

**School of Engineering and Technology**

**Programme Structure & Syllabus**

**M.Tech. (MANUFACTURING SYSTEM ENGINEERING (MSE))**

**2022-23**



**K.K. University**  
**Bihar Sharif, Nalanda - 803115**



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Nalanda - 803115 (Bihar)

## FIRST SEMESTER

S. No	CODE	TITLE	CREDIT	L	T	P	HOURS PER WEEK	Internal Marks	External Marks
1	MTMSE 101-A	Design of Experiments	4	3	1	0	4	30	70
2	MTMSE -102-A	Advanced Manufacturing Science	4	3	1	0	4	30	70
3	MTMSE -103-A	IT in Manufacturing	4	3	1	0	4	30	70
4	MTMSE -104-A	Metal Forming Analysis and Technology	4	3	1	0	4	30	70
5	MTMSE -121/122/123/124-A	Elective I	4	3	1	0	4	30	70
6	MTMSE -111-A	IT in Manufacturing Lab	2	0	0	3	3	30	70
<b>Total</b>			22	15	5	3	23	180	420

## SECOND SEMESTER

S. No	CODE	COURSE TITLE	CREDIT	L	T	P	HOURS PER WEEK	INTERNAL MARKS	EXTERNAL MARKS
1	MTMSE-201-A	Mechatronics	4	3	1	0	4	30	70
2	MTMSE -202-A	Advanced Machining Process and Analysis	4	3	1	0	4	30	70
3	MTMSE -203-A	Modelling and Simulation of Manufacturing System	4	3	1	0	4	30	70
4	MTMSE -221/222/223/224-A	Elective II	4	3	1	0	4	30	70
5	MTMSE -225/226/227/228-A	Elective III	4	3	1	0	4	30	70
6	MTMSE -211-A	Modelling and Simulation of Manufacturing System Lab	2	0	0	3	3	30	70
<b>TOTAL</b>			22	12	3	3	18	180	420



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### THIRD SEMESTER

S. No	CODE	COURSE TITLE	CREDIT	L	T	P	HOURS PER WEEK	INTERNAL MARKS	EXTERNAL MARKS
1	MTMSE-301-A	Advanced welding process	4	3	1	0	4	30	70
2	MTMSE -302-A	Industrial Engineering & Management	4	3	1	0	4	30	70
3	MTMSE-311-A	Minor Project	6	0	0	1	1 2	30	70
<b>TOTAL</b>			14	6	2	1 2	2 0	<b>90</b>	<b>310</b>

### FOURTH SEMESTER

S.No	CODE	COURSE TITLE	CREDIT	L	T	P	Hours Per Week	Internal Marks	External Marks
1	MTMSE-411-A	Dissertation	12	0	0	24	24	30	70
<b>TOTAL</b>			<b>12</b>	<b>0</b>	<b>0</b>	<b>24</b>	<b>24</b>	<b>30</b>	<b>70</b>




  
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### Elective I

S.NO	CODE	TITLE
1	MTMSE -121-A	Robotics
2	MTMSE -122-A	Quality Engineering & Management
3	MTMSE -123-A	Diagnostic Maintenance & Monitoring
4	MTMSE -124-A	Finite Element Methods

### Elective II

S.NO	CODE	TITLE
1	MTMSE -221-A	Tool & Cutter Design
2	MTMSE -222-A	Composites Materials & their Manufacturing
3	MTMSE -223-A	Advanced Optimization Techniques
4	MTMSE -224-A	Control System in Manufacturing

### Elective III

S.NO	CODE	TITLE
1	MTMSE -225-A	Machine Tool Design
2	MTMSE -226-A	Tribology
3	MTMSE -227-A	Product Design & Development
4	MTMSE -228-A	System Analysis



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## DESIGN OF EXPERIMENTS / MTMSE-101-A

### Module-I

**Introduction:** Strategy of experimentation, Some typical applications of experimental design, Basic principles, Guidelines for designing experiments, A brief history of statistical design, Using statistical design in experimentation

### Module-II

**Simple Comparative Experiments:** Introduction, Basic statistical concepts, Sampling and sampling Distribution, Inferences about the Differences in means, randomized designs, Paired comparison Designs, Inferences about the Variances of Normal Distributions

### Module-III

**Introduction To Factorial Design:** Basic definition and principles, Advantages of factorials, The two factor factorial design, General factorial design, Fitting response curves and Surfaces, Blocking in a factorial design

### Module-IV

**Fitting Regression Models:** Introduction, Linear regression models, Estimate of parameters in linear regression models, Hypothesis testing in multiple regression, Confidence intervals in multiple regression, Prediction of new response observations, Regression model diagnostics, Testing for lack of fit

### Module-V

**Taguchi Method Of Design Of Experiments:** Concept design, Parameter design, Tolerance design, Quality loss function, Signal-to- Noise ratio, Orthogonal array experiments, Analysis of Mean (ANOM), Quality characteristics, Selection and testing of noise factors, Selection of control factors, Parameter optimization experiment, Parameter design case study

**Analysis of Variance (ANOVA):** Introduction, Example of ANOVA process, Degrees of freedom, Error variance and pooling, Error variance and application, Error variance and utilizing empty columns, the F-test

(12 Hrs)



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Recommended Books:

