

Syllabus of
UNDERGRADUATE DEGREE COURSE

B.Tech. VI Semester

Mechanical Engineering



Rajasthan Technical University, Kota
Effective from session: 2025 – 2026



RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

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

6ME3-01: MEASUREMENT and METROLOGY

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	Concept of measurement: General concept of measurement, Need for measurement, Generalized measuring system, Units, Standards, Sensitivity, Readability, Range of accuracy, Precision, Accuracy Vs precision, Uncertainty.	3
	Repeatability and reproducibility, Errors in measurement, Types of error, Systematic and random error, Calibration, Interchangeability.	3
3	Linear and angular measurements: Linear measuring instruments: Vernier caliper, Micrometer, Interval measurements:- Slip gauges, Checking of slip gauges for surface quality, Optical flat, Application of limit gauges.	3
	Comparators:- Mechanical comparators, Electrical comparator, Optical comparator, Pneumatic comparator;	2
	Sine bar, Use of sine bar, Limitations of sine bars, Sources of error in sine bars, Bevel protractor, Applications of bevel protractor.	3
4	Form measurement: Introduction, Screw thread measurement, Thread gauges, Measurement of gears: Gear errors.	2
	Surface finish measurement:-Introduction, Elements of surface texture, Analysis of surface finish, Methods of measuring surface finish, Straightness measurement, Flatness testing, Roundness measurements.	3
5	Coordinate measuring machine (CMM):-Types of CMM, Features of CMM, Computer based inspection,	2
	Measurement of power, flow and temperature related properties Measurement of force, Accelerometer, Load cells, Bourdon tube. Torque measurement: Torque measurement using strain gauges, Torque measurement using torsion bars, Mechanical dynamometers.	3
6	Measurement of flow: Variable area meters – rotameter, Hot wire anemometer, Pitot tube.	3
	Temperature measurement, Bimetallic strip, Thermocouples (Thermo electric effects), Thermistors, Pyrometers	
TOTAL		28

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Syllabus

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

6ME4-02: COMPUTER INTEGRATED MANUFACTURING SYSTEMS (CIMS)

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 to CIM: Overview of Production Systems, the product cycle, Automation in Production Systems, computer's role in manufacturing, sources and types of data used in manufacturing. The Beginning of CAM: Historical Background,	2
	Numerical Control (NC): Basic components of an NC system, coordinate system and motions control systems. Computer Numerical Control (CNC): features of CNC, machine control unit, CNC software. Direct Numerical Control and Distributed Numerical Control. Applications, advantages and disadvantages of NC. Adaptive control of machining system.	3
3	NC Part programming: Manual and computer assisted part programming, Part programming with APT. NC part programming using CAD/CAM software. NC cutter path verification.	8
4	Computer Aided Process Planning: Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data systems, computer generated time standards.	4
	Group Technology: Introduction, part families, part classification and coding, coding system and machining cells.	4
5	Computer Aided Production Management Systems: Introduction to computer aided PPC, Introduction to computer aided inventory management, manufacturing resource planning (MRPII), computer process monitoring and shop floor control, computer process control.	6
	Computer Aided Quality Control; Computer in quality control, contact inspection methods, Non contact inspection methods, optical and non optical computer aided testing.	3
6	Computer Aided Material Handling; Computer control on material handling, conveying, picking. Ware house control, computerized material handling for automated inspection and assembly.	3
	Computer Integrated Manufacturing Systems: Introduction, types special manufacturing systems, flexible manufacturing systems (FMS).	5
	Collaborative Engineering; Introduction, Faster Design throughput, Web based design, Changing design approaches, extended enterprises, concurrent engineering, Agile and lean manufacturing.	3
	TOTAL	41

