malkin, Ellis Harwood Publication, U.K.
10. "Micromachines" - I. Fujimasa, Oxford University Press.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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PROGRAM ELECTIVE - I**

PEM 103A : Operations Management

Structure : 3-0-0

Credit : 3

Introduction to production / operations management for competitiveness of corporate, Product life cycle, types of productive systems, process life cycles and technology, focus of an organization.

Forecasting, inventory planning and control, MRP, operations scheduling, statistical quality control.

Product and process design and technological choice, capital cost and criteria for investment, capacity planning, MRP-II, location theory and distribution, work measurement, facility layout and assembly line balancing, multiple criteria decision making methods, Line of Balance (LOB), Markov Model.

Generic enterprise strategies, role of productivity improvement, components of operations strategy and its implementation, Utility theory.

Operations systems of the future; Computer integrated factory of the future, customer-centric systems, SCM, Application of Soft Computing to Production Management.

References:

1. "Production and Operations Management" – E.E. Adam, Jr. and R.J. Ebert, Prentice Hall Publication
2. "Operations Management" – B. Shore, EMH Publishing Co. Ltd., India
3. "Management for Business and Industry" – G.S. George, PHI Publication
4. "Production/ Operations Management" – E.S. Buffa, PHI Publication
5. "Production and Operations Management - Concepts Models and Behaviour" - 5th Ed., Adam and Ebert, PHI Publication.
6. "Advances in Production Management Systems" – C.H. Okino, Narosa Book Distributors Pvt. Ltd.
7. "The Management of Engineering" – J.W. Bennett, Narosa Book Distributors Pvt. Ltd.
8. "Production and Operations Management" - A W Muthelmann, Narosa Book Distributors Pvt. Ltd.
9. "Production and Operations Management" - W. Bolton, Orient Longman Pub.
10. "Total Quality Management" – A. Tenner and I.J. Detoro, Addison Wesley Publication.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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PEM 103B : Advanced Engineering Mathematics

Structure : 3-0-0

Credit : 3

Statistics: Elements of statistics; frequency distribution, concept of mean, median, mode and different types of distribution; Standard deviation and Variance; Curve fitting by least square method; Correlation and Regression; Testing of hypothesis; Basic types of factorial design and analysis of variance (ANOVA). - 10

Matrix Operation: Matrix operations; Eigen value and Eigen vector by iterative methods; Diagonalisation of a square matrix. - 8

Laplace Transform, Fourier Transform; Fourier Integral and their applications. - 6

Numerical methods: Interpolation by polynomials; Error analysis; Solution of system of linear equation by Gauss-Seidel iterative method; Newton-Raphson method; Numerical integration by Gauss-quadrature; solution of ordinary differential equation by Rayleigh-Ritz method. - 10

References:

1. "Introductory Methods of Numerical Analysis" - S.S. Sastry, PHI
2. "Numerical Methods for Scientific and Engineering Computation" - M.K. Jain, S.R.K. Iyengar, R.K. Jain, New Age International Pub.
3. "An Outline of Statistical Theory" Volume I, II -A.M. Goon, M.K. Gupta, B. Dasgupta, The World Press Private Ltd.
4. "The Design of Experiments to find Optimal Conditions" - Yu.P. Adler, E.V. Markova, Ylu.V. Granovsky, MIR publication, Moscow
5. "Advanced Engineering Mathematics"- E. Kreyszig, John Wiley & Sons.
6. "Advanced Engineering Mathematics"- S. Grossman and W.R. Derrick, Harper & Row Publishers.
7. "Experimental Designs" - W.C. Cochran and G.M. Cox, John Wiley & Sons, New York.
8. "Design and Analysis of Experiments"- D.C. Montgomery, Wiley-India Edition.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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PEM 103C : Introduction to Finite Element Methods in Engineering

Structure : 3-0-0

Credit : 3

Fundamental Concepts: Outline of presentation, stress and equilibrium, boundary conditions, strain-displacement relations, stress-strain relations, temperature effect, potential energy and equilibrium, the Rayleigh-Ritz Method, Galerkin's method, saint Venant's principle, von Misses stress, computer programming, historical references.

Matrix Algebra and Gaussian Elimination: Matrix algebra, Gaussian elimination, conjugate gradient method for equation solving.

One Dimensional Problems: Introduction, finite element modeling, coordinates and shape functions, the potential energy approach, the Galerkin approach, assembly of the global stiffness matrix and load factor, properties of stiffness matrix [K], finite element equations, treatment of boundary conditions, quadratic shape functions, temperature effects.

Machine Frames: Introduction, plane trusses, assembly of global stiffness matrix for the banded and skyline solutions.

Two-Dimensional Problems Using Constant Strain Triangles: Introduction, finite element modeling, constant strain triangle (CST), problem modeling and boundary conditions, orthotropic materials.

Axi-Symmetric Solids Subjected to Axi-Symmetric Loading: Introduction, Axi-symmetric formulation, finite element modeling, triangular element, problem modeling and boundary conditions.

Two Dimensional Iso-Parametric Elements and Numerical Integration: Introduction, four-node quadrilateral, numerical integration, higher-order elements.

Beams and Frames: Introduction, finite element formulation, load vector, boundary considerations, shear force and bending moment, plane frames.

Scaler Field Problems: Introduction, steady-state heat transfer, torsion, potential flow, seepage, fluid flow in ducts, unsteady 1-D and 2-D heat conduction problems.

Pre-Processing and Post-processing: Introduction, mesh generation, post-processes.

References:

1. "Introduction to Finite Elements in Engineering", T.R. Chandrupatla and A.D. Belegundu, Prentice Hall of India Publication, 2nd Edition
2. "Textbook of Finite Element Analysis"- P. Seshu, PHI Learning Pvt. Ltd.
3. "An Introduction to the Finite Element Method"- J.N. Reddy, McGraw-Hill, New York.
4. "Finite Element Analysis"- S. S. Bhavikatti, New Age International.

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5. "Fundamentals of Finite Element Analysis"- D.V. Hutton, McGraw-Hill, New York.
6. "Applied Finite Element Analysis", L.J. Segerlind, Wiley & Sons Publication, 2nd Edition.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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PROGRAM ELECTIVE - II

PEM 104A : Planning and Control of Production Systems

Structure : 3-0-0

Credit : 3

Organisation, organisational structure, types of organisation structure, multi-plant organisation. Production, Types of Production, Production System and its elements, Generalized model of Production System.

Products and Services, Design & Development.

Forecasting: Importance, the marketing interface, the materials interface, Basic Techniques.

System Economics: Tactics & Strategies, Break-Even-Analysis, Life Cycle analysis and capacity requirement planning, VAT analysis, Learning curve.

The plant or facilities - Location and design of the plant or facilities, Layout of the facilities, Equipment selection, Maintenance of the facilities and equipment.

Material and Inventory Management.

Demand analysis, Resource Planning, Aggregate Production Planning, Line Balancing.

Materials requirement planning, Sequencing and Scheduling and loading.

Human Factors: Manpower planning, Placement, Leadership and Supervision, Training, Motivation, Safety, Theory of decision making, An overview of control and control techniques.

Production Monitoring and Control, Productivity analysis, Performance Criteria and evaluation, Case Studies and Example.

References:

1. "Production and Operations Management" - E.S. Buffa, New Age International (P) Ltd., New Delhi.
2. "Production Systems: Planning, analysis and Control" - J.L. Riggs, John Wiley & Sons, New York.
3. "Production and Operations Management" - S.N. Chary, Tata McGraw-Hill Publishing Co. Ltd., New Delhi

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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PEM 104B : Project Engineering and Management

Structure : 3-0-0

Credit : 3

Objectives and importance, Project Scheduling, role of entrepreneur, consultant and vendor, Types of Contract, market and demand analysis, technical analysis, requirement of machinery, utilities, land) building, plant layout and man-power calculation using SLP, Assembly Line Balancing; Social cost benefit analysis, environmental perspective, selection of site and factors involved. Feasibility report, Design basis report, Detail Project Report, Financial, Economic, Technical and Market Appraisal of Projects.