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
Design and Analysis of Experiments	Douglas C Montgomery	John Wiley
Statistical Design and Analysis of Experiments	John P.W.M.	John Wiley
Introduction to Linear Regression Analysis	Montgomery D.C., Runger G. C.,	John
Response Surface Methodology Process and Product Optimization Using Designed Experiments	Myres R.H. and Montgomery D. C.	Wiley Wiley
Introduction to Quality Engineering White Plains, New York	Taguchi, G	UNIPUB,



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## ADVANCED MANUFACTURING SCIENCE / MTMSE-102-A

### Module-I

**Engineering Materials:** Applications and Important Properties of ferrous materials- cast iron, steels and alloy steels, non-ferrous materials-Cu, Al and their alloys. New industrial materials and their properties with special emphasis to composites, Selection of materials

### Module-II

**Metal Machining:** Tool Geometry, different system of representation, mechanics of orthogonal and oblique cutting, shear angle relation in orthogonal cutting, shear angle & chip flow direction in oblique cutting, chip control methods, analysis of cutting process like turning, drilling, milling. Temp. Distribution at the tool chip interface

### Module-III

**Casting Processes:** Introduction, Mould and cores, Coating for moulds and cores, melting of metals, furnaces, cooling and solidifications of metals, mechanism of solidifications, rate of solidification, continuous casting process, Riser Design and its placement, defects in casting, inspection of casting process

### Module-IV

**Welding:** Introduction, Principle of solid state welding, Heat source, Metal Transfer in Arc Welding, Heat flow characteristics, Gas Metal Reactions, Cooling of fusion weld, weld defects and inspection

### Module-V

Advance welding process, Ultrasonic Welding, Electronic beam welding, Laser beam welding, Explosive Welding, Plasma welding, Development in welding Technology, Some research trends in welding, quality control of weldments



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Recommended Books:

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
Manufacturing Science Welding Processes and Technology	Ghosh and Malik R.S. Parmar,	EWP Khanna Publishers
Production Technology	Frnk Kreith	HMT



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## **IT IN MANUFACTURING/MTMSE -103-A**

### **Module-I**

**Computer Aided Design:** Interaction device and technique, viewing in three dimensions, Geometrical transformations, Modeling and object hierarchy, Raster algorithms display, representation of 3D shapes, Hidden lines, edge and surface removal, Introduction to shading & rendering of surfaces and solids

**Computer aided manufacturing:** Introduction to conventional and modern manufacturing systems. NC, CNC, DNC systems, functions, their components advantages and disadvantages, Industrial automation, Special purpose machines, Concept of CIM

**APT part programming:** Fundamentals, geometry, tool motion, post processor and auxiliary statements, application to simple jobs

### **Module-II**

**Adaptive control system:** Introduction, types, ACC, ACO area of application, advantages **Group technology:** Introduction, part families, various systems of part classification and coding, production flow analysis, Cellular manufacturing, Composite part concept, Machine cell design, application and benefits **Conveyor System:** Types of conveyors, Conveyor operation and features **Automated storage and retrieval system AS/RS:** Storage system performance, Storage location strategies, Automated storage systems, Automated storage and retrieval system

### **Module-III**

**Robotics:** Introduction, History, Definition, Classification, Description of manipulators, Basic motions, Precision of movements, PTP and CP robots, Types of drives, Introduction to robot programming, Robot programming languages, End of arm tooling, Sensors used in robots, Robot safety and economic analysis

### **Module- IV**

**Automated Inspection Quality Control:** Inspection fundamentals, Automated inspection, Contact and non-contact inspection techniques, Coordinate measuring machines, construction, operation, software, applications and benefits, Surface measurements,



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Machine vision, other optical inspection techniques, non-contact non optical inspection techniques

## Module-V

**Computer Integrated Manufacturing System:** Introduction, Types, machine tool and related equipment, material handling system, Computer control system, Human labor in manufacturing system, role of computers in CIMS, Introduction to CIM software, Benefits of CIMS

**ERP, FOF:** Computer managing system, Enterprise Resource Planning (ERP), factory offuture

### Recommended Books:

Title	Author(s)	Publisher
Automation, production systems and computer integrated manufacturing	Groover, M. P	PHI
CAD/CAM Theory & Practice	Zeid, Ibraheim	TMH
Computer Numerical control of machine Tools	Thyer, G.E.	Heinemann
CAD/CAM	Mcmaho	Adison Wesley
n	& Browne	



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# METAL FORMING ANALYSIS & TECHNOLOGY / MTMSE -104-A

## Module-I

**Introduction:** Stress-strain relations in elastic and plastic deformations, yield criteria for ductile metals, work hardening and anisotropy in yielding. Flow curves, elements of theory of plasticity, application of theory of plasticity for solving metal forming problems using slab method, upper and lower bound methods, slip line field theory, extremism principles, and effect of temperature and strain rate in metal working

## Module-II

**Drawing:** Drawing of a flat strip and round bar, determination of drawing load, drawing with wedge shaped dies, cylindrical dies, cylindrical rod drawing with a conical die analysis of the processes and maximum possible reduction

## Module-III

**Tube making:** Tube making and deep drawing: introduction, plug drawing with a conical die, load determination, tandem drawing of tubes on a mandrel, tube sinking, concept of tube production by rolling and extrusion methods

**Exclusion:** Extrusion: round bar extrusion through a conical die, flat strip extrusion through dies of constant angles, impact extrusion, and hot extrusion of steels

## Module-IV

**Rolling:** Rolling of flat slabs and strip: Cold rolling and hot rolling, roll-pressure determination, rolling with no external tensions, rolling with front and back tensions

**Forging:** Forging: Introduction, determination of plain strain compression load, weight friction condition, inclined platen, thin strip, load evaluation for forging a flat circular disc

## Module-V



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**Frictions lubrication:** Friction and lubrication in metal working, introduction, influences of friction in metalworking processes, lubricants used for different metalworking processes.

