Rajasthan Technical University (RTU)
Mechanical Engineering

YEAR II / SEMESTER III

THEORY

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	3ME1	Mech. of Solids	3	1	100	3
2.	3ME2	Material Science & Engg.	2	0	100	3
3.	3ME3	Engg. Thermodynamics	3	1	100	3
4.	3ME4	Manufacturing Processes	3	0	100	3
5.	3ME5	Object Oriented Programming in C ++	3	0	100	3
6.	3ME6	Advanced Engg. Mathematics	2	1	100	3
		Total	16	3	600	-

PRACTICALS AND SESSIONALS

S. No.	Code No.	Subject	T/S	P	MM
7.	3ME7	Strength of Material Lab	0	2	50
8.	3ME8	Material Science lab	0	2/2	50
9.	3ME9	Thermal Engg. lab – 1	0	2	50
10.	3ME10	Production Engg. Practice	0	3	75
11.	3ME11	Computer Programming lab.	0	2	50
12	3ME12	Machine Drawing	0	3	75
13.	3MEDC	Disci. & ECA	0	0	50
		Total	0	13	400
				Grand Total	1000

Total Hours	L	T	P
32	16	03	13

Rajasthan Technical University (RTU)
Mechanical Engineering

YEAR II / SEMESTER IV

THEORY

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	4ME1	Design of M/c Elements - I	3	0	100	3
2.	4ME2	Automobile Engineering	3	0	100	3
3.	4ME3	Fluid Mechanics	3	1	100	3
4.	4ME4	Machining & Machine Tools	3	0	100	3
5.	4ME5	Kinematics of Machines	3	1	100	3
6.	4ME6	Measurement & Control	3	0	100	3
		Total	18	2	600	-

PRACTICALS AND SESSIONALS

S. No.	Code No.	Subject	T/S	P	MM
7.	4ME7	Dynamics of Machine lab - I	0	2	75
8.	4ME8	Fluid Mechanics lab.	0	2	50
9.	4ME9	Thermal Engg. lab –II	0	3	75
10.	4ME10	Mechanical Measurement & control lab	0	2	75
11.	4ME11	M/c Design Sessional - I	0	3	75
12	4MEDC	Disc & ECA	0	0	50
		Total	0	12	400
				Grand Total	1000

Total Hours	L	T	P
32	18	02	12

Rajasthan Technical University (RTU)
Mechanical Engineering

YEAR III / SEMESTER V

THEORY

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	5ME1	Advanced Mechanics of Solids	3	1	100	3
2.	5ME2	Heat Transfer	3	1	100	3
3.	5ME3	Fundamentals of Aerodynamics	3	0	100	3
4.	5ME4	Industrial Engg.- I	3	0	100	3
5.	5ME5	Dynamics of Machines	3	1	100	3
6.	5ME6	Principles of Turbomachines	3	1	100	3
		Total	18	4	600	-

PRACTICALS AND SESSIONALS

S. No.	Code No.	Subject	T/S	P	MM
7.	5ME7	P.E. Lab.-I	0	3	100
8.	5ME8	Automobile Engg. Lab.	0	2	75
9.	5ME9	DOM Lab - II	0	2	75
10.	5ME10	Matlab & Computer Graphics	0	3	100
11	5MEDC	Disc. & ECA	0	0	50
		Total	0	10	400
				Grand Total	1000

Total Hours	L	T	P
32	18	04	10

Rajasthan Technical University (RTU)
Mechanical Engineering

YEAR III / SEMESTER VI

THEORY

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	6ME1	Design of M/c Elements - II	3	1	100	3
2.	6ME2	I.C. Engines & Diesel Power Plant	3	0	100	3
3.	6ME3	Manufacturing Science & Technology	3	1	100	3
4.	6ME4	Noise, Vibration and Harshness	3	1	100	3
5.	6ME5	Hydraulic Machines & Hydroelectric Power Plant	3	1	100	3
6.	6ME6	Numerical Methods and Applied Statistics	3	0	100	3
		Total	18	4	600	-

