Scheme of

UNDERGRADUATE DEGREE COURSE

Mechanical Engineering

Rajasthan Technical University, Kota

Effective from session: 2021 – 2022

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Teaching & Examination Scheme

B.Tech. : Mechanical Engineering
2nd Year - III Semester

THEORY												
SN	Category	Course		Contact hrs/week			Marks				Cr
		Code	Title	L	T	P	Exm Hrs	IA	ETE	Total	
1	BSC	3ME2-01	Advance Engineering Mathematics-I	3	0	0	3	30	70	**100**	**3**
2	HSMC	3ME1-02/ 3ME1-03	Technical Communication/ Managerial Economics and Financial Accounting	2	0	0	2	30	70	**100**	**2**
3	ESC	3ME3-04	Engineering Mechanics	2	0	0	2	30	70	**100**	**2**
4	PCC	3ME4-05	Engineering Thermodynamics	3	0	0	3	30	70	**100**	**3**
5		3ME4-06	Materials Science and Engineering	3	0	0	3	30	70	**100**	**3**
6		3ME4-07	Mechanics of Solids	3	1	0	3	30	70	**100**	**4**
			Sub Total	16	1	0					**17**
PRACTICAL & SESSIONAL											
7	PCC	3ME4-21	Machine drawing practice	0	0	3		60	40	**100**	**1.5**
8		3ME4-22	Materials Testing Lab	0	0	3		60	40	**100**	**1.5**
9		3ME4-23	Basic Mechanical Engineering Lab	0	0	3		60	40	**100**	**1.5**
10		3ME4-24	Programming using MATLAB	0	0	3		60	40	**100**	**1.5**
11	PSIT	3ME7-30	Industrial Training	0	0	1		60	40	**100**	**1**
12	SODECA	3ME8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0				**100**	**0.5**
			Sub- Total	0	0	13					**7.5**
			TOTAL OF III SEMESTER	16	1	13					**24.5**

L: *Lecture,* ***T:*** *Tutorial,* ***P:*** *Practical,* ***Cr:*** *Credits*

ETE: *End Term Exam,* ***IA:*** *Internal Assessment*

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Teaching & Examination Scheme

B.Tech. : Mechanical Engineering
2nd Year - IV Semester

THEORY												
SN	**Category**	**Course**		**Contact hrs/week**			**Marks**				**Cr**
		Code	**Title**	**L**	**T**	**P**	**Exm Hrs**	**IA**	**ETE**	**Total**	
1	BSC	4ME2-01	Data analytics	2	0	0	2	30	70	**100**	**2**
2	HSMC	4ME1-03/ 4ME1-02	Managerial Economics and Financial Accounting/ Technical Communications	2	0	0	2	30	70	**100**	**2**
3	ESC	4ME3-04	Digital Electronics	2	0	0	2	30	70	**100**	**2**
4	PCC	4ME4-05	Fluid Mechanics and Fluid Machines	3	1	0	3	30	70	**100**	**4**
5		4ME4-06	Manufacturing Processes	3	0	0	3	30	70	**100**	**3**
6		4ME4-07	Theory of machines	3	1	0	3	30	70	**100**	**4**
			Sub Total	15	2	0					**17**
PRACTICAL & SESSIONAL											
7	PCC	4ME3-21	Digital Electronics lab	0	0	3		60	40	**100**	**1.5**
8		4ME4-22	Fluid Mechanics lab	0	0	3		60	40	**100**	**1.5**
9		4ME4-23	Production practice lab	0	0	3		60	40	**100**	**1.5**
10		4ME4-24	Theory of machines Lab	0	0	3		60	40	**100**	**1.5**
11	SODECA	4ME8-00	Social Outreach, Discipline & Extra Curricular Activities							**100**	**0.5**
			Sub- Total	0	0	12					**6.5**
			TOTAL OF IV SEMESTER	15	2	12					**23.5**

L: *Lecture,* ***T:*** *Tutorial,* ***P:*** *Practical,* ***Cr:*** *Credits*

ETE: *End Term Exam,* ***IA:*** *Internal Assessment*

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

Syllabus of

UNDERGRADUATE DEGREE COURSE

Mechanical Engineering

Rajasthan Technical University, Kota

Effective from session: 2018 – 2019

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

2nd Year - III Semester: B.Tech. (Mechanical Engineering)

