

Syllabus of
UNDERGRADUATE DEGREE COURSE

B.Tech. V Semester

Mechanical Engineering



Rajasthan Technical University, Kota

Effective from session: 2025 – 2026



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

SME3-01: MECHATRONIC SYSTEMS

Credit: 2
2L+0T+0P

Max. Marks: 100(IA: 30, ETE:70)
End Term Exam: 3 Hours

SN	CONTENTS	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Overview of Mechatronics: Historical perspective, Definition, Applications, Block diagram of Mechatronic system, Functions of Mechatronics Systems, Systems Engineering, Verification Vs Validation, Benefits of mechatronics in manufacturing.	2
	Electrical and Electronic Systems: Electrical circuits and Kirchhoff's laws, Network Theorems and AC circuit Analysis, Transformers, Analog Devices, Signal Conditioning, Digital Electronics, Data Acquisition systems.	3
3	Modeling, Analysis and Control of Physical Systems: Basics of System Modeling: LTI and LTV systems, Need for modeling, Types of modeling, Steps in modeling, Building blocks of models, Modelling of one and two degrees of freedom systems, Modeling of Electro-mechanical systems, Mechanical Systems, Fluid systems, Thermal systems; Dynamic Responses, System Transfer Functions, State Space Analysis and System Properties, Stability Analysis using Root Locus Method, Stability Analysis using Bode Plots, PID Controllers (with and without Time Delay)	5
4	Sensors and Actuators: Static characteristics of sensors and actuators, Position, Displacement and Proximity Sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors, Actuators: Electrical Actuators (Solenoids, Relays, Diodes, Thyristors, Triacs, BJT, FET, DC motor, Servo motor, BLDC motor, AC motor, Stepper motors), Hydraulic and Pneumatic actuators, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys.	7
5	Microprocessors, Microcontrollers and Programmable Logic Controllers: Logic Concepts and Design, System Interfaces, Communication and Computer Networks, Fault Analysis in Mechatronic Systems, Synchronous and Asynchronous Sequential Systems, Architecture, Microcontrollers.	3
6	Programmable Logic Controllers (PLCs): Architecture, Number Systems Basics of PLC Programming, Logics, Timers and Counters, Application on real time industrial automation systems.	4
	Case Studies: Design of pick and place robot, Car engine management system, Automated manufacturing system, Automatic camera, Automatic parking system, Safety devices and systems.	3
	TOTAL	28



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

SME4-02: HEAT TRANSFER

Credit: 3
3L+0T+0P

Max. Marks: 100(IA: 30, ETE:70)
End Term Exam: 3 Hours

SN	CONTENTS	HOURS
1	Introduction: Objective, scope and outcome of the course.	1
2	Introduction: Heat transfer processes, conduction and radiation. Fourier's law of heat conduction, thermal conductivity, thermal conductivity of solids, liquids and gases, effect of temperature on thermal conductivity. Newton's law of cooling, definition of overall heat transfer coefficient. General parameters influence the value of heat transfer coefficient.	4
	Conduction: General 3-Dimensional conduction equation in Cartesian, cylindrical and spherical coordinates; different kinds of boundary conditions; nature of differential equations; one dimensional heat conduction with and without heat generation; electrical analogy; heat conduction through composite walls; critical thickness of insulation	3
3	Heat transfer from extended surfaces: Governing differential equation of fin, fin efficiency and effectiveness for different boundary conditions.	3
	Unsteady state heat conduction for slab, cylinder and sphere, Heisler chart.	2
	Convection: Review of Navier - Stokes and energy equation, hydrodynamic and thermal boundary layers; laminar boundary layer equations; forced convection appropriate non dimensional members; effect of Prandtl number; empirical relations for flow over a flat plate and flow through pipes.	4
4	Natural convection: Dimensional analysis, Grashoff number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations.	4
	Heat transfer with change of phase: Nature of vaporization phenomena; different regimes of boiling heat transfer; correlations for saturated liquid vaporization; condensation on flat plates; correlation of experimental results, drop wise condensation.	4
5	Heat exchanger: Types of heat exchangers, arithmetic and logarithmic mean temperature differences, heat transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness of heat exchanger, N.T.U. method, fouling factor. Constructional and manufacturing aspects of Heat Exchangers.	8
6	Thermal Radiation: Plank distribution law, Krichoff's law; radiation properties, diffuse radiations; Lambert's law. Radiation intensity, heat exchange between two black bodies heat exchanger between gray bodies. Shape factor; electrical analogy; reradiating surfaces heat transfer in presence of reradiating surfaces.	8
	TOTAL	41

