Syllabus and Scheme

B.Tech. in Mechanical Engineering

(For students admitted since 2018)

SEMESTER-I & II

Teaching and Examination Scheme

I Semester: B.Tech
Common to all branches of UG Engineering & Technology

SN	Category	Course Code	Course Title	Hours			Marks			Cr
				L	T	P	IA	ETE	Total	
1	BSC	1FY2-01	Engineering Mathematics-I	3	1	-	40	160	**200**	**4**
2	BSC	1FY2-02/ 1FY2-03	Engineering Physics/ Engineering Chemistry	3	1	-	40	160	**200**	**4**
3	HSMC	1FY1-04/ 1FY1-05	Communication Skills/ Human Values	2	-	-	20	80	**100**	**2**
4	ESC	1FY3-06/ 1FY3-07	Programming for Problem Solving/ Basic Mechanical Engineering	2	-	-	20	80	**100**	**2**
5	ESC	1FY3-08/ 1FY3-09	Basic Electrical Engineering/ Basic Civil Engineering	2	-	-	20	80	**100**	**2**
6	BSC	1FY2-20/ 1FY2-21	Engineering Physics Lab/ Engineering Chemistry Lab	-	-	2	30	20	**50**	**1**
7	HSMC	1FY1-22/ 1FY1-23	Language Lab/ Human Values Activities	-	-	2	30	20	**50**	**1**
8	ESC	1FY3-24/ 1FY3-25	Computer Programming Lab/ Manufacturing Practices Workshop	-	-	3	45	30	**75**	**1.5**
9	ESC	1FY3-26/ 1FY3-27	Basic Electrical Engineering Lab/ Basic Civil Engineering Lab	-	-	2	30	20	**50**	**1**
10	ESC	1FY3-28/ 1FY3-29	Computer Aided Engineering Graphics/ Computer Aided Machine Drawing	-	-	3	45	30	**75**	**1.5**
11	SODECA	1FY8-00							**25**	**0.5**
								Total	**1025**	**20.5**

L = Lecture, **T =** Tutorial,

P = Practical, **IA=**Internal Assessment**,**
ETE=End Term Exam, **Cr**=Credits

Teaching and Examination Scheme

II Semester: B.Tech.
Common to all branches of UG Engineering & Technology

SN	Category	Course Code	Course Title	Hours			Marks			Cr
				L	T	P	IA	ETE	Total	
1	BSC	2FY2-01	Engineering Mathematics-II	3	1	-	40	160	**200**	**4**
2	BSC	2FY2-03/ 2FY2-02	Engineering Chemistry/ Engineering Physics	3	1	-	40	160	**200**	**4**
3	HSMC	2FY1-05/ 2FY1-04	Human Values/ Communication Skills	2	-	-	20	80	**100**	**2**
4	ESC	2FY3-07/ 2FY3-06	Basic Mechanical Engineering/ Programming for Problem Solving	2	-	-	20	80	**100**	**2**
5	ESC	2FY3-09/ 2FY3-08	Basic Civil Engineering/ Basic Electrical Engineering	2	-	-	20	80	**100**	**2**
6	BSC	2FY2-21/ 2FY2-20	Engineering Chemistry Lab/Engineering Physics Lab	-	-	2	30	20	**50**	**1**
7	HSMC	2FY1-23/ 2FY1-22	Human Values Activities/ Language Lab	-	-	2	30	20	**50**	**1**
8	ESC	2FY3-25/ 2FY3-24	Manufacturing Practices Workshop/ Computer Programming Lab	-	-	3	45	30	**75**	**1.5**
9	ESC	2FY3-27/ 2FY3-26	Basic Civil Engineering Lab/Basic Electrical Engineering Lab	-	-	2	30	20	**50**	**1**
10	ESC	2FY3-29/ 2FY3-28	Computer Aided Machine Drawing/ Computer Aided Engineering Graphics	-	-	3	45	30	**75**	**1.5**
11	SODECA	1FY8-00							**25**	**0.5**
								Total	**1025**	**20.5**

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SYLLABUS
I Semester
Common to all branches of UG Engineering & Technology

1FY2-01: Engineering Mathematics-I

Credit: 4 **Max. Marks: 200 (IA:40, ETE:160)**

3L+1T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Calculus:** Improper integrals (Beta and Gamma functions) and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.	8
2	**Sequences and Series:** Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.	6
3	**Fourier Series:** Periodic functions, Fourier series, Euler's formula, Change of intervals,Half range sine and cosine series, Parseval's theorem.	6
4	**Multivariable Calculus (Differentiation):** Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.	10
5	**Multivariable Calculus (Integration):** Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Centre of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.	10
	TOTAL	**40**

I & II Semester

Common to all branches of UG Engineering & Technology

1FY2-02/ 2FY2-02: Engineering Physics

Credit: 4 **Max. Marks: 200 (IA:40, ETE:160)**

3L+1T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Wave Optics:** Newton's Rings, Michelson's Interferometer, Fraunhofer Diffraction from a Single Slit. Diffraction grating: Construction, theory and spectrum, Resolving power and Rayleigh criterion for limit of resolution, Resolving power of diffraction grating, X-Ray diffraction and Bragg's Law.	9
2	**Quantum Mechanics:** Introduction to quantum Mechanics, Wave-particle duality, Matter waves, Wave function and basic postulates, Time dependent and time independent Schrodinger's Wave Equation, Physical interpretation of wave function and its properties, Applications of the Schrodinger's Equation: Particle in one dimensional and three dimensional boxes.	6
3	**Coherence and Optical Fibers:** Spatial and temporal coherence: Coherence length; Coherence time and 'Q' factor for light, Visibility as a measure of Coherence and spectral purity, Optical fiber as optical wave guide, Numerical aperture; Maximum angle of acceptance and applications of optical fiber.	4
4	**Laser:** Einstein's Theory of laser action; Einstein's coefficients; Properties of Laser beam, Amplification of light by population inversion, Components of laser, Construction and working of He-Ne and semiconductor lasers, Applications of Lasers in Science, engineering and medicine.	6
5	**Material Science & Semiconductor Physics:** Bonding in solids: covalent and metallic bonding, Energy bands in solids: Classification of solids as Insulators, Semiconductors and Conductors, Intrinsic and extrinsic semiconductors, Fermi dirac distribution function and Fermi energy, Conductivity in semiconductors, Hall Effect: Theory, Hall Coefficient and applications.	7
6	**Introduction to Electromagnetism:** Divergence and curl of electrostatic field, Laplace's and Poisson's equations for electrostatic potential, Bio-Savart law, Divergence and curl of static magnetic field, Faraday's law, Displacement current and magnetic field arising from time dependent electric field, Maxwell's equations, Flow of energy and Poynting vector.	8
	TOTAL	**40**

I & II Semester

Common to all branches of UG Engineering & Technology

1FY2-03/ 2FY2-03: Engineering Chemistry

Credit: 4 **Max. Marks: 200 (IA:40, ETE:160)**
3L+1T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Water:** Common impurities, hardness, determination of hardness by complexometric (EDTA method), Degree of hardness, Units of hardness Municipal water supply: Requisite of drinking water, Purification of water; sedimentation, filtration, disinfection, breakpoint chlorination. Boiler troubles: Scale and Sludge formation, Internal treatment methods, Priming and Foaming, Boiler corrosion and Caustic embrittlement Water softening; Lime-Soda process, Zeolite (Permutit) process, Demineralization process. Numerical problems based on Hardness, EDTA, Lime-Soda and Zeolite process.	10
2	**Organic Fuels:** Solid fuels: Coal, Classification of Coal, Proximate and Ultimate analyses of coal and its significance, Gross and Net Calorific value, Determination of Calorific value of coal by Bomb Calorimeter. Metallurgical coke, Carbonization processes; Otto-Hoffmann by-product oven method. Liquid fuels : Advantages of liquid fuels, Mining, Refining and Composition of petroleum, Cracking, Synthetic petrol, Reforming, Knocking, Octane number, Anti-knocking agents, Cetane number Gaseous fuels; Advantages, manufacturing, composition and Calorific value of coal gas and oil gas, Determination of calorific value of gaseous fuels by Junker's calorimeter Numerical problems based on determination of calorific value (bomb calorimeter/Junkers calorimeter/Dulongs formula, proximate analysis & ultimate and combustion of fuel.	10
3	**Corrosion and its control:** Definition and significance of corrosion, Mechanism of chemical (dry) and electrochemical (wet) corrosion, galvanic corrosion, concentration corrosion and pitting corrosion. Protection from corrosion; protective coatings-galvanization and tinning, cathodic protection, sacrificial anode and modifications in design.	3
4	**Engineering Materials:** Portland Cement; Definition, Manufacturing by Rotary kiln. Chemistry of setting and hardening of cement. Role of Gypsum. Glass: Definition, Manufacturing by tank furnace, significance of annealing, Types and properties of soft glass, hard glass, borosilicate glass, glass wool, safety glass Lubricants: Classification, Mechanism, Properties; Viscosity and viscosity index, flash and fire point, cloud and pour point.	10

