Vivekananda Global University

M.Tech (Production Engineering) **Semester I**

MTH 101 RESEARCH METHODOLOGY

3L-0T-0P-3.0C **MM 100**

MODULE I

RESEARCH - (a) Types, process and steps in it, Hypothesis, Research proposals and aspects.

(b) Research Design: Need, Problem Definition, variables, research design concepts, Literature survey and review, Research design process, Errors in research.

(c) Research Modeling: Types of Models, Model building and stages, Data consideration and testing, Heuristic and Simulation modeling.

MODULE II

REPORT WRITING - Pre writing considerations, Formats of report writing, formats of publications in Research journals.

MODULE III

DESIGN OF EXPERIMENTS – (a) Objectives, strategies, Factorial experimental design, Designing engineering experiments, basic principles-replication, randomization, blocking, Guidelines for design of experiments.

(b) Single Factor Experiment: Hypothesis testing, Analysis of Variance components (ANOVA) for fixed effect model; Total, treatment and error of squares, Degrees of freedom, Confidence interval; ANOVA for random effects model, Estimation of variance components, Model adequacy checking.

(c) Two factor Factorial Design, Basic definitions and principles, main effect and interaction, response surface and contour plots, General arrangement for a two-factor factorial design; Models-Effects, means and regression, Hypothesis testing.

MODULE IV

SPREADSHEET TOOL - Introduction to spreadsheet application, features and functions, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts/ graph and other features. Tools used may be Microsoft Excel, Open office or similar tool.

MODULE V

PRESENTATION TOOL - Introduction to presentation tool, features and functions, Creating presentation, Customizing presentation, showing presentation. Tools used may be Microsoft Power Point, Open Office or similar tool.

Web Search: Introduction to Internet, Use of Internet and WWW, Using search engine like Google, Yahoo etc, and Using advanced search techniques.

Text/ Reference Books:

1. Montgomery, Douglas C. (2007), 5/e, Design and Analysis of Experiments, (Wiley India)
2. Montgomery, Douglas C. & Runger, George C. (2007), 3/e, Applied Statistics & Probability for Engineers (Wiley India)
3. Kothari C.K. (2004), 2/e, Research Methodology- Methods and Techniques (New Age International, New Delhi)

M.Tech (Production Engineering) **Semester I**

MPE 102 ADVANCED MANUFACTURING PROCESS

3L-0T-0P-3.0C **MM 100**

MODULE I

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

MODULE II

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

MODULE III

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

MODULE IV

Processing of ceramics: Applications characteristics, classification Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

MODULE V

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

Text/ Reference Books:

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

M.Tech (Production Engineering) **Semester I**

MPE 103 COMPUTER INTEGRATED MANUFACTURING SYSTEM

3L-1T-0P-3.5C **MM 100**

MODULE I

Computer Aided Design: Concept of CAD as drafting and designing facility, desirable features of CAD package, drawing features in CAD- Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate, typical CAD command structure, wire frame modeling, surface modeling and solid modeling (concepts only) in relation to popular CAD packages.

MODULE II

Components Of CIM: CIM as a concept and a technology, CASA/Sme model of CIM, CIM II, benefits of CIM, communication matrix in CIM, fundamentals of computer communication in CIM- CIM data transmission methods- serial, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex. Types of communication in CIM- point to point (PTP), star and multiplexing. Computer networking in CIM- the seven layer OSI model, LAN model, MAP model, network topologies- star, ring and bus, advantages of networks in CIM

MODULE III

Group Technology and Computer Aided Process: PLANNTNG 9 History of Group Technology- role of GT in CAD/CAM Integration- part families- classification and coding- DCLASS and MCLASS and OPTIZ coding systems- facility design using GT- benefits of GT- cellular manufacturing, Process planning- role of process planning in CAD/CAM Integration- approaches to computer aided process planning- variant approach and generative approaches- CAPP and CMPP systems.

MODULE IV

Shop Floor Control and Introduction to FMS: shop floor control- phases- factory data collection system- automatic identification methods- Bar code technology- automated data collection system. FMS- components of FMS- types- FMS workstation- material handling and storage system- FMS layout- computer control systems- applications and benefits.

MODULE V

Computer Aided Planning And Control And Computer: Monitoring9 Production planning and control- cost planning and control inventory management- material requirements planning (MRP) - shop floor control. Lean and Agile Manufacturing. Types of production monitoring systems- structure model of manufacturing- process control and strategies- direct digital control.

