School of Engineering and Technology

Programme Structure & Syllabus

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

2023-24

K.K. University
Bihar Sharif, Nalanda - 803115

Pro Vice Chancellor
KK University
Berauti, Nepura, Bihar Sharif
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
Total			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
TOTAL			22	12	3	3	18	**180**	**420**

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	12	12	30	70
		TOTAL	14	6	2	12	20	**90**	**310**

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
TOTAL			**12**	**0**	**0**	**24**	**24**	**30**	**70**

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 & theirManufacturing
3	MTMSE -223-A	Advanced OptimizationTechniques
4	MTMSE -224-A	Control System inManufacturing

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

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)

Recommended Books:

Title	Author(s)	Publisher
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 OptimizationUsing Designed Experiments	Myres R.H. and Montgomery D. C.	Wiley
		Wiley
Introduction to Quality Engineering White Plains,New York	Taguchi, G	UNIPUB,

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

Recommended Books:

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

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
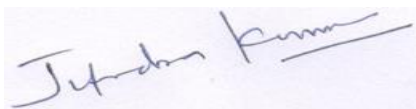
Adaptive control system: Introduction, types, ACC, ACO area of application, advantages **Group technology:** Introduction, part families, various systems of part classification and coding, production flow analysis, Cellular manufacturing, Composite part concept, Machine cell design, application and benefits **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,

Machine vision, other optical inspection techniques, non-contact non opticalinspection techniques
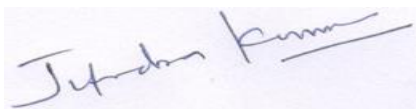
Module-V

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 n & Browne	Adison Wesley

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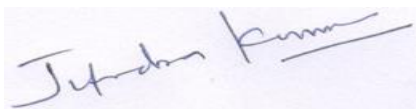
Exclusion: Extrusion: round bar extrusion through a conical die, flat strip extrusion throughdies of constant angles, impact extrusion, and hot extrusion of steels

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 flatcircular disc

Module-V

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:

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

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

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
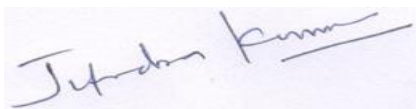
Module-II

Control charts: Special control charts for variables, Group control charts, Arithmeticmoving X ad R charts, Geometric Moving charts, X control charts with reject limits, Steadytrend 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

plans Acceptance/rejection ad acceptance/rectification plans, procedure's risk ad consumer's risk, difference quality   level, Average outgoing quality curve, average
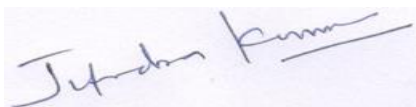
outgoing quality limit, quality protection offered by a sampling plan. average samplenumber, Design of single, double and sequential plans

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
		Statistical Quality Control Grant & Leaveworth
		McGraw Hill Quality Control &
Industrial Statistics Duncan		Irwin Press Quality Control
Handbook		Juran
McGraw Hill Quality Control		
	Han	
senPrentice Hall		
An Introduction to reliability & control	Thomason	Machinery

DIAGNOSTIC MAINTENANCE AND MONITORING /
MTMSE -123-A

Module-I

Introduction: Introduction to maintenance techniques, maintenance StrategiesClassifications (Plant maintenance, Running Maintenance, Shut Down, Emergencycorrective, 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
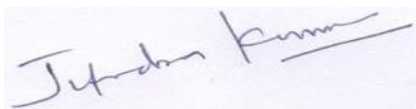
Module-IV

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
Diagnostic 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 & Chawla | Proceedings of SERC, IIT |
| Engineering Maintenance Management | Nielsel Benjamin | Maries | |

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 andMatrices

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
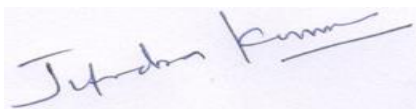
Module-IV

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 Elementsand Patch Test

Module-V

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

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

Computer Implementation: Introduction; Computer Program Organization for Calculation

of System Matrices

Recommended Books:

Title	Author(s)	Publisher
Introduction to Finite Elementsin Engineering	Chandrupatla and Belegundu	PHI
Finite Element Procedures	Bathe	PHI
An Introduction toFinite	Reddy	TMH
Element Method The Finite Element Methods for Engineers	Huebner	John Wiley
The Finite Element Method	Zienkiewicz	TMH
Finite Element Analysis	Buchanan	McGraw Hill