	Emulsification and steam emulsion number.	
5	**Organic reaction mechanism and introduction of drugs:** Organic reaction mechanism: Substitution; SN1, SN2, Elecrophilic aromatic substitution in benzene, free radical halogenations of alkanes, Elimination; elimination in alkyl halides, dehydration of alcohols, Addition: electrophilic and free radical addition in alkenes, nucleophilic addition in aldehyde and ketones, Rearrangement; Carbocation and free radical rearrangements Drugs : Introduction, Synthesis, properties and uses of Aspirin, Paracetamol	**7**
	TOTAL	**40**

I & II Semester

Common to all branches of UG Engineering & Technology

1FY1-04/ 2FY1-04: Communication Skills

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**

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

SN	CONTENTS	Hours
1	**Communication:** Meaning, Importance and Cycle of Communication. Media and Types of Communication. Verbal and Non-Verbal Communication. Barriers to communication. Formal and Informal Channels of Communication (Corporate Communication). Divisions of Human Communication and Methods to improve Interpersonal Communication. Qualities of good communication.	5
2	**Grammar:** Passive Voice. Reported Speech. Conditional Sentences. Modal Verbs. Linking Words (Conjunctions)	5
3	**Composition:** Job Application and Curriculum-Vitae Writing. Business Letter Writing. Paragraph Writing. Report Writing.	5
4	**Short Stories:** "Luncheon" by Somerset Maugham."How Much Land Does a Man Need?" by Count Leo Tolstoy. "The Night Train at Deoli" by Ruskin Bond.	5
5	**Poems:** "No Men are Foreign" by James Kirkup. "If" by Rudyard Kipling. "Where the Mind is without Fear" by Rabindranath Tagore.	5
	TOTAL	25

I & II Semester
Common to all branches of UG Engineering & Technology

1FY1-05/ 2FY1-05: Human Values

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education** Understanding the need, basic guidelines, Self Exploration - its content and process; 'Natural Acceptance' and Experiential Validation, Continuous Happiness and Prosperity- Human Aspirations, Right understanding, Relationship and Physical Facilities,Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfill the above human aspirations: understanding and living in harmony at various levels	5
2	**Understanding Harmony in the Human Being - Harmony in Myself** Understanding human being as a co-existence of the sentient 'I' and the material 'Body' Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha Understanding the Body as an instrument of 'I',Understanding the characteristics and activities of 'I' and harmony in 'I' Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.	5
3	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding harmony in the Family, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) , meaning of Vishwas; Difference between intention and competence, meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, harmony in the society , Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals ,Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family.	5
4	**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence** Understanding the harmony in the Nature. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature. Understanding Existence as Co-existence	5

	(Sah-astitva) of mutually interacting units in allpervasive Space. Holistic perception of harmony at all levels of existence	
5	**Implications of the above Holistic Understanding of Harmony on Professional Ethics. Natural acceptance of human values** Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models. Strategy for transition from the present state to Universal Human Order: At the level of individual: as socially and ecologically responsible engineers, technologists and managers. Case studies related to values in professional life and individual life.	**5**
	TOTAL	**25**

1FY3-06/ 2FY3-06: Programming for Problem Solving

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	**Fundamentals of Computer:** Stored program architecture of computers, Storage device- Primary memory, and Secondary storage, Random, Direct, Sequential access methods, Concepts of High-level, Assembly and Low-level languages, Representing algorithms through flowchart and pseudo code.	**8**
2	**Number system:** Data representations, Concepts of radix and representation of numbers in radix r with special cases of r=2, 8, 10 and 16 with conversion from radix r1 to r2, r's and (r-1)'s complement, Binary addition, Binary subtraction, Representation of alphabets.	**8**
3	**C Programming:** Problem specification, flow chart, data types, assignment statements, input output statements, developing simple C programs, If statement, for loops, while loops, do-while loops, switch statement, break statement, continue statement, development of C programs using above statements, Arrays, functions, parameter passing, recursion, Programming in C using these statements, Structures, files, pointers and multi file handling.	**12**
	TOTAL	**28**

I & II Semester

Common to all branches of UG Engineering & Technology

1FY3-07/ 2FY3-07: Basic Mechanical Engineering

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	**Fundamentals:** Introduction to mechanical engineering, concepts of thermal engineering, mechanical machine design, industrial engineering and manufacturing technology. Steam Boilers classification and types of steam boilers and steam turbines. Introduction and Classification of power plants.	
2	**Pumps and IC Engines:** Applications and working of Reciprocating and Centrifugal pumps. Introduction, Classification of IC Engines, Main Components of IC Engines, Working of IC Engines and its components.	
3	**Refrigeration and Air Conditioning:** Introduction, classification and types of refrigeration systems and air-conditioning. Applications of refrigeration and Air-conditioning.	
4	**Transmission of Power:** Introduction and types of Belt and Rope Drives, Gears.	
5	**Primary Manufacturing Processes:** Metal Casting Process: Introduction to Casting Process, Patterns, Molding, Furnaces. Metal Forming Processes: Introduction to Forging, Rolling, Extrusion, Drawing. Metal Joining Processes: Introduction to various types of Welding, Gas Cutting, Brazing, and Soldering.	
6	**Engineering Materials and Heat Treatment of Steel:** Introduction to various engineering materials and their properties.	

I & II Semester

Common to all branches of UG Engineering & Technology

1FY3-08/ 2FY3-08: Basic Electrical Engineering

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**

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

SN	CONTENTS	Hours
1	**DC Circuits:** Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, Series-Parallel circuits, Node voltage method, Mesh current method, Superposition, Thevenin's, Norton's and Maximum power transfer theorems.	5
2	**AC Circuits:** Representation of sinusoidal waveforms, peak and r.m.s values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase AC circuits consisting of R, L, C, RL, RC and RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.	4
3	**Transformers:** Ideal and practical transformer, EMF equation, equivalent circuit, losses in transformers, regulation and efficiency.	4
4	**Electrical Machines:** Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Starting and speed control of induction motor, single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited DC motor. Construction and working of synchronous generators.	7
5	**Power Converters:** Semiconductor PN junction diode and transistor (BJT). Characteristics of SCR, power transistor and IGBT. Basic circuits of single phase rectifier with R load, Single phase Inverter, DC-DC converter.	4
6	**Electrical Installations:** Layout of LT switchgear: Switch fuse unit (SFU), MCB, ELCB, MCCB, Type of earthing. Power measurement, elementary calculations for energy consumption.	4
	TOTAL	**28**

I & II Semester
Common to all branches of UG Engineering & Technology

1FY3-09/ 2FY3-09: Basic Civil Engineering

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**
2L+0T+0P **End Term Exam: 2 Hours**

SN	CONTENTS	Hours
1	**Introduction to objective, scope and outcome the subject**	1
2	**Introduction:** Scope and Specialization of Civil Engineering, Role of civil Engineer in Society, Impact of infrastructural development on economy of country.	2
3	**Surveying:** Object, Principles & Types of Surveying; Site Plans, Plans& Maps; Scales & Unit of different Measurements. Linear Measurements: Instruments used. Linear Measurement by Tape, Ranging out Survey Lines and overcoming Obstructions; Measurements on sloping ground; Tape corrections, conventional symbols. Angular Measurements: Instruments used; Introduction to Compass Surveying,Bearings and Longitude & Latitude of a Line, Introduction to total station. Levelling: Instrument used, Object of levelling, Methods of levelling in brief, Contour maps.	8
4	**Buildings:** Selection of site for Buildings, Layout of Building Plan, Types of buildings, Plinth area, carpet area, floor space index, Introduction to building byelaws, concept of sun light and ventilation. Components of Buildings & their functions, Basic concept of R.C.C., Introduction to types of foundation.	3
5	**Transportation:** Introduction to Transportation Engineering; Traffic and Road Safety: Types and Characteristics of Various Modes of Transportation; Various Road Traffic Signs, Causes of Accidents and Road Safety Measures.	2
6	**Environmental Engineering:** Environmental Pollution, Environmental Acts and Regulations, Functional Concepts of Ecology, Basics of Species, Biodiversity, Ecosystem, Hydrological Cycle;Chemical Cycles: Carbon, Nitrogen& Phosphorus; Energy Flow in Eco-systems. Water Pollution: Water Quality standards, Introduction to Treatment & Disposal of Waste Water. Reuse and Saving of Water, Rain Water Harvesting.	4 3 2

	Solid Waste Management: Classification of Solid Waste, Collection, Transportation and Disposal of Solid. Recycling of Solid Waste: Energy Recovery,Sanitary Land fill, On-Site Sanitation. Air& Noise Pollution: Primary and Secondary air pollutants, Harmful effects of Air Pollution, Control of Air Pollution. . Noise Pollution, Harmful Effects of noise pollution, control of noise pollution, Global warming& Climate Change, Ozone depletion, Green House effect	**3**
	TOTAL	**28**

1FY2-20/ 2FY2-20: Engineering Physics Lab

Credit: 1 **Max. Marks: 50 (IA:30, ETE:20)**
0L+0T+2P

1. To determine the wave length of monochromatic light with the help of Michelson's interferometer.
2. To determine the wave length of sodium light by Newton's Ring.
3. To determine the wave length of prominent lines of mercury by plane diffraction grating with the help of spectrometer.
4. Determination of band gap using a P-N junction diode.
5. To determine the height of given object with the help of sextant.
6. To determine the dispersive power of material of a prism with the help of spectrometer.
7. To study the charge and discharge of a condenser and hence determine the same constant (both current and voltage graphs are to be plotted.
8. To determine the coherence length and coherence time of laser using He – Ne laser.
9. To measure the numerical aperture of an optical fibre.
10. To study the Hall Effect and determine the Hall Voltage and Hall coefficients.