Text/ References Books

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. James A. Rehg and HenryW. Kraebber, "Computer-Integrated Design and Manufacturing", 3rd Edition .
3. 2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.Prentice Hall 2005

M.Tech (Production Engineering) **Semester I**

MTH 104 ADVANCE NUMERICAL METHODS AND ANALYSIS

3L-1T-0P-3.5C **MM 100**

MODULE I

Solution of Algebraic and Transcendental Equation: Newton-Raphson method including method of complex roots, Graeffe's root square method (Computer based algorithm and programme for these methods)

MODULE II

Interpolation and Approximation: Lagrange's and Newton-divided difference formula, Newton interpolation formula for finite differences, Gauss's forward and backward interpolation formulae, Bessel's and Laplace-Everett's formulae, Cubic spline, least squares approximation using Chebyshev polynomial.

MODULE III

Solution of Linear Simultaneous Equations: Cholesky's (Crout's) method, Gauss-Seidel iteration and relaxation methods, Solution of Eigen value problems; Smallest, largest and intermediate Eigen values (Computer based algorithm and Programme for these methods)

MODULE IV

Numerical Differentiation and Integration: Numerical differentiation using difference operators, Simpson's 1/3 and 3/8 rules, Boole's rule, Weddle's rule

MODULE V

Solution of Differential Equations: Modified Euler's method, Runge-Kutta method of 2nd, 3rd and 4th orders, Predictor- Corrector method, Stability of Ordinary differential equation, Solution of Laplace's and Poisson's equations by Liebmann's method, Relaxation method.

Text/Reference Books:

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

M.Tech (Production Engineering **Semester I**

MPE 105 THEORY OF METAL FORMING

3L-0T-0P-3.0C **MM 100**

MODULE I

Stress-Strain relations in Elastic and plastic deformations, Yield criteria for ductile metals, Work hardening and Anisotropy in Yielding, Flow Curves. Formulations of plastic deformation problems, application of theory of plasticity for solving metal forming problems using Slab method, Upper and lower Bound methods, Slip line field theory.

MODULE II

Effects of temperature and strain rate in metal working, friction and lubrication in Hot and Cold working. Technology and analysis of important metal forming processes- Forging, Rolling, Extrusion. Wire drawing, Introduction to; (i) Theory of slip lines, (ii) upper bound theorem and (iii) Lower bound theorem

MODULE III

Application of Finite Element Methods to Metal Forming Processes- special Discretization, Shape function, Stiffness matrices and their assembly, Implicit and explicit formulations, Elasto-plastic approximations, Lagrangian Vs Eularian schemes, Material integration schemes, auxiliary equations for contact, friction and incompressibility, Thermo-mechanical problem formulation, steady state solutions for Drawing, Forging, rolling and extrusion problems

MODULE IV

Case Studies- analysis and validation of metal forming processes problems by standard software. Forming defects in products and their critical effects, remedies. An introduction to use of International standards in Metal Forming Problem solutions and system Design.

MODULE V

SHEET METAL FORMING Processes: various sheet metal operations, Blanking and punching operations, compound and progressive dies, nesting, clearance, forces in blanking, Bending of plates, bendability, spring back, bending force, bending moment for real material, stress and strain in bending, stress in deep drawing, drawability. Drawing load, Anisotropy in sheet metal.

TEXT REFERENCE BOOKS:

1. Metal Fomging AnalysisR. H. Wagonez; Cambridge university press.
2. Theory of Elasticity- Dally and Rilry
3. Physical Metallurgy- Dieter McGraw Hill Inc.
4. Metal Forming Handbook by H Frohtzek, M Kasperbauer, Springer Veleg

M.Tech (Production Engineering) **Semester I**

MPE 106 MECHATRONICS

3L-0T-0P-3.0C **MM 100**

MODULE I

Introduction: Introduction, scope and applications of Mechatronics systems. Process control automation, FMS and CNC Machines. Basics of Micro- and Nanotechnology, microprocessor-based controllers and Microelectronics

MODULE II

Introduction to Sensors: Linear and Rotational Sensors, Acceleration, Force, Torque, Power, Flow and Temperature Sensors, Light Detection, Image, and Vision Systems, Integrated Micro-sensors.

Introduction to Actuators: Electro-mechanical Actuators, Electrical Machines, Piezoelectric Actuators, Hydraulic and Pneumatic Actuation Systems, MEMS: Micro-transducers Analysis, Design and Fabrication.

MODULE III

Systems and Controls: The Role of Controls in Mechatronics, Role of Modeling in Mechatronics Design, Signals and Systems: Continuous- and Discrete-time Signals, Z-Transforms and Digital Systems, Continuous- and Discrete-time State-space Models.

Advanced Control Systems: Digital Signal Processing for Mechatronics Applications, Control System Design, Adaptive and Nonlinear Control Design, Neural Networks and Fuzzy Systems, Design Optimization of Mechatronics Systems.