Financial Analysis: Cost of project, cost of capital, means of finance, norms and policies of financial Institutions, Government incentives; Estimate of sales, cost of production, working capital requirement and financing; Profitability, projection and statements, treatment of depreciation and taxes, pre-operative expenses, projected cash flows, projected balance sheet, financial appraisal criteria viz. NPV, IRR, payback period, BSCR, BEP and key financial ratios. Sensitivity and risk analysis. Application for financial assistance and incentives.

Project Implementation: Pre-requisites of successful project implementation, network techniques for project planning and control - PERT and CPM, Approval of various statutory bodies and govt. departments.

References:

1. "Projects-Planning, Analysis, Selection, Implementation & Review" - P. Chandra, Tata McGraw-Hill, New Delhi.
2. "A Management Guide to PERT /CPM" - J.D. Wiest and F.K. Levy, 2nd edition, Prentice Hall of India, New Delhi.
3. "Financial Management Policy" - J.C. van Horne, 12th ed., Pearson Education Asia, Singapore (Low Priced Edition).
4. Institute of Chartered Financial Analysis of India (ICFAI), Hyderabad.
5. "Project Planning and Management" - K. Deb.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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PEM 104C : Materials Management

Structure : 3-0-0

Credit : 3

Integrated material management; The material cycle, forecasting material need, procurement and storage; Vendor rating, incoming material inspection and acceptance sampling, Classification of Inventory; ABC, VED, and FSN analysis.

Standardization, codification and variety reduction, control of level of inventory and frequency of purchase, Assessment of risk of inventory through Beta analysis in uncertain conditions of demand, Kanban inventory, TOC, SCM, MRP and JIT. Optimal Control theory in materials management.

Material management and Legal Environment; Value Analysis, Price Negotiation Strategies, Information System for Effective materials management, Application of Soft Computing in materials management.

References:

1. "Manufacturing Planning and Control Systems" - Vollmann, Bery and Whybarn, Tata-McGraw Hill Publication, New Delhi.
2. "Integrated Materials Management" - Plossel.
3. "Integrated Materials Management" - Tersine.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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PEM 104D : Industrial Ergonomics

Structure : 3-0-0

Credit : 3

Defining human factors in a production system; Characteristic features of man-machine system; Human Performance and Reliability; Human sensory motor system, Stimulus Dimensions, Human information processing, noise and the theory of signal detection (TSD), quantitative and qualitative visual displays, Human factors associated with speech communication; Introduction to Kinesiology; Bio-mechanics and bio-engineering aspects of human motor activity; Performance analysis of limbs in making specific types of movements; Energy expenditure in physical activities, Spatial movements and conceptual relationships of stimuli and responses; Continuous control systems, types of control functions, tools and related control device.

Design of workplace and work-components; Applied anthropometry, activity analysis, Work arrangement by simulation, Design of individual workplace, Human performance under heat, cold, illumination, vibration, noise, pollution, static and dynamic conditions. Work design, method study and work measurement techniques.

References:

1. "Human Factors in Engineering and Design" - E.J. McCormick, TMH Publication.
2. "Methods, Standards and Work Design" - B. Niebel and A. Freivalds, McGraw Hill Publication.
3. "Ergonomics and Work Design" - P.K. Nag, New Age International Publication.

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

PEM 104E : Environmental Degradation of Materials

Structure : 3-0-0

Credit : 3

Introduction: Definitions, Different forms of Environmental degradation, Cost of Corrosion, Electrochemical Nature, Aim.

Thermodynamics: Process at Interface, Free Energy and Electrochemical Potential, EMF Series, Nernst Relationship, Important Reactions, Cell Potential, Reference Electrodes, Advanced Thermodynamics (E-pH Diagrams).

Kinetics: Current Density and Corrosion Rate, Exchange Current Density, Polarization, Experimental Techniques. Mixed Potential Theory: Postulates, Applications to Active Metals.

Passivation: Historical Interest, Polarization Behaviour, Application of Mixed Potential Theory.

Forms of Corrosion: Uniform, Galvanic, Intergranular, Crevice, Pitting, De-alloying, Erosion, Stress related corrosion, Different Factors- Metal Purity, Crystal Defects, Grain Structure, Concentration cells, Velocity, Temperature, Humidity, Stress, Microbial effect, Liquid metal effect. High Temperature Oxidation: Reactions, Thermodynamics, Oxide Structure, Oxide Growth, Hot Corrosion.

Corrosion Measurement and Failure Analysis: Philosophy, Laboratory Tests, Electronic Probes.

Corrosion Control: Philosophy, Materials Selection- Stainless Steels, Nickel and Nickel Alloys, Other Metal Alloys, Plastics, Nonmetallics, Protective Coatings/ Claddings- Metallic Coatings, Conversion Coatings, Organic Coatings, Ceramic Coatings, Cladding, Inhibitors- Passivators, Barrier Inhibitors, Poisons, Scavengers, Neutralizers, Mixed Potential Theory Approach, Electrical Methods- Sacrificial Anode Cathodic Protection, Impressed Current Cathodic Protection, Anodic Protection, Mixed Potential Theory Analysis, Corrosion Control by Design- Establishing Uniform Corrosion, Minimization of Moisture Condensation, Prevention of Galvanic Cells, Prevention of Environment Cells, Prevention of Corrosion-Mechanical Interactions, Design for Inspection and Maintenance.

Degradation of Polymeric Materials: Swelling and Dissolution, Bond Rupture, Weathering, Other Processes, Polymer Cycling and Degradation.

Corrosion of Composite Materials: Galvanic Effects, Matrix Nature, Reinforcement Nature, Prevention.

Future Outlook: Corrosion and Society, Research, Industry.

References:

1. "Corrosion and Corrosion Control", H. H. Uhlig and R. W. Revie, Wiley, NY, 1985.
2. "Corrosion Engineering", Fontana M.G., McGraw Hill.
3. "Corrosion", Vol I and II, L.L. Shreir, Butterworths, Kent, 1976.
4. "Atlas of Electrochemical Equilibria in aqueous solutions", M. Pourbaix, NACE, Houston, 1974.
5. "Modern Electrochemistry", Vol. I and II, J.O.M. Bockris and A.K.N. Reddy, Plenum Press, NY, 1970.
6. "Fundamental Aspects of Corrosion of Metals in Aqueous Environments", R.W. Staehle, Special Lecture Series on the fundamentals of corrosion, Univ. of Minnesota, USA, 1968.
7. "Advances in Corrosion Engineering", NPTEL Course, <http://www.iitm.ac.in>

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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PEM 104F : Computational Fluid Dynamics

Structure : 3-0-0

Credit : 3

A Brief Overview of the Basic Conservation Equations for Fluid Flow And Heat Transfer, Classification of Partial Differential Equations and Pertinent Physical Behaviour, Parabolic, Elliptic and Hyperbolic Equations, Role of Characteristics.

Common Methods of Discretization: An Overview of Finite Difference, Finite Element and Finite Volume Methods.

Numerical Solution of Parabolic Partial Differential Equations Using Finite-Difference and Finite-Volume Methods: Explicit and Implicit Schemes, Consistency, Stability and Convergence.

Numerical Solution of Systems of Linear Algebraic Equations: General Concepts of Elimination and Iterative Methods, Gaussian Elimination, LU Decomposition, Tridiagonal Matrix Algorithm, Jacobi and Gauss-Seidel Iterations, Necessary and Sufficient Conditions for Convergence of Iterative Schemes, Gradient Search Methods, Steepest Descent and Conjugate Gradient Methods. The Finite Volume Method of Discretization for Diffusion Problems: One-Dimensional Steady Diffusion Problems, Specification of Interface Diffusivity, Source-Term Linearization. Discretization of Transient One-Dimensional

Diffusion Problems, Discretization for Multi-Dimensional Diffusion Problems. Solution of Discretized Equations Using Point and Line Iterations, Strongly Implicit Methods and Pre-Conditioned Conjugate Gradient Methods.

Convection-Diffusion Problems: Central Difference, Upwind, Exponential, Hybrid and Power-Law Schemes, Concept of False Diffusion, QUICK Scheme.