I & II Semester
Common to all branches of UG Engineering & Technology

1FY2-21/ 2FY2-21: Engineering Chemistry Lab

Credit: 1 **Max. Marks: 50 (IA:30, ETE:20)**
0L+0T+2P

1. Determination the hardness of water by EDTA method
2. Determination of residual chlorine in water
3. Determination of dissolved oxygen in water
4. Determination of the strength of Ferrous Ammonium sulphate solution with the help of $K_2Cr_2O_7$ solution by using diphenyl amine indicator
5. Determination of the strength of $CuSO_4$ solution iodometrically by using hypo solution
6. Determination of the strength of NaOH and Na_2CO_3 in a given alkali mixture
7. Proximate analysis of Coal
8. Determination of the flash & fire point and cloud & pour point of lubricating oil
9. Determination of the kinematic viscosity of lubricating oil by Redwood viscometer no. 1 at different temperature
10. Synthesis of Aspirin/ Paracetamol

I & II Semester
Common to all branches of UG Engineering & Technology

1FY2-22/ 2FY2-22: Language Lab

Credit: 1 **Max. Marks: 50 (IA:30, ETE:20)**
0L+0T+2P

1. Phonetic Symbols and Transcriptions.
2. Extempore.
3. Group Discussion.
4. Dialogue Writing.
5. Listening comprehension.

I & II Semester
Common to all branches of UG Engineering & Technology

1FY2-23/ 2FY2-23: Human Values Activities

Credit: 1 **Max. Marks: 50 (IA:30, ETE:20)**
0L+0T+2P

PS 1:
Introduce yourself in detail. What are the goals in your life? How do you set your goals in your life? How do you differentiate between right and wrong? What have been your salient achievements and shortcomings in your life? Observe and analyze them.

PS 2:
Now-a-days, there is a lot of talk about many technogenic maladies such as energy and material resource depletion, environmental pollution, global warming, ozone depletion, deforestation, soil degradation, etc. - all these seem to be manmade problems, threatening the survival of life Earth - What is the root cause of these maladies & what is the way out in opinion?
On the other hand, there is rapidly growing danger because of nuclear proliferation, arms race, terrorism, breakdown of relationships, generation gap, depression & suicidal attempts etc. - what do you think, is the root cause of these threats to human happiness and peace - what could be the way out in your opinion?

PS 3:
1. Observe that each of us has the faculty of 'Natural Acceptance', based on which one can verify what is right or not right for him. (As such we are not properly trained to listen to our 'Natural Acceptance' and may a time it is also clouded by our strong per-conditioning and sensory attractions).

Explore the following:
(i) What is Naturally Acceptable' to you in relationship the feeling of respect or disrespect for yourself and for others?
(ii) What is 'naturally Acceptable' to you - to nurture or to exploit others?

Is your living in accordance with your natural acceptance or different from it?
2. Out of the three basic requirements for fulfillment of your aspirations - right understanding, relationship and physical facilities - observe how the problems in your family are related to each. Also observe how much time & effort you devote for each in your daily routine.

PS 4:
list down all your important desires. Observe whether the desire is related to Self (I) or the Body. If it appears to be related to both, visualize which part of it is related to Self (I) and which part is related to Body.

PS 5:
1. a. Observe that any physical facility you use, follows the given sequence with time:

Necessary and tasteful - unnecessary but still tasteful - unnecessary and tasteless - intolerable

b. In contrast, observe that any feeling in you is either naturally acceptable or not acceptable at all. If not acceptable, you want it continuously and if not acceptable, you do not want it any moment!

2. List down all your important activities. Observe whether the activity is of 'I' or of

Body or with the participation of both or with the participation of both 'I' and Body.
3. Observe the activities within 'i'. Identify the object of your attention for different moments (over a period of sy 5 to 10 minutes) and draw a line diagram connecting these points. Try observe the link between any two nodes.

PS 6:

1. Chalk out some programs towards ensuring your harmony with the body - in terms of nurturing, protection and right utilization of the body.
2. Find out the plants and shrubs growing in and around your campus, which can be useful in curing common diseases.

PS 7:

Form small groups in the class and make them carry out a dialogue focusing on the following eight questions related to 'TRUST';
1a. Do I want to make myself happy?
2a. Do I want to make the other happy?
3a. Does the other want to make himself/herself happy?
4a. Does the other want to make me happy?
What is the answer?
Intention (Natural Acceptance)
1b. Am I able to always make myself happy?
2b. Am I able to always make the other happy?
3b. Is the other able to always make himself/herself happy?
What is the answer?
Let each student answer the questions for himself and everyone else. Discuss the difference between intention and competence. Observe whether you evaluate yourself and others on the basis of intention/competence.

PS 8:

1. Observe, on how many occasions, you are able to respect your related ones (by doing the right evaluation) and on how many occasions you are disrespecting by way of under-evaluation, over-evaluation or otherwise evaluation.
2. Also, observe whether your feeling of respect is based on treating the other as you would treat yourself or on differentiations based on body, physical facilities or belieds.

PS 9:

1. Write a narration in the form of a story, poem, skit or essay to clarify a salient Human Value to the children.
2. Recollect and narrate an incident in your life where you were able to exhibit willful adherence to balues in a difficult situation.

PS 10:

List down some common units (things) of Nature which you come across in your daily life and classify them in the four orders of Nature. Analysis and explain the aspect of mutual fulfillment of each unit with other orders.

PS 11:

Make a chart to show the whole existence as co-existence. With the help of this chart try to identify the role and the scope of some of the courses of your study. Also indicate the areas which are being either over-emphasized or ignored in the present context.

PS 12:

Identify any two important problems being faced by the society today and analyze the root cause of these problems. Can these be solved on the basic of natural acceptance of human values. If so, how should one proceed in this direction from

the present situation?

PS 13:

1. Suggest ways in which you can use your knowledge of Science/Technology/Management etc. for moving towards a universal human order.
2. Propose a broad outline for humanistic Constitution at the level of Nation.

PS 14:

The course is going to be over now. It is time to evaluate what difference in your thinking it has made. Summarize the core massage of this course grasped by you. How has this affected you in terms of;

a. Thought
b. Behavior
c. Work and
d. Relization

What practical steps are you able to visualize for the transition of the society from its present state.

Project:

Every student required to take-up a social project e.g. educating children in needy/weaker section, services in hospitals, NGO's and other such work i.e. social work at villages adopted by respective institute/ college.

