Faculty of Engineering & Technology

P.K. University

Shivpuri (MP)

Evaluation Scheme & Syllabus for
Department Of Mechanical Engineering

M. Tech.-(Mechanical Engineering.)

(I to IV Semester)

(Effective from session 2019-20)

EVALUATION SCHEME

M.Tech- Mechanical Engg.

Semester-I

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT (70)	SESS. (25)	EXT .(25)	
MTME-101	Simulation, Modeling & Analysis	30	70	25	25	150
MTME-102	Operations Research	30	70	25	25	150
MTME-103	CAD/CAM	30	70	NA	NA	100
MTME-104	Advanced I.C. Engines	30	70	NA	NA	100
MTME-105	Research Process & Methodology	30	70	NA	NA	100

Semester-II

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
MTME-201	Computer Integrated Manufacturing (CIM)	30	70	25	25	150
MTME-202	Advanced Mechanics Of Solids	30	70	NA	NA	100
MTME-203	Industrial Automation And Robotics	30	70	NA	NA	100
MTME-204	Advanced Mechanical Design	30	70	NA	NA	100
MTME-205	Modern Manufacturing Process	30	70	NA	NA	100
MTME-206	Seminar-1	NA	NA	25	25	50

Semester-III

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	
MTME-301	Dissertation phase-I	NA	NA	300	300	600
MTME-302	Seminar-II	NA	NA	25	25	50

Semester-IV

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		
		SESS.(30)	EXT.(70)	SESS.(25)	EXT.(25)	TOTAL
MTME-401	Dissertation phase-II	NA	NA	300	300	600

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I Year I Semester
MTME-101-Simulation, Modeling & Analysis

UNIT I: **L T P 3 0 2**

Introduction: Simulation: a tool, advantages and disadvantages of simulation, areas of application, systems and system environment, components of a system, discrete and continuous systems, discrete event system simulation. General Principles: Concepts in discrete event simulation, time advance algorithm, manual simulation using event scheduling, basis properties and operations.

UNIT II:

Models In Simulation: Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Bionomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution; Gamma distribution; Normal distribution; Weibull distribution; Triangular Distribution; Lognormal distribution, poisson process,

UNIT III:

Queuing Models: Characteristics of queuing systems, the calling population, system capacity, arrival process, service mechanism, queuing notations, long run measures of performance of queuing systems, server utilization in G/G/1/∞/∞ queues, server utilization in G/G/C/∞/∞ queues, server utilization and system performance, costs in queuing problems, Larkovian models.

UNIT IV:

Random Number Generation: Properties of random numbers, Pseudo random numbers, techniques of generating random numbers, tests of random numbers. Random Variate Generation: Inverse transform technique, Direct transformation for the Normal and Lognormal distribution, Convolution Method, Acceptance rejection technique.

UNIT V:

Input Modelling And Validation: Steps in the development of model, data collection, Distribution identification, Parameter estimation, Goodness of Fit Tests, selecting input models without data, verification and validation of simulation models.

Books:

1. Simulation Modelling and Analysis by Law and Kelton, Mc Graw Hill.
2. Simulation Model Design& execution by Fishwich, Prentice Hall.
3. Discrete event system simulation by Banks, Carson, Nelson and Nicol.

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MTME102: Operations Research L T P 3 0 2

Introduction: definition and scope of OR; Techniques and tools; Model formulation; general methods for solution; Classification of optimization problems; Optimization techniques. Linear

Optimization Models: Complex and revised simplex algorithms; Duality theorems, sensitivity analysis; Assignment, transportation and transshipment models; Traveling salesman problem as an Assignment problem; Integer and parametric programming; Goal programming.

Game Problems: Mini-max criterion and optimal strategy; Two person zero sum game; Games by simplex dominance rules.

Waiting Line Problems: Classification of queuing situations; Kendall's notation, Poisson arrival with exponential or Erlang service time distribution; Finite and infinite queues; Optimal service rates; Application of queuing theory to industrial problems.

Dynamic Programming: Characteristic of dynamic programming problems (DPPs); Bellman's principle of optimality; Problems with finite number of stages; Use of simplex algorithm for solving DPPs.