Numerical Solution of the Navier-Stokes System for Incompressible Flows: Stream-Function Vorticity and Artificial Compressibility Methods, Requirement of a Staggered Grid. MAC, SIMPLE, SIMPLEC and SIMPLER Algorithms.

An Introduction to Unstructured Grid Finite Volume Methods.

Special Topics: Turbulence and Its Modeling, Phase-Change Problems, Interface/ Free-Surface Tracking Methods.

References:

1. "Computational Fluid Dynamics: The Basics with Applications. Science/Engineering/Math", Anderson, J.D., McGraw-Hill Science.
2. "Numerical Heat Transfer and Fluid Flow. Hemisphere Series on Computational Methods in Mechanics and Thermal Science", Patankar, S., Taylor & Francis.
3. "Numerical Computation of Internal and External Flows" (Vol. 1&2), Hirsch, C., John Wiley & Sons.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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PRACTICAL

PEM 191 : Manufacturing Process Laboratory

Structure : 0-0-4

Credit : 2

Laboratory Modules on the following areas:

- 1) Testing of moulding sand, and Casting of non-ferrous metals / alloys,
- 2) Heat Treatment, and Metallographic studies,
- 3) Characterisation and Testing of Fabrication processes: GMAW, GTAW, etc.,
- 4) Surface Grinding operation and its parametric dependence,
- 5) Grinding of Cutting Tools with a given tool signature,
- 6) Chip formation in machining processes under different process parameters,
- 7) Metal forming, etc.

PEM 192 : Computational Laboratory

Structure : 0-0-4

Credit : 2

Laboratory Modules on the following areas:

- 1) Component drafting and drawing through AutoCAD or similar software
- 2) Stress analysis using standard software such as ANSYS, etc.
- 3) Use of CAD/CAM software like Solid Edge, ProEngineer, etc. for component manufacture
- 4) Use of a Project Engineering Software, etc.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

SEMESTER - II

THEORY

PROGRAM CORE – III

PEM 201 : Automation in Manufacturing

Structure : 3-0-0

Credit : 3

Review of basic principles of automation, type and degree of automation, hard automation and flexible automation, working of stand alone semi-automatic machine tools- turret and capstan lathes, stand alone automatic machine tools, multi-spindle machine tools, transfer machines.

Introduction to computer aided manufacturing (CAM) systems, basic building blocks of computer integrated manufacturing (CIM).

Numerical Control Machines and Systems- CNC, DNC (Direct and Distributed), FMC, FMM, FMS, Machining Centres, CAPP, Part Programming on CNC machines for machining, EDMing, forming, etc. using G and M codes, APT, etc., toolings of CNC machines; Adaptive Control systems, tool and work handling systems involving robot, AGV, AS/RS, ATC, APC, etc.

Robotics; types, anatomy, drives, kinematics, controls, and applications of the robot.

Computer aided production planning and control, CAD-CAM interface, Manufacturing from product design- concept of group technology (GT), Control systems, Process monitoring, Automatic inspection systems, use of CMM.

References:

1. “Automation, Production Systems, and Computer-Integrated Manufacturing” - M.P. Groover, Prentice Hall of India.
2. “CAD/CAM - Theory and Practice” - I. Zeid, Tata McGraw-Hill PublishingCo. Ltd., New Delhi.
3. “CAD/CAM” - M.P. Groover and E.W. Zimmers Jr., Prentice Hall of India
4. “CAD/CAM/CIM” - P. Radhakrishnan, S. Subramanyan and V. Raju, New Age International Publishers.
5. “Computer Aided Manufacturing” - P.N. Rao, N.K. Tewari and T.K. Kundra, Tata McGraw-Hill Publication.
6. “Robotics Technology and Flexible Automation” - S.R. Deb, Tata McGraw-Hill Publication.
7. “Industrial Robots and Computer Integrated Manufacturing” - S. Kumar, Oxford & IBH Publishing Co. Ltd.
8. “Computer-Aided Production Management” - P.B. Mahapatra, Prentice Hall of India.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

PROGRAM CORE – IV

PEM 202 : Modern Machining Processes

Structure : 3-0-0

Credit : 3

Modern Machining Processes; Non-traditional machining: Introduction, Specific Applications and Advantages over Traditional Machining Processes; Need of High production rate machining. Mechanical Non-Traditional Machining Processes; Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, and Abrasive Water Jet Machining; Process details, parametric effects, recent advancements and modelling.

Thermal Non-Traditional Machining Processes; Electro discharge Machining, Plasma Arc Machining, Electron Beam Machining, and Laser Beam Machining; process, parameters, recent advances and modelling.

Chemical and Electrochemical processes; Chemical Machining, Electro Chemical Machining and Electrochemical grinding.

Hybrid-type systems; Electro Chemical Discharge Machining, Ultrasonic-assisted Electro Discharge Machining, ELID during grinding and other types,

High Production Rate Machining and Grinding; Designing suitable tooling, cutting fluid application; alternative processes- hot machining, stretch machining, etc.; obstacles faced and possible remedies.

Micro and Nano machining, Environment friendly machining.

Intelligent Manufacturing Systems: Fuzzy, Neural Networks, Genetic Algorithms to be applied in smart / digital manufacturing. Industry 4.0: Cyber Physical Manufacturing System.

References:

1. "Modern Machining Processes" - P.C. Pandey and H.S. Shan, Tata McGraw-Hill Publication.
2. "Non-Conventional Machining" - P.K.Mishra, Narosa Publishers.
3. "Advanced Machining Processes – Nontraditional and Hybrid Machining Processes"- H.A.G. El-Hofy, McGraw-Hill.
4. "Manufacturing Science"- A. Ghosh and A.K. Mallik, East-West Publications.
5. "Manufacturing Engineering and Technology" - S. Kalpakjian, Addison Wesley.
6. "Materials and Processes in Manufacturing" - E.P. DeGarmo, J.T. Black and R.A. Kohser, Prentice Hall of India.
7. "A Text Book of Production Technology" - O.P. Khanna and M. Lal, Dhanpat Rai and Sons.
8. "Rapid Prototyping: A Brief Introduction"- A. Ghosh, East West Publication.
9. "Manufacturing Processes"- Amstead, Ostwald and Begeman, John Wiley and Sons.
10. "Micromachines", I. Fujimasa, Oxford University Press.
11. "Precision Engineering in Manufacturing", R.L. Murty, New Age International Publishers.
12. "Laser Machining and Welding" - N. Rykalin, A. Uglov and A. Kokora, Mir Publishers, Moscow.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME
PROGRAM ELECTIVE - III**

PEM 203A : Machine Tools Engineering

Structure : 3-0-0

Credit : 3

Chronological developments of machine tools, design principles of metal cutting machine tools, machine kinematics, criterion for selection of operating capacity and design parameters, analysis of formative motions and preparation of layouts, concept of standardization, design of elements for strength, rigidity and life.

Design of Speed and Feed box, stepless regulations of speed and feed, machine tool structure, design of bed, headstock, guide ways, slide ways, structure analysis, use of finite element method.

Concepts of oil hydraulics and pneumatics, electro hydraulics servo mechanisms, basic configuration of hydraulic power supplies, bypass regulated and stroke regulated hydraulic power supplies, heat generation and dissipation in hydraulic systems, hydraulic control elements - DCV, PCV, FCV, valve configuration and analysis.

Mechatronic elements of a CNC machine, machine tool error analysis, sources of error, error compensation strategies, use of neural networks.

Machine tool dynamics, free and forced vibrations, review of multiple degree of freedom systems, response to excitations, models of vibrations, self excited vibrations, random vibrations and stability analysis.

Acceptance tests of machine tools.

Agile manufacturing, Reconfigurable machining systems, Application of ergonomics in machine tool design.