I & II Semester
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1FY3-24/ 2FY3-24: Computer Programming Lab

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**
0L+0T+3P

1. To learn about the C Library, Preprocessor directive, Input-output statement.
2. Programs to learn data type, variables, If-else statement
3. Programs to understand nested if-else statement and switch statement
4. Programs to learn iterative statements like while and do-while loops
5. Programs to understand for loops for iterative statements
6. Programs to learn about array and string operations
7. Programs to understand sorting and searching using array
8. Programs to learn functions and recursive functions
9. Programs to understand Structure and Union operation
10. Programs to learn Pointer operations
11. Programs to understand File handling operations
12. Programs to input data through Command line argument

I & II Semester

Common to all branches of UG Engineering & Technology

1FY3-25/ 2FY3-25: Manufacturing Practices Workshop

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**
0L+0T+3P

Carpentry Shop

1. T – Lap joint
2. Bridle joint

Foundry Shop

3. Mould of any pattern
4. Casting of any simple pattern

Welding Shop

5. Lap joint by gas welding
6. Butt joint by arc welding
7. Lap joint by arc welding
8. Demonstration of brazing, soldering & gas cutting

Machine Shop Practice

9. Job on lathe with one step turning and chamfering operations

Fitting and Sheet Metal Shop

10. Finishing of two sides of a square piece by filing
11. Making mechanical joint and soldering of joint on sheet metal
12. To cut a square notch using hacksaw and to drill a hole and tapping

1FY3-26/ 2FY3-26: Basic Electrical Engineering Lab

Credit: 1 **Max. Marks: 50 (IA:30, ETE:20)**
0L+0T+2P

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Transformers: Observation of the no-load current waveform on an oscilloscope. Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
3. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents).Phase-shifts between the primary and secondary side.
4. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
5. Torque Speed Characteristic of separately excited dc motor.
6. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

1FY3-27/ 2FY3-27: Basic Civil Engineering Lab

Credit: 1 **Max. Marks: 50 (IA:30, ETE:20)**
0L+0T+2P

1. Linear Measurement by Tape:
   a) Ranging and Fixing of Survey Station along straight line and across obstacles.
   b) Laying perpendicular offset along the survey line
2. Compass Survey: Measurement of bearing of linesusing Surveyor's and Prismatic compass
3. Levelling: Using Tilting/ Dumpy/ Automatic Level
   a) To determine the reduced levels in closed circuit.
   b) To carry out profile levelling and plot longitudinal and cross sections for road by Height of Instrument and Rise & Fall Method.
4. To study and take measurements using various electronic surveying instruments like EDM, Total Station etc.
5. To determine pH, hardness and turbidity of the given sample of water.
6. To study various water supply Fittings.
7. To determine the pH and total solids of the given sample of sewage.
8. To study various Sanitary Fittings.

1FY3-28/ 2FY3-28: Computer Aided Engineering Graphics

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**
0L+0T+3P

Introduction: Principles of drawing, lines, type of lines, usage of Drawing instruments, lettering, Conic sections including parabola, hyperbola, Rectangular Hyperbola (General method only); Scales-Plain, Diagonal and Vernier Scales.

Projections of Point & Lines: Position of Point, Notation System, Systematic Approach for projections of points, front view & Top view of point, Position of straight lines, line parallel to Both the RPs, Line perpendicular to either of the RPs, Line inclined to one RP and parallel to the other, Line inclined to Both the RPs, Traces of a line (One drawing sheet, one assignment in sketch book).

Projection of Planes: Positions of planes, Terms used in projections of planes, plane parallel to RP, plane inclined to one RP and perpendicular to the other RP, plane perpendicular to Both the RPs, plane Inclined to Both the RPs, True shape of the plane, Distance of a point from plane, Angle between two planes.

Projections of Regular Solids: frustum and truncated solids, those inclined to both the Planes-Auxiliary Views.

Section of Solids: Theory of sectioning, section of prisms and cubes, section of pyramids and Tetrahedron section of Cylinders, section of cones, section of spheres (One drawing sheet, one assignment in sketch book)

Overview of Computer Graphics : Covering theory of CAD software [such as: The menu System, Toolbars (standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.: Isometric Views of lines, Planes, Simple and compound Solids.

1FY3-29/ 2FY3-29: Computer Aided Machine Drawing

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**
0L+0T+3P

Introduction: Principles of drawing, conventional representation of machine components and materials, lines, types of lines, dimensioning types, rules of dimensioning.

Conversion of pictorial views into orthographic views: (1 drawing sheet) Introduction to orthographic projection, concept of first angle and third angle projection, drawing of simple machine elements in first angle projection, missing view problems covering Principles of Orthographic Projections.

Sectional views of mechanical components: (1 drawing sheet) Introduction, cutting plane line, type of sectional views-full section, half section, partial or broken section, revolved section, removed section, offset section, sectioning conventions-spokes, web rib, shaft, pipes, different types of holes, conventions of section lines for different metals and materials.

Fasteners and other mechanical components: (Free hand sketch) Temporary and permanent fasteners, thread nomenclature and forms, thread series, designation, representation of threads, bolted joints, locking arrangement of nuts, screws, washers, foundation bolts etc., keys, types of keys, cotter and knuckle joints. Riveted joints, rivets and riveting, type of rivets, types of riveted joints etc. Bearing: Ball, roller, needle, foot step bearing. Coupling: Protected type, flange, and pin type flexible coupling. Other components: Welded joints, belts and pulleys, pipes and pipe joints, valves etc.

Overview of Computer Graphics: (2 drawing sheets) Covering theory of CAD software such as: The menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Command Line (Where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.: Isometric Views of Lines, Planes, Simple and compound Solids.

II Semester

Common to all branches of UG Engineering & Technology

2FY2-01: Engineering Mathematics-II

Credit: 4 **Max. Marks: 200 (IA:40, ETE:160)**

3L+1T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Matrices:** Rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.	10
2	**First order ordinary differential equations:** Linear and Bernoulli's equations, Exact equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.	6
3	**Ordinary differential equations of higher orders:** Linear Differential Equations of Higher order with constant coefficients, Simultaneous Linear Differential Equations, Second order linear differential equations with variable coefficients: Homogenous and Exact forms, one part of CF is known, Change of dependent and independent variables, method of variation of parameters, Cauchy-Euler equation; Power series solutions including Legendre differential equation and Bessel differential equations.	12
4	**Partial Differential Equations – First order:** Order and Degree, Formation; Linear Partial differential equations of First order, Lagrange's Form, Non Linear Partial Differential equations of first order, Charpit's method, Standard forms.	6
5	**Partial Differential Equations– Higher order:** Classification of Second order partial differential equations, Separation of variables method to simple problems in Cartesian coordinates including two dimensional Laplace, one dimensional Heat and one dimensional Wave equations.	6
	TOTAL	**40**

SEMESTER-III to VIII

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	120	**150**	**3**
2	HSMC	3ME1-02/ 3ME1-03	Technical Communication/ Managerial Economics and Financial Accounting	2	0	0	2	20	80	**100**	**2**
3	ESC	3ME3-04	Engineering Mechanics	2	0	0	2	20	80	**100**	**2**
4	PCC	3ME4-05	Engineering Thermodynamics	3	0	0	3	30	120	**150**	**3**
5		3ME4-06	Materials Science and Engineering	3	0	0	3	30	120	**150**	**3**
6		3ME4-07	Mechanics of Solids	3	1	0	3	40	160	**200**	**4**
			Sub Total	16	1	0		170	680	**850**	**17**
PRACTICAL & SESSIONAL											
7	PCC	3ME4-21	Machine drawing practice	0	0	3		45	30	**75**	**1.5**
8		3ME4-22	Materials Testing Lab	0	0	3		45	30	**75**	**1.5**
9		3ME4-23	Basic Mechanical Engineering Lab	0	0	3		45	30	**75**	**1.5**
10		3ME4-24	Programming using MATLAB	0	0	3		45	30	**75**	**1.5**
11	PSIT	3ME7-30	Industrial Training	0	0	1		0	0	**50**	**1**
12	SODECA	3ME8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0		0	0	**25**	**0.5**
			Sub- Total	0	0	13		180	120	**375**	**7.5**
			TOTAL OF III SEMESTER	16	1	13		350	800	**1225**	**24.5**

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

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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	20	80	**100**	**2**
2	HSMC	4ME1-03/ 4ME1-02	Managerial Economics and Financial Accounting/ Technical Communications	2	0	0	2	20	80	**100**	**2**
3	ESC	4ME3-04	Digital Electronics	2	0	0	2	20	80	**100**	**2**
4	PCC	4ME4-05	Fluid Mechanics and Fluid Machines	3	1	0	3	40	160	**200**	**4**
5		4ME4-06	Manufacturing Processes	3	0	0	3	30	120	**150**	**3**
6		4ME4-07	Theory of machines	3	1	0	3	40	160	**200**	**4**
			Sub Total	15	2	0		170	680	**850**	**17**
PRACTICAL & SESSIONAL											
7	PCC	4ME3-21	Digital Electronics lab	0	0	3		45	30	**75**	**1.5**
8		4ME4-22	Fluid Mechanics lab	0	0	3		45	30	**75**	**1.5**
9		4ME4-23	Production practice lab	0	0	3		45	30	**75**	**1.5**
10		4ME4-24	Theory of machines Lab	0	0	3		45	30	**75**	**1.5**
11	SODECA	4ME8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0		0	0	**25**	**0.5**
			Sub- Total	0	0	12		180	120	**325**	**6.5**
			TOTAL OF IV SEMESTER	15	2	12		350	800	**1175**	**23.5**

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Office of Dean Academic Affairs
Rajasthan Technical University, Kota

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Teaching & Examination Scheme
B.Tech. : Mechanical Engineering
3rd Year –V Semester