**Unconventional Forming:** Introduction to unconventional forming processes like hydrostatic extrusion, hydro-forming of sheets and tubes, powder forming.

**Recommended Books:**

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
Principles of Industrial Metal working Processes.	G. B. Rowe	CBS
Manufacturing Science	Ghosh & Malik	East West
Foundry, forming and welding	P.N. Rao	TMH



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# ROBOTICS / MTMSE -121-A

## Module-I

**Introduction:** Evolution of robot and robotics, laws of robotics, robot anatomy: Links, joints, Degrees of freedom (DOF), Arm configuration, wrist configuration, end-effector

## Module-II

**Coordinate Frame, Mapping and Transforms:** Coordinate frames, description of objects in space, transformation of vectors, inverting a homogeneous transform, fundamental rotation matrices

## Module-III

**Kinematics:** Denavit- Hartenberg Notation, kinematic relationship between adjacent links, Manipulator transformation matrix, Inverse kinematics, Linear and angular velocity of a rigid body, velocity propagation along links, manipulator jacobian

## Module-IV

**Dynamics:** Lagrange-Euler Formulation, Newton-Euler Formulation

## Module-V

**Control of manipulators:** Position control, Force control: Applications of standard control strategies

### Recommended Books:

Title	Author(s)	Publisher
Robotics and Control	Mittal and Nagrath	TMH
Introduction to Robotics	J.J. Craig	Pearson Education
Vector mechanics	Beer and Johnston	TMH
Control System Engineering	Nise	Wiley
Simulation Modeling & Analysis	David Kelton	Tata McGraw Hill



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# QUALITY ENGINEERING AND MANAGEMENT

MTMSE -122-A

## Module-I

**Introduction:** Statistical concepts in quality control, Graphical representation of ground data, Continuous & discrete probability distributions, central limit theorem, Chi-square test, Introduction to quality control, process control and product control, chance and assignable causes of quality variation, advantages of Shewart control charts, process control charts for variables, Fixation of control limits, Type I and Type II errors, Theory of runs, interpretation of out of control points, Probability limits, initiation of control charts, trial control limits, determination of aimed-at value of process setting, rational Method of sub grouping, control chart parameters, control limits and specifications limits, natural tolerance limits, relationship of process in control to upper and lower specifications limits, process capability studies

## Module-II

**Control charts:** Special control charts for variables, Group control charts, Arithmetic moving X and R charts, Geometric Moving charts, X control charts with reject limits, Steady trend in process average with cost dispersion, trend chart with sloping limits, variable subgroup size CUSUM or cumulative sum control chart

## Module-III

**Sampling plans:** Probability theory, hyper-geometric, Binomial and Poisson distributions, Acceptance inspection 100% inspection, no inspection and sampling inspection, Operating characteristic curve, effect of sample size and acceptance number.

## Module-IV

Type a and Type B O.C curves, single, Double and multiple sampling plans, Sequential sampling



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plans Acceptance/rejection and acceptance/rectification plans, procedure's risk and consumer's risk, difference quality level, Average outgoing quality curve, average



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outgoing quality limit, quality protection offered by a sampling plan. average samplenumber,  
 Design of single, double and sequential plans

**Module-V**

**Quality systems:** Economics of product inspection. real point, selection of economic sampling plans, Product quality ad reliability, failure data analysis ad life testing, elements of total quality control quality assurance, ISO9000 quality system

Recommended Books:

Title	Author(s)	Publisher
Industrial Statistics Handbook Duncan McGraw Hill Quality Control	Grant & Leaveworth McGraw Hill Quality Control & Irwin Press Quality Control Juran	Han
Prentice Hall An Introduction to reliability & control	Thomason	Machinery



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# DIAGNOSTIC MAINTENANCE AND MONITORING /

## MTMSE -123-A

### Module-I

**Introduction:** Introduction to maintenance techniques, maintenance Strategies Classifications (Plant maintenance, Running Maintenance, Shut Down, Emergency corrective, curative, Breakdown, preventive predictive, Reliability, Total productive Maintenance, Guidelines for selecting best strategy

### Module-II

**Fault Tree analysis:** Fault Tree analysis, Methodology for tree development, Family tree definitions in symbols. Fault Tree construction, fault tree simplification, fault tree evaluation, common cause failure, Probability evaluation in fault trees, Simulation approach

### Module-III

**Wear analysis:** Wear analysis through Thermo-graphy and Ferro-graphy

### Module-IV

**Condition Monitoring:** Various Techniques of condition Monitoring, condition based Maintenance, visual monitoring, performance monitoring, vibration monitoring, war debris monitoring, Decision elements in condition based maintenance detection, diagnosis, Prescription, Benefits of condition nmaintenance