References:

1. "Principles of Machine Tools" - G.C. Sen and A. Bhattacharya
2. "Machine Tool Design" - J.N. Acherkan, Vol. 1 to 4, MIR Publishers
3. "Machine Tool Design", N.K. Mehta, TMG Publications,
4. "Fluid Power Control" - J.F. Blackburn, G. Reetholf and J.L. Shearer, New York Technology Press of MIT and Wiley
5. "Oil Hydraulic Power and Its Industrial Applications" - W. Ernst, 2nd Ed. New York, McGraw Hill
6. "Hydraulic Control Systems" - H.E. Merrit
7. "Testing of Machine Tools" - G. Shleisinger, Pergamon Press
8. "Elements of Vibration Analysis" - L. Meirovitch, McGraw Hill Co.
9. "Mechatronics" - W. Bolton, Addition Wesley Longman, Singapore.
10. "Mechatronics" - HMT Limited, Tata McGraw Hill
11. "Precision Engineering in Manufacturing" - R. L. Murty, New Age International Publishers.
12. "Ergonomics and Work Design" - P.K. Nag, New Age Int. Publishers
13. "Mechanical Vibration" - M.P. Groover, PHI Publication.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

PEM 203B : Micro and Precision Manufacturing Systems

Structure : 3-0-0

Credit : 3

Introduction to micromachining, milimachining *and* nanotechnology, different fabrication and other processes involved and related process parameters, application of miniaturized components.

Mesoscopic domain of micromachines- introduction, biological systems, cells as machines, role of proteins, physics of micromechanism, future prospects.

Precision manufacturing- Introduction, concept of accuracy, tolerance and fits, influence of different factors on the maintainability of accuracy of the machine tools and the product, compensation of thermal errors and location errors, effects of vibration and tool wear, dimensioning and dimensional chains, microfinishing processes.

Different Measuring Systems: Different Optical / Acoustic / Magnetic etc. equipment to be used in post treatment and measurements.

References:

1. "Precision Engineering in Manufacturing" - R.L. Murty, New Age International Publishers.
2. "Micromachines: A New Era in Mechanical Engineering" - I. Fujimasa, Oxford Science Publications.
11. "Manufacturing Engineering and Technology" - S. Kalpakjian, Addison Wesley Publication.
12. "Modern Machining Processes" - P.C. Pandey and H.S. Shan, Tata McGraw Hill Publication.
13. "Advanced Machining Processes – Nontraditional and Hybrid Machining Processes"- H.A.G. El-Hofy, McGraw-Hill.

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

PEM 203C : Mechatronic Systems Design and Applications

Structure : 3-0-0

Credit : 3

Basic concepts of mechatronics; components of a mechatronic system.

Motion conversion techniques- different linear, rotary and complex motions, its mechanisms and transmission; mechanical load analysis for actuator selection.

Electro-mechanical energy conversion; transducers, stepper motors- principles of operation, types, construction, basics of stepper motor drives; brushless motor (BLM) control, analog-digital conversion, speed control of induction motor, vector control, servo control- principles, operations of a servo motor.

Control Systems: Open loop and closed loop control, transfer functions, Laplace transforms; PID controllers, automatic process control, PLC controller, time and frequency domains analysis, transient response of first and second order systems; introduction to nonlinear control; State space analysis, optimal and adaptive control; introduction to discrete-time systems and Z-transform, stability analysis of a system.

Electro-pneumatic and electro-hydraulic control; solenoid control valves, PLC control, microprocessors and control using it, computer interface.

Applications of mechatronic systems- robots, position and level control systems, etc. Designing typical mechatronic systems.

References:

1. "Mechatronics"- W. Bolton, Addison Wesley Longman, Singapore.
2. "Introduction to Mechatronics and Measurement Systems" - M.B. Histan and D.G. Alciatore, McGraw Hill Co.
3. "Understanding Electro-Mechanical Engineering: An Introduction to Mechatronics" - L.J. Kamm, Prentice Hall of India.
4. "Mechatronics"- N.P. Mahalik, Tata McGraw-Hill.
5. "Mechatronics"- HMT Limited, Tata McGraw-Hill.
6. "Analytical Robotics and Mechatronics"- W. Stadler, McGraw-Hill Book Co.
7. "Machine design for mobile and industrial applications"- G.W. Kurtz, J.K. Schueller and P.W. Claar, SAE.
8. "Hydraulics and Pneumatics"- A. Parr, Butterworth/ Jaico Publishing House.
9. "Engineering Applications of Pneumatics and Hydraulics"-I.C. Turner, Arnold.
10. "Pneumatic Systems-Principles and Maintenance"-S.R. Majumdar, TMH Pub.
11. "Fluid Power with Applications" - A. Esposito, Prentice Hall International.
12. "Mechatronic Systems Design"- D. Shetty and R.A. Kolk, Brooks/Cole, Thompson Learning/ Vikas Publishing House.
13. "Automatic Control Engineering"- F.H. Raven, 5th ed., McGraw-Hill International.
14. "Modern Control Engineering"- K. Ogata, 3rd ed., Prentice Hall.
15. "Automatic Control Systems"- B.C. Kuo, 6th ed., Prentice Hall.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME
PROGRAM ELECTIVE – IV**

PEM 204A : Quality Management

Structure : 3-0-0

Credit : 3

Basic concepts, definitions and history of quality control, Quality function and concept of quality cycle, Quality policy and objectives, Quality considerations in design, Economics of quality and measurement of the cost of quality, definitions, classifications, Quality Cost Matrix, Evaluation of Quality Costs. Taguchi's Quality Loss Function.

Process control: Upper and Lower Specification Limits, Accuracy and Precision. Process Capability, Potential Capability and Actual Capability. Use of control charts and process engineering techniques for implementing the quality plan.

Total Quality Control and Management, definition, vision and philosophy, Concepts of TQM, Concepts of customer centered environment, Golden Rules of TQM, the PDCA Cycle, Tools and Techniques, Implementation of TQM, Waste Elimination, the 5S campaign, Flow Chart, Pareto analysis, Cause and Effect Diagram, Force Field Analysis, Brain Storming, Quality Circle, Quality Function Deployment, Just-In- Time Approach, Quality Standards, ISO 9000 Standard, Implementation and Registration.

References:

1. "Quality Control Handbook" - J. Juran, McGraw-Hill Book Company.
2. "Quality Planning and Analysis" - M. Juran, F. M. Gryana, Tata McGraw Hill (3rd Ed.).
3. "Statistical Quality Control" - M. Mahajan, Dhanpat Rai Publication.
4. "Handbook of Total Quality Management" - R.P. Mohanty and R.R. Lakhe, Jaico Publishing House.
5. "Total Quality Management" - D. H. Besterfield, et al., Pearson Education, Asia.
6. "Quality Control and Industrial Statistics" - A.J. Duncan, Richard D. Irwin Inc., USA.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

PEM 204B : CAD-CAM Systems

Structure : 3-0-0

Credit : 3

Basic concepts of product design. Different phases of computer aided design (CAD), integration of CAD-CAM, system software, benefits of CAD

Elements of interactive computer graphics (ICG); introduction, point and line plotting and display techniques, 2D and 3D transformation, concatenation, clipping, segmentation, 2D and 3D graphics, input and output devices, raster scan graphics systems.

Geometric modeling; wire-frame, surface and solid modeling techniques.

Computer-aided drafting; drafting packages, dimensions, text, shading, hatching, etc. of mechanical components.

Engineering analysis; design reviews and evaluation.

Element of CAM/CIM systems; CNC Machines, DNC, FMS, Machining Centres, A.C. Systems, different handling and robotic configurations employed; Computer Integrated Production Planning and Control; MRP, MRP-II, CAPP, CAI and CAQC, Application of softwares. Interfacing of CAD with CAM; manufacturing data generated from CAD data.

