

# MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal, MP)

## MECHANICAL ENGINEERING DEPARTMENT

Flexible Scheme: Course Outcomes (COs) The course outcomes of the courses of 2019 admitted batch from 1st year to 4th year of the undergraduate course of mechanical Engineering Program are given below:

Course	Course Outcomes	
<b>100105: Engineering Graphics</b>	CO1	<b>Visualize</b> the geometric details of engineering objects
	CO2	<b>Translate</b> the geometric information of engineering objects into engineering drawings
	CO3	<b>Draw</b> orthographic projections and sections
	CO4	<b>Develop</b> knowledge to read, understand and explain drawing
	CO5	<b>Improve</b> their skills so that they can apply these skills in developing new products
	CO6	<b>Prepare</b> simple layout of factory, machine and buildings
<b>100106: Manufacturing Practices</b>	CO1	<b>Discuss</b> the hand tools, machine tools and power tools
	CO2	<b>Utilize</b> appropriate tools required for specific operation.
	CO3	<b>Apply</b> safety measures required to be taken while using the tools in floor shops, Machine shops and carpentry shop
	CO4	<b>Use</b> the techniques, skills, and modern engineering tools necessary for manufacturing and production engineering
	CO5	<b>Conduct</b> experiments in the field of Production engineering
	CO6	<b>Design</b> a system, components, or process to meet desired needs, ethical, health and safety, manufacturability and sustainability
<b>100204: Basic Mechanical Engineering</b>	CO1	<b>Define</b> the essential concepts of thermal, design and production used in Mechanical Engineering
	CO2	<b>Summarize</b> fundamental techniques and process used in power generating machines
	CO3	<b>Solve</b> the various problems based on basic concepts of Mechanical Engineering
	CO4	<b>Analyze</b> the various gas, steam and air cycles
	CO5	<b>Evaluate</b> the problems of Steam Generator, Thermodynamics, Steam and I.C. engines
	CO6	<b>Generate</b> the skills to demonstrate steam Generator and reciprocating machine in depth
<b>120301: Material Science</b>	CO1	<b>State</b> the principles of diffusion theory and various types of defects in materials
	CO2	<b>Discuss</b> mechanical properties of materials
	CO3	<b>Compare</b> the different processes to alter the material properties
	CO4	<b>Determine</b> the effect of different phases, impurities on the behavior of materials
	CO5	<b>Analyze</b> crystal structure and composition of different materials
	CO6	<b>Create</b> the different engineering materials and alloys

# MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal, MP)

## MECHANICAL ENGINEERING DEPARTMENT

<b>120302: Mechanics of Materials-I</b>	CO1	<b>Identify</b> various structural elements and its application
	CO2	<b>Illustrate</b> different types of stress and strain on various types of structural elements like beam, shaft column etc
	CO3	<b>Calculate</b> principal stresses, maximum shearing stress, and the different stresses acting on a structural member.
	CO4	<b>Analyse</b> stresses and deflection for beam, shaft, long columns, thin cylinder etc
	CO5	<b>Select</b> appropriate materials in design considering engineering properties, sustainability, cost and weight
	CO6	<b>Design</b> simple bars, beams, and circular shafts to meet desired needs in terms of strength and deformation
<b>120302(P): Mechanics of Materials-I lab</b>	CO1	<b>Evaluate</b> the values of yield stress, breaking stress and ultimate stress of the given specimen under tension test
	CO2	<b>Conduct</b> the torsion test to determine the modulus of rigidity of given specimen
	CO3	<b>Perform</b> compression tests on spring and wood
	CO4	<b>Justify</b> the Rockwell hardness test over with Brinell hardness and measure the hardness of the given specimen
	CO5	<b>Determine</b> elastic constants using flexural and torsion tests
	CO6	<b>Examine</b> the stiffness of the open coil and closed coil spring and grade them
<b>120303: Theory of Machines-I</b>	CO1	<b>Identify</b> basic mechanisms in real life applications
	CO2	<b>Discuss</b> about mechanics of various machines
	CO3	<b>Apply</b> fundamental principles of statics and dynamics to machinery.
	CO4	<b>Analyse</b> various types of motions and mechanisms of machinery
	CO5	<b>Compare</b> various components suitable for different applications. e.g. different types of governor, clutch, brakes, flywheel etc
	CO6	<b>Create</b> the mechanism or components to justify the demands of work
<b>120303(P): Theory of Machines-I lab</b>	CO1	<b>Design</b> and <b>analyze</b> mechanism required for the specified type of motion
	CO2	<b>Draw</b> inversions and determine velocity and acceleration of different mechanisms
	CO3	<b>Construct</b> different types of cam profile for a given data.
	CO4	<b>Analyze</b> various motion transmission elements like gears, gear trains, cams, belt drive and rope drive.
	CO5	<b>Compare</b> the various components related to machines and mechanism
	CO6	<b>Determine</b> the degrees-of-freedom (mobility) of a mechanism

# MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal, MP)

## MECHANICAL ENGINEERING DEPARTMENT

<b>120304: Fluid Mechanics and Hydraulic Machines</b>	CO1	<b>Define</b> the fundamental properties of fluids
	CO2	<b>Relate</b> the concepts of mechanics with various laws of fluid mechanics.
	CO3	<b>Identify</b> the laws of fluid mechanics applicable for the body in various fluids under different conditions
	CO4	<b>Analyse</b> various forces and their effects, related to fluids mechanics
	CO5	<b>Measure</b> and compare losses in different fluid flow conditions
	CO6	<b>Compare</b> different turbo machines depending on their behaviour and their merits and demerits
<b>120304(P): Fluid Mechanics and Hydraulic Machines lab</b>	CO1	<b>Experiment</b> with flow measurement devices like venturimeter and orifice meter
	CO2	<b>Estimate</b> the friction and measure the frictional losses in fluid flow.
	CO3	<b>Predict</b> the coefficient of discharge for flow through pipes
	CO4	<b>Evaluate</b> pressure drop in pipe flow using Hagen-Poiseuille's equation for laminar flow in a pipe
	CO5	<b>Calculate</b> the Critical Reynolds's Number through Pipe Set Apparatus
	CO6	<b>Compare</b> the overall efficiency of various types of turbines
<b>120305: Software Lab</b>	CO1	<b>Describe</b> AutoCAD and CATIA toolbars
	CO2	<b>Summarize</b> 2D and 3D commands
	CO3	<b>Solve</b> real time problems using AutoCAD and CATIA software
	CO4	<b>Analyse</b> various mechanical engineering problems
	CO5	<b>Evaluate</b> technical drawings of machine assemblies as a design engineer
	CO6	<b>Generate</b> 2D and 3D solid models with new features in machine elements
<b>120401: Theory of Machines-II</b>	CO1	<b>Identify</b> the motion and the dynamical forces acting on mechanical systems composed of linkages, gears and cams
	CO2	<b>Classify</b> various components of machines like gear, gear train cam etc
	CO3	<b>Solve</b> numerical problems of various components of machines like gear, gear train cam etc
	CO4	<b>Analyze</b> the forces and motion of complex systems of linkages, gears and cams
	CO5	<b>Evaluate</b> the applications of components e.g. gear, gear train, balancing, cam etc. and select appropriate machine elements for the required applications
	CO6	<b>Design</b> the mechanism or components to justify the demands of work such as linkage, cam, gear, gear train mechanism etc

# MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal, MP)

## MECHANICAL ENGINEERING DEPARTMENT

<b>120401(P): Theory of Machines-II lab</b>	CO1	<b>Identify</b> the kinematic chain and mobility, and perform the kinematic analysis of a given mechanism
	CO2	<b>Analyze</b> various motion transmission elements like gears, gear trains, cams, belt drive and rope drive
	CO3	<b>Determine</b> the degrees-of-freedom (mobility) of a mechanism
	CO4	<b>Apply</b> the fundamental principles of statics and dynamics to machinery
	CO5	<b>Evaluate</b> the dynamic forces for various machines
	CO6	<b>Analyze</b> the fundamentals of machines for desired kinematic or dynamic performance.
<b>120402: Design of Machine Elements</b>	CO1	<b>Describe</b> the basic design process and function of Permanent and temporary joints used in Machine Design
	CO2	<b>Summarize</b> the design techniques, skills and tools used in design
	CO3	<b>Solve</b> the various design engineering problems by formulate and proper assumptions for practice
	CO4	<b>Analyze</b> the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts
	CO5	<b>Evaluate</b> the cases of Temporary and permanent joints problems successfully
	CO6	<b>Create</b> design techniques for a mechanical component under variety of environmental and service conditions
<b>120402(P): Design of Machine Elements lab</b>	CO1	<b>Design</b> and analysis the different part of an I.C Engine like Piston, cylinder, connecting rod , crank shafts , flywheel
	CO2	<b>Compare</b> the materials used in designing the automobile engine parts
	CO3	<b>Use</b> the software like AUTO CAD , CATIA , PRO/E, SOLID WORKS
	CO4	<b>Select</b> the spring for a proper application also can select the proper material of spring
	CO5	<b>Design</b> the different types of gear like spur gear, helical gear , worm gear , bevel gear and also able to know their practical applications.
	CO6	<b>Create</b> a gear box for modern Automotive vehicles and can use this for the benefits of society.
<b>120403: Manufacturing Processes</b>	CO1	<b>Describe</b> the different types of manufacturing processes and their applications
	CO2	<b>Identify</b> suitable manufacturing process to achieve the required product shape with the aim of avoid defects, material and time wastage
	CO3	<b>Illustrate</b> the advantage and limitations of various manufacturing processes with regard to shape formation and surface quality.
	CO4	<b>Analyse</b> the manufacturing processes for given problem and able to select an appropriate process according to a specific requirement.
	CO5	<b>Evaluate</b> the procedures and techniques involved for the manufacturing of components for its optimization.

# MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal, MP)

## MECHANICAL ENGINEERING DEPARTMENT

	CO6	<b>Propose</b> a simplified manufacturing processes with the aim of reduction of cost and manpower.
<b>120404: Engineering Thermodynamics</b>	CO1	<b>Define</b> energy interactions between system and surroundings
	CO2	<b>Correlate</b> the law of thermodynamics to real life applications
	CO3	<b>Apply</b> the laws of thermodynamics to analyze boilers, heat pumps, refrigerators, heat engines, compressors and nozzles
	CO4	<b>Investigate</b> the effectiveness of energy conversion device in mechanical power generation
	CO5	<b>Analyze</b> air standard cycles applied in prime movers
	CO6	<b>Describe</b> benefits of improvements to thermodynamic systems
<b>120405: Production Lab</b>	CO1	<b>Define</b> the different conventional method of material removal and function of different parts
	CO2	<b>Apply</b> the theory of metal cutting in experiments
	CO3	<b>Perform</b> step, taper turning, knurling and threading
	CO4	<b>Produce</b> stepped surface using shaper and keyway using milling machine
	CO5	<b>Demonstrate</b> knowledge of different machine tools used in machine shop
	CO6	<b>Evaluate</b> the chip thickness ratio, shear angle and material removal rate
<b>120501: Industrial Engineering</b>	CO1	<b>Analyze</b> and measure productivity
	CO2	<b>Acquire</b> the knowledge and understanding regarding Production planning and controlled required for industry to analyze the engineering problems
	CO3	<b>Utilize</b> the operation research techniques as a problem solving techniques
	CO4	<b>Gives</b> practice through various Management and Operation Tools for Improving Quality and Quantity
	CO5	<b>Solve</b> various kinds of problems or issue faced by service and manufacturing industries like economic consideration, optimum utilization of resources, productivity.
	CO6	<b>Get</b> the solutions for materials requirement planning
<b>120502: Metal Cutting and Machine Tools</b>	CO1	<b>Apply</b> cutting mechanics to metal machining based on cutting force and power consumption
	CO2	<b>Operate</b> lathe, milling machines, drill press, grinding machines, etc
	CO3	<b>Select</b> cutting tool materials and tool geometries for different metals
	CO4	<b>Choose</b> appropriate machining processes and conditions for different metals
	CO5	<b>Optimize</b> parameters for material removal in unconventional machining processes

# MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal, MP)

## MECHANICAL ENGINEERING DEPARTMENT

	CO6	<b>Identify</b> the process parameters, their effect and applications of different processes
<b>120503: Heat and Mass Transfer</b>	CO1	<b>State</b> principles of heat and mass transfer to basic engineering systems
	CO2	<b>Develop</b> basic concepts of heat transfer, differentiate between heat transfer and thermodynamics, modes of heat transfer (rates) i.e. Conduction, Radiation and convection.
	CO3	<b>Analyze</b> and <b>solve</b> heat transfer problem of conduction, convection and radiation
	CO4	<b>Apply</b> physics of heat transfer in the processes like Condensation and 'Boiling' and in applications like 'Fins' and 'Heat-Exchangers'. Analyze and design heat exchangers
	CO5	<b>Formulate</b> and <b>solve</b> one dimensional conduction with and without heat generation, convection and radiation heat transfer problems
	CO6	<b>Create</b> solution techniques which include both closed form and numerical methods of heat conduction and Convection
<b>120504: Thermal Engineering</b>	CO1	<b>Selection</b> of various types of fuels based on required applications
	CO2	<b>Outlining</b> the basics of Refrigeration and Air conditioning
	CO3	<b>Solve</b> analytical problems of thermal engineering
	CO4	<b>Compare</b> different turbo machines depending on their behaviour and their merits and demerits
	CO5	<b>Select</b> proper fluid machines for appropriate operation
	CO6	<b>Design</b> of various types of combustion chambers for Internal Combustion Engines
<b>120505: Machine Design</b>	CO1	<b>Describe</b> the design procedure used in automotive industry to design the engine parts
	CO2	<b>Classify</b> the different types of spring, bearing and Gears
	CO3	<b>Choose</b> the right strategy for designing the machine components based on material and methods
	CO4	<b>Apply</b> the design procedure for solving and drafting the different design of machine elements
	CO5	<b>Compare</b> the various curves and design procedure used
	CO6	<b>Selection</b> of machine elements under various loading and environmental conditions
<b>120601: Advanced Production Technology</b>	CO1	<b>Illustrate</b> the concepts/components of computer integrated manufacturing and integrate them in a coordinated fashion
	CO2	<b>Demonstrate</b> the machining operations, programming languages and its control system used for solving practical problems of automation based
	CO3	<b>Compare</b> the components of computer integrated manufacturing and integrate them in a coordinated manner

# MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal, MP)

## MECHANICAL ENGINEERING DEPARTMENT

	CO4	<b>Decide</b> between the various trade-offs when selecting AM processes, devices and materials to suit particular engineering requirements
	CO5	<b>Designing</b> Flexible manufacturing cell after carrying out Group technology study, Automated Material Handling Systems, Automated Inspection Systems and finally creating FMS
	CO6	<b>Knowledge</b> in the broad spectrum of Production Engineering
<b>120611: Vibration and Noise Engineering</b>	CO1	<b>Understand</b> basics of vibration and noise
	CO2	<b>Define</b> the physical systems in to spring-mass-damper systems
	CO3	<b>Use</b> different methods and principles applicable to dynamic systems
	CO4	<b>Determine</b> responses of vibrating systems
	CO5	<b>Analyse</b> the behaviours of physical systems
	CO6	<b>Design</b> the mechanical systems by considering vibration and noise.
<b>120612: Statistical Quality Control</b>	CO1	<b>Draw</b> the histogram, bar charts
	CO2	<b>State</b> various techniques including various variable and attribute control charts
	CO3	<b>Relate</b> mathematical standard plots for defect analysis
	CO4	<b>Justify</b> the life cycle of component on the basis of Reliability and Quality
	CO5	<b>Compare</b> various statistical quality control tools
	CO6	<b>Solve</b> quality-related problems using these SQC tools and methods
<b>120613: Work Study and Ergonomics</b>	CO1	<b>Identify</b> potential and current OH&S hazards in the workplace relating to ergonomics issue
	CO2	<b>Describe</b> relation between human motion and industry
	CO3	<b>Calculate</b> the production capacity of man power of an organization
	CO4	<b>Analyze</b> the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems
	CO5	<b>Devise</b> appropriate wage and incentive plan for the employees of an organization
	CO6	<b>Design</b> physical and psychosocial work system and work places
<b>120614: Turbo Machinery</b>	CO1	<b>Understand</b> the working principles of rotating machines
	CO2	<b>Describe</b> the velocity triangles, thermodynamic plots and losses in turbo-machinery
	CO3	<b>Demonstrate</b> the knowledge of working, stages, performance characteristics, governing and selection of turbo machinery
	CO4	<b>Analyze</b> energy transfer through graphical and analytical methods in turbo machines
	CO5	<b>Design</b> different type of rotating machines
	CO6	<b>Evaluate</b> the performance characteristics of different kinds of turbo machines

# MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal, MP)

## MECHANICAL ENGINEERING DEPARTMENT

<b>900101 (OC-1): Robotics</b>	CO1	<b>Understand</b> importance of robotics and its impact on human safety, quality of life, economy, environment, etc.; basics of open-ended type of Robotic manipulators
	CO2	<b>Discuss</b> Kinematics and dynamics of open-ended robotic mechanisms; Fixing frames
	CO3	<b>Ability to formulate</b> , derive, analyse, design and synthesize kinematics and dynamics of open-ended robotic mechanisms
	CO4	<b>Apply</b> detailed concepts relating to various actuators, sensors, and their integration with drives and signal conditioning for robotics
	CO5	<b>Impart</b> knowledge on the basic concepts of measurement, static and dynamic characteristics of measurement systems. control theory and applying them to design and development of robots
<b>900102 (OC-1): Product Design</b>	CO1	<b>Analyze</b> the demands and needs of customers to conceptualize product
	CO2	<b>Describe</b> the different steps involved in the product design
	CO3	<b>Analyze</b> the shortcoming in the product development
	CO4	<b>Identify</b> the opportunities to develop the product
	CO5	<b>Utilize</b> the recourses available in efficient manner for maximum productivity
	CO6	<b>Forecast</b> the impact of product on the surrounding environment
<b>120711: Refrigeration and Air-conditioning</b>	CO1	<b>Understand</b> vapour compression refrigeration system
	CO2	<b>Describe</b> the working principles of air, vapour absorption, thermoelectric and steam-jet refrigeration systems
	CO3	<b>Obtain</b> cooling capacity and coefficient of performance by conducting test on vapor compression refrigeration systems
	CO4	<b>Analyze</b> the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning
	CO5	<b>Develop</b> thermal comfort conditions with respect to temperature and humidity
	CO6	<b>Estimate</b> cooling and heating loads in an air-conditioning system
<b>120713: Metrology, Measurement and Control</b>	CO1	<b>State</b> the basic of standards of measurement, limits, fits & tolerances
	CO2	<b>Compare</b> quality in engineering products
	CO3	<b>Apply</b> the principle of measurement in QC & QA aspects and calibration of measuring instruments
	CO4	<b>Analysis</b> the accuracy in the measurement
	CO5	<b>Evaluate</b> the product quality in manner of dimensional accuracy.
	CO6	<b>Design</b> limit gauges



# MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal, MP)

## MECHANICAL ENGINEERING DEPARTMENT

<b>120714: Total Quality Management</b>	CO1	<b>Discuss</b> about quality measures, Quality control techniques
	CO2	<b>Describe</b> various theories of Total quality management.
	CO3	<b>Determine</b> the cost of poor quality and process effectiveness and efficiency to track performance quality
	CO4	<b>Apply</b> appropriate techniques in identifying customer needs, as well as the quality impact that will be used as inputs in TQM methodologies
	CO5	<b>Evaluate</b> the performance excellence of an organization, and determine the set of performance indicators
	CO6	<b>Enhance</b> management processes, such as benchmarking and business process reengineering
<b>900203: INDUSTRIAL AUTOMATION</b>	CO1	<b>Identify</b> potential areas for automation and justify need for automation
	CO2	<b>Select</b> suitable major control components required to automate a process or an activity
	CO3	<b>Translate</b> and simulate a real time activity using modern tools and discuss the benefits of automation
	CO4	<b>Decide</b> suitable automation hardware for the given application
	CO5	<b>Design</b> appropriate modelling and simulation tool for the given manufacturing application
<b>900204: SOLAR ENERGY</b>	CO1	<b>Define</b> the basic terms used in solar systems and various sun-earth angles
	CO2	<b>Establish</b> the energy balance and develop the thermal model of different solar systems
	CO3	<b>Investigate</b> the effectiveness of utilizing the solar energy by different solar systems
	CO4	<b>Analyze</b> the life cycle cost and other economic aspects of solar systems
	CO5	<b>Describe</b> the application of solar systems and find out the areas of improvement
<b>900214: ENGINEERING MATERIALS FOR INDUSTRIAL APPLICATIONS</b>	CO1	<b>State</b> the properties of engineering materials
	CO2	<b>Understand</b> the material composition and their effects
	CO3	<b>Classify</b> different engineering material.
	CO4	<b>Discuss</b> the production and fabrication techniques of Engineering Materials
	CO5	<b>Select</b> different types of materials as per requirement.

# MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR

(A Govt. Aided UGC Autonomous & NAAC Accredited Institute Affiliated to RGPV, Bhopal, MP)

## MECHANICAL ENGINEERING DEPARTMENT

<b>900215: Maintenance Engineering</b>	CO1	<b>Describe</b> the fundamental concepts of maintenance engineering noise and vibration, measurement techniques of Condition Monitoring
	CO2	<b>Show</b> skills of fault diagnosis
	CO3	<b>Demonstrate</b> the need of instrumentation and signal processing for condition monitoring
	CO4	<b>Examine</b> the condition of machine parts through Failure analysis of plant machineries
	CO5	<b>Apply</b> correct usage of a method or procedure of maintenance