3ME2-01: ADVANCE ENGINEERING MATHEMATICS-I

Credit: 3 **Max. Marks: 100 (IA:30, ETE:70)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Numerical Methods – 1:** Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Gauss's forward and backward interpolation formulae. Stirling's Formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae. Numerical Differentiation, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.	**10**
2	**Numerical Methods – 2:** Numerical solution of ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge- Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Solution of polynomial and transcendental equations-Bisection method, Newton-Raphson method and Regula-Falsi method.	**8**
3	**Laplace Transform:** Definition and existence of Laplace transform, Properties of Laplace Transform and formulae, Unit Step function, Dirac Delta function, Heaviside function, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs by Laplace transforms method.	**10**
4	**Fourier Transform:** Fourier Complex, Sine and Cosine transform, properties and formulae, inverse Fourier transforms, Convolution theorem, application of Fourier transforms to partial ordinary differential equation (One dimensional heat and wave equations only).	**7**
5	**Z-Transform:** Definition, properties and formulae, Convolution theorem, inverse Z-transform, application of Z-transform to difference equation.	**5**
	Total	**40**

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

2nd Year - III Semester: B.Tech. (Mechanical Engineering)

3ME1-02/4ME1-02: TECHNICAL COMMUNICATION

Credit: 2 **Max. Marks: 100 (IA:30, ETE:70)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	**Introduction to Technical Communication-** Definition of technical communication, Aspects of technical communication, forms of technical communication, importance of technical communication, technical communication skills (Listening, speaking, writing, reading writing), linguistic ability, style in technical communication.	4
2	**Comprehension of Technical Materials/Texts and Information Design & development-** Reading of technical texts, Reading and comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media.	6
3	**Technical Writing, Grammar and Editing**- Technical writing process, forms of technical discourse, Writing, drafts and revising, Basics of grammar, common error in writing and speaking, Study of advanced grammar, Editing strategies to achieve appropriate technical style, Introduction to advanced technical communication. Planning, drafting and writing Official Notes, Letters, E-mail, Resume, Job Application, Minutes of Meetings.	8
4	**Advanced Technical Writing**- Technical Reports, types of technical reports, Characteristics and formats and structure of technical reports. Technical Project Proposals, types of technical proposals, Characteristics and formats and structure of technical proposals. Technical Articles, types of technical articles, Writing strategies, structure and formats of technical articles.	8
	Total	26

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3ME1-03/4ME1-03 : MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTING

Credit: 2 **Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+0P **End Term Exam: 2 Hours**

SN		Hours
1	**Basic economic concepts-** Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement.	4
2	**Demand and Supply analysis-** Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply.	5
3	**Production and Cost analysis-** Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation.	5
4	**Market structure and pricing theory**- Perfect competition, Monopoly, Monopolistic competition, Oligopoly.	4
5	**Financial statement analysis-** Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.	8
	TOTAL	26

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

2nd Year - III Semester: B.Tech. (Mechanical Engineering)

3ME3-04: ENGINEERING MECHANICS

Credit: 2 **Max. Marks: 100 (IA:30, ETE:70)**

2L+0T+0P **End Term Exam: 2 Hours**

Applicable to the students admitted from 2018-19 onwards

SN	Contents	Hours
1	Statics of particles and rigid bodies: Fundamental laws of mechanics, Principle of transmissibility, System of forces, Resultant force, Resolution of force, Moment and Couples, Varignon's theorem, Resolution of a force into a force and a couple, Free body diagram, Equilibrium, Conditions for equilibrium, Lami's theorem. Plane trusses: Types of structures, Trusses, Support Conditions, Types of Loadings, Classification of trusses, Determinacy of trusses, Basic assumptions of truss analysis, Method of joints, Method of sections. Virtual work: Principle of Virtual Work, Active forces and active force diagram, Stability of equilibrium.	5
2	**Centroid & Moment of inertia**: Location of centroid and center of gravity, Moment of inertia, Parallel axis and perpendicular axis theorem, Radius of gyration, M.I of composite section, Polar moment of inertia, M.I of solid bodies. **Lifting machines**: Mechanical advantage, Velocity Ratio, Efficiency of machine, Ideal machine, Ideal effort and ideal load, Reversibility of machine, Law of machine, Lifting machines; System of pulleys, Simple wheel and axle, Wheel and differential axle, Weston's differential pulley block, Worm and worm wheel, Single purchase winch crab, Double purchase winch crab, Screw jack, Differential screw jack.	5
3	**Friction**: Types of Friction, Laws of friction, Angle of friction, Angle of repose, Ladder, Wedge, Belt Friction. **Belt and Rope drive**: Types of belts, Types of belt drives, Velocity ratio, Effect of slip on Velocity ratio, Crowing of pulleys, Length of belt, Ratio of tensions in flat belt drive, Power transmission by belt drives, Advantage and disadvantages of V-Belt over Flat Belt.	5
4	**Kinematics of particles and rigid bodies**: Velocity, Acceleration, Types of Motion, Equations of Motion, Rectangular components of velocity and acceleration, Angular velocity and Angular acceleration, Radial and transverse velocities and accelerations, Projectiles motion on plane and Inclined Plane, Relative Motion. **Kinetics of particles and rigid bodies**: Newton's second law, Equation of motion in rectangular coordinate, Equation of motion in radial and transverse components, Equation of motion in plane for a rigid body, D'Alembert principle.	5
5	**Work, Energy and power**: Work of a force, weight, spring force and couple, Power, Efficiency, Energy, Kinetic energy of rigid body, Principle of work and energy, Conservative and Non-conservative Force, Conservation of energy. Office of Dean Academic Affairs Rajasthan Technical University, Kota	6