References:

1. "CAD/CAM - Theory and Practice", Ibrahim Zeid, Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
2. "CAD/CAM" - M. P. Groover and E. W. Zimmers Jr., Prentice Hall of India
3. "Automation, Production Systems, and Computer-Integrated Manufacturing" M.P. Groover, Prentice Hall of India.
4. "Computer Aided Mechanical Design and Analysis" - V. Ramamurti, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 3rd Edition.
5. "Mathematical Elements for Computer Graphics", D. F. Rogers and J. A. Adams, McGraw-Hill Publishing Co., Singapore, 2nd Edition.
6. "Principles of Interactive Computer Graphics", W. M. Newman and R. F. Sproull, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2nd Edition.
7. "Schaum's Outlines of Theory and Problems of Computer Graphics" - Z. Xiang and R. Plastock, McGraw Hill, Singapore, 2nd Edition.
8. "CAD/CAM/CIM"- P. Radhakrishnan, S. Subramanyan and V. Raju, New Age International Publishers.
9. "Computer Aided Manufacturing"- P.N. Rao, N.K. Tewari and T.K. Kundra, Tata McGraw-Hill Publication.
10. "Robotics Technology and Flexible Automation"- S.R. Deb, Tata McGraw-Hill Publication.
11. "Industrial Robots and Computer Integrated Manufacturing"- S. Kumar, Oxford & IBH Publishing Co. Ltd.
12. "Computer-Aided Production Management"- P.B. Mahapatra, Prentice Hall of India.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

PEM 204C: Design of Experiments

Structure : 3-0-0
Credit : 3

Introduction to design of experiments- Its utility, Historical background, Basic statistical concepts, Analysis of Variance (ANOVA), Distribution of function of variables, Sampling, Estimation and Test of Hypothesis, Power of tests, Non-Parametric Tests.

Types of design of experiments- Factorial design, Latin Square, Response Surface Methodology, Randomised design strategy, Taguchi method for optimizing the number of experiments, etc.

Analysis of the result- Chi-Square Test, 't' test, ANOVA, etc.

Application examples of different designs of experiments.

References:

1. "Applied Statistics" – P. Mukhopadhyay, Books and Allied (P) Ltd.
2. "An Outline of Statistical Theory" Volume I, II, -A. M. Goon, M. K. Gupta, B. Dasgupta, The World Press Private Ltd.
3. "Elements of Probability & Statistics" – B. Jash, TMG
4. "Mathematical Statistics"- S. K. De, S. Sen, U.N. Dhur & Sons Private Ltd.
5. "The Design of Experiments to find Optimal Conditions" - Yu.P. Adler, E.V. Markova, Ylu V. Granovsky, MIR, 1975, Moscow
6. "Design and analysis of Experiments" - R.G. Petersen, Marcel Dekkar Inc., New York.
7. "Experimental Designs" – W.C. Cochran and G.M. Cox, John Wiley & Sons, Inc., New York.
8. "Design and Analysis of Experiments"- D. C. Montgomery, Wiley-India Edition.
9. "Design of Experiments (DOE) Using the Taguchi Approach"- Ranjit Gupta, John Wiley & Sons.
10. "Engineering Quality by Design: Interpreting the Taguchi Approach"- T.B. Barker, Marcel Dekker, Inc., New York.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

PEM 204D : Advanced Welding Technology

Structure : 3-0-0

Credit : 3

Review of Welding Processes: Fusion and Solid State Welding.

Process Descriptions: Solid State Welding processes, and Fusion Welding processes- Arc welding- SMAW, Stud arc welding, GMAW, GTAW and FCAW; Gas welding; Resistance welding processes.

Equipment of Arc Welding: Different types, Power sources, Arc characteristics,

Welding Consumables: Electrode and Filler selection with different types of flux.

Precision Welding Processes: PAW, LBW, EBW, USW, Friction stir welding.

Joining of Non-Metals: Ceramics, Plastics, and Composites.

Welding Metallurgy: HAZ, Effects of different process parameters on weldment.

Weldability of Work Materials: Plain carbon steel, Stainless steel, Cast iron, Aluminium & Copper and its alloys, Welding of Dissimilar Materials.

Applications of Welding Techniques Other than Joining: Hard facing, Cladding, Repair welding.

Inspection and Testing of Weld Defects and their Remedies: Welding Defects, Inspection and Testing of Welding Joints, Residual stresses and Distortion, Remedial Measures.

References:

1. "A Text Book of Welding Technology", O.P. Khanna, Dhanpat Rai & Sons.
2. "Welding Engineering and Technology", R.S. Parmar, Khanna Publishers.
3. "Weldment Design", M. Bhattacharyya, The Association of Engineers, India Publication, Kolkata.
4. "Welding Metallurgy and Weldability of Stainless Steels", J.C. Lippold and D.J. Kotecki, Wiley-India (P) Ltd., New Delhi.
5. "Modern Arc Welding Technology", S.V. Nadkarni, Oxford & IBH Publishing Co. Pvt. Ltd./ Advani-Oerlikon Ltd.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

PEM 204E : Product Design and Development

Structure : 3-0-0

Credit : 3

1. Introduction to Product Design, Design and Development Process, Sequential Engineering Design Method, Product Planning and Project Selection.
2. Identifying Customer Needs – Interpreting Raw Data; Product Specifications – Establishing Target Specifications, Setting Final Specifications.
3. Concept Generation – Activities of Concept Generation, Clarifying Problem, Exploring the Output; Concept Selection – Concept Screening and Concept Scoring, Methods of Selection.
4. General Theory of Innovation and TRIZ (Theory of Inventive Problem Solving), Applications in Product Design and Development.
5. Concept Testing – Qualitative and Quantitative Methods Including Survey, Measurement and Customer's Response; Design for Environment – Basic Concepts.

References:

1. "Product Design and Development", K.T. Ulrich and S.D. Eppinger, Tata McGraw Hill.
2. "Inventive Thinking through TRIZ: A Practical Guide", M.A. Orloff, Springer.
3. "Concepts in Engineering Design", A. K. Gupta, Dhanpat Rai Publications.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

PRACTICAL

PEM 291 : Manufacturing System and Process Laboratory

Structure : 0-0-4

Credit : 2

Experiments on modern, computer aided manufacturing and allied systems, such as;

- Part programming on a CNC lathe
- Part programming on a CNC milling / machining centre
- Using MasterCAM, etc. for making a job from AutoCAD drafting
- Computer Aided Process Planning
- Robotic Programming
- Electric Discharge Machining
- Testing for alignment/ error in machine tools
- Finding out speed ratios and constructing ray diagrams of machine tools.
- Machine Tool Vibration
- Mechatronic elements in automated machine tools

PEM 292 : Design Laboratory

Structure : 0-0-4

Credit : 2

Tasks on computer aided designing and analysis of components and systems, such as;

- Design of components of machine tools, cutting tool, other toolings, metal working processes, etc.
- Stress analysis of components of machine tools, cutting tool, other toolings, metal working processes, etc. under different types of loading conditions using standard software such as ANSYS, etc.
- Designing for New Product Development.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

**SESSIONAL
MINI PROJECT**

PEM 281 : Mini Project with Seminar

Structure : 2-0-0

Credit : 2

Mini Project would be to do some preliminary works that would lead to the detailed project work spanning over Semester III and IV. Related to the same, the Seminar would be based on literature review on some emerging areas related to this course and the preliminary works done on the mini project.

Seminar presentation would be made by an individual student, and a report would have to be submitted by each student separately.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

SEMESTER – III

THEORY

PROGRAM ELECTIVE – V

PEM 301A : Logistics and Supply Chain Management

Structure : 3-0-0

Credit : 3

Introduction: Understanding logistics and supply chain management (SCM); wholistic approach to physical flow; customer focus in SCM: efficient customer response (ECR), quick response (QR), accurate response (AR), corporate goal through competitive advantage, push and pull type system.

Inbound and Outbound Logistic: SCM integration considering material flow, information flow and cash flow; Bullwhip effect, transportation and warehousing.

Cost Analysis: Historical costing, standard costing and estimated costs, marginal costs, concept of cost drivers; activity based costing (ABC), through put accounting.

Benchmarking for SCM: Techniques of performance measurement and its barriers and evaluation of SCM.

Transportation and Warehousing Location: Multi-model transport operation, routing, scheduling, fleet size insurances, sales tax, outsourcing, 3rd and 4th party logistics.

IT and Its Applications in SCM: MRP, ERP, distribution resource planning (DRP/DRPB) and designing SCM.

Supply chain management in service sector, global market and global sourcing, supplier alliance, supplier quality control, supplier chain re-engineering.

Green supply chain management.