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

5ME4-03: MANUFACTURING TECHNOLOGY

Credit: 3
3L+0T+0P

Max. Marks: 100(IA: 30, ETE:70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Classification of metal removal process and machines: Geometry of single point cutting tool and tool angles, tool nomenclature in ASA, ORS. Concept of orthogonal and oblique cutting.	5
	Type of chips, Mechanics of metal cutting; interrelationships between cutting force, shear angle, strain and strain rate. Thermal aspects of machining and measurement of chip tool interface temperature.	5
3	Concept of machinability, machinability index, factors affecting machinability, Different mechanism of tool wear. Types of tool wear (crater, flank etc), Concept of tool life.	5
	Taylor's tool life equation. Introduction to economics of machining. Cutting fluids: Types, properties, selection and application methods.	5
4	Basic machine tools: Constructional configuration, estimation of machining time on lathe, drilling, shaping, milling, grinding, Gear cutting on milling, Gear hobbling.	5
	Special Purpose Machine Tools: Automatic lathes, capstan and turret lathe machines, operational planning and turret tool layout, sequence of operations.	5
5	Introduction to Grinding and different methods of grinding, Abrasives; natural and synthetic, manufacturing and selection of grinding wheels, Wheel specifications. Honing, lapping, super-finishing.	5
6	High Velocity Forming Methods: Definition; Hydraulic forming, Explosive forming, Electro-hydraulic forming, Magnetic pulse forming.	5
	TOTAL	41



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

5ME4-04: DESIGN OF MACHINE ELEMENTS – I

Credit: 3
3L+0T+0P

Max. Marks: 100(IA: 30, ETE:70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Materials: Mechanical Properties and IS coding of various materials, Selection of material from properties and economic aspects.	3
	Manufacturing Considerations in Design: Standardization, Interchangeability, limits, fits tolerances and surface roughness, BIS codes, Design consideration for cast, forged and machined parts. Design for assembly.	4
3	Design for Strength: Modes of failure, Strength and Stiffness considerations, Allowable stresses, factor of safety, Stress concentration: causes and mitigation, fatigue failures.	4
	Design of Members subjected to direct stress: pin, cotter and keyed joints.	5
4	Design of Members in Bending: Beams, levers and laminated springs. Design for stiffness of beam: Use of maximum deflection formula for various end conditions for beam design.	7
5	Design of Members in Torsion Shaft and Keys: Design for strength, rigidity. Solid and hollow shafts. Shafts under combined loading. Sunk keys.	5
	Couplings: Design of muff coupling, flanged couplings: rigid and flexible.	3
6	Design of Threaded fasteners: Bolt of uniform strength, Preloading of bolts: Effect of initial tension and applied loads, Eccentric loading.	4
	Power screws like lead screw, screw jack.	2
	Design of members which are curved like crane hook, body of C-clamp, machine frame etc.	3
	TOTAL	41



