# Bundelkhand Institute of Engineering and Technology, Jhansi

## Department of Mechanical Engineering

**Session: 2019 – 2020**

**(Even & Odd Semester)**

# 1st & 2nd Year

**[Effective from session 2009-10]**

# M.Tech (Manufacturing Science & Technology)

# BUNDELKHAND INSTITUT OF ENGINEERING & TECHNOLOGY, JHANSI
## NEW STUDY & EVALUATION SCHEME

**M.Tech. Manufacturing Science & Technology**

**[Effective Form session 2009-10]**

| S N | Course Code | Subject | Periods | | | Evaluation Scheme | | | | | Subject Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Sessional | | | | Exam | |
| | | | | | | CT | Attd | TA | Total | ESE | |
| | | **Semester I** | | | | | | | | | |
| 1 | MME-101 | Numerical Methods & Computer Programming | 3 | 1 | 2 | 30* | 10 | 10 | 50 | 100 | 150 |
| 2 | MME-102 | Simulation, Modelling and Analysis | 3 | 1 | - | 30 | 10 | 10 | 50 | 100 | 150 |
| 3 | MME-105 | Applied Operations Research | 3 | 1 | - | 30 | 10 | 10 | 50 | 100 | 150 |
| 4 | MME-158 | Elective-I Machining Science | 3 | 1 | 2 | 30* | 10 | 10 | 50 | 100 | 150 |
| | | **Total** | **12** | **4** | **4** | | | | **200** | **400** | **600** |
| | | **Semester II** | | | | | | | | | |
| 1 | MME-201 | Optimization for Engineering Design | 3 | 1 | 2 | 30* | 10 | 10 | 50 | 100 | 150 |
| 2 | MME-202 | Computer Aided Manufacturing | 3 | 1 | 2 | 30* | 10 | 10 | 50 | 100 | 150 |
| 3 | MME-207 | Production Technology | 3 | 1 | - | 30 | 10 | 10 | 50 | 100 | 150 |
| 4 | MME-258 | Elective-II Heat treat. of metals | 3 | 1 | 2 | 30* | 10 | 10 | 50 | 100 | 150 |
| | | **Total** | **12** | **4** | **6** | | | | **200** | **400** | **600** |
| | | **Semester III** | | | | | | | | | |
| 1 | MME-301 | Advance Machining Processes | 3 | 1 | - | 30 | 10 | 10 | 50 | 100 | 150 |
| 2 | OEL-308 | Open Elective Reliability M. M. & Saftey | 3 | 1 | - | 30 | 10 | 10 | 50 | 100 | 150 |
| 3 | MME-351 | Dissertation # | - | - | 8 | - | - | - | 50 | - | 50 |
| 4 | MME-352 | Seminar / Minor Project | - | - | 2 | - | - | - | 100 | - | 100 |
| | | **Total** | **6** | **2** | **10** | | | | **250** | **200** | **450** |
| | | **Semester IV** | | | | | | | | | |
| 1 | MME-451 | Dissertation | - | - | 18 | - | - | - | 150 | 200 | 350 |
| | | **Total** | **-** | **-** | **18** | | | | **150** | **200** | **350** |
| | | **GRAND TOTAL** | | | | | | | | | **2000** |

**Note:** *15 Marks are for Class Test and 15 Marks are for Lab., if any, Otherwise 30 Marks are for Class Test
# Dissertation to be continued in IV Semester

# List of Electives

**Semester – I**

**Elective-I**

| S.No. | Subject code | Subject Name |
|---|---|---|
| 1 | MME-152 | CAD/CAM |
| 2 | MME-157 | Machine Tool Design |
| 3 | MME-158 | Machining Science |
| 4 | MME-160 | Production, planning & control |
| 5 | MME-161 | Modern Manufacturing processes |
| 6 | MME-162 | Metal Cutting |
| 7 | MME-163 | Metal Forming |
| 8 | MME-166 | Rapid Prototyping & Tooling |

**Semester-II**
**Elective-II**

| S.No. | Subject code | Subject Name |
|---|---|---|
| 1 | MME-257 | Advanced Materials Technology |
| 2 | MME-258 | Heat Treatment of Metals |
| 3 | MME-261 | Flexible Manufacturing System |
| 4 | MME-251 | Finite Element Method |
| 5 | MME-262 | CNC, FMS & CIM |
| 6 | MME-255 | Fracture Mechanics |