### Module-V

**Diagnostic maintenance:** Application of diagnostic maintenance to Industrial Machine & Plants, Case studies

#### Recommended Books:

Title	Author(s)	Publisher
Diagnotic maintenance & conditionMonitoring	Kelly	Butterworth & Co.
Maintenance and spare partsmanagement	Krishan G	Prentice Hall
Maintenance Engineering Handbook	Higgins	McGraw Hill



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RAM in manufacturing

Gandhi &  
Chawl  
a

Proceedings of SERC, IIT

Engineering Maintenance Management

Nielsen Benjamin

Maries



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# FINITE ELEMENT METHODS / MTMSE -124-A

## Module-I

**Introduction:** Historical Background, Stresses and equilibrium, Boundary Conditions, Strain-Displacement Relations, Stress-Strain Relations, Temperature Effects, Vectors and Matrices

## Module-II

**Introduction & Fundamental Concepts:** Classification of Differential Equations, Rayleigh-Ritz Method, Galerkin's Method, Point Collocation Method, Least Square Method, Weighted Residual Method, Variational Formulation

## Module-III

**1-D FE Modeling:** Finite Element Modeling, Coordinates and Shape Functions, Generalized Coordinates, Natural Coordinates in 1D, 2D and 3D, Coordinate Transformation, Assembly of Global Stiffness matrix and Load vector, Properties of Stiffness Matrix, Treatment of Boundary Conditions and Temperature Effects, Truss and Beam Elements **2-D FE Modeling:** Finite Element Modeling, Constant Strain Triangle

## Module-IV

**2-D FE Modeling:** The Four Node Quadrilateral, Numerical Integration, Higher Order Elements; Nine Node Quadrilateral, Eight Node Quadrilaterals, Six Node Triangle Truss: Introduction, Plane Trusses, Assembly of Global Stiffness Matrix and load vector Higher-Order Elements: Plate Bending,  $C^0$  and  $C^1$  Elements, Non-conforming Elements and Patch Test

## Module-V

**Scalar Field Problems:** Introduction, Steady-state heat transfer, Potential Flow, Fluid Flow in Ducts

**Dynamic Considerations:** Element Mass Matrices, Evaluation of Eigen Values and Eigen Vectors. (Introduction only)

**Computer Implementation:** Introduction; Computer Program Organization for Calculation



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of System Matrices

<b>Title</b>	<b>Recommended Books: Author(s)</b>	<b>Publisher</b>
Introduction to Finite Elements in Engineering	Chandrupatla and Belegundu	PHI
Finite Element Procedures	Bathe	PHI
An Introduction to Finite Element Method The	Reddy	TMH
Finite Element Methods for Engineers	Huebner	John Wiley
The Finite Element Method	Zienkiewicz	TMH
Finite Element Analysis	Buchanan	McGraw Hill



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# MECHATRONICS / MTMSE -201-A

## Module-I

**Introduction:** The Mechatronics approach: A methodology for integrated design of Mechanical, Electronics, Electrical, Control, computer and Instrumentation

**Fundamentals of Electronics and digital circuits:** Number systems: Binary, Octal, Hexadecimal, Conversion from Binary to Decimal, Octal and Hexadecimal and vice

–versa, Binary arithmetic: Addition, subtraction, Multiplication and division

## Module-II

Boolean Algebra: Laws, De-Morgan's laws, Logic Gates, Truth tables, Karnaugh maps and logic circuits. Generation of Boolean function from truth tables and simplification, Review of semiconductor devices, operational amplifier, Configurations: Inverting, summing, integrating and differentiating, Concepts of digital and analog systems, Digital to analog conversion (DAC): R-2R and summing Op-amp circuit, Analog to digital conversion (ADC): successive approximation method, Programs for DI, DO, DA and AD for PCL 208 card

## Module-III

**Sensors and Actuators:** Strain Gauge, Potentiometer, Optical encoders: incremental and absolute encoders, Linear variable differential transformer (LVDT), Piezoelectric, Proximity sensor, Resistance Temperature Detector, (RTD), Thermistors, Thermocouple, Hall effect sensor, Permanent Magnet DC motor, Stepper motor

## Module-IV

**Control systems:** Mathematical modeling of physical systems, system equations, controllability and observability, pole placement, PID controller

## Module-V

**Microprocessor and computers:** Introduction to 8085, Architecture, programming, I/O, Computer interfacing, Function of PLC, Architecture, Components of PLC, selection of PLC,



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Ladder Logic diagram, Logic functions: latching, sequencing, counters, shift registers, jumpers, manipulation of data, arithmetic operations



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<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
Mechatronics	W. Bolton	Pearson Education
Pneumatic system	Majumdar	TMH
Hydraulic and Pneumatic systems	Andrew Parr	
Automation, production systems and computer integrated manufacturing	TMH M.P. Groover	
	TMH	
Mechatronics system design learning	Shetty and Kolk Mahalik	Thomson TMH



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# ADVANCED MACHINING PROCESSES & ANALYSIS / MTMSE -202-A

## Module-I

**Overview of mechanical removal processes:** Introduction, Classification of various modern machining processes. Considerations in process selection, Working principle, selection of processes, Material removal rate, Horn design, process capabilities, applications & limitations of the Ultrasonic machining (USM)