Non-linear Programming: One dimensional minimization methods; Unconstrained optimization techniques; Optimization techniques characteristics of a constrained problem; Indirect methods; Search and gradient methods.

Books:

1. Operations Research, H.A. Taha, Prentice Hall
2. Engg. Optimization, S.S. Rao, New Age Publication

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MTME103: CAD/CAM

L T P 3 0 0

Mathematical Elements, CAD, Solid modeling methods, Database structures for CAD, CSG formulation, B-rep and wire frame methods, Intersection surface generation methods, Boundary file generation methods,

Feature based modeling systems, Surface modeling, B- splines, Coons and Bezier surfaces, NURBS and surface patches, fitting surfaces for arbitrary digested points, Offset surfaces, Fillet surfaces, Sewn surfaces. Features recognition from the databases, IGES, STEP, PDES, and DXF data exchange formats, Graphic standards for CAD/CAM such as GKS, PHIGS and VDI.

Concurrent engineering integration of manufacturing principles and analytical principles in design, Manufacturing
Information generation from CAD data, Planar sectioning, Penalty functions, cavity milling, Optimization of cutter path, Effect of tool profile geometry, Methods for multi-axis machining,

Methods for software design for CAD/CAM system, use of software libraries, Development of software package for a specific problem as part of course using software libraries.

Introduction to automation, CAM/CIM, Part programming, Interpolator & Control.

Books:

1. Computer Graphics D Hearn & M P Baker Prentice Hall
2. CAD/CAM Theory and Practice Ibrahim Zeid & R Sivasubramanian Tata McGraw-Hill
3. Mathematical Elements for Comp. Graphics D F Rogers and J A Adams McGraw-Hill International
4. Computer Aided Engineering & Design Jim Browne New ATC International
5. The Engineering Database D.N. Chorafas and S.J. Legg Butterworths
6. Principles of CAD J Rooney &P Steadman Longman Higher Education

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MTME-104- Advanced I.C. Engines

UNIT I: **L T P 3 0 0**

INTRODUCTION: Historical Review – Engine Types – Design and operating Parameters. Cycle Analysis: Thermo-chemistry of Fuel – Air mixtures, properties – Ideal Models of Engine cycles – Real Engine cycles - differences and Factors responsible for – Computer Modeling.

UNIT II:
GAS EXCHANGE PROCESSES: Volumetric Efficiency – Flow through ports – Supercharging and Turbo charging. Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows.

UNIT III:
ENGINE COMBUSTION IN S.I ENGINES: Combustion and Speed – Cyclic Variations – Ignition –Abnormal combustion Fuel factors, MPFI, SI engine testing.

COMBUSTION IN CI ENGINES: Essential Features – Types off Cycle. Pr. Data – Fuel Spray Behavior – Ignition Delay – Mixing Formation and control, Common rail fuel injection system.

UNIT IV:
POLLUTANT FORMATION AND CONTROL: Nature and extent of problems – Nitrogen Oxides, Carbon monoxide, unburnt Hydrocarbon and particulate – Emissions – Measurement – Exhaust Gas Treatment, Catalytic converter, SCR, Particulate Traps, Lean, NOx, Catalysts.

UNIT V:
ENGINE HEAT TRANSFER: Importance of heat transfer, heat transfer and engine energy balance, Convective heat transfer , radiation heat transfer, Engine operating characteristics. Fuel supply systems for S.I. and C.I engines to use gaseous fuels like LPG, CNG and Hydrogen.

UNIT VI:
MODERN TRENDS IN IC ENGINES: Lean Burning and Adiabatic concepts, Rotary Engines, Modification in I.C engines to suit Bio – fuels, HCCI and GDI concepts.

REFERENCES:

1. I.C. Engines / V.Ganesan/TMH
2. I.C. Engines Fundamentals/Heywood/TMH
3. I.C. Engines/G.K. Pathak & DK Chevan/ Standerd Publications
4. I.C. Engines /RK Rajput/Laxmi Publications

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MTME105: Research Process and Methodology

L T P 3 0 0

UNIT 1:

Introduction to Research and Problem Definition-Meaning, Objective and importance of research, Types of research, steps involved in research, defining research problem.