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

SME4-05: PRINCIPLES OF MANAGEMENT

Credit: 2
2L+0T+0P

Max. Marks: 100(IA: 30, ETE:70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Basic concepts of management: Definition – Need and Scope – Different schools of management thought – Behavioural, Scientific, Systems, and Contingency	2
	Contribution of Management Thinkers: Kautilya, Taylor, Fayol, Peter Drucker and C.K. Prahlad.	4
3	Functions of Management: Planning: Essentials of Planning and Managing by Objectives; Strategies, Policies and Planning Premises; Decision making.	2
	Organizing The Nature of organizing, Entrepreneurship, and Reengineering; Organizational Structure, Departmentation; Line/staff authority, empowerment, and decentralization; Effective organizing and organization culture;	3
4	Staffing Human resource Management and Selection; Performance Appraisal and Career Strategy; managing change through Manager and Organization Development.	2
5	Leading Human Factors and Motivation; Leadership: Committees, Terms, and Group Decision making; Communication.	3
	Controlling The system and process of controlling; Control Techniques and Information Technology; Productivity, Operations Management and Total Quality Management.	2
6	Management practices of: Dhirubhai Ambani, Narayan Murthy, Premji, Ratan Tata, Steve Jobs, Bill Gates.	4
	Studying organizational structures of any 10 companies and classifying them into different types of organizations which are studied above and justifying why such structures are chosen by those organizations.	2
	Preparing the leadership profiles of any 5 business leaders and studying their leadership qualities.	3
	TOTAL	28

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

SME5-11: STEAM ENGINEERING

Credit: 3
3L+0T+0P

Max. Marks: 100(IA: 30, ETE:70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Steam generators: Classification of Boilers, water and fire tube boilers, High pressure boilers, Advantages of high pressure Boilers, Natural and forced circulation boilers, Water wall.	4
	Steam drum internal, steam super heaters, Economizers, air preheater, induced, forced and balanced draught boilers, Fluidized bed boilers.	4
3	Definition and type of nozzle and diffuser equation of continuity, sonic velocity, mach no. and stagnation properties, the steady flow energy equation for nozzles, momentum energy equation for flow through steam nozzles nozzle efficiency, effect of friction, nozzle for uniform pressure drop, throat pressure for maximum discharge or chock flow, critical pressure ratio, design of nozzle and diffuser.	8
4	Steam Turbines: Principle and working of steam turbines, type of turbines, compounding for pressure and velocity. Overview and difference of various type of turbine, different types of governing of turbines.	3
	Impulse turbine: The effect of blade friction on velocity diagram. Force, work and power, Blade or diagram efficiency, Gross stage efficiency, steam speed to blade, speed ratio for optimum performance, turbine performance at various loads.	5
5	Impulse reaction turbine: Velocity diagram and work done, degree of reaction, Parson turbine, blade efficiency, gross stage efficiency comparison of enthalpy drop in various stages, size of blades in impulse reaction turbines for various stages of impulse reaction and impulse turbine.	5
	Regenerative Feed Heating Cycles: Introduction, Ideal regenerative feed heating cycle, Regenerative heating cycles and their representation on T-s and h-s Diagram, Representation of actual process on T-s and h-s Diagram Regenerative cycles, types of feed heating arrangements, Optimum feed water temperature and saving in Heat Rate. direct contact and surface heaters.	4
6	Reheating of steam: Practical reheating and Non- reheating cycles, advantage and disadvantages of reheating, reheat regenerative cycle, regenerative water extraction cycles.	4
	Process heat and by product power cycle, pass out turbine, Binary vapour cycle. Condensers.	3
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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