## Module-II

**Abrasive water-jet processes:** Working principles, mechanism of material removal study and selection of process parameters, machining characteristics, applications & limitations of the following processes, Abrasive jet Machining (AJM), Water jet machining (WJM), Abrasive Flow Machining Process (AFM), Abrasive water jet Machining (AWJM)

## Module-III

**Electro chemical processes:** Principle of operation, mechanism of material removal, study of equipment and selection of process parameters, process capabilities, tool design applications & limitations of the following processes, chemical machining (CM), Electro chemical machining (ECM). Electrochemical Honing, Electrochemical de-burring, Electro stream and shaped Tube Electrolytic Machining

## Module -IV

**Thermal metal removal processes:** Thermal energy methods of material processing by Electric Discharge machining (EDM), Electron Beam machining (EBM), Ion-beam machining (IBM), and Laser Beam machining (LBM),

## Module -V

Introduction to new concept of High Speed Machining, Ultra-Precision Machining and



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hardturning

Recommended Books:

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
Non conventional Machining	P.K. Mishra	Narsoa
Modern machining methods	Pandey & Shan	TMH
Principles of Electrochemical Machining	Mc Geough	Chapman & Hall
Plasma, Electron and Laser beam Technology	Arata. A	ASM
Laser Machining-Theory & Practice	George Chryssolouris	Springer



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# MODELING AND SIMULATION OF MANUFACTURING SYSTEMS / MTMSE -203-A

## Module-I

**Introduction:** Introduction and Overview, concept of system environment, element of systems, system modeling, types of models. Monte Carlo method, system simulation, Simulation-Management Laboratory, Advantages limitations of systems, Simulation of Continuous and Discrete system

**Simulation of Continuous system:** Characteristics of Continuous System, comparison of Numerical integration with continuous simulation system simulation of integration formula

## Module-II

**Simulation of Discrete System:** Time flow mechanisms, Discrete and continuous probability density function, Generation of random numbers, Testing of random numbers for randomness and for auto correction, generation of random variates for discrete distribution, generation of random variates for continuous probability distribution- binomial, normal exponential and beta distribution, combination of discrete event and continuous models.

## Module-III

**Simulation of queuing system:** Concept of queuing theory, Characteristics of queues, stationary and time dependent queue, queue discipline, time series analysis, measure of system performance, Kendall's notation, auto covariance and auto correlation function, auto correlation effects in queuing system, simulation of single server queues, Multi server queues, queues involving complex arrivals and service times with blanking and renegeing

## Module-IV

**Simulation of inventory system:** Rudiments of inventory theory, MRP in progress inventory,



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Necessity of simulation in inventory problems. Forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlang variants simulation of complex inventory situations

**Design of simulation experiments:** Length of run, elimination of initial bias variance reduction techniques, stratified sampling, antipathetic sampling common random numbers, time series analysis, spectral analysis, model validation, optimization procedures,



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search methods, single variable deterministic case search, single variable non-deterministic

capacity planning production system, reliability

**Simulation Languages:** Continuous and Discrete simulation languages block structure

continuous languages, special purpose simulation languages

(8 Hrs)

**Recommended Books:**

**Title**

**Author(s)**

**Publisher**

Simulation and Modeling  
Hill

Loffick

Tata McGraw

System Simulation with Digital Computer  
India System Simulation

Deo Narsingh  
D.S. Hira

Prentice Hall of  
S. Chand & Co.

System Simulation

Gorden

Prentice Hall

Simulation Modeling & Analysis

David Kelton

Tata McGraw Hill



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## TOOL AND CUTTER DESIGN / MTMSE -221-A

### Module-I

**Classification of cutting tools:** Various machining operations and the tools required to carryout these operations: principle elements of various cutting tools; single point cutting

tool geometry in ASA, ORS & NRS systems.

**Tool Materials:** Properties of cutting tool materials, development of cutting tool materials, composition, production process and application of different cutting tool materials viz. High carbon steel, HSS, carbides, Ceramics, CBN, UCON, diamond etc.

### Module-II

**Design of Single point cutting tools:** Cutting parameters of a lathe, different turning operations and cutting tools used for these operations. Classification of single point cutting tools: solid, carbide tipped tools, geometrical parameters of a single point cutting tool, design procedure of single point cutting tool, re-sharpening of single point cutting tools **Form Tools:** Purpose and types, design procedure and their sharpening

### Module-III

**Drill design:** Drilling operations, Cutting parameters of drilling operations, different drilling operations and cutting tools used for these operations, Types of drills, solid, carbide tipped drills, geometrical parameters of a twist drill, design procedure of a twist drill, re- sharpening of the twist drill.

### Module-IV

**Milling Cutter Design:** Milling operations, milling cutting parameters, different milling operations and cutting tools for these operations, Types of milling cutters, solid, and carbide tipped cutter; geometrical parameters of a milling cutter, design procedure of a disc type milling cutter, re-sharpening of the cutters



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## Module- V

**Broach design:** Broaching operation and its advantages, broaching cutting parameters, types of broaches, solid, and carbide tipped broaches; design procedure of a broach, re-sharpening of the broach.



