# *Faculty of Engineering & Technology*
# *P.K.University*
# *Shivpuri (MP)*


## Evaluation Scheme & Syllabus for
## Department of Mechanical Engg.

**M.Tech .-(Mechanical Engg.)**
**(II Semester)**
(Effective from session 2025-26)

# EVALUATION SCHEME

## M.Tech MECHANICAL ENGG. (II SEMESTER)

**STUDY AND EVALUATION SCHEME FOR M.TECH MECHANICAL ENGINEERING**

**SEMESTER-II**

| SUBJECT CODE | SUBJECTS NAME | STUDY SCHEME Periods/Week | | | Credits | MARKS IN EVALUATION SCHEME | | | | | | Total Marks of Internal & External |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | INTERNAL ASSESSMENT | | | EXTERNAL ASSESSMENT | | | |
| | | L | T | P | | Th | Pr | Tot | Th | Pr | Tot | |
| MCOMPME201 | Computer Integrated Manufacturing | 3 | 0 | 0 | 2 | 30 | - | 30 | 70 | - | 70 | 100 |
| MADVAME202 | Advanced Mechanics of Solids | 3 | 0 | 0 | 4 | 30 | - | 30 | 70 | - | 70 | 100 |
| MINDUME203 | Industrial Automation and Robotics | 3 | 1 | 0 | 3 | 30 | - | 30 | 70 | - | 70 | 100 |
| MADVAME204 | Advanced Mechanical Design | 3 | 1 | 0 | 3 | 30 | - | 30 | 70 | - | 70 | 100 |
| MMODEME205 | Modern Manufacturing Process | 3 | 1 | 0 | 3 | 30 | - | 30 | 70 | - | 70 | 100 |
| MSEMIME206 | Seminar -I | | | | | | | | | | | |
| MCOMPME207 | Computer Integrated Manufacturing Lab | | | | | | | | | | | |
| | Total | 15 | 3 | 8 | 24 | 180 | 125 | 305 | 420 | 125 | 545 | 850 |

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*Department Of Mechanical engineering*
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*I Year II Semester*

## MCOMPME201
## Computer Integrated Manufacturing (CIM)

**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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*I Year II Semester*

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## MADVAME202
## Advanced Mechanics of Solids

**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,

***Department Of Mechanical engineering***
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**MINDUME203**
**Industrial Automation and Robotics**

**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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**MADVAME204**
**Advanced Mechanical Design**

**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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**MMODEME205**
**Modern Manufacturing Process**

**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 Trends.

**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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**MCOMPME207**
**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.