MODULE IV

Data Acquisition and related Instrumentation: Introduction to Data Acquisition Measurement Techniques: Sensors and Transducers, Quantizing theory, Analog to Digital Conversion, Digital to Analog (D/A) conversation, Signal Conditioning.

Real time Instrumentation: Computer-Based Instrumentation Systems, Software Design and Development, Data Recording and Logging.

MODULE V

Design of Mechatronics systems: Introduction of mechatronics systems: Home appliances, ABS (anti-lock braking system) and other areas in automotive engineering, Elevators and escalators, Mobile robots and manipulator arms, Sorting and packaging systems in production lines, Computer Numerically Control (CNC) production machines.

Text/Reference Books:

1. Bolton, W., "Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, "Pearson Education"
2. Mechatronics, HMT Hand Book, Tata McGraw Hill.
3. Mahalik N.P., "Mechatronics: Principles, Concepts and applications", Tata McGraw Hill.

M.Tech (Production Engineering) **Semester I**

MPE 107 ADVANCE WELDING TECHNOLOGY

3L-0T-0P-3.0C **MM 100**

MODULE I

Thermal Effects of Welding: Grain size Control, Micro structure control, Internal Stresses, control, Distortion, methods to avoid distortion. Stresses in Joint Design.

Welding and Cladding of dissimilar materials, overlaying and surfacing different methods and applications, thermal –Spray coating or metalizing.

MODULE II

Types of Welding: Forge welding, Electro Slag Welding, Electron Beam Welding, Plasma arc Welding, Laser Beam Welding, Explosion Welding, Diffusion Welding, Ultrasonic Welding, Friction welding.

MODULE III

Weldability of metals like stainless steel, Cast iron, Copper, and Aluminium. Advanced soldering and brazing processes-different types. Welding of plastics- different methods.

MODULE IV

Welding design- principles of sound welding design, welding joint design, welding positions, Allowable strength of welds under steady loads, allowable fatigue strength of welds, Design of welds subjected to combined stresses**.**

MODULE V

Welding symbols-Need for representing the welds, Basic weld symbols, location of weld, supplementary symbols, dimensions of weld, examples Adhesive bonding: adhesive materials and properties, non-structural and special adhesives, surface preparation and joint design considerations .

Inspection of Welds: ASTM standards for testing weldments, Destructive techniques like Tensile, Bend, Nick break, Impact & Hardness. Non Destructive techniques like 'X' rays, Ultrasonic, Magnetic particle, Dye penetration.

Text/Reference books:

1. Welding Engineering Handbook by A.W.S. Ninth Edition
2. Advanced Welding processes – G.Nikolaev & N.Olshansky, MIR Publications 1977.
3. Welding Technology by O.P. Khanna, Dhanpat Rai Publication 2008
4. Welding and welding Technology by Richard Little Tata Mc Graw hill 2005.
5. ASM handbook on welding, brazing and soldering, vol 6, 2005.

M.Tech (Production Engineering) **Semester I**

MPE 108 SIMULATION AND MODELING

3L-0T-0P-3.0C **MM 100**

MODULE I

Introduction: Introduction to Simulation: Simulation, Advantages, Disadvantages, Areas of application, System environment, components of a system, Model of a system, types of models, steps in a simulation study. Simulation Examples: Simulation of Queuing systems, Simulation of Inventory System, Other simulation examples.

MODULE II

General Principles: Concepts in discrete - event simulation, event scheduling/ Time advance algorithm, simulation using event scheduling. Random Numbers: Properties, Generations methods, Tests for Random number- Frequency test, Runs test, Autocorrelation test.

MODULE III

Statistical Models in Simulation: Discrete distributions, continuous distributions.

Random Number Generation: Techniques for generating random numbers- Mid square method - the mod product method -Constant multiplier technique -Additive congruential method -Linear congruential method -Tests for random numbers -The Kolmogorov-Smimov test -the. Ulfaskluna and Annita borsen Dohlgvist Publisher Artechhouse. .

MODULE IV

Random Variable Generation: Inversion transforms technique-exponential distribution. Uniform distribution,weibull distribution, continuous distribution, generating approximate normal variates.

MODULE V

Design and Evaluation of Simulation Experiments: variance reduction techniques -antithetic variables, variables-verification. Simulation Software: Selection of simulation software, simulation packages..