UNIT 2:

Research Design-Research design, Methods of research design, research process and steps involved, Literature Survey

UNIT 3:

Data Collection-Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research

UNIT 4:

Data Analysis and interpretation-Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results

UNIT 5:

Technical Writing and reporting of research-Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism

Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques , New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition

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MTTE-101-Simulation, Modeling & Analysis Lab

LIST OF EXPERIMENTS:-

1. Study of simulation software Like ARENA , MATLAB.
2. Simulation of translational and rotational mechanical systems
3. Simulation of Queuing systems
4. Simulation of Manufacturing System 5. Generation of Random number
6. Modeling and Analysis of Dynamic Systems
7. Simulation mass spring damper system
8. Simulation of hydraulic and pneumatic systems.
9. Simulation of Job shop with material handling and Flexible manufacturing systems 10. Simulation of Service Operations.

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MTME102: Operations Research Lab

LIST OF EXPERIMENTS:-

1. Using queuing theory method to solve a given facility design problem.
2. Writing a program to solve a sequencing problem.
3. Using Monte Carlo simulation to solve a given problem.
4. Solving a given product mix problem.
5. Optimizing weight of a given truss or any machine element.
6. To optimize operational time by using Genetic Algorithm method.
7. To optimize system reliability by using simulated annealing method.
8. Optimization of maintenance time by using artificial neural network method.
9. Optimization of transport cost by using transportation problem.
10. Optimization of life cycle costing

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MTME-201- Computer Integrated Manufacturing (CIM)

L T P 3 0 2

Introduction to CNC Machine Tools: Development of CNC Technology-Principles and classification of CNC machines, Advantages & economic benefits, Types of control, CNC controllers, Characteristics, Interpolators, Applications, DNC concept.

CNC Programming: Co-ordinate System, Fundamentals of APT programming, Manual part programming-structure of part programme, G & M Codes, developing simple part programmes, Parametric programming, CAM packages for CNC machines-IDEAS, Unigraphics, Pro Engineer, CATIA, ESPIRIT, MasterCAM etc., and use of standard controllers-FANUC, Heidenhain and Sinumeric control system.

Tooling for CNC Machines: Cutting tool materials, Carbide inserts classification; Qualified, semiqualified and preset tooling, Cooling fed tooling system, Quick change tooling system, Tooling system for machining centre and turning center, tool holders, Tool assemblies, Tool magazines, ATC mechanisms, Tool management.

Robotics and Material Handling Systems: Introduction to robotic technology, and applications, Robot anatomy, material handling function, Types of material handling equipment, Conveyer systems, Automated guided vehicle systems, Automated storage/retrieval systems, Work-in-process storage, Interfacing handling and storage with manufacturing. Group Technology and Flexible Manufacturing System: group Technology-part families, Parts classification and coding, Production flow analysis, Machine Cell Design, Benefits of Group Technology,

Flexible manufacturing systems- Introduction, FMS workstations, Computer control system, Planning for FMS, Applications and benefits.

Computer Integrated Manufacturing: Introduction, Evaluation of CIM, CIM hardware and software, Requirements of computer to be used in CIM system, Database requirements, Concurrent engineeringPrinciples, design and development environment, advance modeling techniques.

Books:

1. Computer Numerical Control Machines P. Radahkrishnan New Central Book Agency
2. CNC Machines M.S. Sehrawat and J.S. Narang Dhanpat Rai and Co.
3. CNC Programming Handbook Smid Peter Industrial Press Inc.
4. Automation, Production systems and Computer M.P. Groover

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MTME-202- Advanced Mechanics of Solids

L T P 3 0 0

Mathematical Preliminaries: Scalars, vectors and matrix variables, index notation and the related rules, Cartesian tensors and their algebra, coordinate transformation, transformation rules for the nth order tensors, elements of tensor calculus and the related theorems (divergence, Stokes' and Green's), principal value theorem, eigenvalues and eigenvectors, invariants of a 2nd order tensor.