SME4-12: AUTOMOBILE ENGINEERING

Credit: 3
3L+0T+0P

Max. Marks: 100(IA: 30, ETE:70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Frame & Body: Layout of chassis, types of chassis frames and bodies, their constructional features and materials.	3
	Clutches: single plate, multi-plate, cone clutch, semi centrifugal, electromagnetic, vacuum and hydraulic clutches. Fluid coupling. Brakes: Classification and function; Mechanical, hydraulic, vacuum air and self engineering brakes; Brake shoes and lining materials.	5
3	Gear Boxes: Sliding mesh, constant mesh, synchromesh and epicyclic gear boxes, Automatic transmission system; Hydraulic torque converter;	4
	Drives: Overdrive, Propeller shaft, Universal joints, Differential; Rear axle drives. Hotchkiss and torque tube drives; Rear axle types; Front wheel and All wheel drive.	4
4	Wheels and Tyres: Tyre types, Tyre construction; Tyre inflation pressure, Tyre wear and their causes; Re-treading of the tyre,	2
	Steering system: steering gear boxes, Steering linkages, Steering mechanism, Under and Over steering. Steering Geometry, Effect of camber, caster, king pin inclination, toe in and toe out; Power steering; Integral and linkage types.	3
	Suspension system: objective and requirements, Suspension spring, front and rear suspension systems, Independent suspension system Shock absorbers.	3
5	Automotive Electrical System: Battery construction, Charging and testing, battery types, Starting and Battery Charging System: Starter motor construction, types of drive, Alternator construction, regulation and rectification.	4
	Ignition System: Magneto and coil ignition systems, System components and requirements, Automotive lighting: Wiring systems Electrical instruments; head lamp, electric horn, fuel level indicator.	4
6	Automotive Air Conditioning: Introduction, Loads, Air conditioning system Components, Refrigerants, Fault Diagnosis.	4
	Automotive Safety: Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision System) GPS (Global Positioning System)	4
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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

SME5-13: NON DESTRUCTIVE EVALUATION AND TESTING

Credit: 3
3L+0T+0P

Max. Marks: 100(IA: 30, ETE:70)
End Term Exam: 3 Hours

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	ACOUSTICAL METHODS: Ultrasonic testing- Generation of ultrasonic waves, Horizontal and shear waves, Near field and far field acoustic wave description, Ultrasonic probes- Straight beam, direct contact type, Angle beam, Transmission/reflection type, and delay line transducers, acoustic coupling and media.	5
	ULTRASONIC TESTS: Transmission and pulse echo methods, A-scan, B-scan, C-scan, F- scan and P-scan modes, Flaw sizing in ultrasonic inspection: AVG, Amplitude, Transmission, TOFD, Satellite pulse, Multi-modal transducer, zonal method using focused beam. Flow location methods, Signal processing in Ultrasonic NDT; Mimics, spurious echo's and noise. Ultrasonic flaw evaluation.	5
3	ELECTRO-MAGNETIC METHODS- magnetic particle inspection-introduction to electrical impedance, principles of eddy current testing, flaw detection using eddy currents.	6
4	RADIOGRAPHIC METHODS: Introduction to x-ray radiography, the radiographic process, X-ray and Gamma ray sources, Geometric principles, Factors governing exposure, radio graphic screens, scattered radiation, arithmetic of exposure, radiographic image quality and detail visibility, industrial X-ray films.	6
	X-RAY RADIOGRAPHY PROCESES: Fundamentals of processing techniques, process control, the processing room, special processing techniques, paper radiography, sensitometric characteristics of X-ray films, film graininess signal to noise ratio in radiographs. The photographic latent image, radiation protection.	6
5	OPTICAL METHODS: holography- Principles and practices of Optical holography, acoustical, microwave, x-ray and electron beam holography techniques.	6
6	APPLICATIONS: NDT in flaw analysis of Pressure vessels, piping NDT in Castings, Welded constructions, etc., Case studies.	6
	TOTAL	41



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

5ME3-21: MECHATRONICS LAB.

Credit: 1
OL+OT+2P

Max. Marks: 100(IA:60, ETE:40)
End Term Exam: 2 Hours

SN	NAME OF EXPERIMENT
1	Using Transducers Kit :- <ul style="list-style-type: none">• Characteristics of LVDT• Principle & Characteristics of Strain Gauge• Characteristics of Summing Amplifier• Characteristics of Reflective Opto Transducer
2	Mobile Robot <ul style="list-style-type: none">• Program for Operating Buzzer Beep• Program for Operating Motion control• Program for Operating Direction control• Program for Operating White line follower for the given arena
3	PLC PROGRAMMING <ul style="list-style-type: none">• Ladder programming on Logic gates ,Timers & counters• Ladder Programming for digital & Analogy sensors• Ladder programming for Traffic Light control, Water level control and Lift control Modules
4	MATLAB Programming <ul style="list-style-type: none">• Sample programmes on Mat lab• Simulation and analysis of PID controller using SIMULINK
	Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation of sessional component shall include 30% weight age to mini project. <ul style="list-style-type: none">• Mini project can be integration of sensor, actuator and transduction units for various home and office applications.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

5ME4-22: HEAT TRANSFER LAB.