Text/Reference Books:

1. Bitra Leuis and Arbez,Gilbert, "Modeling and Simulation Exploring Dynamic system behavior"-Delhi:Springer 2007.
2. 2. Jerry Banks, John S Carson, II, Berry L Nelson, David M Nicol, Discrete Event system Simulation, Pearson Education, Asia, 4th Edition, 2007, ISBN: 81-203-2832-9.
3. Geoffrey Gordon, System Simulation, Prentice Hall publication, 2nd Edition, 1978.
4. Averill M Law, W David Kelton, Simulation Modelling & Analysis, McGraw Hill International Editions – Industrial Engineering series, 4th Edition, ISBN: 0-07-100803-9.
5. Narsingh Deo, Systems Simulation with Digital Computer, PHI Publication (EEE), 3rd Edition, 2004.

M.Tech (Production Engineering) **Semester I**

MPE 109 ADVANCED PRODUCTION LAB .

0L-0T-4P-2.0C **MM 100**

Following Experiments to be performed:-

1 Study of the morphology of chips produced from different materials sand machining processes.
2 Effect of tool geometry on chip flow direction in simulated orthogonal cutting conditions.
3 Study of cutting ratio/chip thickness ratio in simulated orthogonal cutting with different materials and tool geometry.
4. Evaluations of tool face temperature with thermocouple method.
5. Roughness of machined surface. Influence of tool geometry and feed rate.
6 Study of the construction and operating parameters of metal spinning Lathe.
7 Study of the water hammer equipment and hydrostatic extrusion setup.
8. Extrusion of cylindrical billets through dies of different included angles and exit diameters and their effect on extrusion pressure.
9. Practice and study of blanking and punching process and their characteristic features on mechanical press with existing dies.
10 Experiments on TIG and MIG welding to find out the mechanical properties of metals
11 hydraulic and Pneumatic circuits
12 Study of operation of tool and cutter grinder, twist drill grinder, Centreless grinder
13 Determination of cutting forces in turning
14 Inspection of parts using tool makers microscope, roughness and form tester

M.Tech (Production Engineering) **Semester I**

MPE 110 COMPUTER INTEGRATED MANUFACTURING LAB

0L-0T-4P-2.0C **MM 100**

LIST OF EXPERIMENTS:

1. CIM model for any industry.
2. Manual part programming on CNC lathe, milling and drilling.
3. Simulation on CNC lathe and CNC mill.
4. Study and demonstration on Robots.
5. Study of computer aided process planning.
6. Study of Group Technology & part families.
7. Study of computer aided quality control.
8. Introduction to CAD softwares.
9. Introduction to CAM software.
10. Study of computer controlled business functions.
11. Study of interfacing requirements in CIMS.
12. Generation of any one simple solid model using any CAD software.
13. Program for generation of any surface.

M.Tech (Production Engineering) **Semester II**

MPE 201 THEORY OF METAL CUTTING

3L-1T-0P-3.5C **MM 100**

MODULE I

Mechanics of Metal Cutting: Geometry of Metal Cutting Process, Chip formation, Chip thickness ratio, radius of chip curvature, cutting speed, feed and depth of cut – Types of chips chip breakers. Orthogonal and Oblique cutting processes – definition, Forces and energy calculations (Merchant's Analysis) – Power consumed – MRR- Effect of Cutting variables on Forces, Force measurement using Dynamometers.

MODULE II

Single Point Cutting Tool: Various systems of specifications, single point cutting tool geometry and their inter-relation. Theories of formation of built-up edge and their effect, design of single point contact tools throwaway inserts.

MODULE III

Multipoint Cutting Tool: Drill geometry, design of deills, Rake& Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, milling cutters, cutting speed &feed machining time- design – from cutters. Grinding: Specifications of grinding of grinding wheel, mechanics of grinding, Effect of Grinding conditions on wheel wear and grinding ratio. Depth of cut, speed, machining time, temperature power.

MODULE IV

Tool Life and Tool Wear: Theories of tool wear – adhesion, abrasive and diffusion wear mechanisms, forms of wear, Tool life criteria and machinability index. Types of sliding contact, real area of contact, laws of friction and nature of frictional force in metal
cutting. Effect Tool angle, Economics, cost analysis, mean co-effect of friction.

MODULE V

Cutting Temperature: Sources of heat in metal cutting, influence of metal conditions, Temperature distribution, zones, experimental techniques, analytical approach. Use of tool- work thermocouple for determination of temperature. Temperature distribution in Metal Cutting.Cutting fluids: Functions of cutting fluids, types of cutting fluids, properties, selection of cutting fluids. Cutting tool materials: Historical developments, essential properties of cutting tool materials, types, composition and application of various cutting tool materials, selection of cutting tool materials.