Kinetics of Deformation: Types of forces (point, surface and body), traction vector, state of stress at a point, Cauchy's relation and its proof, conservation of linear and angular momentum, stress equilibrium equations, symmetry of stress tensor, stress transformation, principal stresses and the associated planes, 3D Mohr's circle representation, planes of maximum shear, octahedral planes, hydrostatic and deviatoric stress, first and second Piola-Kirchoff stress tensors and their properties.

Kinematics of Deformation: Material and spatial co-ordinates, Eulerian and Lagrangian description of motion; deformation and displacement gradients, Green-Lagrange and Almansi strain tensor; Cauchy's small strain tensor and the rotation tensor, geometrical interpretation of strain components and sign convention, principal strains and directions, strain invariants, octahedral strain, maximum shear strain, volumetric strain, strain compatibility equations.

Constitutive Modeling: Thermodynamic principles, first and second law of thermodynamics, Generalized Hooke's law for isotropic materials, elastic constants and their relations, anisotropic, hyperelastic and viscroelastic material models, strain hardening, constitutive relations for elasto-plastic materials, flow and hardening rules.

Boundary Value Problems in Linear Elasticity: Field equations and boundary conditions, Navier equations, Beltrami-Michell stress compatibility conditions, 2D approximations (plane stress and plane strain) and solution strategies. Variational Principles in Solid Mechanics: Elements of variational calculus, extremum of a functional, Euler-Lagrange equation and its application, types of boundary conditions, principle of virtual work, Principle of total potential energy and complementary potential energy, Ritz method, time-dependent problems and Hamilton's principle for continuum.

Books :

1. Sadd, M.H., "Elasticity Theory Applications and Numerics", Elsevier Academic Press.
2. Boresi, A.P., Sidebottom, O. M., "Advanced Mechanics of Materials", 5th Ed., John Wiley and Sons Singh,

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MTME-203- Industrial Automation and Robotics

L T P 3 1 0

Introduction to Automation: Automation production system, Mechanization and automation, Types of automation, Automation strategies, Mechanical, electrical, hydraulic and Pneumatic automation devices and controls, Economics of automation.

High Volume Manufacturing Automation: Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multimodel and mixed model production lines.

Programmable Manufacturing Automation: CNC machine tools, Machining centers, Programmable robots, Robot time estimation in manufacturing operations. Flexible Manufacturing Automation: Introduction to Group Technology, Grouping methods, Cell Design, Flexible manufacturing system.

Assembly Automation: Assembly systems, Automatic transfer, feeding and orienting devices, Flexible assembly systems, Performance evaluation and economics of assembly systems.

Robotics: Review of robotic technology and applications, Laws of robotics, Robot systems and anatomy, Robot classification, End Effectors, Robot kinematics, Object location, Homogeneous transformation, Direct and inverse kinematics, Manipulator motions, Robot drives, actuators and control, Drive systems, Hydraulic, Pneumatic Electrical DC and AC servo motors and stepped motors, Mechanical transmission method Rotary-to-rotary motion conversion, Robot motion and path planning control and Controllers, Robot sensing, Range sensing, Proximity sensing, touch sensing, Force and torque sensing etc., Robot vision, Image representation, Image recognition approaches.

Robot Applications: Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation, Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference, Economics and social aspects of robotics, Future applications.

Books: 1. Automation, Production System & Computer Integrated Manufacturing by Groover McGraw Hill.
2. Principles of Automation & Automated Production Process Malov and Ivanov Mir Publication
3. Robotics K.S. Fu, R.C. Gonzalez, C.S.G. Lee McGraw Hill
4. Stochastic Models of Manufacturing Systems Buzacott & shanty Kumar Prentice Hall India.

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MTME-204- Advanced Mechanical Design

L T P 3 1 0

Introduction: Concepts related to kinematics and mechanisms, Degrees of freedom, Grubler's Criteria, Transmission and Deviation angles, Mechanical advantage.

Kinematic Synthesis: Type, number and dimensional synthesis, Spacing of accuracy points, Chebyshev polynomials, Motion and function generation, Graphical synthesis with two, three and four prescribed motions and points, The complex number modeling in kinematic synthesis, The Dyad, Standard form, Freudentein's equation for three point function generation coupler curves, Robert's law, Cognates of the slider crank chain.