**Semester-III**

**Open Elective**

| S.No. | Subject code | Subject Name |
|---|---|---|
| 1 | OEL-308 | Reliability, Maintenance Management & Safety |
| 2 | OEL-311 | Neural Network & Fuzzy System |
| 3 | OEL-312 | Applied Probability & Statistics |
| 4 | OEL-316 | Micro-Electro-Mechanical System |

## 1st SEMESTER

### MME-101 NUMERICAL METHODS AND COMPUTER PROGRAMMING L T P 3 1 2

**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)

**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.

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

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

**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.

### MME-102 SIMULATION, MODELLING AND ANALYSIS L T P 3 1 –

**Introduction:** A review of basic probability and statistics, random variables and their properties, Estimation of means variances and correlation.

**Physical Modelling:** Concept of System and environment, Continuous and discrete systems, Linear and non-linear systems, Stochastic activities, Static and Dynamic models, Principles of modeling, Basic Simulation modeling, Role of simulation in model evaluation and studies, advantages of simulation

**System Simulation:** Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Numerical computation techniques, Continuous system models, Analog and Hybrid simulation, Feedback systems, Computers in simulation studies, Simulation software packages.

**System Dynamics:** Growth and Decay models, Logistic curves, System dynamics diagrams.

**Probability Concepts in Simulation:** Stochastic variables, discrete and continuous probability functions, Random numbers, Generation of Random numbers, Variance reduction techniques, Determination of length of simulation runs.

**Simulation of Mechanical Systems:** Building of Simulation models, Simulation of translational and rotational mechanical systems, Simulation of hydraulic systems.

**Simulation of Manufacturing Systems:** Simulation of waiting line systems, Job shop with material handling and Flexible manufacturing systems, Simulation software for manufacturing, Case studies.

**MME-105 APPLIED OPERATIONS RESEARCH** **L T P 3 1 –**

**Introduction**: Definition and scope of OR, Techniques and tools, model formulation, general methods for solution, Classification of Optimization problems, Optimization techniques
**Linear Optimization Models:** Complex and revised Simplex algorithms, Degeneracy and duality, Post optimum and Sensitivity analysis, Assignment, transportation and transshipment models, Traveling salesman problem, Integer and parametric programming.
**Game Problems:** Minimax criterion and optimal strategy, two persons zero sum game, Games by Simplex dominance rules.
**Waiting Line Problems:** Classification of queuing problems, M/M/1 & M/M/1/N queuing systems, Steady state analysis of M/M/m queues, Discrete and continuous time Markov models, Chapman-Kolmogorov equation, Birth & death processes in manufacturing, Open and Closed queuing networks.
**Inventory Management:** ABC analysis, deterministic and Probabilistic models.
**Dynamic Programming:** Characteristics of dynamic programming problems, Bellman's principle of optimality, Problems with finite number of stages.
**Stochastic Programming:** Basic concepts of Probability theory, Stochastic linear

**MME-158 MACHINING SCIENCE** **L T P 3 1 2**

Mechanics of metal cutting-Tool geometry, Mechanics of orthogonal and oblique cutting, Shear angle relations in orthogonal cutting, Shear angle and chip flow direction in oblique cutting, Chip control methods, Analysis of cutting process, Machining with rotary tools, Thermodynamics of chip formation, Machining at super high speeds, Theories of tool wear, Basic action of cutting fluids, tool life, Factors governing tool life, Machinability-definition and evaluation. Economics of metal cutting-Single and multipass machining operations, Criteria, variables, and restrictions for the economical conditions.
Dynamic metal cutting-Comparison of steady and dynamic process, Shear angle and force relationships, Grinding mechanics, Wheel characteristics and theory of wheel wear, Lapping, Honning, High speed grinding theory, Grinding of drills, form cutters etc., Problems associated with machining of plastics, Tools for plastic cutting, Analysis of nonconventional machining processes ECM, EDM, LBM, WJM, USM etc.