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Syllabus

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

6ME4-03: MECHANICAL VIBRATIONS

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 to Sound: Frequency dependent human response to sound, Sound pressure dependent human response, Relationship among sound power, sound intensity and sound pressure level.	2
	Introduction to Noise: Auditory and Non auditory effects of Noise, Major sources of the noise, Industrial noise sources, Industrial noise control strategies.	3
	Introduction to Vibration: Importance and scope of vibrations, terminology and classification, Concept of Degrees of freedom, Harmonic motion, vectorial representation, complex number representation, addition.	3
3	Undamped Single Degree of Freedom System: Derivation of equation of motion for one dimensional longitudinal, transverse and torsional vibrations without damping using Newton's second law, D' Alembert's principle and Principle of conservation of energy, Compound pendulum and centre of percussion.	3
	Damped vibrations of single degree of freedom systems: Viscous damping, under-damped, critically damped and over-damped systems, Logarithmic decrement.	3
	Vibration characteristics of Coulomb damped system and Vibration characteristics of Hysteretic damped systems.	2
3	Forced Vibrations of Single Degree of Freedom Systems: Forced vibration with constant harmonic excitation, Steady state and transient parts, Frequency response curves and phase angle plot, Forced vibration due to excitation of support.	4
	Vibration Isolation and Transmissibility: Force transmissibility, Motion transmissibility, Forced vibration with rotating and reciprocating unbalance, Materials used in vibration isolation.	4
5	System with Two Degrees of Freedom: principle mode of vibration, Mode shapes, Undamped forced vibrations of two degrees of freedom system with harmonic excitation, Vibration Absorber, Undamped dynamic vibration absorber and centrifugal pendulum absorber.	5
	Critical Speed of Shaft: Critical speed of a light shaft without damping, critical speed of shaft having multiple discs, secondary critical speed.	3
6	Many Degrees of Freedom Systems (Exact analysis): Equation of Motion, The matrix method, Eigen Values and Eigen Vectors, Method of influence Coefficients and Maxwell's reciprocal theorem. Torsional vibrations of multi rotor system, vibrations of geared system, Generalized coordinates and coordinate coupling Many Degrees of Freedom Systems (approximate methods): Rayleigh's, Dunkerley's, Stodola's and Holzer's methods.	5
	Vibrations of continuous systems: Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft.	3
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Syllabus

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

6ME4-04: DESIGN OF MACHINE ELEMENTS- II

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	Fatigue Considerations in Design: Variable load, loading pattern, endurance stresses, Influence of size, surface finish, notch sensitivity and stress concentration.	3
	Goodman line, Soderberg line, Design of machine members subjected to combined, steady and alternating stresses.	3
	Design for finite life, Design of Shafts under Variable Stresses, Bolts subjected to variable stresses.	2
3	Design of IC Engine components: Piston, Cylinder, Connecting Rod and Crank Shaft.	8
4	Design of helical compression, tension, torsional springs, springs under variable stresses.	4
	Design of belt, rope and pulley drive system,	4
5	Design of gear teeth: Lewis and Buckingham equations, wear and dynamic load considerations.	4
	Design and force analysis of spur, helical, bevel and worm gears, Bearing reactions due to gear tooth forces.	4
6	Design of Sliding and Journal Bearing: Methods of lubrication, hydrodynamic, hydrostatic, boundary etc. Minimum film thickness and thermal equilibrium.	4
	Selection of anti-friction bearings for different loads and load cycles, Mounting of the bearings, Method of lubrication.	4
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Syllabus

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

6ME4-05: QUALITY MANAGEMENT

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	The meaning of Quality and quality improvement dimensions of quality, history of quality methodology, quality control, Quality of design and quality of conformance, Quality policy and objectives, Economics of quality.	5
	Modeling process quality: Describing variation, frequency distribution, continuous and discrete, probability distributions, pattern of variation, Inferences about process quality: sampling distributions and estimation of process parameters. Analysis of variance.	4
3	Statistical Quality Control: Concept of SQC, Chance and assignable causes of variation, statistical basis of control chart, basic principles, choice of control limits, sample size and sampling frequency, analysis of patterns on control charts. The magnificent seven.	4
	Control chart for variables,: X-bar and R charts, X-bar and S charts, control chart for individual measurement. Application of variable control charts.	4
4	Control chart for attributes: control chart for fraction non conforming P- chart, np-chart, c-chart and u-chart. Demerit systems, choice between attribute and variable control chart. SPC for short production runs. Process capability analysis using histogram and probability plot, capability ratios and concept of six sigma.	7
5	Quality Assurance: Concept, advantages, field complaints, quality rating, quality audit.	2
	Acceptance Sampling: Fundamental concepts in acceptance sampling, operating characteristics curve. Acceptance sampling plans, single, double and multiple sampling plans, LTPD, AOQL, AOQ.	4
	Introduction to Quality systems like ISO 9000 and ISO 14000.	2
6	Reliability and Life Testing- Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations, Redundancy and improvement factors evaluations. Introduction to Availability and Maintainability.	4
	Introduction to Taguchi Method of Design of Experiments, Quality loss function.	4
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Syllabus