	Impulse and momentum: Linear and angular momentum, Linear and angular impulse, Principle of momentum for a particle and rigid body, Principle of linear impulse and momentum for a particle and rigid body, Principle of angular momentum and Impulse, Conservation of angular momentum, Angular momentum of rigid body, Principle of impulse and momentum for a rigid body, Central impact, Oblique impact, System of variable mass, Rocket.	
	TOTAL	**26**

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3ME3-04: ENGINEERING MECHANICS

Credit: 2 **Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+0P **End Term Exam: 2 Hours**

Applicable to the students admitted in 2017-18 only

SN	Contents	Hours
1	**Statics of particles and rigid bodies:** Fundamental laws of mechanics, Principle of transmissibility, System of forces, Resultant force, Resolution of force, Moment and Couples, Varignon's theorem, Resolution of a force into a force and a couple, Free body diagram, Equilibrium, Conditions for equilibrium, Lami's theorem. **Plane trusses:** Types of structures, Trusses, Support Conditions, Types of Loadings, Classification of trusses, Determinacy of trusses, Basic assumptions of truss analysis, Method of joints, Method of sections. Virtual work: Principle of Virtual Work, Active forces and active force diagram, Stability of equilibrium.	5
2	**Centroid & Moment of inertia**: Location of centroid and center of gravity, Moment of inertia, Parallel axis and perpendicular axis theorem, Radius of gyration, M.I of composite section, Polar moment of inertia, M.I of solid bodies. **Lifting machines**: Mechanical advantage, Velocity Ratio, Efficiency of machine, Ideal machine, Ideal effort and ideal load, Reversibility of machine, Law of machine, Lifting machines; System of pulleys, Simple wheel and axle, Wheel and differential axle, Weston's differential pulley block, Worm and worm wheel, Single purchase winch crab, Double purchase winch crab, Screw jack, Differential screw jack.	5
3	**Friction**: Types of Friction, Laws of friction, Angle of friction, Angle of repose, Ladder, Wedge, Belt Friction. **Belt and Rope drive**: Types of belts, Types of belt drives, Velocity ratio, Effect of slip on Velocity ratio, Crowing of pulleys, Length of belt, Ratio of tensions in flat belt drive, Power transmission by belt drives, Advantage and disadvantages of V-Belt over Flat Belt.	5
4	**Kinematics:** Fundamentals of rectilinear motion and curvilinear motion, applications of general equations, Projectiles motion on plane and on inclined plane, Concept of Relative motion. **Dynamics:** Principles of dynamics, D'Alembert's principle, conservation of momentum and energy, Work and Energy and impulse momentum methods, central impact, oblique impact, system of variable mass.	6
5	**Vibrations:** Introduction to vibrations, Free vibrations of particles, Simple, compound and torsional pendulum, Energy Method.	5
	TOTAL	**26**

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

2nd Year - III Semester: B.Tech. (Mechanical Engineering)