References:

1. "Logistics and Supply Chain Management"- M. Christopher, Pearson Education Limited, UK.
2. "Essentials of Supply Chain Management"- M. Hugos, Wiley Publication.
3. "Supply Chain Management: Strategy, Planning, and Operation"- S. Chopra, Pearson Education Limited, UK.
4. "Production and Operations Management"- Kanishka Bedi, Oxford University Press.
5. "Management Information Systems- Managing the Digital Firm"- Kenneth C. Laudon, Jane P. Laudon, Pearson Education.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

PEM 301B : Introduction to Management Information Systems

Structure : 3-0-0

Credit : 3

An Overview of Management Information Systems, Structure of a Management Information System, Need of MIS.

Hardware, Software and Communication Technology for Information Systems. Storage and Retrieval of Data, Transaction Processing, Office Automation and Information Processing.

Data processing Systems, The Decision Making Process, Concepts of Information, Human as Information Processors, System concepts, Concepts of Planning and Control, Real Time Systems, Organizational Structure and Management Concepts. Case Studies

Supports Systems for Planning Control and Decision Making, Support Systems for Management of Knowledge Work.

Data Communication hardware, Computer Networks, Developing a Long Range Information system Plan, Strategies for the Determination of Information Requirements, Database Requirements, User Interface Requirements.

Data sources and Data Management, Hierarchy of data organisation, Design & development of Application Systems, Quality assurance and Evaluation of Information Systems, Organization and Management of the Information Resources function, Future Developments and Their Organizational and Social Implications. Elements of software Engineering-models design issue.

References:

1. "Management Information System : Conceptual Foundations, Structure and Development" - Gordon B. Dads, Margrethe H. Olson, McGraw-Hill Book Company.
2. "Management Information Systems"- Larry Long, Prentice .Hall Erewood Cliffs, New Jersey
3. "Principles of MIS" - G.M. Scott, McGraw-Hill Publishing Company.
4. "Theory & Problems on Quantitative Techniques: Management Information System & Data Processing" - S. K. Chakraborty, New Central Book Agency.
5. "Software Project Management"- B. Hughes and M. Cotterell, 2nd ed.
6. "Management Information Systems- Managing the Digital Firm" Kenneth C. Laudon, Jane P. Laudon, Pearson Education.
7. "Management - Principles, Processes and Practices"- Anil Bhat, Arya Kumar, Oxford University Press.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

PEM 301C : Robotics and Robot Applications

Structure : 3-0-0

Credit : 3

Robot definition: Robotic systems - Its role in automated manufacturing; robot anatomy; robot classifications and specifications.

Robot kinematics, forward and reverse transformations, homogeneous transformation.

Robot Dynamics: Introduction to Force Analysis, Trajectory generation.

Robot actuators and control; Pneumatic, hydraulic and electrical drives and controls used in robots. Robot end-effectors- mechanical, magnetic and vacuum grippers, gripping forces, RCC and design features of grippers. Robot sensors- contact and non-contact sensors, Robot vision and their interfaces.

Robot languages and programming techniques.

Applications of robots in materials handling, machine loading/unloading, inspection, welding, spray painting and finish coating, and assembly, etc.

Economic performance and evaluation strategies, Robot installation and planning. Safety features.

References:

1. "Introduction to Robotics"- J.J. Craig, Addison-Wesley.
2. "Fundamentals of Robotics Analysis and Control"- R.J. Schilling, Prentice Hall of India.
3. "Robotics Technology and Flexible Automation"- S.R. Deb, Tata McGraw-Hill Publication.
4. "Foundations of Robotics Analysis and Control"- T. Yoshikawa, Prentice Hall of India.
5. "Robotics for Engineers"- Y. Koren, McGraw-Hill Book Company, New York.
6. "Industrial Robots and Computer Integrated Manufacturing"- S. Kumar, Oxford & IBH Publishing Co. Ltd.
7. "Automation, Production Systems, and Computer-Integrated Manufacturing" - M.P. Groover, Prentice Hall of India.
8. "Computer Aided Manufacturing"- P.N. Rao, N.K. Tewari and T.K. Kundra, Tata McGraw-Hill Publication.
9. "Robotics: Control, Sensing, Vision and Intelligence"- K.S. Fu, R.C. Gonzales and C.S.G. Lee, McGraw Hill, 1997
10. "Analytical Robotics and Mechatronics", W. Stadler, McGraw Hill Book Co.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

PEM 301D : Tribology and Terotechnology

Structure : 3-0-0

Credit : 3

Introduction to tribological systems, economic aspects, lubrication of bearings, friction control and wear prevention, properties and testing of lubricants, mechanisms of fluid flow- Reynold's equation and its limitations.

Idealized hydrodynamic bearing, plane slider bearings, journal bearings- finite and infinite, finite bearing, numerical solution, bearing design, fluid inertia and turbulence, hydrodynamic instability.

Squeeze film bearing, thrust and journal bearing, gas lubricated bearing, hydrodynamic bearings, hydrostatic bearings, porous bearings, elasto-hydrodynamic lubrication, solid lubricants.

Physico-mechanical interactions at interfacial contact, surfaces; Analysis and assessment of topography; tribo-models for asperity contact, frictional resistance and wear; Frictional instability and stick-slip phenomenon; Models of adhesion - diffusion wear process; Kinetics of solid state interfacial interactions.

Reliability, Maintainability and Availability Analysis: Failure Data Analysis, Hazard Models, System Reliability, Optimization in Reliability System, Reliability Economics and Life Cycle Analysis.

References:

1. "Lubrication"- R.C. Gunther, Baily Brothers and Swinfen Limited.
2. "Principles of Tribology" - Halling J. (Editor), Macmillan, London.
3. "Handbook of Tribology: Materials, Coatings and Surface Treatments"- B. Bhooshan and B. K. Gupta, McGraw Hill, New York.
4. "Tribology Handbook"- M.J. Neale, Butterworth Publication
5. "Basic Lubrication Theory"- A.t. Cameron, Wiley Eastern Limited
6. "Introduction to Tribology of Bearings"- B.C. Majumdar, A.H. Wheeler and Co. Pvt. Ltd. Allahabad.
7. "Tribology: Friction and Wear of Engineering Materials"- L.M. Hutchings, Edward Arnold, London.
8. "Engineering Tribology" - A.H. Williams, Oxford University' Press.
9. "Theory and Practice of Lubrication for Engineers"- D.D. Fuller, John Wiley and Sons.
10. "Principles and Applications of Tribology"- D.F. Moore, Pergamon Press.
11. "Friction and Wear of Metals"- E. Rabinowicz, John Wiley and Sons.
12. "Bearing Design and Application"- D.F. Wilcock and E.R. Booser, McGraw-Hill.
13. "Fundamentals of Fluid Film Lubrication"- B.J. Hamrock, McGraw-Hill.
14. "Friction Wear Lubrication- Tribology Handbook"- (Vol- I, II, III)- LV. Kragelsky and V.B. Alisin, Mir Publication, Moscow.

Maulana Abul Kalam Azad University of Technology, West Bengal

(Formerly West Bengal University of Technology)

**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

PEM 301E : Design and Manufacture of Cutting Tools, Mould and Dies

Structure : 3-0-0

Credit : 3

Design of cutting tools- designing for single and multi-point tools, form tool design, drill, milling cutter, gear cutting hob, broach; designing for product quality requirement.

Design of high-production cutting tools- features, typical tools available.

Economics of tooling- analyses for optimum machining conditions, comparison between inserted and brazed tools.

Process steps for tool manufacture- moulding, die making, powder forming, machining, grinding, brazing, surface coating, etc., special purpose and unconventional machine tools and equipment for tool making, related heat treatment processes and furnaces, finishing techniques.

Mould construction - injection mould, compression mould, transfer mould; feed system, ejection system, cooling system, heating system; selection of parting surfaces, mould with external and internal undercuts, mould for threaded components, under feed moulds. Defects in moulding and its remedies.

Design features of mould, methodical approach for design of mould, moulding machines.

Rapid prototyping; utility, integration of CAD data with the rapid prototyping machine.