PRACTICALS AND SESSIONALS

S. No.	Code No.	Subject	T/S	P	MM
7.	6ME7	Heat Transfer Lab.	0	3	100
8.	6ME8	Turbomachinery Lab.	0	2	75
9.	6ME9	Computer Oriented Numerical Methods Lab.	0	2	75
10.	6ME10	Machine Design Sessional -II	0	3	100
11.	6MEDC	Disc. & ECA	0	0	50
		Total	0	10	400
				Grand Total	1000

Total Hours	L	T	P
32	18	04	10

Rajasthan Technical University (RTU) Mechanical Engineering

YEAR IV / SEMESTER VII

THEORY

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	7ME1	Computer Aided Design	3	0	100	3
2.	7ME2	Refrigeration & Air-conditioning	3	1	100	3
3.	7ME3	Operations Research	3	1	100	3
4.	7ME4	Steam Turbines & Steam Power Plant	3	1	100	3
5.	7ME5	Product Development and Launching	3	0	100	3
6.	7ME6	Elective I i. Robotics ii. Mechatronics iii. Computer Integrated manufacturing	3	0	100	3
		Total	18	3	600	-

PRACTICALS AND SESSIONALS

S. No.	Code No.	Subject	T/S	P	MM
7.	7ME7	P.E.Lab.- II	0	3	100
8.	7ME8	Mechanical Vibrations Lab.	0	2	50
9.	7ME9	I.C. Engine Lab.	0	2	50
10.	7ME10	Practical Training and Industrial Visit*	0	2	100
11.	7ME11	Project stage-I	0	2	50
12.	7MEDC	Disc. & ECA	0	0	50
		Total	0	11	400
				Grand Total	1000

Total Hours	L	T	P
32	18	03	11

* Industrial visit (20 marks) is for the duration of 10 days at the end of V semester and Practical Training (80 marks) is for the duration of 30 days at the end of VI semester. Both will be evaluated during the VII semester.

Rajasthan Technical University (RTU) Mechanical Engineering

YEAR IV / SEMESTER VIII

THEORY

S. No.	Code No.	Subject	L	T	MM	Ex. Hrs.
1.	8ME1	Renewable Energy Technology	4	0	100	3
2.	8ME2	Operations Management	3	1	100	3
3.	8ME3	Gas Turbines & Gas Power Plant	3	1	100	3
4.	8ME4	Elective II i. Reliability and Maintenance Engg. ii. Computational Fluid flow & Heat Transfer iii. Finite Element Methods	4	0	100	3
		Total	14	2	400	-

PRACTICALS AND SESSIONALS

S. No.	Code No.	Subject	T/S	P	MM
7.	8ME5	CAD Lab (Pro E/Unigraphics/Autocad inventor)	0	3	100
8.	8ME6	CAM and Robotics Lab.	0	2	75
9.	8ME7	Industrial Engg. Lab	0	2	75
10.	8ME8	Seminar	0	2	100
11.	8ME9	Project stage-II	0	4	200
12.	8MEDC	Disc. & ECA	0	0	50
		Total	0	13	600
				Grand Total	1000

Total Hours	L	T	P
29	14	02	13

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Syllabus for 3Semester (II Year) B. Tech. (Mechanical Engineering)

3ME1 : MECHANICS OF SOLIDS 3L+1T MM : 100 Ex. Hrs. : 3

Unit – 1

Stress & strain: Tension, compression, shearing stress & strain; Poisson's ratio: Stress-strain relationship, Hooke's law; equations of static = w for 2D & 3D cars Elastic constants and their relations for a isotropic hookean material, anisotropy & orthotropy, thermal stresses, composite bars; simple elastic, plastic & visco-elastic behavior of common materials in tension and compression test, stress-strain curves. Concept of factor of safety & permissible stress. Conditions for equilibrium. Concept of free body diagram; Introduction to mechanics of deformable bodies.

Unit – 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. Bending stresses, Section modulus and transverse shear stress distribution in circular, hollow circular, I, Box, T, angle sections etc.