SN	Category	Course		Contact hrs/week			Marks				Cr
		Code	Title	L	T	P	Exm Hrs	IA	ETE	Total	
THEORY											
1	ESC	5ME3-01	Mechatronic Systems	2	0	0	2	20	80	**100**	**2**
2	PCC/ PEC	5ME4-02	Heat Transfer	3	0	0	3	30	120	**150**	**3**
3		5ME4-03	Manufacturing Technology	3	0	0	3	30	120	**150**	**3**
4		5ME4-04	Design of Machine Elements I	3	0	0	3	30	120	**150**	**3**
5		5ME4-05	Principles of Management	2	0	0	2	20	80	**100**	**2**
6		Professional	Elective I (any one)	3	0	0	3	30	120	**150**	**3**
		5ME5-11	Steam Engineering								
		5ME5-12	Automobile Engineering								
		5ME5-13	Non Destructive Evaluation & Testing								
		Sub Total		**16**	**0**	**0**		**160**	**640**	**800**	**16**
PRACTICAL & SESSIONAL											
7	ESC	5ME3-21	Mechatronic Lab	0	0	2	2	30	20	**50**	**1**
8	PCC	5ME4-22	Heat Transfer lab	0	0	2	2	30	20	**50**	**1**
9		5ME4-23	Production Engineering Lab	0	0	2	2	30	20	**50**	**1**
10		5ME4-24	Machine Design Practice I	0	0	2	2	30	20	**50**	**1**
11	PSIT	5ME7-30	Industrial Training	0	0	1	1	75	50	**125**	**2.5**
12	SODECA	5ME8-00	Social Outreach, Discipline & Extra Curricular Activities						25	**25**	**0.5**
		Sub- Total		**0**	**0**	**9**		**195**	**155**	**350**	**7**
		TOTAL OF V SEMESTER		**16**	**0**	**9**		**355**	**795**	**1150**	**23**

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Office of Dean Academic Affairs
Rajasthan Technical University, Kota

Teaching & Examination Scheme
B. Tech.: Mechanical Engineering
3rd Year – VI Semester

SN	Category	Course Code	Course Title	Contact hrs/week L	T	P	Marks Exm Hrs	IA	ETE	Total	Cr
THEORY											
1	ESC	6ME3-01	Measurement and Metrology	2	0	0	2	20	80	**100**	**2**
2	PCC/ PEC	6ME4-02	CIMS	3	0	0	3	30	120	**150**	**3**
3		6ME4-03	Mechanical Vibrations	3	0	0	3	30	120	**150**	**3**
4		6ME4-04	Design of Machine Elements II	3	0	0	3	30	120	**150**	**3**
5		6ME4-05	Quality Management	3	0	0	3	30	120	**150**	**3**
6		Professional	Elective II (any one)	3	0	0	3	30	120	**150**	**3**
		6ME5-11	Refrigeration and Air Conditioning								
		6ME5-12	NON Conventional Machining Methods								
		6ME5-13	MEMS and Microsystems								
		Sub Total		**17**	**0**	**0**		**170**	**680**	**850**	**17**
PRACTICAL & SESSIONAL											
7	PCC	6ME4-21	CIMS Lab	0	0	3	3	45	30	**75**	**1.5**
8		6ME4-22	Vibration Lab	0	0	3	3	45	30	**75**	**1.5**
9		6ME4-23	Machine Design Practice II	0	0	3	3	45	30	**75**	**1.5**
10		6ME4-24	Thermal Engineering Lab I	0	0	3	3	45	30	**75**	**1.5**
11	SODECA	6ME8-00	Social Outreach, Discipline & Extra Curricular Activities						25	**25**	**0.5**
		Sub- Total		**0**	**0**	**12**		**180**	**145**	**325**	**6.5**
		TOTAL OF VI SEMESTER		**17**	**0**	**12**		**350**	**825**	**1175**	**23.5**

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Office of Dean Academic Affairs
Rajasthan Technical University, Kota

Teaching & Examination Scheme
B.Tech.: Mechanical Engineering
4th Year – VII Semester

SN	Category	Course		Contact hrs/week			Marks				Cr
		Code	Title	L	T	P	Exm Hrs	IA	ETE	Total	
THEORY											
1	PEC	7ME5-11	I. C. Engines	3	0	0	3	30	120	**150**	**3**
2		7ME5-12	Operations Research								
3		7ME5-13	Turbomachines								
4	OE		Open Elective-I	3	0	0	3	30	120	**150**	**3**
			Sub Total	**6**	**0**	**0**		**60**	**240**	**300**	**6**
PRACTICAL & SESSIONAL											
5	PCC	7ME4-21	FEA Lab	0	0	3	3	45	30	**75**	**1.5**
6		7ME4-22	Thermal Engineering Lab II	0	0	3	3	45	30	**75**	**1.5**
7		7ME4-23	Quality Control Lab	0	0	2	2	30	20	**50**	**1**
8	PSIT	7ME7-30	Industrial Training *	1	0	0	1	75	50	**125**	**2.5**
9		7ME7-40	Seminar *	2	0	0	2	60	40	**100**	**2**
10	SODECA	7ME8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0		0	25	**25**	**0.5**
			Sub- Total	**3**	**0**	**8**		**255**	**195**	**450**	**9**
			TOTAL OF VII SEMEESTER	**9**	**0**	**8**		**315**	**435**	**750**	**15**

*for the purpose of counting teaching load

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Office of Dean Academic Affairs
Rajasthan Technical University, Kota

Teaching & Examination Scheme
B.Tech.: Mechanical Engineering
4th Year – VIII Semester

SN	Category	Course		Contact hrs/week			Marks				Cr
		Code	Title	L	T	P	Exm Hrs	IA	ETE	Total	
THEORY											
1	PEC	8ME5-11	Hybrid and Electric Vehicles	3	0	0	3	30	120	**150**	**3**
2		8ME5-12	Supply and Operations Management								
3		8ME5-13	Additive Manufacturing								
4	OE		Open Elective - II	3	0	0	3	30	120	**150**	**3**
			Sub Total	**6**	**0**	**0**		**60**	**240**	**300**	**6**
PRACTICAL & SESSIONAL											
5	PCC	8ME4-21	Industrial Engineering Lab	0	0	2	2	30	20	**50**	**1**
6		8ME4-22	Metrology Lab	0	0	2	2	30	20	**50**	**1**
7	PSIT	8ME7-50	Project *#	3	0	0	3	210	140 #	**350**	**7**
8	SODECA	8ME8-00	Social Outreach, Discipline & Extra Curricular Activities	0	0	0		0	25	**25**	**0.5**
			Sub- Total	**3**	**0**	**4**		**270**	**205**	**475**	**9.5**
			TOTAL OF VIII SEMEESTER	**9**	**0**	**4**		**330**	**445**	**775**	**15.5**

*for the purpose of counting teaching load

#Evaluation by one internal and one external examiner (External examiner will preferably be from Industry)

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

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Office of Dean Academic Affairs
Rajasthan Technical University, Kota

List of Open Electives for Mechanical Engineering			
Subject Code	**Title**	**Subject Code**	**Title**
Open Elective - I		**Open Elective - II**	
7AG6-60.1	Human Engineering and Safety	8AG6-60.1	Energy Management
7AG6-60.2	Environmental Engineering and Disaster Management	8AG6-60.2	Waste and By-product Utilization
7AN6-60.1	Aircraft Avionic System	8AN6-60.1	Finite Element Methods
7AN6-60.2	Non-Destructive Testing	8AN6-60.2	Factor of Human Interactions
7CH6-60.1	Optimization Techniques	8CH6-60.1	Refinery Engineering Design
7CH6-60.2	Sustainable Engineering	8CH6-60.2	Fertilizer Technology
7CR6-60.1	Introduction to Ceramic Science & Technology	8CR6-60.1	Electrical and Electronic Ceramics
7CR6-60.2	Plant, Equipment and Furnace Design	8CR6-60.2	Biomaterials
7CE6-60.1	Environmental Impact Analysis	8CE6-60.1	Composite Materials
7CE6-60.2	Disaster Management	8CE6-60.2	Fire and Safety Engineering
7CS6-60.1	Quality Management/ISO 9000	8CS6-60.1	Big Data Analytics
7CS6-60.2	Cyber Security	8CS6-60.2	IPR, Copyright and Cyber Law of India
7EE6-60.1	Electrical Machines and Drives	8EE6-60.1	Energy Audit and Demand side Management
7EE6-60.2	Power Generation Sources.	8EE6-60.2	Soft Computing
7EC6-60.1	Principle of Electronic communication	8EC6-60.1	Industrial and Biomedical applications of RF Energy
7EC6-60.2	Micro and Smart System Technology	8EC6-60.2	Robotics and control
7MI6-60.1	Rock Engineering	8MI6-60.1	Experimental Stress Analysis
7MI6-60.2	Mineral Processing	8MI6-60.2	Maintenance Management
7PE6-60.1	Pipeline Engineering	8PE6-60.1	Unconventional Hydrocarbon Resources
7PE6-60.2	Water Pollution control Engineering	8PE6-60.2	Energy Management & Policy
7TT6-60.1	Technical Textiles	8TT6-60.1	Material and Human Resource Management
7TT6-60.2	Garment Manufacturing Technology	8TT6-60.2	Disaster Management