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**Hob design:** Gear nomenclature, construction of involutes profile, hobbing operation and its advantages, geometrical parameters of a hob, design procedure of a hob (12 Hrs)

**Recommended Books:**

**Title**

Tool Design

Cutting tools

Metal Cutting theory & practice

**Author(s)**

Donaldson

Prakash Joshi

Arschinow & Alearoov

**Publisher**

McGraw Hill

Wheeler Publishing

Mir publication



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# COMPOSITE MATERIALS & THEIR MANUFACTURING / MTMSE -222-A

## Module-I

**Introduction:** General introduction to composites; historical background; concept of matrix and reinforcement and particulates.

**Matrix and reinforcement:** Types of matrix and reinforcement, volume fraction and weight fraction Fiber architecture fiber packing arrangements, whiskers

## Module-II

**Fabrication methods of polymer composites:** Liquid resin impregnated routes, pressurized consolidation of resin pre-pregs, consolidation of resin molding compounds, injection molding of thermoplastics, hot press molding of thermoplastics

**Fabrication of ceramic composites:** Powder based routes, reactive processing, layered ceramic composites, carbon/carbon composites

## Module-III

**Fabrication routes of metal matrix composites:** Squeeze infiltration, stir casting, spray deposition, powder blending and consolidation, diffusion bonding of foils, PVD

## Module-IV

**Testing and characterization:** Different tests like internal stress measurement by diffraction, metallographic preparation etc. with special emphasis to metal matrix composites

## Module-V

**Secondary processing and application of composites:** Secondary processing like machining, joining, extrusion of composites; Application and case studies

### Recommended Books:

Title	Author(s)	Publisher
Composite materials	S.C.Sharma	Narosa Publishers
Metal matrix composite R.J.	R.K.Everret &	Academic press

Introduction to metal Matrix



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Composite

Arsenault

T. W. Clyne & P. J. Withers

Cambridge press



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# ADVANCED OPTIMIZATION TECHNIQUES / MTMSE -223-A

## Module-I

**Linear programming:** Modelling of linear programming problem – a few examples; Solution of linear programming problem – simplex method, two-phase method, M-method; Sensitivity analysis – graphical approach

## Module-II

**Non-linear programming:** Convex and non-convex search space, Kuhn-Tucker conditions, Hessian matrix; Transformation of constrained optimization problems into unconstrained ones – penalty function approach; Direct search – variable elimination method, random search method

## Module-III

**Integer Programming:** Modelling of integer programming problem – a few examples; Solution of integer programming problem – branch & bound algorithm, cutting-plane algorithm; Travelling salesman problem – formulation, solution and practical applications

## Module-IV

**Heuristic models:** Limitations of traditional optimization approaches to solve real world problems, Population based optimization techniques

## Module-V

Simple genetic algorithms – introduction, representation of variables, fitness function, genetic operators – reproduction, crossover, mutation; Advantages and limitations of population based optimization techniques over the point-to-point based ones

Operations  
Research

Title  
Recommended Books:  
Author(s)



Publisher

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Optimization

Deb, K.

PHI

o

Engineering Design

Operations Research

Optimization techniques

international

D.S. Hira, P. K. Gupta

Rao

S. Chand

New Age



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# CONTROL SYSTEMS IN MANUFACTURING / MTMSE -224-A

## Module-I

**Introduction:** Examples of control systems, closed loop and open loop control systems, Laplace transform

## Module-II

**Mathematical Modelling of Dynamic systems:** Transfer function and impulse response function, block diagrams, signal flow graph, state-space representation  
Transient response analysis of first order and second order systems

## Module-III

**Time domain analysis and design:** Root locus method, Routh stability criteria, effect of poles and zeros on system performance

## Module-IV

**Frequency domain analysis and design:** Bode plot , Nyquist stability criteria, Lag , lead compensation

## Module-V

**Analysis and design in state-space method:** Controllability and observability, pole placement method, examples of control system design using MATLAB

### Recommended Books:

Title	Author(s)	Publisher
Modern Control Engineering	K. Ogata	PHI
Automatic Control Systems	B.C. Kuo	PHI
Control System Engineering	Nise	Wiley
Modern Control Systems	Dorf and Bishop	Pearson Education
Modern Control System Theory	M. Gopal	New Age International



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# MACHINE TOOL DESIGN

## MTMSE -225-A

### Module-I

**Design approach:** Design requirements of machine tools, A design approach for machinetools, Identification and quantification of objectives and constraints in machine tool design

### Module-II

**Power requirements:** Estimation of power requirements and selection of motor for metalcutting machine tool spindles

### Module-III

**Gearbox design:** Design of gearbox, spindle and guide-ways

**Structural design:** Principles of design of structural components, namely, head stock, tail stock, carriage, table, knee, column and overarms to achieve desired static & fatigue strength, stiffness, dynamic characteristics and other requirements, Exercises on the design of machine tools using existing CAD software packages

### Module- IV

**CNC machine design:** Introduction to computer integrated manufacturing systems and CNC machine tools

### Module-V

**Design of CNC systems:** Design/selection of linear motion systems, ball, screws, CNC feedback devices, controllers, feed drives and servomotors for CNC machine tools, Recent developments in CNC and other machine tools

### Recommended Books:

Title	Author(s)	Publisher
Design of Devices and Systems	William H. Middendorf and Richard H. Engelmann	CRC Press
Computer numerical control of machine tools	G. E. Thyer	Heinemann Prof.