Text/ References Books:

1. Metal Cutting Principles/ MC Shaw / Oxford and IBH Publications, New Delhi,1969
2. Fundamentals of Machining /Boothryd/ Edward Amold publishers Ltd 1975
3. ' Tool Design' by David Son / Lacain/ Goud, Tata Me Graw Hill
4. Fundamentals of Tool Design by Wilson fw , ASTME PHI 2010.

M.Tech (Production Engineering) **Semester II**

MPE 202 ADVANCED OPERATION RESEARCH

3L-1T-0P-3.5C **MM 100**

MODULE I

Single Variable Non-Linear Unconstrained Optimization: One dimensional Optimization methods:- Uni-modal function, elimination methods, Fibonacci method, golden section method, interpolation methods – quadratic & cubic interpolation methods.

MODULE II

Multi variable non-linear unconstrained optimization: Direct search method – Univariant method -pattern search methods – Powell's- Hook -Jeeves, Rosenbrock search methods- gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.

MODULE III

Linear Programming – Formulation – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints. Simulation – Introduction – Types- steps – application – inventory – queuing – thermal system

MODULE IV

Integer Programming- Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method

Stochastic Programming: Basic concepts of probability theory, random variables-distributions-mean, variance, correlation, co variance, joint probability distribution-stochastic linear, dynamic programming.

MODULE V

Geometric Programming: Posynomials – arithmetic - geometric inequality – unconstrained G.P, constrained G.P.

Non Traditional Optimization Algorithms: Genetics Algorithm-Working Principles, Similarities and Differences between Genetic Algorithm & Traditional Methods. Simulated Annealing- Working Principle-Simple Problems.

Text/ Reference Books:

1. Optimization theory & Applications / S.S.Rao / New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI
3. S.D.Sharma / Operations Research
4. Operation Research / H.A.Taha /TMH
5. Optimization in operations research / R.LRardin
6. Optimization Techniques /Benugundu & Chandraputla / Pearson Asia.
7. Optimization Techniques theory and practice / M.C.Joshi, K.M.Moudgalya/ Narosa Publications

M.Tech (Production Engineering) **Semester II**

MPE 203 DESIGN AND MANUFACTURE OF MEMS & MICRO SYSTEMS

3L-0T-0P-3.0C **MM 100**

MODULE I

Overview and working principles of MEMS and Microsystems: MEMS & Microsystems, Evolution of Micro fabrication, Microsystems & Microelectronics, Microsystems & miniaturization, Applications of MEMs in Industries, Micro sensors, Micro actuation, MEMS with Micro actuators Micro accelerometers, Micro fluidics

MODULE II

Engineering Science for Microsystems Design and Fabrication: Atomic structure of Matter, Ions and Ionization, Molecular Theory of Matter and Intermolecular Forces, Doping of Semiconductors, The Diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics.

MODULE III

Engineering Mechanics for Microsystems Design: Static Bending of Thin plates, Mechanical Vibration, Thermo mechanics , Fracture Mechanics, Thin- Film Mechanics, Overview of Finite Element Stress Analysis

MODULE IV

Thermo Fluid Engineering & Microsystems Design: Overview of Basics of Fluid Mechanics in Macro and Mesoscales, Basic equations in Continum Fluid Dynamics, Laminar Fluid Flow in Circular Conduits, Computational Fluid Dynamics, Incompressible Fluid Flow in Micro conduits, Fluid flow in Sub micrometer and Nano scale, Overview of Heat conduction in Solids, Heat Conduction in Multilayered Thin films and in solids in sub micrometer scale, Design Considerations, Process Design Mechanical Design, Mechanical design using FEM, Design of a Silicon Die for a Micro pressure sensor.

MODULE V

Materials for MEMS & Microsystems and their fabrication: Substrates and Wafers, Active substrate materials, Silicon as a substrate material, Silicon compounds, Silicon Piezoresistors, Gallium Arsenide, Quartz, Piezoelectric Crystals and Polymers, Photolithography, Ion implantation, Diffusion and oxidation, Chemical and Physical vapor deposition, etching, Bulk micro manufacturing, Surface Micromachining, The LIGA Process.

Text/ References Book:

1. Tia-Ran Hsu, MEMS & Microsystems. Design & Manufacturing, TMH 2002
2. Foundation of MEMS/ Chang Liu/Pearson, 2012
3. Maluf, M., "An Introduction to Microelectromechanical Systems Engineering". Artech House Boston 2000
4. Trimmer , W.S.N., "Micro robots and Micromechnaical Systems", Sensors & Actuators, Vol 19 1989
5. Trim., D.W., "Applied Partial Differential Equations"., PWS-Kent Publishing, Boston, 1990

M.Tech (Production Engineering) **Semester II**

MPE 204 METROLOGY AND COMPUTER AIDED INSPECTION

3L-0T-0P-3.0C **MM 100**

MODULE I

Concepts of Metrology: Terminologies- Standards of measurement- Errors in measurement- Interchangeability and Selective assembly- Accuracy and Precision- Calibration of instruments- Basics of Dimensional metrology and form metrology

MODULE II

Measurement of Surface Roughness: Definitions- Types of Surface Texture: Surface Roughness Measurement Methods- Comparison, Contact and Non-Contact type roughness measuring devices, 3D Surface Roughness Measurement, Nano Level Surface Roughness Measurement- Instruments.