Office of Dean Academic Affairs
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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

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

3ME2-01: ADVANCE ENGINEERING MATHEMATICS-I

Credit: 3 **Max. Marks: 150 (IA:30, ETE:120)**

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**

Office of Dean Academic Affairs
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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:20, ETE:80)**

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

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

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

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**

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

Office of Dean Academic Affairs
Rajasthan Technical University, Kota

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

SYLLABUS

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

3ME3-04: ENGINEERING MECHANICS

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**

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**

3ME3-04: ENGINEERING MECHANICS

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**
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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3ME4-05 : ENGINEERING THERMODYNAMICS

Credit: 3 **Max. Marks: 150 (IA:30, ETE:120)**

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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SYLLABUS

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

3ME4-06 : MATERIAL SCIENCE AND ENGINEERING

Credit: 3 **Max. Marks: 150 (IA:30, ETE:120)**

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

	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

SYLLABUS

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

3ME4-07 : MECHANICS OF SOLIDS

Credit: 4 **Max. Marks: 200 (IA:40, ETE:160)**

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**

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3ME4-21 : MACHINE DRAWING PRACTICE

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**

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

3ME4-22 : MATERIALS TESTING LAB

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**

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: 75 (IA:45, ETE:30)**

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.

3ME4-24: PROGRAMMING USING MATLAB

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**
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

4ME2-01: DATA ANALYTICS

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**

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:20, ETE:80)**
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

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

Credit: 2 **Max. Marks: 100 (IA:20, ETE:80)**

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:20, ETE:80)**
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

4ME4-05: FLUID MECHANICS AND FLUID MACHINES

Credit: 4 **Max. Marks: 200 (IA:40, ETE:160)**

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: 150 (IA:30, ETE:120)**
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: 200 (IA:40, ETE:160)**
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

4ME3-21: DIGITAL ELECTRONICS LAB

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**
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

4ME4-22: FLUID MECHANICS LAB

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**
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.

4ME4-23: PRODUCTION PRACTICE LAB

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**
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.

4ME4-24: THEORY OF MACHINES LAB

Credit: 1.5 **Max. Marks: 75 (IA:45, ETE:30)**
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.

5ME3-01: MECHATRONIC SYSTEMS

Credit: 2 **Max. Marks: 100(IA: 20, ETE:80)**

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

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5ME4-02: HEAT TRANSFER

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **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-Dimensoinal 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

5ME4-03: MANUFACTURING TECHNOLOGY

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **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

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

5ME4-04: DESIGN OF MACHINE ELEMENTS – I

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **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

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

5ME4-05: PRINCIPLES OF MANAGEMENT

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 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, Entrepreneuring, 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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3rd Year - V Semester: B.Tech. : Mechanical Engineering

5ME5-11: STEAM ENGINEERING

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **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
	TOTAL	**41**

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

5ME4-12: AUTOMOBILE ENGINEERING

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **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
	TOTAL	41

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

5ME5-13: NON DESTRUCTIVE EVALUATION AND TESTING

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **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

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5ME3-21: MECHATRONICS LAB.

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**

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

SN	NAME OF EXPERIMENT
1	Using Transducers Kit :- • Characteristics of LVDT • Principle & Characteristics of Strain Gauge • Characteristics of Summing Amplifier • Characteristics of Reflective Opto Transducer
2	Mobile Robot • 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 • 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 • 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. • Mini project can be integration of sensor, actuator and transduction units for various home and office applications.

5ME4-22: HEAT TRANSFER LAB.

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**

0L+0T+2P **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.
	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. • Heat exchanger design for different applications, designing for thermal insulation, Use of relevant BIS codes for designing

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5ME4-23: PRODUCTION ENGINEERING LAB.

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**

0L+0T+2P **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.
	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. • Fabrication of an assembly in which parts shall be machined and standard parts shall be procured.

5ME4-24: MACHINE DESIGN PRACTICE - I

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**

0L+0T+2P **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. • Design and analysis of simple mechanical systems/products

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

6ME3-01: MEASUREMENT and METROLOGY

Credit: 2 **Max. Marks: 100(IA:20, ETE:80)**

2L+0T+0P **End Term Exam: 2 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. Temperature measurement, Bimetallic strip, Thermocouples (Thermo electric effects), Thermistors, Pyrometers	3
	TOTAL	**28**

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Syllabus

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

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

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **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
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3rd Year - VI Semester: B.Tech. : Mechanical Engineering

6ME4-03: MECHANICAL VIBRATIONS

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **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
	TOTAL	**41**

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

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

6ME4-04: DESIGN OF MACHINE ELEMENTS- II

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **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
	TOTAL	**41**

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6ME4-05: QUALITY MANAGEMENT

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **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
	TOTAL	**41**

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6ME5-11: REFRIGERATION AND AIR CONDITIONING

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **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, psychometric relations, pyschrormetric charts, psychrometric processes, cooling coils, By-pass 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
	TOTAL	**41**

Office of Dean Academic Affairs
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6ME5-12: NON CONVENTIONAL MACHINING METHODS

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **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

Office of Dean Academic Affairs
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6ME5-13: MICRO ELECTRO AND MECHANICAL SYSTEMS (MEMS) and MICROSYSTEMS

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **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, moleculat 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 dyanimics, 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
	TOTAL	**41**

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6ME4-21: CIMS LAB.

Credit: 1.5 **Max. Marks: 75(IA:45, ETE:30)**

0L+0T+3P **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.
	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. • Engraving of students' name, manufacturing of a part.

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

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

6ME4-22: VIBRATION LAB.

Credit: 1.5 **Max. Marks: 75(IA:45, ETE:30)**

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

SN	NAME OF EXPERIMENT
1	To verify relation T = 2π (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	Harmonicaly 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	Harmonicaly 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. • Design of vibration system, measurement of vibration, FFT analysis using MATLAB

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

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

6ME4-23: MACHINE DESIGN PRACTICE – II

Credit: 1.5 **Max. Marks: 75(IA:45, ETE:30)**

0L+0T+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. • Design of assembly (mechanical systems) using various BIS codes/data book

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RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

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

6ME4-24: THERMAL ENGINEERING LAB-1

Credit: 1.5 **Max. Marks: 75(IA:45, ETE:30)**

0L+0T+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
	Important Note: • 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.

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7ME5-11: I. C. Engines

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**History of IC engines:** Nomenclature, Classification & Comparison, SI & CI, 4stroke- 2 stroke, First Law analysis, Energy Balance. Fuel-air cycles, Actual cycles.	4
3	**Testing & Performance:** Performance parameters, Measurement of operating parameters e.g. speed, fuel & air consumption, Powers, IHP, BHP, FHP, Efficiencies Thermal, Mechanical, Volumetric, Emission Measurement, Indian & International standards of Testing, Emission.	4
4	**Fuel & Combustion:** Combustion in CI & SI engines, Ignition Limits, Stages of combustion, Combustion parameters. Delay period and Ignition Lag, Turbulence and Swirl, Effects of engine variables on combustion parameters, abnormal combustion in CI & SI engines, Detonation & knocking, Theories of detonation, Control of abnormal combustion, Combustion chamber design principles, Types of combustion chamber.	4
5	**Alternative Fuels:** Methanol, Ethanol, Comparison with gasoline, Manufacturing, Engine performance with pure Methanol, Ethanol & blends, Alcohols with diesel engine, Vegetable oils, Bio gas.	2
6	**Engine Systems & Components:** Fuel System (SI Engine), Carburetion & Injection, process & parameters, properties of A/F mixture, Requirements of A/F ratios as per different operating conditions, Carburettors, types, Aircraft carburettor, comparison of carburetion & injection, F/A ratio calculations.	4
7	**CI engine:** Mixture requirements & constraints, Method of injection, Injection systems, CRDI etc. system components, pumps injectors.	3
8	**Ignition system:** Conventional & Modern ignition systems Magneto v/s Battery, CB point v/s Electronic ignition, Fuel Ignition Energy requirements. Spark advance, centrifugal, vacuum Firing order, spark plugs.	3
9	**Engine Friction & Lubrication:** Determination of friction, Lubrication principles, Types of lubrication, Places of lubrication Bearings and piston rings etc., Functions of Lubrication, Properties, Rating and Classification of lubricating oil, Additives, Lubrication systems. Engine Cooling: Requirements of cooling, Areas of heat flow, High temperature regions of combustion chamber. Heat Balance, Cooling Systems, Air, Water Cooling, Cooling system components.	5