Punch and die design for shearing operations; blank layouts; die sets, split dies, strippers, stops, pilots and punch mounting methods; progressive, compound and combination dies; fine blanking; bending tools; drawing and deep drawing tools; miscellaneous tools like embossing, coining, standard die set, etc.

Design of rolling and extruding dies, plastic processing, multiple extrusion dies. Flow analysis in forming; theory of spring back.

Selection of press; feeding devices; Press working lubricant. Material selection and heat treatment.

References:

1. "Design of Cutting Tools: Use of Metal Cutting Theory"- A. Bhattacharyya and I.Ham, ASTME, Michigan, 1969.
2. "Metal Cutting : Theory and Practice" - A. Bhattacharyya , Central Book Publishers, Kolkata
3. "Metal Cutting Theory and Cutting Tool Design" - V. Arshinov and G. Alekseev Mir Publishers, Moscow
4. "Manufacturing Science" - A. Ghosh and A.K. Mallik, Affiliated East-West Press Pvt. Ltd., New Delhi
5. "Metal Cutting Principles" - M.C. Shaw, Oxford University Press CBS
6. "Fundamentals of Metal Machining & Machine Tools" - G. Boothroyd, McGrawHill
7. "Metal Cutting" - E.M. Trent and P.K. Wright, Butterworth Heinemann Publication
8. "Cutting Tools"- P.H. Joshi, Wheeler Publication.
9. "Grindings Technology: Theory and Application of Machining with abrasives" - S. Malkin, Ellis Harwood Publication, U. K., 1990.
10. "Injection Mould Design" - R.J.W. Pye, Longman Scientific Technical
11. "Die Design Fundamentals" - J.R. Paquin, Industrial Press. Inc.

Maulana Abul Kalam Azad University of Technology, West Bengal

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

12. "Injection/Transfer Moulding of Thermosetting Plastics" - R.E. Wright, Hanser
13. "Metal Forming Processes" - Nagpal, Khanna Pub.
14. "Product Design & Manufacturing" - A.K. Chitale, R.C. Gupta
15. "Principles of Manufacturing Materials & Processing" - J.S. Campbell

Maulana Abul Kalam Azad University of Technology, West Bengal
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DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME

Sessional

Subject Code : IEM381	Category : Major Project
Subject Name : Dissertation-I (Progress)	Semester : <i>Third</i>
L-T-P : 0-0-20	Credit :10
Pre-Requisites:	

A Project Dissertation would be of two-semester duration and one project would be allotted to one student. The Progress of project dissertation up to the end of the Third Semester would be evaluated by the concerned supervisor and a panel of examiners through a seminar presentation on the progress of dissertation followed by viva voce. The Progress of project dissertation up to the end of the Third Semester would be presented by the student concerned and viva voce will be conducted by a panel of examiners.

Quality of the project is measured in terms of

- Very clear and concise objectives
- Very clear methodology, articulated using technical terms indicating all steps and tools
- Cites substantial current and good quality literature
- Clarity in design/setting up of experiment.
- Benchmarks used / Assumptions made
- Interpretation of results and justification thereof and validity of the results presented.
- Overall presentation of the report

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME
Sessional

Subject Code : IEM481	Category : Major Project
Subject Name : Dissertation-II (Completion)	Semester : <i>Fourth</i>
L-T-P : 0-0-32	Credit :16
Pre-Requisites:	

Total output of the project work would have to be submitted in form of a bound thesis containing literature review, objective, details of work done, conclusion, reference, etc. The evaluation of the thesis will be done by a panel of examiners.

Final presentation and viva voce of the project will be based on the project thesis submitted to be conducted by a panel of examiners.

Quality of the project is measured in terms of

- Very clear and concise objectives
- Very clear methodology, articulated using technical terms indicating all steps and tools
- Cites substantial current and good quality literature
- Clarity in design/setting up of experiment.
- Benchmarks used / Assumptions made
- Interpretation of results and justification thereof and validity of the results presented.
- Overall presentation of the report

Maulana Abul Kalam Azad University of Technology, West Bengal
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DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME

Mandatory Learning Course

Maulana Abul Kalam Azad University of Technology, West Bengal

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

Subject Code : MLC101	Category : Mandatory Learning Course
Subject Name : Research Methodology and IPR	Semester : First
L-T-P : 2-0-0	Credit:2
Pre-Requisites:	

Course Outcomes:

- At the end of this course, students will be able to
- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- 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 in turn brings about, economic growth and social benefits.

Course Outline:

Unit 1: Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research ethics,

Unit 3: Effective technical writing, how to write report, Paper

Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Unit 4: Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Learning Resources:

- Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
- Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
- Ranjit Kumar, 2 nd Edition, "Research Methodology: A Step by Step Guide for beginners"
- Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
- Mayall, "Industrial Design", McGraw Hill, 1992.
- Niebel, "Product Design", McGraw Hill, 1974.
- Asimov, "Introduction to Design", Prentice Hall, 1962.
- *Introduction To Research*, NPTEL online certification course.

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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Audit courses 1& 2

Maulana Abul Kalam Azad University of Technology, West Bengal

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

Subject Name : English for Research Paper Writing	Category : Audit course
Subject Code : AC101A / AC201A	Semester : First/ Second
L-T-P : 2-0-0	Credit : 0
Pre-Requisites:	

Course Objectives:

Students will be able to:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
Ensure the good quality of paper at very first-time submission

Course Outline:

Units	Contents	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	Key skills are needed when writing a Title; key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.	4
5	Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
6	Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

Learning Resources:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.
Highman's book.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

Subject Name : Pedagogy Studies	Category: Audit Courses
Subject Code : AC101B/ AC201B	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objective:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Course Outline:

Units	Contents	Hours
1	❖ Introduction and Methodology: <ul style="list-style-type: none"> • Aims and rationale, Policy background, Conceptual framework and terminology • Theories of learning, Curriculum, Teacher education. • Conceptual framework, Research questions. • Overview of methodology and Searching 	4
2	<ul style="list-style-type: none"> • Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. • Curriculum, Teacher education 	2
3	<ul style="list-style-type: none"> • Evidence on the effectiveness of pedagogical practices • Methodology for the in depth stage: quality assessment of included studies. • How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? • Theory of change. • Strength and nature of the body of evidence for effective pedagogical practices. • Pedagogic theory and pedagogical approaches. • Teachers' attitudes and beliefs and Pedagogic strategies. 	4
4	<ul style="list-style-type: none"> • Professional development: alignment with classroom practices and follow-up support • Peer support • Support from the head teacher and the community. • Curriculum and assessment • Barriers to learning: limited resources and large class sizes 	4
5	❖ Research gaps and future directions <ul style="list-style-type: none"> • Research design 	2

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

	<ul style="list-style-type: none">• Contexts• Pedagogy• Teacher education• Curriculum and assessment• Dissemination and research impact	
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Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Learning Resources:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, *Compare*, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, *Journal of Curriculum Studies*, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? *International Journal Educational Development*, 33 (3): 272–282.
5. Alexander RJ (2001) *Culture and pedagogy: International comparisons in primary education*. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Maulana Abul Kalam Azad University of Technology, West Bengal

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

Subject Name : Constitution of India	Category: Audit Courses
Subject Code : AC101C/ AC201C	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objective

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution

Course Outline:

Units	Contents	Hours
1	❖ History of Making of the Indian Constitution: <ul style="list-style-type: none">• History• Drafting Committee, (Composition & Working)	4
2	❖ Philosophy of the Indian Constitution: <ul style="list-style-type: none">• Preamble• Salient Features	4
3	❖ Contours of Constitutional Rights & Duties: <ul style="list-style-type: none">• Fundamental Rights• Right to Equality• Right to Freedom• Right against Exploitation• Right to Freedom of Religion• Cultural and Educational Rights• Right to Constitutional Remedies• Directive Principles of State Policy• Fundamental Duties.	4
	❖ Organs of Governance: <ul style="list-style-type: none">• Parliament• Composition• Qualifications and Disqualifications• Powers and Functions• Executive• President	4