3ME4-05 : ENGINEERING THERMODYNAMICS

Credit: 3 **Max. Marks: 100 (IA:30, ETE:70)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Basic Concepts and definitions of Thermodynamics**: System, Surroundings, Property, Energy, Thermodynamic Equilibrium, Process, work and modes of work.	2
	Zeroth and First Law of Thermodynamics: Zeroth of Thermodynamics**,** Temperature scale, First law of thermodynamics, First law analysis of some elementary processes. Steady and unsteady flow energy equations.	5
2	**Second Law of Thermodynamics:** Heat engine, Heat pump and refrigerator, Second law of thermodynamics, Equivalence of the Kelvin-Plank and Clausius statements. Reversible and Irreversible Processes, Carnot engine, Efficiency of a Carnot engine, Carnot principle, thermodynamic temperature scale, Clausis Inequality.	4
	Entropy: Entropy, Calculation of Entropy change, Principle of entropy increase. Temperature-Entropy diagram, Second law analysis of a control volume.	3
	Availability: Available energy, Loss in available energy, Availability Function, Irreversibility.	3
3	**Thermodynamic Properties of Fluids:** Pure substance, Concept of Phase, Graphical representation of p-v-T data, Properties of steam. Steam tables, Mollier chart	4
	Ideal Gas and Real Gas: Ideal gas, Real gas, Internal energy, enthalpy and specific heats of an ideal gas, equations of state, Dalton's law of partial pressures, Gibbs Dalton law, Thermodynamic properties of gas mixtures.	4
4	**Thermodynamic Relations:** Thermodynamic variables, Independent and dependent variables, Maxwell's thermodynamic relations, Thermodynamic relations involving entropy, Thermodynamic relations involving enthalpy and internal energy, Joule-Thomson coefficient, Clapeyron equation.	4
	Power Cycles: Otto cycle, Diesel cycle, Dual cycle, Brayton cycle and Ericsson cycle.	4
5	**Vapour power cycle:** Rankine cycle, effect of operating conditions on its efficiency, properties of ideal working fluid in vapour power cycle	3
	Reheat cycle, regenerative cycle, bleeding extraction cycle, feed water heating co-generation cycle.	3
	TOTAL	39

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

2nd Year - III Semester: B.Tech. (Mechanical Engineering)

3ME4-06 : MATERIAL SCIENCE AND ENGINEERING

Credit: 3 **Max. Marks: 100 (IA:30, ETE:70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	Crystal structure – BCC, FCC and HCP, unit cell, crystallographic planes and directions, miller indices. Crystal imperfections, point, line, surface and volume defects.	4
	Frank Reed source of dislocation, Elastic & plastic modes of deformation, Bauschinger's effect, slip & twinning, strain hardening, cold/hot working recovery, re-crystallization and grain growth.	4
2	Classification of Engineering Materials: Solidification of metals and of some typical alloys, mechanism of crystallization (I) nuclear formation (ii) crystal growth, general principles of phase transformation in alloys, phase rule and equilibrium diagrams, equilibrium diagram of binary system having complete mutual solubility in liquid state and limited solubility in solid state, binary isomorphous alloy system, Hume-Rothery rule , binary system with limited solid solubility of terminal phase and in which solubility decreases with temperature and also alloy with a peritectic transformation, equilibrium diagram of a system whose components are subject to allotropic change.	5
	Iron carbon equilibrium diagram, phase transformation in the iron carbon diagram, eutectic, peritectic, eutectoid and peritectoid reactions and microstructures.	3
3	Isothermal transformation diagrams –cooling curves superimposed on Isothermal Transformation diagram, critical cooling rate. (i) Formation of Austenite from Pearlite (ii) Transformation of Austenite into Pearlite.	4
	Full annealing, stress relief, spheroidizing – normalizing, hardening and tempering of steel. Hardenability, Jominey end quench test – Austempering, martempering. Case hardening, carburising, nitriding, cyaniding, carbonitriding. Flame and Induction hardening.	4
4	Non-Metallic Materials- Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO,PPS, PEEK, PTFE Polymers. Urea and Phenol formaldehydes.	4
	Constitution of alloys: Solid solutions - substitutional and interstitial. Ferrous and Non Ferrous Metals- Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA steel.	4
5	Mechanical Properties and Testing: Types of fracture, testing of materials under tension, compression and shear loads – hardness tests (Brinell, Vickers and Rockwell) Impact test Izod and charpy, fatigue and creep test.	4

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	Classification of steels and cast iron constitution and properties. BIS standards. Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ etc. Fiber and particulate reinforced composites and resin plastics. Introduction to Nano materials- Nano structured materials. Nano clusters & Nano crystals.	**3**
	TOTAL	**39**

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Rajasthan Technical University, Kota

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

2nd Year - III Semester: B.Tech. (Mechanical Engineering)

3ME4-07 : MECHANICS OF SOLIDS

Credit: 4 **Max. Marks: 100 (IA:30, ETE:70)**
3L+1T+0P **End Term Exam: 3 Hours**