10	**Supercharging:** Objectives, Thermodynamic cycle & performance of super charged SI & CI engines, Methods of super charging, Limitations, Two stroke engines: Comparison of 4s & 2s engines construction & valve lining scavenging. Process parameters, systems, supercharging of 2 stroke engines.	**5**
11	**Dual & Multi fuel engines:** Principle, fuels, Combustion, performance Advantages, Modification in fuel system.	**3**
12	**Special Engines:** Working principles of Rotary, Stratified charge, Free piston, Variable compression ratio engines.	**2**
	Total	**40**

TEXT BOOK	
1	Mathur and Sharma, Internal Combustion Engines, Dhanpat Rai & Sons
REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**
1	Gupta H.N., Fundamentals of Internal Combustion Engines, Prentice Hall of India
2	F. EdwardObert, Internal Combustion Engines, Harper and Raw Publisher
3	John B. Heyword, Internal Combustion Engines Fundamentals, McGraw Hill
4	Lichty, Internal Combustion Engines, McGraw Hill.
5	Gill, Smith, Ziurs, Fundamentals of Internal Combustion Engines, Oxford & IBH Publishing
6	Rogowsky, IC Engines, International Book Co.
7	Ganeshan V., Internal Combustion Engines, Tata McGraw Hill.
8	R. Yadav, I.C. Engines, Central Publishing House, Allahabad

7ME5-12: OPERATIONS RESEARCH

Credit:3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Overview of Operations Research**	1
3	**Linear Programming**: Applications and model formulation, Graphical method, Simplex method, duality and Sensitivity analysis.	4
4	Transportation Model and Assignment Model including travelling salesman problem.	4
5	**Integer Linear Programming:** Enumeration and cutting Plane solution concept, Gomory's all integer cutting plane method, Branch and Bound Algorithms, applications of zero-one integer programming.	5
6	**Replacement Models:** Capital equipment replacement with time, group replacement of items subjected to total failure.	3
7	**Queuing Theory**: Analysis of the following queues with Poisson pattern of arrival and exponentially distributed service times, Single channel queue with infinite customer population, Multichannel queue with infinite customer population,	3
8	**Competitive Situations and Solutions**: Game theory, two person zero sum game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy, approximate solution, and simplified analysis for other competitive situations. Application of linear programming	4
9	Theory of Decision making: Decision making under certainty, risk and uncertainty. Decision trees.	3
10	**Deterministic Inventory control models:** functional role of inventory, inventory costs, model building, Single item inventory control model without shortages, with shortage and quantity discount. Inventory control model with uncertain demand, service level, safety stock, P and Q systems, two bin system. Single period model. Selective Inventory control techniques.	4
11	**Probabilistic Inventory control models:** Instantaneous demand without setup cost and with setup cost, Continuous demand without setup cost	4
12	**Simulation**: Need of simulation, advantages and disadvantages of simulation method of simulation. Generation of Random numbers, Generation of Normal Random numbers. Use of random numbers for system simulation. , Monte Carlo simulation, simulation language ARENA, Application of simulation for solving queuing Inventory Maintenance, Scheduling and other industrial problems	4
	Total	40

TEXT BOOK	
1	Operations Research, Ravindran, Phillips and Solberg, Wiley India.
2	Operations Research, Gupta and Heera, S. Chand Publications.
REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**
1	Introduction to Operations Research, Hillier F.S. and Lieberman G.J., CBS Publishers.
2	Operations Research, Taha H.A., Pearson Education
3	Linear Programming and Network Flows, Bazaraa, Jarvis and Sherali, Wiley India.
4	Principles of Operations Research, Wagner H.M., Prentice Hall of India.

7ME5-13: TURBOMACHINES

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	01
2	**Basic Concepts of Turbo Machines:** Definition & classification of Turbo machine, Basic laws and governing equations: continuity equation, steady flow energy equation(1st law of thermodynamics),2nd law of thermodynamics applied to turbo machines, Newton's 2nd law of motion applied to turbomachines - Euler's pump equation and Euler's turbine equation	4
3	Dimensional analysis applied to hydraulic machines, power coefficient, flow coefficient, head coefficient, non-dimensional specific speed, Range of specific speeds for various turbo machines, Dimensional analysis applied to compressible flow machines, pressure ratio as a Function of temperature ratio, mass flow rate parameter and speed parameter	3
4	**Centrifugal Compressors and Fans:** Components and description, velocity iagrams, slip factor, energy transfer, power input factor, stage pressure rise and loading coefficient, pressure coefficient, degree of reaction, Centrifugal compressor characteristic, surging, rotating Stall and Choking	8
5	**Axial Flow Compressors and Fans:** Basic constructional features, Advantages of axial flow compressors, working principle, velocity triangle, elementary theory, stage work, work done factor, stage loading, degree of reaction; vortex theory, simple design calculations, introduction to blade design, cascade test, compressibility effects, operating characteristics	8
6	**Reciprocating Compressors:** Basic constructional features, working principle, work done calculation, single and double acting compressors	4
7	**Centrifugal Pumps:** Main parts, work done and velocity triangles, slip and slip factor, pump losses and efficiencies, minimum starting speed, net positive suction head, performance curve.	4
8	**Axial Flow Pumps:** Description, velocity triangles, work done on the fluid, energy transfer, axial pump characteristics, cavitation.	4
9.	**Reciprocating Pumps:** Classification, component and working, single acting and double acting, discharge, work done and power required, coefficient of discharge, indicator diagram, slip, effect of friction and acceleration, theory of air vessels.	4
	Total	40

TEXT BOOK	
1	Gas turbines, V. Ganesan, Tata McGraw-Hill
2	Hydraulic Machines, Subramanya, K., Tata McGraw Hill
REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**
1	Principle of Turbo Machinery, Turton R.K., Springer Publication
2	Fundamentals of Turbo Machinery, William W., John Wiley and Sons.
3	Turbo Machinery Basic Theory and Application, Logan E.J.
4	Principles of Turbo Machinery, Shepherd Dennis G., Mac Millan Pub, N.York.
5	TurboMachines, A ValanArasu, Vikas Publishing House Pvt. Ltd.
7	Gas turbine theory, Cohen and Saravanamutto, Pearson Educational Pub.
8	Hydraulic Machines: Turbines and Pumps, Nazarov N.T., Springer New York.
9	Gas Turbine Theory, Cohen and Roger, Pearson Education.
10	Hydraulic Machinery, Jagdish Lal, Metropolitan Books.

7ME4-21: FEA LAB

Credit: 1.5 **Max. Marks: 75(IA:45, ETE:30)**
0L+0T+3P **End Term Exam: 3 Hours**

SN	List of Experiments
1	Laboratory work for the solution of solid mechanics problems, heat transfer problems, and free vibration problems
A: by using FE packages such as NASTRAN/ANSYS/SIMULIA/ABAQUS	
2	Introduction of GUI of the software in the above mentioned areas' realistic problems.
3	Analysis of beams and frames (bending and torsion problems)
4	Plane stress and plane strain analysis problems
5	Problems leading to analysis of axisymmetric solids
6	Problems leading to analysis of three dimensional solids (a) Heat transfer problems (b) Modal analysis problem
B: by writing own code for finite element analysis using MATLAB for:	
7	Plane stress and plane strain analysis problems
8	Modal Analysis problem

7ME4-22: Thermal Engineering Lab-II

Credit: 1.5 **Max. Marks: 75(IA:45, ETE:30)**
0L+0T+3P **End Term Exam: 3 Hours**

SN	List of Experiments
1	To perform constant speed load test on a single cylinder diesel engine and to plot performance curves: indicated thermal efficiency, brake thermal efficiency, mechanical efficiency Vs. Brake power and heat balance sheet.
2	To estimate the Indicated Power, Friction Power and Mechanical Efficiency of a multi-cylinder Petrol Engine. (Morse Test)
3	Analysis of engine exhaust gases using Orsat apparatus /Engine gas analyzer.
4	Determination of coefficient of performance of Refrigeration cycle and tonnage capacity of refrigeration unit.
5	To determine the COP and tonnage capacity of a Mechanical heat pump.
6	To study various controls used in Refrigeration and Air conditioning system.
7	Study of commercial Refrigeration equipments like cooling towers, hermetically sealed compressors, automotive swash plate compressor etc.
8	To study automotive air conditioning system.
9	Determination of dryness fraction of steam.
10	Study and Performance of Simple Steam Turbine
11	Performance characteristics of Hydraulic turbines.
12	Study and Performance of Gas Turbine Plant.
13	Performance characteristics of variable and rated speed centrifugal pump.