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Machine Design Fundamentals: A  
Mechanical Designers' Workbook  
Numerical Control and Computer-aided  
manufacture

Joseph Edward Shigley  
and Charles R. Mischke  
Kundra, Rao, Tiwari

publishing

McGraw Hill

Tata McGraw Hill



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# TRIBOLOGY

## MTMSE -226-A

### Module-I

**Introduction:** Friction, wear and lubrication, Types of Engg. Contacts: conforming and non-conforming. Types of Motion, rubbing, sliding, oscillating, Rolling and surface interactions, elastic and plastic deformations, properties of materials, surface energy and flash temp theory

### Module-II

**Friction:** Law of sliding friction, concept of adhesion, Taylor's model of friction, Measurement of friction.

### Module-III

**Wear:** Laws of wear, types of wear such as adhesive, delamination, abrasive, fatigue, corrosive, fretting erosive, electrical and oxidative. Measurement of wear in dry atmosphere and different environments preventive, control of wear, wear of cutting tool and dies, study of abrasion in grinding, lapping and honing

### Module-IV

**Lubricants:** Mechanisms of lubricants, boundary, squeeze film hydrodynamic and elasto hydrodynamic and hydrostatic lubricants plasto hydrodynamic lubricants, solution of Reynolds equation in two and three-dimensional flow. Pressure distribution load carrying capacity friction forces in oil film and coefficient of friction in journal bearing. Solid lubricants types and applications

**Bearing Design:** Design of bearing, Clearance in journal bearing, minimum film thickness, Sommerfeld number, oil grooves and flow of oil in axial and circumferential grooves cavitations and turbulence in oil bearings, Heat generation and cooling of bearing hydrostatic and dynamic and their applications in machine tools, Design of air bearing other gas bearing

### Module-V



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**Rolling friction:** Reynolds's slip, concept, selection of roller bearings and their methods of lubrication design aspects and modes of bearing failures and also hydrodynamic lubrication



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**Solid Lubricants:** Solid lubricants and its applications in metal forming processes

(12 Hrs)

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
A text book	Sharma & Aggarwal	Kataria
A Machine Design Handbook	Powell	McGraw Hill
Standard handbook of machinedesign	Shigley, Mischke & Brown	McGraw Hill
Industrial Tribology	Dr.B.S.Prabhu	McGraw Hill



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# PRODUCT DESIGN & DEVELOPMENT

MTMSE -227-A

## Module-I

Stages in design process: Introduction to various stages of the design process: Formulation of problem, Generation of alternatives, Evaluation, Guided Redesign. Case study Product life cycle: New product introduction: early introduction, increased product life. Life cycle management tools: System integration, QFD, House of quality, Pugh's method, Pahl and Beitz method, Case studies

## Module-II

Value engineering: Introduction, nature and measurement of value, Value analysis jobplan, Creativity and techniques of creativity, Value analysis test, Case studies

Concurrent/ reverse engineering: Introduction, basic principles, components, benefits of concurrent engineering. Concept of reverse engineering

(12

Hr

s)

## Module-III

Material selection: Materials in design, The evolution of engineering materials, Design tools and material data, Function, material, shape and process, Material selection strategy, attribute limits, selection process, computer aided material selection, Case studies

Process selection: Introduction, Process classification: shaping, joining and finishing, Systematic process selection, Ranking, process cost, Computer – aided process selection

(12

Hrs)

## Module-IV

Design for manufacture and assembly: Design for Manufacture and Assembly (DFMA), Reasons for not implementing DFMA, Advantages of DFMA with case studies, Design features and requirements with regard to assembly, production, Design for Manufacture in relation to any two manufacturing processes: machining and injection molding, Need, objectives

Design for 'X': Introduction, Design for: Safety, packaging and storage, quality, reliability, energy conservation, environment, aesthetics, ergonomics, maintenance, recyclability and disposal, Case studies. (5

Hrs)

## Module-V

Patents, liability and ethics: Introduction, Protecting your design: patents, copyright, basic tools of design protection. Liability issues in product design. Ethical considerations, Examples/ case studies

(7

Hrs)

Recommended Books:



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Title	Author(s)	Publisher
Product Design & Development Steven D. Eppinger	Karl T. Ulrich,	Mc GrawHill
Integrated Product and Process Development	John M. Usher, Utpal Royand H. R. Parasaei	Tata McGraw
Product Design for Manufactureand Assembly	G. Boothroyd, P. Dewhurstand W. Knight	HillMarcel Dekker
Product Design and Manufacture	A. K. Chitale and R. C. Gupta	PHI



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Selection of Materials and  
Manufacturing Processes for  
Engineering Design Engineering Design  
and Design for Manufacturing: A  
structured approach  
Material Selection in Mechanical Design  
Concurrent Engineering

Mahmoud M. Farag  
John R. Dixon and Corrado Poli  
Stone Publishers, USA  
M. F. Ashby  
Biren Prasad

Printice Hall  
Field  
Elsevier  
Prentice Hall



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# SYSTEM ANALYSIS

MTMSE -228-A

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Credits: 4

## Module-I

**System Components:** The environment and the system concept; system structure; system inputs and outputs; system approach to macro problems; problem definition with system concepts and approach (6