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

6ME5-11: REFRIGERATION AND AIR CONDITIONING

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: Refrigeration and second law of Thermodynamics, Refrigeration effect and unit of Refrigeration, Heat pump, reversed Carnot cycle. Vapour Compression Refrigeration System: Analysis of simple vapour compression Refrigeration cycle by p-h and T-S diagram. Effect of operating conditions.	5
	Multiple Evaporator and compressor system: Application, air compressor system, Individual compressor, compound compression, cascade system. Application, air compressor systems, individual compressor, compound compression, cascade system.	3
3	Gas Cycle Refrigeration: Limitation of Carnot cycle with gas, reversed Brayton cycle, Brayton cycle with regenerative heat exchanger.	4
	Air cycle for air craft: Necessity of cooling of air craft, Basic cycle, boot strap, regenerative type air craft refrigeration cycle.	4
4	Other refrigeration systems (description only): Vapour absorption refrigeration system, Electrolux refrigerator, Lithium Bromide - Water system, Water vapour refrigeration system, Vortex tube refrigeration system, thermo electric refrigeration system.	4
	Refrigerants: Classification, Nomenclature, selection of Refrigerants, global warming potential of CFC Refrigerants. Refrigeration Equipments: Compressor, condenser, evaporator, expansion devices, types & working.	4
5	Psychrometry: Psychrometric properties, psychrometric relations, psychrometric charts, psychrometric processes, cooling coils, Bypass factor, Apparatus Dew point temperature and air washers.	5
	Human Comfort: Mechanism of body heat losses, factors affecting human comfort, effective temperature, comfort chart.	3
6	Cooling load calculations: Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling.	5
	Selection of air conditioning: Apparatus for cooling and dehumidification, Air conditioning system, year round air conditioning.	3
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Syllabus

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

6ME5-12: NON CONVENTIONAL MACHINING METHODS

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 and classification of advanced machining process, consideration in process selection, difference between traditional and non-traditional process, Hybrid process.	4
	Abrasive finishing processes: AFM, MAF (for Plain and cylindrical surfaces).	4
3	Mechanical advanced machining process: Introduction, Mechanics of metal removal, process principle, Advantages, disadvantages and applications of AJM, USM, WJC.	6
4	Thermo electric advanced machining process: Introduction, Principle, process parameters, advantages, disadvantages and applications about EDM, EDG,	4
	LBM, PAM, EBM	6
5	Electrochemical and chemical advanced machining process: ECM, ECG, ESD, Chemical machining,	6
	Anode shape prediction and tool design for ECM process. Tool (cathode) design for ECM Process.	4
6	Introduction to Micro and nanomachining,	5
	TOTAL	40

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Syllabus

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

6ME5-13: MICRO ELECTRO AND MECHANICAL SYSTEMS (MEMS) and MICROSYSTEMS

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	Over view of MEMS and Microsystems: Microelectromechanical Systems (MEMS) and Microsystems, Typical MEMS and Microsystem products, Evaluation of Microfabrication, Microsystem and microelectronics, the multidisciplinary nature of microsystem design and manufacture, Microsystems and miniaturization, Application of Microsystems in the automotive industry, applications of Microsystems in other industries.	2
	Working Principles of Microsystems: Introduction, Microsensors, Microactuation, MEMS with Microactuators, Microaccelerometers, Microfluidics.	3
3	Engineering Science for Microsystem Design and Fabrication: Introduction, atomic structure of matter, ions and ionization, molecular theory of matter and intermolecular forces, doping of semiconductors, the diffusion process, plasma physics, electrochemistry, quantum physics.	4
	Engineering Mechanics for Microsystem design: Introduction, static bending of thin plates, mechanical vibration, thermomechanics, fracture mechanics, thin-film mechanics, overview of finite element stress analysis.	4
4	Thermofluid Engineering and Microsystem design: Introduction, overview of the basics of fluid mechanics in Macro and mesoscales, Basic equations in continuum fluid dynamics, laminar fluid flow in circular conduits, computational fluid dynamics, Incompressible fluid flow in microconduits, fluid flow in submicrometer and nanoscale, overview of heat conduction in solids, heat conduction in multilayered thin films, heat conduction in solids in submicrometer scale.	5
	Scaling laws in Miniaurization: Introduction to scaling, scaling in geometry, scaling in rigid-body dynamics, scaling in electrostatic forces, scaling in electromagnetic forces, scaling in electricity, scaling in fluid mechanics, scaling in heat transfer.	5
5	Materials for MEMS and Microsystems: Introduction, substrate and wafers, active substrate materials, silicon as a substrate material, silicon compounds, silicon piezoresistors, gallium arsenide, quartz, piezoelectric crystals, polymers, packaging materials.	5
	Microsystem Fabrication Processes: Introduction, Photolithography, Ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition- sputtering, deposition by epitaxy, etching.	6
6	Overview of Micromanufacturing: Introduction, bulk micromanufacturing, surface micromachining, LIGA.	3
	Microsystem Design: Introduction, design consideration, process design, mechanical design, mechanical design using finite element method, design of a silicon die for a micropressure sensor, design of microfluidic network systems, design case: capillary electrophoresis network system.	3
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Syllabus

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

6ME4-21: CIMS LAB.