7ME4-23: Quality Control Lab

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**
0L+0T+2P **End Term Exam: 2 Hours**

SN	List of Experiments
1	Case study on X bar chart and R chart of an industrial process output and process capability analysis of the process. The charts are to be drawn and calculations of process capability analysis to be reported.
2	p Chart: (a)To verify the Binomial Distribution of the number of defective balls by treating the balls with a red colour to be defective. (b) To plot a p -chart by taking a sample of n=20 and establish control limits
3	Case study on C-chart of a product and establish control limits.
4	Operating Characteristics Curve: (a) To plot the operating characteristics curve for single sampling attribute plan for n = 20; c = 1, 2, 3. Designate the red ball as defective. (b) To compare the actual O.C. curve with theoretical O.C. curve using approximation for the nature of distribution
5	Distribution Verification: (a) To verify Normal Distribution using the experimental setup. (b) To find the distribution of numbered cardboard chips by random drawing one at a time with replacement. Make 25 subgroups in size 5 and 10 find the type of distribution of sample average in each case. Comment on your observations
6	To carry out verification of Poisson distribution using experimental set up.
7	Central Limit Theorem: (a) To show that a sample means for a normal universe follow a normal distribution (b) To show that the sample means for a non normal universe also follow a normal Distribution.
8	Solve quality control problems using SPC software like STATGRAPHICS/MINITAB/SIGMA XL /SYSTAT/EXCEL etc.
	Important Note: It is mandatory for every student to undertake a Case Study. The case study shall be of real problem involving quality issues preferably from local industry whose quality issues shall be solved using seven magnificent tools of SQC and other techniques of quality control. Case study shall be a group activity. A group shall consist of maximum five students. Final evaluation shall include 30% weight age to case study.

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8ME5-11: Hybrid and Electric Vehicles

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	**Introduction to Hybrid Electric Vehicles:** History of hybrid and electric vehicles, environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.	5
3	**Conventional Vehicles:** Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.	4
4	**Hybrid Electric Drive-trains:** Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	6
5	**Electric Drive-trains:** Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electricdrive-train topologies, fuel efficiency analysis.	6
6	**Electric Propulsion unit:** Introduction to electric components used inhybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives	6
7	**Energy Storage:** Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.	6
8	**Sizing the drive system:** Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology	6
	Total	40

TEXT BOOK	
1	Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press
REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**
1	James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley
2	Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press

8ME5-12: SUPPLY AND OPERATIONS MANAGEMENT

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	Introduction to operations management (OM), the scope of OM; Historical evolution of OM; Trends in business; the management process. Operations Strategy, Competitiveness and Productivity	4
3	Demand Forecasting: components of forecasting demand, Approaches to forecasting: forecasts based on judgment and opinion, Time series data. Associative forecasting techniques, Accuracy and control of forecasts, Selection of forecasting technique.	4
4	Product and Service design, Process selection, Process types, Product and process matrix, Process analysis.	5
5	Capacity Planning: Defining and measuring capacity, determinants of effective capacity, capacity strategy, steps in capacity planning process, determining capacity requirements, Capacity alternatives, Evaluation of alternatives; Cost-Volume analysis.	5
6	Facility Location: Need for location decisions, factors affecting location, qualitative and quantitative techniques of location. Facilities layout: Product, Process, Fixed position, combination and cellular layouts; line balancing. Material Handling	5
7	Planning levels: long range, Intermediate range and Short range planning, Aggregate planning: Objective, Strategies, and techniques of aggregate planning. Master scheduling; Bill of materials, MRP; inputs processing and outputs, and overview of MRPII , use of MRP to assist in planning capacity requirements, Introduction to ERP	4
8	Techniques of production control in job shop production, batch production and mass production systems. sequencing: priority rules, sequencing jobs through two work centers, scheduling services	4
9	Introduction to Just-in-time (JIT) and Lean Operations: JIT production, JIT scheduling, synchronous production, Lean operations system	4
10	Supply Chain Management (SCM): Need of SCM, Bullwhip effect, Elements of SCM, Logistics steps in creating effective supply chain, Purchasing and supplied management.	4
	Total	40

TEXT BOOK	
1	Stevenson, Operations Management, Tata McGraw Hill.
REFERENCE BOOKS	
SN	**Name of Authors /Books /Publisher**
1	Roberta S. Russell, Bernard W. Taylor, Operations Management, John Wiley
2	Joseph S. Martinich, Production And Operations Management, John Wiley
3	S.N. Chary, Production and Operations Management, Tata McGraw Hill
4	Norman Gaither, Greg Frazier, Operations Management, Thomson Learning

8ME5-13: ADDITIVE MANUFACTURING

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1.	**Introduction:** Objective, scope and outcome of the course.	1
2.	Overview of Rapid Product Development (RPD): Need for the compression in product development, history of RP systems, Definition of RPD; Components of RPD. Rapid Prototyping (RP); Principle of RP; Technologies and their classifications.	2
3.	**Stereo Lithography Systems**: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application	2
4.	**Selective Laser Sintering& Fusion Deposition Modelling:** Selective Laser Sintering: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications. Fusion Deposition Modelling: Principle, Process parameter, Path generation, Applications.	4
5.	**Solid Ground Curing**: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.	4
6.	Selection of RP process; Issues in RP; Emerging trends.	2
7.	**Rapid Tooling (RT):** Introduction to RT, Indirect RT process-Silicon rubber molding, Epoxy tooling, Spray metal tooling and Investment Casting, Cast kirksite, 3Q keltool, etc.	3
8.	**Direct RT processes**: Laminated Tooling, Powder Metallurgy based technologies, Welding based technologies, Direct pattern making (Quick Cast, Full Mold Casting),	3
9.	Emerging Trends in RT, Reverse Engineering: Geometric data acquistion, 3D reconstruction, Applications and Case Studies, Engineering applications, Medical applications.	3
10.	Processing Polyhedral Data: Polyhedral B-Rep modeling, STL format, Defects and repair of STL files,	2
11.	Introduction to software for RP : Brief overview of Solid view, magics etc.	2
	TOTAL	40

TEXT BOOK	
1.	Rapid Prototyping: Principles and Applications, Volume 1 by Chee Kai Chua, Kah Fai Leong, Chu Sing Lim, World Scientific.
REFERENCE BOOKS	
1.	Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing by Brent Stucker, David W. Rosen, and Ian Gibson, Springer
2.	Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Gibson, Ian, Rosen, David, Stucker, Brent, Pearson.
3.	Rapid Prototyping: Principles and Applications in Manufacturing Noorani R, John Wiley & Sons.
4.	Rapid Prototyping and Engineering applications: A tool box for prototype development, Liou W. L., Liou F. W., CRC Press.
5.	Rapid Prototyping: Theory and practice, Kamrani A. K., Nasr E. A., Springer.

8ME4-21: INDUSTRIAL ENGINEERING LAB

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**
0L+0T+2P **End Term Exam: 2 Hours**

SN	List of Experiments
1	Determination of time standard for a given job using stopwatch time-study.
2	Preparation of flow process chart, operation process chart and man-machine charts for an existing setup and development of an improved process.
3	Study of existing layout of a workstation with respect to controls and displays and suggesting improved design from ergonomic viewpoint.
4	To perform ABC analysis for the given set of inventory data.
5	To develop Bill of Materials/Product structure tree and calculate planned order release (POR) using MRP format
6	To solve the operations research problems on Linear programming/Transportation/Assignment etc. using OR software's like TORA/LINGO/LINDO/SAS/EXCEL SOLVER etc.
7	Simulation of inventory system/Queuing system/production system using Monte-Carlo method.
8	To perform case study on sales forecasting.
9	To perform case study on project management using PERT/CPM.
10	To perform a case study on plant location and layout planning.
11	To perform a case study on capacity planning.

Important Note:

It is mandatory for every student to undertake a Mini project. The mini project shall involve a detailed project report of establishing a factory in which plant location, plant layout, capacity planning, selection of processes, ergonomically designing of equipments and other facilities are to be installed. 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.

8ME4-22: METROLOGY LAB

Credit: 1 **Max. Marks: 50(IA:30, ETE:20)**
0L+0T+2P **End Term Exam: 2 Hours**

SN	List of Experiments
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	To measure a gap by using slip gauges
4	Measurement of angle by using sine bar.
5	Study and use of surface roughness instrument (Taylor Hobson make) Inspection of various elements of screw thread by Tool makers microscope and optical projector.
6	Measurement of gear tooth thickness by using gear tooth vernier caliper.
7	To check accuracy of gear profile with the help of profile projector.
8	To determine the effective diameter of external thread by using three-wire method.
9	To measure flatness and surface defects in the given test piece with the help of monochromatic check light and optical flat.
10	To plot the composite errors of a given set of gears using composite gear tester.
11	Measurement of coating thickness on electroplated part and paint coating on steel and non-ferrous material using coating thickness gauge.
12	Study and use of hardness tester for rubber and plastics.
13	To check the accuracy of a ground, machined and lapped surface - (a) Flat surface (b) Cylindrical surface.
14	To compare & access the method of small-bore measurement with the aid of spheres.