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

	<ul style="list-style-type: none">• Governor• Council of Ministers• Judiciary, Appointment and Transfer of Judges, Qualifications• Powers and Functions	
	<p>❖ Local Administration:</p> <ul style="list-style-type: none">• District's Administration head: Role and Importance,• Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.• Pachayati raj: Introduction, PRI: Zila Pachayat.• Elected officials and their roles, CEO Zila Pachayat: Position and role.• Block level: Organizational Hierarchy (Different departments),• Village level: Role of Elected and Appointed officials,• Importance of grass root democracy	4
	<p>❖ Election Commission:</p> <ul style="list-style-type: none">• Election Commission: Role and Functioning.• Chief Election Commissioner and Election Commissioners.• State Election Commission: Role and Functioning.• Institute and Bodies for the welfare of SC/ST/OBC and women	4

Course Outcome:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

Learning Resources:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

Subject Name : Disaster Management	Category: Audit Courses
Subject Code : AC101D/ AC201D	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objective:

Students will be able to:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Course Outline:

Units	Contents	Hours
1	Introduction Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	4
2	Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.	4
3	Disaster Prone Areas in India Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.	4
4	Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data From Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.	4
5	Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	4

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6	Disaster Mitigation Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.	4
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Learning Resources:

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)” Disaster Mitigation Experiences And Reflections”, Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration And Management Text And Case Studies” ,Deep &Deep Publication Pvt. Ltd., New Delhi.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

Subject Name : Value Education	Category: Audit Courses
Subject Code : AC101E/ AC201E	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objectives:

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Course Outline:

Units	Contents	Hours
1	<ul style="list-style-type: none"> ❖ Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. ❖ Moral and non- moral valuation. Standards and principles. ❖ Value judgments 	4
2	<ul style="list-style-type: none"> ❖ Importance of cultivation of values. ❖ Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. ❖ Honesty, Humanity. Power of faith, National Unity. ❖ Patriotism. Love for nature , Discipline 	6
3	<ul style="list-style-type: none"> ❖ Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. ❖ Punctuality, Love and Kindness. ❖ Avoid fault Thinking. ❖ Free from anger, Dignity of labour. ❖ Universal brotherhood and religious tolerance. ❖ True friendship. ❖ Happiness Vs suffering, love for truth. ❖ Aware of self-destructive habits. ❖ Association and Cooperation. ❖ Doing best for saving nature 	6
	<ul style="list-style-type: none"> ❖ Character and Competence –Holy books vs. Blind faith. ❖ Self-management and Good health. ❖ Science of reincarnation. ❖ Equality, Non violence, Humility, Role of Women. ❖ All religions and same message. ❖ Mind your Mind, Self-control. ❖ Honesty, Studying effectively 	6

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Course Outcomes:

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

Learning Resources:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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Subject Name : Stress Management by Yoga	Category: Audit Courses
Subject Code : AC101F /AC201F	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objective:

1. To achieve overall health of body and mind
2. To overcome stress

Course Outline:

Units	Contents	Hours
1	❖ Definitions of Eight parts of yog. (Ashtanga)	8
2	❖ Yam and Niyam: Do's and Don'ts in life. i. Ahinsa, satya, astheya, bramhacharya and aparigraha ii. Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
3	❖ Asan and Pranayam: i. Various yog poses and their benefits for mind & body ii. Regularization of breathing techniques and its effects-Types of pranayam.	8

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

Learning Resources:

1. 'Yogic Asanas for Group Training-Part-I' :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

Subject Name : Personality Development through life Enlightenment skills	Category: Audit Courses
Subject Code : AC101G/ AC201G	Semester : First/ Second
L-T-P : 2-0-0	Credit: 0
Pre-Requisites:	

Course Objective:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Course Outline:

Units	Contents	Hours
1	❖ Neetisatakam-Holistic development of personality: <ul style="list-style-type: none">• Verses- 19,20,21,22 (wisdom)• Verses- 29,31,32 (pride & heroism)• Verses- 26,28,63,65 (virtue)• Verses- 52,53,59 (don'ts)• Verses- 71,73,75,78 (do's)	8
2	<ul style="list-style-type: none">• Approach to day to day work and duties.• Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,• Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,• Chapter 18-Verses 45, 46, 48.	8
3	<ul style="list-style-type: none">• Statements of basic knowledge.• Shrimad Bhagwad Geeta : Chapter2-Verses 56, 62, 68• Chapter 12 -Verses 13, 14, 15, 16,17, 18• Personality of Role model. Shrimad Bhagwad Geeta :• Chapter2-Verses 17,Chapter 3-Verses 36,37,42,• Chapter 4-Verses 18, 38,39• Chapter18 – Verses 37,38,63	8

Course Outcomes:

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students

Learning Resources:

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

Subject Name : Sanskrit for Technical Knowledge	Category : Audit Courses
Subject Code : AC101H/ AC201H	Semester : First/ Second
L-T-P : 2-0-0	Credit : 0
Pre-Requisites:	

Course Objective:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

Course Outline:

Units	Contents	Hours
1	❖ Alphabets in Sanskrit, ❖ Past/Present/Future Tense, ❖ Simple Sentences	8
2	❖ Order ❖ Introduction of roots ❖ Technical information about Sanskrit Literature	8
3	❖ Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Course Outcome:

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

Learning Resources:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

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Open Electives

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
IN PRODUCTION ENGINEERING PROGRAMME**

Subject Name : Business Analytics	Category: Open Elective
Subject Code : OE301A	Semester : Third
L-T-P : 3-0-0	Credit: 3
Pre-Requisites:	

Course Objective:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Manage business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outline:

Units	Contents	Hours
1	Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.	9
2	Trendiness and Regression Analysis: Modeling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	8
3	Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization.	9
4	Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time	10

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	Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	
5	Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	8
6	Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	4

Course Outcomes:

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modelling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

Learning Resources:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

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**DETAILED SYLLABI OF MASTER OF TECHNOLOGY
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Subject Name : Operations Research	Category: Open Elective
Subject Code : OE301B	Semester : Third
L-T-P : 3-0-0	Credit: 3
Pre-Requisites:	

Course Outcomes:

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

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

Course Outline:

Unit-I

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit-II

Formulation of a LPP - Graphical solution revised simplex method duality theory dual simplex method - sensitivity analysis - parametric programming

Unit-III

Nonlinear programming problem -Kuhn-Tucker conditions min cost flow problem max flow problem CPM/PERT

Unit-IV

Scheduling and sequencing single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming

Unit-V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

Learning Resources:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

Subject Name : Cost Management of Engineering Projects:	Category: Open Elective
Subject Code: OE301C	Semester : Third
L-T-P : 3-0-0	Credit: 3
Pre-Requisites:	

Course Outline:

Unit-I

Introduction and Overview of the Strategic Cost Management Process

Unit-I

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit-I

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non technical activities. Detailed Engineering activities. Pre project execution main clearances and documents
Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit-I

Cost Behaviour and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

Unit-I

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit-I

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

Learning Resources:

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.

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Subject Name : Industrial Safety	Category: Open Elective
Subject Code : OE301D	Semester : Third
L-T-P : 3-0-0	Credit: 3
Pre-Requisites:	

Course Outline:

Unit-I

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 colour codes. Fire prevention and fire fighting, equipment and methods.

Unit-II

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-III

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-IV

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-V

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.

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Learning Resources:

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

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DETAILED SYLLABI OF MASTER OF TECHNOLOGY IN PRODUCTION ENGINEERING PROGRAMME

Subject Name : Composite Materials	Category: Open Elective
Subject Code : OE301E	Semester : Third
L-T-P : 3-0-0	Credit: 3
Pre-Requisites:	

Course Outline:

Unit-I

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

Unit-II

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

UNIT – III

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT-IV

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

UNIT – V

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

Learning Resources:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Hand Book of Composite Materials-ed-Lubin.
4. Composite Materials – K.K.Chawla.
5. Composite Materials Science and Applications – Deborah D.L. Chung.
6. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi

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Subject Name : Waste to Energy	Category: Open Elective
Subject Code : OE301F	Semester : Third
L-T-P : 3-0-0	Credit: 3
Pre-Requisites:	

Course Outline:

Unit-I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications

Unit-III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Learning Resources:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

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4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.