Hrs)

## Module-II

**System Modeling:** Model formulation; Representation of dynamics signal and system flowgraph; System interactions; System compatibility; Sub-systems and inter-connections; Functional and equipment structuring. Linear graph approach, Time models

## Module-III

(6 Hrs)

**System Simulation:** Basic philosophy of simulation; Analog and Digital Computers; System with feedback. Continuous and Discrete system simulation (12

## Module-IV

**System Dynamics:** Dynamic analysis of systems; Dynamic behavior of organization; Total flow of man, information and materials; Dynamic analysis of the models for capital equipment and orders; Derivation of the policies for management based on system models

(12 Hrs)

## Module-V

**Optimization:** Optimization of system performance; Perturbation analysis of system parameters; Criteria for optimization, Gradient method; Dynamic programming method

**System Design:** Elements of Decision analysis; Game theory; Application of game and decision theory to system design. Techniques for creative design; Elementary sensitivity analysis (12 Hrs)

## Recommended Books:



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**Title**

System Engg. Tools  
Design of Engg. Systems  
System Engg.,  
System Engg. Handbook  
Introduction to System Science  
System Modeling and Analysis  
Hill  
System Simulation  
Industrial Dynamics  
Concepts of Engineering System

**Author(s)**

Chestnut,  
Gosling  
A.D.Hall  
Machol,  
G.M.Sandquist  
Nagrath & Gopal  
  
Geoffrey Gordon  
Foreste  
r  
Design

**Publisher**

John Wiley  
John Wiley  
Van Nostrand, U.K.  
McGraw Hill Inc  
Prentice-Hall  
Tata McGraw  
  
Prentice Hall of India  
MIT Press



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Warren E. Wilson      McGraw  
Realtime System Design and Analysis  
System Design & Analysis,

Hill,  
P. A. Laplante,  
Avadh

Prentice Hall of India  
Galgotia Publishers



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## SEMESTER III

### ADVANCED WELDING PROCESS

L T P  
43 1 0

MTMSE -301-A

Credits:

#### Module -I

Introduction: Importance and application of welding, classification of welding process. Selection of welding process, Brief review of conventional welding process: Gas welding, Arc welding, MIG, TIG welding, Resistance welding, Electroslag welding, Friction welding etc. Welding of MS.CI, Al, Stainless steel & Maurer/Schaefflar Diagram. Soldering & Brazing.

#### Module -II

Advanced welding Techniques- Principle and working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc.

#### Module -III

Advanced welding Techniques (continued) : Principle and working and application of advanced welding techniques such as explosive welding/ cladding, Underwater welding, Spray-welding/Metallising, Hard facing.

#### Module -IV

Weld Design: Welding machines/equipments and its characteristics and arc-stability, Weld defects and distortion and its remedies, Inspection/testing of welds, Weld Design, Welding of pipe-lines and pressure vessels, Life prediction

#### Module -V

Thermal and Metallurgical consideration, Thermal considerations for welding, temperature distribution, Analytical/Empirical analysis/formulae, heating & cooling curves, Metallurgical consideration of weld, Heat affected zone and Parent metal, micro and macro structure, Solidification of weld and properties



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Recommended Books:

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
Advanced Welding Processes	John Norrish	Woodhead Publishing Ltd., Cambridge
Welding Processes and Technology	R. S. Parmar	Khanna Publishers
Welding Technology	O. P. Khanna	Dhanpat Rai Publications



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## INDUSTRIAL ENGINEERING & MANAGEMENT

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43 1 0

MTMSE -302-A

Credits:

### MODULE I

**Forecasting and Break Even Analysis:** Introduction, Demand patterns, Factors affecting demand, Subjective forecasting methods, Casual forecasting methods, Time series forecasting methods, Routine short term forecasting methods, Selection of forecasting model

### MODULE II

**Inventory Management:** Introduction, materials productivity and role of materials management techniques in improved materials productivity, Wilson's lot size model, inventory costs, hidden costs, composition of costs, estimation of inventory related costs, leadtime, stock out point, number of time periods, calculating Economic Order Quantity (EOQ), sensitivity analysis of EOQ model

### MODULE III

**CPM/PERT:** Introduction, Project scheduling with CPM, Project scheduling with PERT

**Production Planning and Control:** Introduction, System approach, Type of manufacturing systems, Factors affecting manufacturing systems

### MODULE IV

**Loading and Scheduling:** General scheduling problem, Significance of loading and scheduling, Factors affecting scheduling, Scheduling system, Flow shop scheduling, Job shopscheduling, Sequencing, Line balancing

### MODULE V

**Human Factors and Ergonomics in Industries:** Relationship of work-study man with management, supervisor and workers, qualities of a work-study man, Prevalence of repetitive strain injury in industry, Assessment of occupational exposure to noise, heat stress and dust. Effect of vibration/ noise, temperature, illumination and dust on human health and performance in industrial environment



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Recommended Books:

<b>Title</b>	<b>Author(s)</b>	<b>Publisher</b>
Industrial Engineering & Management	Philip E. Hicks	McGraw Hill Education
Industrial Engineering & Management	O. P. Khanna	Dhanpat Rai Publications



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