MODULE III

Interferometry: Introduction, Principles of light interference- Interferometers- Measurement and Calibration- Laser Interferometry. Angular measurements- principles and instrument measurements.

MODULE IV

Computer Aided And Laser Metrology: Tool Makers Microscope- Microhite- Coordinate Measuring Machines- Applications- Laser Micrometer, Laser Scanning gauge, Computer Aided Inspection techniques- In-process inspection, Machine Vision system-Applications.

MODULE V

Image Processing For Metrology: Overview, Computer imaging systems, Image Analysis, Preprocessing, Human vision system, Image model, Image enhancement, gray scale models, histogram models, Image Transforms- Examples.

Text/ Reference Books:

1. Gupta, I. C., ”A Text Book of engineering metrology”, Dhanpat Rai and Sons, 1996.
2. Iain, R. K. ,"Engineering Metrology”, Khanna Publishers, 2008.
3. Bewoor, A K and Kulkarni,V. A ,”Metrology and Measurement”, Tata MC Graw-Hill, 2009.
4. Galyer, F. W. and Shotbolt, C. R., ”Metrology for engineers”, ELBS, 1990.
5. Smith,G.T., ”Industrial Metrology”, Springer, 2002
6. Whitehouse,D. I. ., "Surface and their measurement", “Hermes Penton Ltd, 2004
7. ASTE Handbook of Industries Metrology, Prentice Hall of India Ltd., 1992.

M.Tech (Production Engineering) **Semester II**

MPE 205 NANOTECHNOLOGY

3L-0T-0P-3.0C **MM 100**

MODULE I

The Canvas of Nano: Nano and Nature; Our Technologies and the world we live in; Nano – The Beginning. **Investigating and Manipulating Materials in the Nanoscale:** Introduction; Electron Microscopies; Scanning Probe Microscopies; Optical Microscopies for Nanoscience and Technology; Other Kinds of Microscopies; X-Ray Diffraction; Associated Techniques.

MODULE II

Fullerenes: Introduction: Discovery and Early year; Synthesis and Purification of Fullerenes; Mass Spectrometry and Ion/Molecule Reaction; Chemistry of Fullerenes in the Condensed Phase; Endohedral Chemistry of Fullerenes; Orientational Ordering; Pressure Effects; Conductivity and superconductivity in doped fullerenes; ferromagnetism in C_{60} TDAE.

MODULE III

Carbon Nanotubes: Introduction; Synthesis and Purification; Filling of Nanotubes; Mechanism of Growth; Electronic Structure; Transport Properties; Mechanical Properties; Physical Properties; Applications; Nanotubes of other Materials.

Nanoshells: Introduction; Types of Nanoshells; Properties; Characterization; Application.

MODULE IV

Nanosensors: Introduction; what is a Sensor?; Nanosensors – what make them possible? order from Chaos – Nanoscale Organization for Sensors; Characterization – To know what has been put in; Perception – Nanosensors based on optical properties, Nanosensors based on Quantum size Effects; Electrochemical Sensors; Sensors based on physical properties; Nanobiosensores- A step towards Real- time Imaging and Understanding of Biological Events; Smart Dust – Sensors of the Future.

MODULE V

Nanomedicines: Introduction; Approach to Developing Nanomedicines; Various kinds of Nanosystems in Use; Protocols for Nanodrug Administration; Nanotechnology in Diagnostic Application; Materials for Use in Diagnostic and Therapeutic Applications; Future Directions.**Molecular Nanomachines**: Introduction; Covalent and Non Covalent Approaches; Molecular Motors and Machines; Molecular Devices; Single Molecular Devices; Practical Problems with Molecular Devices.

Text/ Referance Books:

1. Nanomaterials, Nanotechnologies and Design: an Introductioh to Engineers and Architects, D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.
2. Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
3. Handbook of Nanoceramics and their Based Nanodevicesv (Vol. 2) Edited by seI ag-Yufai Tseng and Hari Singh N alwa, American Scientific Publishers.