S.No	CONTENTS	Hours
1	**Stress and Strain:** Elementary definition of stress and strain, stress-strain relationship, elastic, plastic and visco-elastic behavior of common materials in tension and compression test, stress-strain curves, Hooke's law, Poisson's ratio, elastic constants and their relations for an isotropic hookean material, anisotropic and orthotropic materials.	3
	Tension, compression, shearing stress and strain, thermal stresses, composite bars, equations of static equilibrium, concept of free body diagram. Strain energy due to axial loading.	5
2	**Members Subjected to Flexural Loads:** Theory of simple bending, bending moment and shear force diagrams for different types of static loading and support conditions on beams.	4
	bending stresses, section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc. Strain energy due to bending.	5
3	**Principal Planes, Stresses and Strains:** Members subjected to combined axial, bending and torsional loads, maximum normal and shear stresses, concept of equivalent bending and equivalent twisting moments, Mohr's circle of stress and strain.	5
	Theories of Elastic Failures: The necessity for a theory, different theories, significance and comparison, applications.	2
4	**Torsion:** Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity. Strain energy due to torsional loads.	4
	Stability of Equilibrium: Instability and elastic stability, long and short columns, ideal strut, Euler's formula for crippling load for columns of different ends, concept of equivalent length, eccentric loading, Rankine formulae and other empirical relations.	3
5	**Transverse Deflection of Beams:** Relation between deflection, bending moment, shear force and load, transverse deflection of beams and shaft under static loading, area moment method, direct integration method.	6
	Thin-walled Pressure Vessels: Stresses in cylindrical and spherical vessels	2
	TOTAL	**39**

Office of Dean Academic Affairs
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3ME4-21 : MACHINE DRAWING PRACTICE

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

SN	CONTENTS
1.	Assembly drawing with sectioning and bill of materials of the following: Lathe tail stock, shaper tool head, swivel machine vice etc (1 drawing sheet of any assembly)
2.	Detailed part drawings from assembly drawing indicating fits, tolerances and surface finish symbols by referring BIS codes: Check-valve, Junction Valve etc (1 drawing sheet)
3.	Computer Aided Drafting: Introduction to different features of the CAD Software (AutoCAD/ProE/ Creo/Solidworks). At least one drawing problem related to a. 2-D Drafting. b. 3-D Modeling. c. 3-D Advanced Modeling. d. Assembly modeling. e. Feature Modification and Manipulation f. Detailing. g. Surface Modeling

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3ME4-22 : MATERIALS TESTING LAB

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

SN	
1	(a) Study of various crystals structures through models BCC, FCC, HCP, tetrahedral and octahedral voids. Material identification of, say, 50 common items kept in a box.
2	Specimen preparation for metallographic examination /micro structural examination-cutting, grinding, polishing, etching.
3	Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.)
4	Heat treatment experiments such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.
5	Study of Microstructure and hardness of steel at different rates of cooling. Microstructure examination of white cast iron.
6	To perform Tensile/Compressive/Shear/torsion test on a given material and to determine its various mechanical properties under tensile/compression/Shear/torsional loading
7	To determine Rockwell/ Vickers/Brinell hardness of a given material
8	To perform Impact test on a given material and to determine its resilience.
9	To study and perform Fatigue test on a given material and to determine fatigue strength of the material
10	To perform Bending test and to determine the Young's Modulus of Elasticity via deflection of beam.
11	Creep testing on creep testing machine

3ME4-23 : BASIC MECHANICAL ENGINEERING LAB

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

SN	
1	Exposure to a wide range of applications of mechanical engineering through a variety of activities, including hands-on assembly and disassembly of machines, such as, bicycle, sewing machine, pumps, engines, air-conditioners, machine-tools, amongst others; observational study of complex systems via cut sections, visits, videos and computer simulations; design of simple machines/systems including specifications formulation; visits to industries.
2	Note: Student will be required to submit written report indicating the learning achieved by Hands on assembly/Disassembly.

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3ME4-24: PROGRAMMING USING MATLAB

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

SN	
1	1. Basics of MATLAB computer programming 2. Use of formulae and inbuilt functions 3. MATLAB scripts and functions (m-files) 4. Loops and nested loops 5. Array, vector and matrices 6. Plotting functions and vector plots 7. Solving differential equations using MATLAB 8. Reading and writing data, file handling 9. Using MATLAB toolboxes 10. MATLAB graphic functions