Credit: 1.5

OL+OT+3P

Max. Marks: 100(IA:60, ETE:40)

End Term Exam: 3 Hours

SN	NAME OF EXPERIMENT
1	To prepare part programming for plain turning operation.
2	To prepare part program for turning operations using turning cycle.
3	To prepare part program for threading operation.
4	To prepare part program for gear cutting using mill cycle.
5	To prepare part program for multiple drilling in X and Z axis using drilling cycle.
	<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 shall include 30% weight age to mini project.</p> <ul style="list-style-type: none">Engraving of students' name, manufacturing of a part.



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

6ME4-22: VIBRATION LAB.

Credit: 1.5

Max. Marks: 100(IA:60, ETE:40)

OL+OT+3P

End Term Exam: 3 Hours

SN	NAME OF EXPERIMENT
1	To verify relation $T = 2\pi\sqrt{l/g}$ for a simple pendulum.
2	To determine radius of gyration of compound pendulum.
3	To determine the radius of gyration of given bar by using bifilar suspension.
4	To determine natural frequency of a spring mass system.
5	Equivalent spring mass system.
6	To determine natural frequency of free torsional vibrations of single rotor system. i. Horizontal rotor ii. Vertical rotor
7	To verify the Dunkerley's rule.
8	Performing the experiment to find out damping co-efficient in case of free damped torsional vibration.
9	To conduct experiment of trifler suspension.
10	Harmonic excitation of cantilever beam using electro-dynamic shaker and determination of resonant frequencies.
11	Study of Vibration measuring instruments.
12	Perform study of the following using Virtual Lab http://www.vlab.co.in/
13	Forced Vibration of a Cantilever Beam with a Lumped Mass at Free End: To calculate the natural freq and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values.
14	Harmonically Excited Forced Vibration of a Single DOF System: To analyze the forced vibration response of a single DOF system at diff damping ratio and frequency ratio.
15	Perform study of the following using Virtual Lab http://www.vlab.co.in/
16	Forced Vibration of a Cantilever Beam with a Lumped Mass at Free End: To calculate the natural freq and damping ratio for forced vibration of a single DOF cantilever beam system, experimentally; and compare the results with theoretical values.
17	Harmonically Excited Forced Vibration of a Single DOF System: To analyze the forced vibration response of a single DOF system at diff damping ratio and frequency ratio.
	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 of vibration system, measurement of vibration, FFT analysis using MATLAB

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

6ME4-23: MACHINE DESIGN PRACTICE – II

Credit: 1.5

Max. Marks: 100(IA:60, ETE:40)

OL+OT+3P

End Term Exam: 3 Hours

SN	SESSIONAL WORK
	Problems on: Use data hand book by Mahadevan and Reddy
1	Fatigue loading.
2	Helical compression, tension and torsional springs design.
3	Curved Beams.
4	Preloaded bolts and bolts subjected to variable stresses.
5	Belt, Rope and Chain drive system.
6	Gear Design.
7	Sliding contact bearing design.
8	Anti-friction bearing selection
	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 of assembly (mechanical systems) using various BIS codes/data book



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

6ME4-24: THERMAL ENGINEERING LAB-1

Credit: 1.5

Max. Marks: 7100(IA:60, ETE:40)

OL+OT+3P

End Term Exam: 3 Hours

SN	Name Of Experiment
1	Study of working of four stroke petrol engine and four stroke diesel engine with the help of cut section models
2	Study of working of two stroke petrol and two stroke diesel engine with the help of cut section models.
3	To draw valve timing diagram for a single cylinder diesel engine.
4	Study of various types of boilers.
5	Study of various types of mountings and accessories.
6	Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle performance.
7	Study of braking system with specific reference to types of braking system, master cylinder, brake shoes.
8	Study of transmission system including clutches, gear box assembly and differential box
	<p>Important Note:</p> <ul style="list-style-type: none">• Study also includes Assembly and disassembly of above systems• It is mandatory for every student to present a term paper. Term paper shall be a group activity. A group shall consist of maximum two students. Final evaluation shall include 30% weight age to term paper. Term paper shall cover study or survey of new technologies in above systems.