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
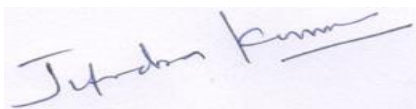
Module-III

Sensors and Actuators: Strain Gauge, Potentiometer, Optical encoders: incremental andabsolute encoders, Linear variable differential transformer (LVDT), Piezoelectric, Proximitysensor, 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,

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

Recommended Books:

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

ADVANCED MACHINING PROCESSES & ANALYSIS / MTMSE -202-A

Module-I

Overview of mechanical removal processes: Introduction, Classification of variousmodern 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

Abrasives 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)
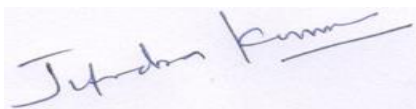
Module-III

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

hardturning

Recommended Books:

Title	Author(s)	Publisher
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

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

Module-I

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

Simulation of Continuous system: Characteristics of Continuous System, comparison of Numerical integration with continuous simulation system simulation of integration formula
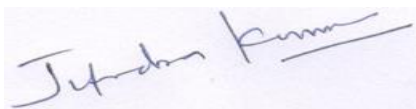
Module-II

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 verities for discrete distribution, generation of random varieties 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, Kendell's notation, auto covariance and auto correlationfunction, auto correlation effects in queuing system, simulation of single server queues,Multi server queues, queues involving complex arrivals and service times with blankingand reneging

Module-IV

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

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,

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

capacity planning production system, reliability

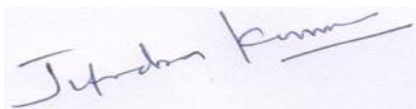**Simulation Languages:** Continuous and Discrete simulation languages block structure

continuous   languages,   special   purpose   simulation

languages

<div align="right">(8 Hrs)</div>

Recommended Books:

Title	Author(s)	Publisher
Simulation and Modeling	Loffick	Tata McGraw Hill
System Simulation with Digital Computer	Deo Narsingh	Prentice Hall of India System Simulation
	D.S. Hira	S. Chand & Co.
System Simulation	Gorden	Prentice Hall
Simulation Modeling & Analysis	David Kelton	Tata McGraw Hill

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.
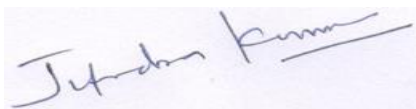
Module-II

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

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.

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

Recommended Books:

Title	Author(s)	Publisher
Tool Design	Donaldson	McGraw Hill
Cutting tools	Prakash Joshi	Wheeler Publishing
Metal Cutting theory & practice	Arschinow & Alearoev	Mir publication

COMPOSITE MATERIALS & THEIR MANUFACTURING / MTMSE -222-A

Module-I

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

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

Module-II

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

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

Module-III

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

Module-IV

Testing and characterization: Different tests like internal stress measurement bydiffraction, metallographic preparation etc. with special emphasis to metal matrixcomposites
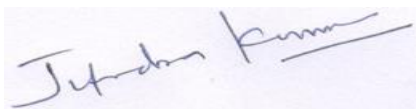
Module-V

Secondary processing and application of composites: Secondary processing likemachining, 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 metalMatrix		

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KK University
Berauti, Nepura, Bihar Sharif
Nalanda - 803115 (Bihar)

Composite   Arsenault

T. W. Clyne & P. J. Withers   Cambridge press

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
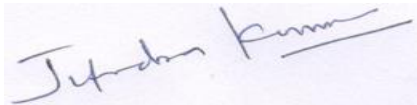
Module-IV

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

Recommended Books:

Title	Author(s)	Publisher

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Optimization of Engineering Design	Deb, K.	PHI
Operations Research	D.S. Hira, P. K. Gupta	S. Chand
Optimization techniques	Rao	New Age international

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 ofpoles and zeros on system performance
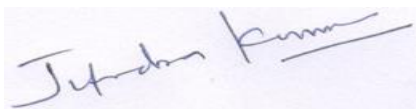
Module-IV

Frequency domain analysis and design: Bode plot , Nyquist stability criteria, Lag , leadcompensation

Module-V

Analysis and design in state-space method: Controllability and obervability, 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

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
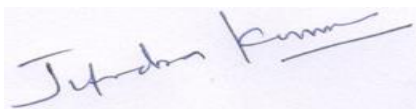
Module- IV