Syllabus of

UNDERGRADUATE DEGREE COURSE

Mechanical Engineering

Rajasthan Technical University, Kota

Effective from session: 2021 – 2022

4ME2-01: DATA ANALYTICS

Credit: 2 **Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	Introduction to Multivariate Statistics-Degree of Relationship among Variables-Review of Univariate and Bivariate Statistics-Screening Data Prior to Analysis-Missing Data, Outliers, Normality, Linearity, and Homoscedasticity.	4
3	Multiple Regression- Linear and Nonlinear techniques- Backward Forward-Stepwise- Hierarchical regression-Testing interactions (2way interaction) - Analysis of Variance and Covariance (ANOVA & ANCOVA) - Multivariate Analysis of Variance and Covariance (MANOVA & MANCOVA).	6
4	Logistic regression: Regression with binary dependent variable - Simple Discriminant Analysis- Multiple Discriminant analysis Assessing classification accuracy- Conjoint analysis (Full profile method).	5
5	Principal Component Analysis -Factor Analysis- Orthogonal and Oblique Rotation-Factor Score Estimation-Multidimensional Scaling-Perceptual Map-Cluster Analysis (Hierarchical Vs Nonhierarchical Clustering).	5
6	Latent Variable Models an Introduction to Factor, Path, and Structural Equation Analysis- Time series data analysis (ARIMA model) – Decision tree analysis (CHAID, CART) - Introduction to Big Data Management.	5
	TOTAL	26

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4ME1-03/3ME1-03 : MANAGERIAL ECONOMICS AND FINANCIAL ACCOUNTING

Credit: 2 **Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+0P **End Term Exam: 2 Hours**

SN		Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Basic economic concepts-** Meaning, nature and scope of economics, deductive vs inductive methods, static and dynamics, Economic problems: scarcity and choice, circular flow of economic activity, national income-concepts and measurement.	3
3	**Demand and Supply analysis-** Demand-types of demand, determinants of demand, demand function, elasticity of demand, demand forecasting –purpose, determinants and methods, Supply-determinants of supply, supply function, elasticity of supply.	5
4	**Production and Cost analysis-** Theory of production- production function, law of variable proportions, laws of returns to scale, production optimization, least cost combination of inputs, isoquants. Cost concepts-explicit and implicit cost, fixed and variable cost, opportunity cost, sunk costs, cost function, cost curves, cost and output decisions, cost estimation.	5
5	**Market structure and pricing theory**- Perfect competition, Monopoly, Monopolistic competition, Oligopoly.	4
6	**Financial statement analysis-** Balance sheet and related concepts, profit and loss statement and related concepts, financial ratio analysis, cash-flow analysis, funds-flow analysis, comparative financial statement, analysis and interpretation of financial statements, capital budgeting techniques.	8
	TOTAL	26

Office of Dean Academic Affairs
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4ME1-02/3ME1-02: TECHNICAL COMMUNICATION

Credit: 2 **Max. Marks: 100 (IA:30, ETE:70)**

2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Introduction to Technical Communication-** Definition of technical communication, Aspects of technical communication, forms of technical communication, importance of technical communication, technical communication skills (Listening, speaking, writing, reading writing), linguistic ability, style in technical communication.	3
3	**Comprehension of Technical Materials/Texts and Information Design & development-** Reading of technical texts, Reading and comprehending instructions and technical manuals, Interpreting and summarizing technical texts, Note-making. Introduction of different kinds of technical documents, Information collection, factors affecting information and document design, Strategies for organization, Information design and writing for print and online media.	6
4	**Technical Writing, Grammar and Editing**- Technical writing process, forms of technical discourse, Writing, drafts and revising, Basics of grammar, common error in writing and speaking, Study of advanced grammar, Editing strategies to achieve appropriate technical style, Introduction to advanced technical communication. Planning, drafting and writing Official Notes, Letters, E-mail, Resume, Job Application, Minutes of Meetings.	8
5	**Advanced Technical Writing**- Technical Reports, types of technical reports, Characteristics and formats and structure of technical reports. Technical Project Proposals, types of technical proposals, Characteristics and formats and structure of technical proposals. Technical Articles, types of technical articles, Writing strategies, structure and formats of technical articles.	8
	Total	26

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4ME3-04: DIGITAL ELECTRONICS

Credit: 2 **Max. Marks: 100 (IA:30, ETE:70)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Semiconductor Devices and Applications:** Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.	4
3	**Operational amplifier and its applications**: Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.	5
4	**Timing Circuits and Oscillators:** RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.	5
5	**Digital Electronics Fundamentals**: Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.	6
6	**Electronic Communication Systems**: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.	5
	TOTAL	26

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4ME4-05: FLUID MECHANICS AND FLUID MACHINES