M.Tech (Production Engineering) **Semester II**

MPE 206 DESIGN OF EXPERIMENTS

3L-0T-0P-3.0C **MM 100**

MODULE I

Introduction: Need for statistical DOE, Terminologies used in DOE; Normal Distribution, t Distribution and F-Distribution, Confidence Intervals, Hypothesis Tests

MODULE II

Experimental Design Strategies-1: Single factor Experiments, Factorial Experiments; 2k designs, Blocking and Confounding in 2k design, Introduction to DOE software's, Factor Effects, Measures of Variability, Probability plots.

MODULE III

Analysis of Data and Mathematical Modeling: Introduction to statistical Analysis softwares, Analysis of variance (ANOVA) in factorial experiments, YATE's algorithm for ANOVA, Mathematical models from experimental data, illustration through numerical examples.

MODULE IV

Experimental Design Strategies: Fractional Factorial Design, 3k designs, Response Surface Design, Development of mathematical models .

MODULE V

Introduction to Taguchi Techniques: Quality Loss function, Estimation of Quality loss,; Nominal-the-better, smaller-the-better and larger-the-better, Robust design concepts; System Design, Parameter Design, Tolerance Design, S-N Ratio, Illustrations through numerical examples.

Text & Reference Books:

1. Quality Engineering using Robust Design - Madhav S. Phadake: Prentice Hall, Englewood Clifts, New Jersey 07632, 1989.
2. Design and analysis of experiments - Douglas Montgomery: Willey India Pvt. Ltd., V Ed., 2007.
3. Techniques for Quality Engineering - Phillip J. Ross: Taguchi 2nd edition. McGraw Hill Int. Ed., 1996.
3. Experiments planning, analysis and parameter design optimization - C.F. Jeff Wu, Michael Hamada: John Willey Ed., 2002.

M.Tech (Production Engineering) **Semester II**

MPE 207 RAPID PROTOTYPING

3L-0T-0P-3.0C **MM 100**

MODULE I

Introduction: Need for the compression in product development, history of RP systems, survey of applications, and classification of RP systems.

MODULE II

Stereo Lithography Systems: Principle, process parameter, process details, data files and machine details, application.

MODULE III

Selective Laser Sintering and Fusion Deposition Modeling: Type of machine, Principle of operation, process parameters, Principle of fusion deposition modeling, process parameter, path generation, Applications.

MODULE IV

Solid Ground Curing: Principle of Operation, Machine Details.

Laminated Object Manufacturing (LOM): Principle of Operation, Process Details, Application

MODULE V

Concept Modeling: Principle, Thermal Jet Printer, Sander's Model Market, 3-D Printer. Genisys Xs Printer HP System 5, Object Quadra Systems..

Text & Reference Books:

1. Stereo Lithography And Other Rp & M Technologies- Paul F Jacobs- SME, NY 1996
2. Rapid Manufacturing- Flham D T & Dinjoy S S- VERLOG LONDON 2001
3. Rapid Automated – Lament Wood- Indus Press - NEW YORK
4. Wohler's Report 2000 – Terry Wohlers – Wohler's Association – 2000.

M.Tech (Production Engineering) **Semester II**

MPE 208 MACHINE TOOL DESIGN

3L-0T-0P-3.0C **MM 100**

MODULE I

Principles of Machine Tool Design: General requirements of machine tool design - design process machine tool layout general requirements of machine tool design – design process machine tool layout.

MODULE II

Machine Tool Drives And Mechanism: Working and auxiliary motion. Drives- Electric drives, Hydraulic transmission, Kinematic structure, Regulation of speed and feeds, stepped regulation, standardization of speed and feed, steeples regulation of speeds and feeds.

MODULE III

Cutting Force Analysis And Power Requirement: In Turning, Milling, Drilling, Shaping and broaching operation with simple problems. General requirements of machine tools - Centre lathe, Milling machine.

MODULE IV

Design of Machine Tool Structures: Functions-Requirements-Design criteria Material used – static and dynamic stiffness – Profile and basic design procedure for machine tool structures. Design of beds, columns, housing, bases, tables, cross-rails, arms saddle, carriages.

MODULE V

Design of Guide ways and power Screws: Function and Types of guide ways, Design and lubrication of slide ways-aerostatic slide ways –antifriction guide ways-protecting devices, design of power screws.