Credit: 1
OL+OT+2P

Max. Marks: 100(IA:60, ETE:40)
End Term Exam: 2 Hours

SN	NAME OF EXPERIMENT
1	To Determine Thermal Conductivity of Insulating Powders.
2	To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
3	To determine the transfer Rate and Temperature Distribution for a Pin Fin.
4	To Measure the Emissivity of the Test plate Surface.
5	To Determine Stefan Boltzmann Constant of Radiation Heat Transfer.
6	To Determine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection.
7	Determination of Heat Transfer Coefficient in Drop Wise and Film Wise condensation.
8	To Determine Critical Heat Flux in Saturated Pool Boiling.
9	To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
10	To Find the Heat transfer Coefficient in Forced Convection in a tube.
11	To study the rates of heat transfer for different materials and geometries
12	To understand the importance and validity of engineering assumptions through the lumped heat capacity method.
	<p>Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation sessional component shall include 30% weight age to mini project.</p> <ul style="list-style-type: none">Heat exchanger design for different applications, designing for thermal insulation, Use of relevant BIS codes for designing.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

5ME4-23: PRODUCTION ENGINEERING LAB.

Credit: 1
OL+OT+2P

Max. Marks: 100(IA:60, ETE:40)
End Term Exam: 2 Hours

SN	NAME OF EXPERIMENT
1	Study of various measuring tools like dial gauge, micrometer, vernier caliper and telescopic gauges.
2	Measurement of angle and width of a V-groove by using bevel protector..
3	(a) To measure a gap by using slip gauges (b) To compare & access the method of small-bore measurement with the aid of spheres.
4	Measurement of angle by using sine bar.
5	(a) Measurement of gear tooth thickness by using gear tooth vernier caliper. (b) To check accuracy of gear profile with the help of profile projector.
6	To determine the effective diameter of external thread by using three- wire method.
7	To measure flatness and surface defects in the given test piece with the help of monochromatic check light and optical flat.
8	To check the accuracy of a ground, machined and lapped surface - (a) Flat surface (b) Cylindrical surface.
9	Find out Chip reduction co-efficient (reciprocal of chip thickness ratio) during single point turning.
10	Forces measurements during orthogonal turning.
11	Torque and Thrust measurement during drilling.
12	Forces measurement during plain milling operation.
13	Measurement of Chip tool Interface temperature during turning using thermocouple technique.
	<p>Important Note:</p> <p>It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to mini project.</p> <ul style="list-style-type: none">Fabrication of an assembly in which parts shall be machined and standard parts shall be procured.



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - V Semester: B.Tech. : Mechanical Engineering

5ME4-24: MACHINE DESIGN PRACTICE - I

Credit: 1
OL+OT+2P

Max. Marks: 100(IA:60, ETE:40)
End Term Exam: 2 Hours

SN	Sessional Work
1	Material selection and relevant BIS nomenclature
2	Selecting fit and assigning tolerances
3	Examples of Production considerations
4	Problems on:
	(a) Knuckle & Cotter joints
	(b) Torque: Keyed joints and shaft couplings
	(c) Design of screw fastening
	(d) Bending: Beams, Levers etc.
	(e) Combined stresses: Shafts, brackets, eccentric loading.
	Important Note: It is mandatory for every student to undertake a Mini project. Mini project shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to mini project. <ul style="list-style-type: none">• Design and analysis of simple mechanical systems/products