Credit: 4 **Max. Marks: 100 (IA:30, ETE:70)**
3L+1T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Fluid Properties:** Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapor pressure, surface tension and capillarity.	2
	Fluid Statics and Flow Characteristics: Basic equation of fluid statics, Manometers, Force on plane areas and curved surfaces, center of pressure, Buoyant force, Stability of floating and submerged bodies. Flow characteristics – concept of control volume - application of continuity equation, energy equation and momentum equation.	5
3	**Flow Through Circular Conduits:** Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli-Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram-minor losses – Flow through pipes in series and parallel.	8
4	**Dimensional Analysis:** Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.	8
5	**Pumps:** Impact of jets - Euler's equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle - work done by the impeller - performance curves - Reciprocating pump- working principle – Rotary pumps –classification.	8
6	**Turbines:** Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities – performance curves for turbines – governing of turbines.	7
	TOTAL	39

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4ME4-06: MANUFACTURING PROCESSES

Credit: 3 **Max. Marks: 100 (IA:30, ETE:70)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	General Classification and Introduction to Manufacturing processes. **Foundry Technology**: Casting: Definition and major classification; Casting materials, Patterns: types, material and pattern allowances. Moulding sands; composition, preparation, properties and testing; Grain fineness; moisture content, clay content and permeability test. Core & core prints; Gating system: types, pouring basin, sprue, runner and risers; Melting, pouring and solidification.	3
	Principles and method of floor mould casting, shell mould casting, pit mould and loam mould casting; centrifugal casting, investment casting; Permanent mould casting. Die casting; Slush casting. Casting defects; types, causes and remedy	5
3	**Forming Processes**: Classification; Hot working and cold working; principle, advantages, disadvantages and applications.	3
	Forging: Classification, drop forging and press forging methods and use; Forging dies; types, materials.	4
	Rolling: Characteristics and applications of hot rolling and cold rolling;	3
4	Extrusion; Work materials and products; Press tool works; Basic principles, system, operations and applications. Shearing; Parting, notching, trimming, nibbling, blanking and piercing,	4
	Drawing: wire drawing, tube drawing and deep drawing.	3
5	**Metal Joining Processes**: Welding, Brazing and soldering, classification of welding process, Principle, characteristics and applications of gas welding, thermit welding, electrical arc welding; Submerged arc welding; TIG and MIG welding; Resistance welding; Spot welding; Butt welding; Seam welding; Projection welding.	6
	Principles and process details of Forge welding; Friction welding; Diffusion welding; Ultrasonic welding. Explosive welding. Welding defects; Types, causes, effects and remedy. Electrodes and Electrode Coatings	3
6	**Powder Metallurgy**: Properties of Powder processed materials, Powder manufacturing, mechanical pulverization, sintering, Electrolytic Process, chemical reduction, atomization, properties of metal powders, compacting of powders sintering, advantages and applications of Powder metallurgy.	4
	TOTAL	39

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4ME4-07: THEORY OF MACHINES

Credit: 4 **Max. Marks: 100 (IA:30, ETE:70)**
3L+1T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	Introduction to mechanism: Basic concept of machines, links, kinematic pair, kinematic chain and mechanism. Inversions of kinematic chains: four bar chain mechanisms, quick return mechanisms, inversions of double slider crank mechanisms.	4
	Velocity and acceleration in mechanism: Velocity and acceleration polygons, relative velocity and instantaneous centre method	3
3	Friction devices: Types and laws of friction. Pivots and collars. Power screws such as lead screw of the lathe.	3
	Clutches: Single and multi-plate clutches. Brakes: Band, block and band and block brakes.	4
4	Gears: Laws of gearing, gears terminology; tooth form; interference, undercutting and minimum number of teeth on pinion. Rack and pinion, Spur, helical, basic introduction of bevel, worm and worm gears.	6
	Gear Trains: Simple, compound and epicyclic gear trains.	3
5	Cams: Type of cams; displacement, velocity and acceleration curves for different cam followers; consideration of pressure angle and wear.	4
	Gyroscope: Principles of gyroscopic couple, effect of gyroscopic couple and centrifugal force on vehicles taking a turn, stabilization of ship.	4
6	Balancing: Balancing of rotating masses in same and different planes, balancing of reciprocating masses, swaying couple, hammer blow and tractive effort.	7
	TOTAL	**39**

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4ME3-21: DIGITAL ELECTRONICS LAB