## 2nd SEMESTER

**MME-201 OPTIMIZATION FOR ENGINEERING DESIGN** **L T P3 1 2**

**Introduction:** Historical Developments, Engineering applications of Optimization

**Classical Optimization Techniques:** Introduction, Review of single and multivariable optimization methods with and without constraints, Non-linear one-dimensional minimization problems, Examples.

**Constrained Optimization Techniques:** Introduction, Direct methods - Cutting plane method and Method of Feasible directions, Indirect methods - Convex programming problems, Exterior penalty function method, Examples and problems

**Unconstrained Optimization Techniques:** Introduction, Direct search method - Random, Univariate and Pattern search methods, Rosenbrock's method of rotating co-ordinates, Descent methods - Steepest Decent methods-Quasi-Newton's and Variable metric method, Examples.

**Geometric Programming:** Introduction, Unconstrained minimization problems, solution of unconstrained problem from arithmetic-geometric inequality point of view, Constrained minimization problems, Generalized polynomial optimization, Applications of geometric problems, Introduction to stochastic optimization.

**Novel methods for Optimization:** Introduction to simulated annealing, selection of simulated annealing parameters, simulated annealing algorithm; Genetic Algorithm (GA), Design of GA, Key concepts of GA, Neural Networks, A frame work for Neural Network models, Construction of Neural Network algorithm, Examples of simulated algorithm, genetic annealing and Neural Network method.

**MME-202 COMPUTER AIDED MANUFACTURING** **L T P 3 1 2**

**Introduction:** Introduction to Automation, Need and future of NC Systems and CAM, Advantages and Disadvantages, Open and Closed loop systems, Historical developments and future trends. Future of NC Machines, Difference between ordinary and NC Machine tools, Methods for improving accuracy and productivity.

**Control of NC Systems:** Types of CNC Machine Tools systems devices, e.g. encoders and interpolators, Features of CNC Systems, Direct Numerical Control (DNC), Standard Controllers and General Programming features available in CNC Systems, Computer Process monitoring and Control. Adaptive control systems.

**NC Part Programming:** Manual Programming for simple parts, e.g., turning, milling, drilling, etc., Computer aided NC Programming in APT language, use of canned cycles, Generation of NC Programmes through CAD/CAM systems, Design and implementation of post processors.

**Computer Aided Process Planning:** Introduction, Manual process planning vs. Computer aided process planning, Basics of variant and generative process planning methods, Examples of automated process planning systems.

**Computer Integrated Manufacturing:** Introduction, features and applications of CIM, key elements, advantages and disadvantages of CIM.

**Artificial Intelligence in Manufacturing:** Introduction, Elements of Expert Systems, Introduction to Neural Networks, Expert Systems application in manufacturing, Case studies.

**MME-207 PRODUCTION TECHNOLOGY** **L T P 3 1 –**

**Welding Technology:** Welding comparison with other fabrication processes, Classification, Fusion and pressure welding, Weldability of metals, Metallurgy of welding, Weld design, Stress distribution and temperature fields in the welds, Recent developments in welding viz. Diffusion, Friction, Electron beam and Induction welding, Cladding, Metallizing, Surfacing and Fabrication, Welding defects and inspection of welds, Thermal cutting of metals and its use in fabrication of process machines, Cutting of cast iron, stainless steel and non-ferrous metals.

**Metal Forming:** Classification of forming process, Stress, strain and strain rules, laws, Yield criterion and flow rules, Friction and lubrication in metal forming processes, Indirect compression processes e.g., Drawing and Extrusion processes, Direct compression processes e.g., forming and rolling, Theory of deep drawing, Load bounding techniques and upper bound estimates of field theory, Bending and forming, High-energy rate forming techniques and their applications, Recent advances in metal forming.

**Metal Cutting:** Tool geometry and signature, Theory of orthogonal and oblique metal cutting, Tool wear and lubrication, Theoretical evaluation of temperature fields at shear zone and tool-chip interface, Dynamics of metal cutting and machine tool stability, A critical review of theories of dynamic cutting machining at super high speeds, recent advances in cutting tool and science of metal cutting.