Text & Reference Books:

1. Design Principles of Metal-Cutting Machine Tools by F. Koenigsberger
2. Machine Tool Design by N. K. Mehta. McGraw Hill Publishing
3. Machine Tool Design by Acherkan, Mir publishing
4. Machine Tool Design by S.K, Basu, Oxford and IBH Publishing
5. Machine tool design by Sen and Bhattacharya, CBS Publications

M.Tech (Production Engineering) **Semester II**

MPE 209 COMPUTER AIDED ENGINEERING LAB

0L-0T-4P-2.0C **MM 100**

Features and selection of CNC turning and milling centers. Practice in part programming and operation of CNC turning machines, subroutine techniques and use of cycles. Practice in part programming and operating a machining center, tool planning and selection of sequences of operations, tool setting on machine, practice in APT based NC programming. Geometric Modeling of 2D & 3D objects by using any CAD packages. Analysis of Objects by using any Analysis packages.

CAD Package References:
AUTO CAD
PROEE
CATIA V5
UNIGRAPHICS
IRON CAD

ANALYSIS Package References:
ANSYS
The students will be given training on the use and application of the following software to manufacturing problems;
1) Auto MOD Software
2) PROMOD
3) SLAM – II
4) CAFIMS
5) Flexsim

They also learn how to write sub routines in C-language and interlinking with the above packages.
Problems for modeling and simulation experiments:
1) AGV planning
2) ASRS simulation and performance evaluation
3) Machines, AGVs and AS/RS integrated problems
4) JIT system
5) Kanban flow
6) Material handling systems
7) M.R.P. Problems
8) Shop floor scheduling etc.

M.Tech (Production Engineering) **Semester II**

MPE 210 METAL CUTTING LAB.

0L-0T-4P-2.0C **MM 100**

LIST OF EXPERIMENTS TO PERFORM

1. Study of the morphology of chips produced from different materials sand machining processes.
2. Effect of tool geometry on chip flow direction in simulated orthogonal cutting conditions.
3. Study of cutting ratio/ chip thickness ratio in simulated orthogonal cutting with different materials and tool geometry.
4. Evaluations of tool face temperature with thermocouple method.
5. Roughness of machined surface, influence of tool geometry and feed rate.
6. Study of the construction and operating parameters of metal Spinning Lathe.
7. Study of the water hammer equipment and hydrostatic extrusion setup.
8. Extrusion of cylindrical billets through dies of different included angles and exit diameters and their effect on extrusion pressure.
9. Practice and study of blanking and punching process and their characteristic features on mechanical press with existing dies.
10. Experiments on TIG and MIG welding to find out the mechanical properties of metals
11. Study of hydraulic and Pneumatic circuits
12. Study of operation of tool and cutter grinder, twist drill grinder, Centreless grinder.
13. Determination of cutting forces in turning.
14. Inspection of parts using tool makers microscope, roughness and form tester.

M.Tech (Production Engineering) **Semester III**

MPE 301 SEMINAR

0L-0T-P-2.0C **MM 100**

Objective: To assess the debating capability of the student to present a technical topic. Also to impart training to students to face audience and present their ideas and thus creating in them self esteem and courage that are essential for engineers.

Individual students are required to choose a topic of their interest from Thermal Engineering related topics preferably from outside the M.Tech syllabus and give a seminar on that topic about 30 minutes. A committee consisting of at least three faculty members (preferably specialized in Thermal Engineering) shall assess the presentation of the seminar and award marks to the students. Each student shall submit two copies of a write up of his/her seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

M.Tech (Production Engineering) **Semester III**

MPE 302 DISSERTATION PART- I

0L-0T-P-8.0C **MM 100**

Objective: To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

The project work can be a design project/experimental project and/or computer simulation project on any of the topics in MATLAB/ANSYS software design related topics and other tools. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute.Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.The student is required to undertake the master research project phase 1 during the third semester and the same is continued in the 4thsemester (Phase 2). Phase 1 consist of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members. The technical paper is to be submitted along with the thesis

M.Tech (Production Engineering) **Semester III**

MPE 303 LIBRARY (REVIEW OF LITERATURE FOR RESEARCH)

0L-0T-P-4.0C **MM 100**

Literature survey Overview -What is literature survey, Functions of literature survey, maintaining a notebook, developing a Bibliography.

Methods of data collection –Observation, survey, contact methods, experimental,determining sample design Searching for publications –Publication databases, search engines and patent databases,Find some/all of the references for a given paper, including those that are not on the web.

M.Tech (Production Engineering) **Semester IV**

MPE 401 DISSERTATION PART- II

0L-0T-P-16.0C **MM 100**

Objective: To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Master Research project phase II is a continuation of project phase I started in the third semester. There would be two reviews in the fourth semester, first in the middle of the semester and the second at the end of the semester. First review is to evaluate the progress of the work, presentation and discussion. Second review would be a pre-submission presentation before the evaluation committee to assess the quality and quantum of the work done. This would be a pre qualifying exercise for the students for getting approval by the departmental committee for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.