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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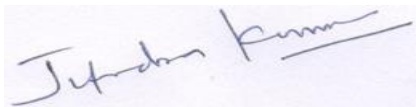|		Publishing
Machine Design Fundamentals:A Mechanical Designers' Workbook	Joseph Edward Shigley and Charles R. Mischke	McGraw Hill
Numerical Control and Computeraided manufacture	Kundra, Rao, Tiwari	Tata McGraw Hill

TRIBOLOGY
MTMSE -226-A

Module-I

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

Module-II

Friction: Law of sliding friction, concept of adhesion, Taylor's model of friction,Measurement of friction.
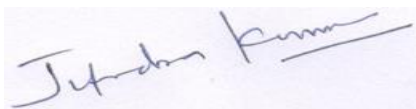
Module-III

Wear: Laws of wear, types of wear such as adhesive, declamation, abrasive, fatigue, corrosive, fretting erosive, electrical and oxidative. Measurement of wear in dryatmosphere and different environments preventive, control of wear, wear of cuttingtool 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, sommar-field number, oil grooves and flow of oil in axial and circumferential grooves cavitations and turbulence in oil bearings, Heat generation and cooling or bearing hydrostatic and dynamic and their applications in machine tools, Design of air bearing other gas bearing

Module-V

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

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

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
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

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 cyclemanagement tools: System integration, QFD, House of quality, Pugh's method, Pahl and Beitz method, Case studies

Module-II

Value engineering: Introduction, nature and meaurement 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 Hrs)

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.
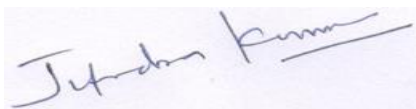
(5 Hrs)

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:

Title	Author(s)	Publisher
Product Design & Development	Karl T. Ulrich, Steven D. Eppinger	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

Selection of Materials and Manufacturing Processes for Engineering Design EngineeringDesign and Design for Manufacturing: A structured approach	Mahmoud M. Farag	Printice Hall
	John R. Dixon and Corrodo Poli StonePublishers, USA	Field
Material Selection in Mechanical Design	M. F. Ashby	Elsevier
Concurrent Engineering	Biren Prasad	Prentice Hall

SYSTEM ANALYSIS

MTMSE -228-A

L T P3 1 0   **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 withsystem 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 Co mputers; System with feedback. Continuous and Discrete system simulation   (12 Hrs)**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
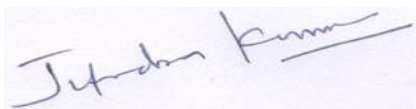
(12 Hrs)

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 sensitivityanalysis   (12 Hrs)

 Recommended Books:

Title	Author(s)	Publisher
System Engg. Tools	Chestnut,	John Wiley
Design of Engg. Systems	Gosling	John Wiley
System Engg.,	A.D.Hall	Van Nostrand, U.K.
System Engg. Handbook	Machol,	McGraw Hill Inc
Introduction to System Science	G.M.Sandquist	Prentice-Hall
System Modeling and Analysis Hill	Nagrath & Gopal	Tata McGraw
System Simulation	Geoffrey Gordon	Prentice Hall of India
Industrial Dynamics	Forester	MIT Press
Concepts of Engineering System	Design	

Warren E. Wilson   McGraw   Hill,
Realtime System Design and Analysis   P. A. Laplante,   Prentice Hall of India
System Design & Analysis,   Avadh   Galgotia Publishers

ADVANCED WELDING PROCESS

L T P   MTMSE -301-A   Credits:

43 1 0

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 weldingtechniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc.
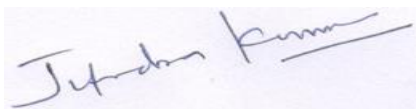
Module -III

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 ofpipe-lines and pressure vessels, Life predication

Module -V

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

Recommended Books:

Title	Author(s)	Publisher
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

INDUSTRIAL ENGINEERING & MANAGEMENT

L T P   MTMSE -302-A   Credits:

43 1 0

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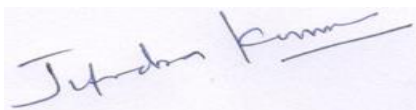
Production Planning and Control: Introduction, System approach, Type of manufacturing systems, Factors affecting manufacturing systems

MODULE IV

Loading and Scheduling: General scheduling problem, Significance of loading and scheduling, Factors affecting scheduling, Scheduling system, Flow shop scheduling, Job shop scheduling, 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

Recommended Books:

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