**MME-258 HEAT TREATMENT OF METALS** **L T P3 1 –**

**Introduction: N**ature and alloys; Heat treatment process, Requirements, Theory, Advantages, Process variables.

**Heat Treatment of Ferrous Metals:** Iron Carbon phase diagram; TTT diagram; different microstructures; transformations; Annealing, Stress relieving; Spherodizing; Normalizing; Hardening; Tempering; Austemepring; Martempering; Quenching; Quenchants; Quenching media; Surface hardening; Hardenability; Sub-zero treatment; Thermo-mechanical treatment; Chemical Treatment; Tool steel and their heat treatment; cast Iron and their heat treatment.

**Heat Treatment of Non-Ferrous Metals:** Aluminium and its alloys; Heat treatable and non heat-treatable aluminum alloys; Classification of heat treatment of aluminum alloys; Heat treatment of Aluminum and its alloys; Heat treatment of Magnesium and its alloys; Heat treatment of Titanium and its alloys; Heat treatment of Copper and its alloys; Heat treatment of Nickel and its alloys, Energy Economy in heat treatment.

## 3rd SEMESTER

**MME-301 ADVANCE MACHINING PROCESSES L T P3 1 –**

**Introduction:** Limitations of Conventional machining processes, Need of advanced machining processes and its classification.

**Mechanical Type Metal Removal Processes:** Ultrasonic machining; Elements of the process; Tool design and economic considerations; Applications and limitations, Abrasive jet and Abrasive water jet machining principles; Mechanics of metal removal; Design of nozzles; applications, Abrasive finishing process, Magnetic abrasive finishing process

**Thermal Type Advance Machining Processes:** Classification, General principles and applications of Electro discharge, Plasma arc, Ion beam, Laser beam, Electron beam machining, Mechanics of metal removal in EDM, selection of EDM pulse generator dielectric, machining accuracy, surface finish and surface damage in EDM, Generation and control of electron beam for machining applications, advantages and limitations

**Chemical and Electro-chemical Type Metal Removal Processes:** Principle, working advantages, disadvantages and applications of Electrochemical, Chemical machining, Economy aspects of ECM, Electro-chemical deburring and honning

**Hybrid Unconventional Machining Processes:** Introduction to ECDM, ECAM, Abrasive EDM etc.

**OEL-308 RELIABILITY, MAINTENANCE MANAGEMENT & SAFETY L T P3 1 –**

**Reliability Engineering:** System reliability - series, parallel and mixed configuration, Block diagram, r-out-of-n structure, Solving problems using mathematical models. Reliability improvement and allocation-Difficulty in achieving reliability, Method of improving reliability during design, different techniques available to improve reliability, Optimization, Reliability – Cost trade off, Prediction and analysis, Problems.

**Maintainability, Availability & Failure Analysis:** Maintainability & Availability – Introduction, formulae, Techniques available to improve maintainability & availability, trade off among reliability, maintainability & availability, simple problems, Defect generation – Types of failures, defects reporting and recording, Defect analysis, Failure analysis, Equipment down time analysis, Breakdown analysis, TA, FMEA, FMECA.

**Maintenance Planning and Replacement:** Maintenance planning – Overhaul and repair; Meaning and difference, Optimal overhaul/Repair/Replace maintenance policy for equipment subject to breakdown, Replacement decisions – Optimal interval between preventive replacements of equipment subject to breakdown, group replacement.

**Maintenance Systems:** Fixed time maintenance, Condition based maintenance, Operate to failure, Opportunity maintenance, design out maintenance, Total productive maintenance, Inspection decision – Optimal inspection frequency, non-destructive inspection, PERT & CPM in maintenance, Concept of terrotechnology.

**Condition Monitoring:** Techniques-visual monitoring, temperature monitoring, vibration monitoring, lubricant monitoring, Crack monitoring, Thickness monitoring, Noise and sound monitoring, Condition monitoring of hydraulic system, Machine diagnostics - Objectives, Monitoring strategies, Examples of monitoring and diagnosis, Control structure for machine diagnosis.

**Safety Aspects:** Importance of safety, Factors affecting safety, Safety aspects of site and plant, Hazards of commercial chemical reaction and operation, Instruments for safe operation, Safety education and training, Personnel safety, Disaster planning and measuring safety effectiveness, Future trends in industrial safety.