Path Curvature Theory: Fixed and moving centrode, Inflection points and inflection circle circle, Euler'-savary Equation, Bobillier's and Hartsman construction.

Dynamic Force Analysis: Introduction, Inertia force in linkages, Kineto static analysis by superposition and matrix approach, Time response of mechanisms, Force and moment balancing of linkages.

Spatial Mechanism: Introduction to 3-dimensional mechanisms, Planar Finite, Rigid body and spatial transformation, Analysis of spatial mechanisms.

Books:

1. Fundamentals of applied Kinematics D.C. Tao Addison Wesley
2. Kinematic Synthesis of Linkages R. Hartenberg and Denavit McGraw Hill
3. Kinematic Analysis and Synthesis of Mechanisms A.K. Mallik and A. Ghosh CRC Press
4. Theory of Mechanisms A.K. Mallik and A. Ghosh East west Press
5. Kinematics and Dynamics of Plane Mechanisms J. Hirschern McGraw Hill, NY

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MTME-205- Modern Manufacturing Process

L T P 3 1 0

Metal cutting: Need for rational approach to the problem of cutting metals-Observation in metal cutting, Energy considerations in machining, Modern theories in mechanics of cutting, Review of Merchant and Lee Shaffer theories, critical comparison, Measurement of cutting forces-Classification of cutting force dynamometers, Lathe tool dynamometer, Drill, Milling and grinding dynamometer, Heat distribution in machining-Effects of various parameters on temperature, Method of temperature measurement in machining, Hot machining, Cutting fluids.

Tool Materials, Tool Life and Tool Wear & Wear Mechanisms: Essential requirements of tool materials, Developments in tool materials, ISO specifications for inserts and tool holders, Tool life, Conventional and accelerated tool life tests.

Concepts of machinability and mach inability index, Economics of machining, Reasons for failure of cutting tools, Forms of wear, Chatter in machining, Chatters types, Mechanism of chatter based on force vs Speed graph, Mechanism of grinding, Various parameters affecting grinding process, Machinability data systems.

Sheet Metal Forming & Special Forming Processes: Review of conventional processes, HERF techniques, Super plastic forming techniques, Principles and Process parameters, Advantages, applications and limitations of HERF techniques, Orbital forging, Isothermal forging, Hot and cold iso-static pressing, High speed extrusion, Rubber pad forming, Water hammer forming, Fine blanking.

Unconventional and special Welding Processes and Automation: Friction welding, Explosive welding, Diffusion bonding, High frequency induction welding, Ultrasonic welding, Electron beam welding, Laser beam welding, Automation in welding, Welding robots,

Applications of welding: Overview of automation of welding in aerospace, Nuclear, Surface transport vehicles and under water welding. Special Casting Processes & Recent

Advances in Casting: Shell moulding, precision investment casting, CO2 moulding, Centrifugal casting, Die and continuous casting, Low pressure die casting, Squeeze casting, Full mound casting process, Layout of mechanized foundry, sand reclamation, Material handling in foundry, Pollution control in foundry, recent trends in casting, Computer aided design of casting.

Books:

1. Metal Cutting Principles M.C. Shaw Oxford Clarendon Press
2. Metal Cutting Theory and Practice Bhattacharya New Central Book Agency
3. Fundamentals of Metal Cutting and Machine Tools B.L. Juneja and G.S. Sekhon New Age International
4. Principles of Metal Cutting G. Kuppuswamy Universities Press
5. Fundamentals of Machining and Machine Tools D.G. Boothroy and W.A. Knight Marcel Dekker, NY
6. Fundamentals of Metal Casting H. Loper and Rosenthal Tata McGraw Hill

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MTME-201- Computer Integrated Manufacturing (CIM)Lab

LIST OF EXPERIMENTS:-

1. 3D Modeling using CAD software.
2. CNC programming on turning.
3. CNC programming on milling.
4. Simulation of CNC programming on CAM Software
5. Study and demonstration on Robots.
6. Basic Robot Programming and Simulation.
7. Study of computer controlled business functions.
8. Study of interfacing requirements in CIMS.
9. Generation of any surface using any CAD software.
10. Design/ Thermal Analysis by CAD Software.