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

SN	
1	To verify the truth tables of basic logic gates: AND, OR, NOR, NAND, NOR. Also to verify the truth table of Ex-OR, Ex-NOR (For 2, 3 & 4 inputs using gates with 2, 3, & 4 inputs).
2	To verify the truth table of OR, AND, NOR, Ex-OR. Ex-NOR realized using NAND & NOR gates.
3	To realize an SOP and POS expression.
4	To realize Half adder/ Subtractor & Full Adder/ Subtractor using NAND & NOR gates and to verify their truth tables.
5	To realize a 4-bit ripple adder/ Subtractor using basic half adder/ Subtractor & basic Full Adder/ Subtractor.
6	To verify the truth table of 4-to-l multiplexer and l-to-4 demultiplexer. Realize the multiplexer using basic gates only. Also to construct and 8-to-1 multiplexer and l-to-8 demultiplexer using blocks of 4-to-1 multiplexer and 1-to-4 demulriplexer.
7	Design & Realize a combinational circuit that will accept a 2421 BCD code and drive a TIL -3 I 2 seven-segment display.
8	Using basic logic gates, realize the R-S, J-K and D-flip flops with and without clock signal and verify their truth table.
9	Construct a divide by 2, 4 & 8 asynchronous counter. Construct a 4-bit binary counter and ring counter for a particular output pattern using D flip flop.
10	Perform input/output operations on parallel in/parallel out and Serial in/Serial out registers using clock. Also exercise loading only one of multiple values into the register using multiplexer.

Note: As far as possible, the experiments shall be performed on bread board. However experiment Nos. l-4 are to be performed on bread board only

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4ME4-22: FLUID MECHANICS LAB

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

SN	
1	Determination of Meta-centric height of a given body.
2	Determination of Cd, Cv & Cc for given orifice.
3	Calibration of contracted Rectangular Notch and / Triangular Notch and determination of flow rate.
4	Determination of velocity of water by Pitot tube.
5	Verification of Bernoulli's theorem.
6	Calibration and flow rate determination using Venturimeter & Orifice meter and Nozzle meter
7	Determination of head loss in given length of pipe.
8	Determination of the Reynold's number for laminar, turbulent and transient flow in pipe.
9	Determination of Coefficient for minor losses in pipes.
10	To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
11	To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
12	Conducting experiments and drawing the characteristic curves of centrifugal pump/submergible pump.
13	Conducting experiments and drawing the characteristic curves of reciprocating pump.
14	Conducting experiments and drawing the characteristic curves of Pelton wheel.
15	Conducting experiments and drawing the characteristics curves of Francis turbine.
16	Conducting experiments and drawing the characteristic curves of Kaplan turbine.

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4ME4-23: PRODUCTION PRACTICE LAB

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

SN	
	Turning Shop
1	To study lathe machine construction and various parts including attachments, lathe tools cutting speed, feed and depth of cut.
2	To perform step turning, knurling and chamfering on lathe machine as per drawing.
3	To cut multi-start Square/Metric threads on lathe machine.
4	Boring using a boring bar in a centre lathe and cut BSW/Metric internal threads on lathe machine.
5	To perform taper turning using compound rest.
	Machine shop
1	To study the milling machine, milling cutters, indexing heads and indexing methods and to prepare a gear on milling machine.
2	To machine a hexagonal /octagonal nut using indexing head on milling machine.
3	To study of single point cutting tool geometry and to grind the tool as per given tool geometry.
4	To study shaper machine, its mechanism and calculate quick return ratio. To prepare a job on shaper from given mild steel rod.
5	Cylindrical grinding using grinding attachment in a centre lathe
	Demonstration and study
1	Demonstration for job by eccentric turning on lathe machine.
2	Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing.
3	Demonstration on milling machine for generation of plane surfaces and use of end milling cutters.
4	Grinding of milling cutters and drills.
	Foundry Shop
1	To prepare mould of a given pattern requiring core and to cast it in aluminium.
2	To perform moisture test and clay content test.
3	To perform permeability test
4	A.F.S. Sieve analysis test.
5	Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core).
	Welding Shop
1	Hands-on practice on spot welding.

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4ME4-24: THEORY OF MACHINES LAB

Credit: 1.5 **Max. Marks: 100 (IA:60, ETE:40)**
0L+0T+3P

SN	
1	To study inversions of four bar chain and slider crank mechanism and their practical applications.
2	To study Steering Mechanisms: Davis and Ackerman.
3	Study of quick return mechanism and its practical applications.
4	Study of inversion of Double slider chain: Oldham Coupling, Scotch Yoke and Elliptical Trammel.
5	Study of various cam-follower arrangements. To plot displacement v/s angle of rotation curve for various cams
6	To determine co-efficient of friction using two roller oscillating arrangement.
7	Study of various types of dynamometers, Brakes and Clutches.
8	Study of differential gear box.
9	To verify the torque relation for gyroscope.
10	To perform wheel balancing. To perform static and dynamic balancing on balancing set up.
11	Study of a lathe gear box, sliding mesh automobile gear box, planetary gear box.