Unit – 3

Principal planes, stresses & strains: Members subjected to combined axial, bending & Torsional loads, maximum normal & shear stresses; Concept of equivalent bending & equivalent twisting moments: Mohr's circle of stress & strain.

Theories of Elastic Failures: The necessity for a theory, different theories, significance and comparison, applications.

Unit – 4

Torsion: Torsional shear stress in solid, hollow and stepped circular shafts, angular deflection and power transmission capacity.

Stability of equilibrium: Instability & elastic stability. Long & 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.

Unit – 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: method of superposition and conjugate beam method. Variational approach to determine deflection and stresses in beam.

Elastic strain energy: Strain energy due to axial, bending and Torsional loads; stresses due to suddenly applied loads; use of energy theorems to determine deflections of beams and twist of shafts. Castigliano's theorem. Maxwell's theorem of reciprocal deflections.

3ME2: MATERIAL SCIENCE AND ENGINEERING

2L+0T MM: 100 Ex Hrs: 3

UNIT 1

Atomic structure of Metals: Crystal structure, crystal lattice of (i) Body centred cubic (ii) Face centred cubic (iii) Closed packed hexagonal, crystallographic Notation of atomic planes and Directions (Miller Indices),

polymorphism and allotropy, Crystal imperfection.

UNIT 2

Theories of plastic deformation. Phenomenon of slip, twinning and dislocation. Identification of crystallographic possible slip planes and direction in FCC, BCC, HCP. Recovery and recrystallization, preferred orientation causes and effects on the property of metals.

UNIT3

Classification of engineering materials. Solidification of metals and of some typical alloys: Mechanism of crystallisation (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. Iron carbon Equilibrium diagram, phase transformation in the iron carbon diagram (I) Formation of Austenite (ii) Transformation of Austenite into pearlite (iii) Martensite transformation in steel, TTT curves.

UNIT 4

Engineering properties and their measurements. Principles and applications of annealing, normalising, hardening, tempering. Recovery and recrystallization. Hardenability -its measures, variables, effecting Hardenability, methods, for determination of Hardenability. Over-heated and Burnt steel, its causes and remedies. Temper brittleness -its causes and remedies. Basic principles involved in heat treatment of plain carbon steel, alloy steels, cast iron and Non-ferrous metals and their alloys. Chemical Heat treatment of steels: Physical principles involved in chemical heat treatment procedure for carburizing, Nitriding, Cyaniding, carbo-nitriding of steel.

UNIT 5

Effects produced by Alloying element on the structures and properties of steel Distribution of alloying elements (Si, Mn, Ni, Cr, Mo, Co, W, Ti, Al) in steel, structural classes of steel. Classification of steels, BIS Standards. Fibre reinforced plastic composites**:** Various fibres and matrix materials, basic composite manufacturing methods, applications of composite materials.

3ME3: ENGINEERING THERMODYNAMICS

3L+1T MM: 100 Ex Hrs: 3

UNIT 1

Basic Concepts of Thermodynamics :Thermodynamics system, control volume, Properties, state, processes and cycle, equality of temperature, Zeroth Law of thermodynamics, temperature scale, laws of perfect gas, Pure substances, vapour-Liquid –solid-phase equibrium in a pure substances, thermodynamic surfaces

UNIT 2

Work and heat, Law of conservation of mass and energy, First law of thermodynamics, steady state

Processes, Second law of thermodynamics, Heat engine, Carnot cycle, thermodynamic temperature scale, entropy, change of entropy for different processes, equivalence of Kelvin plank and clausius statements, clausius inequality.

UNIT 3

Available and unavailable energy, availability of a non flow and steady flow system, Helmbeltz and Gibb's functions, Thermodynamic Relations: Important mathematical relations, Maxwell relations, Tds Relations, Joule-Thomson coefficient, Clayperon relation.

UNIT 4

Air – standard power cycle, Brayton cycle, Otto cycle, diesel cycle, Dual cycle, Stirling cycle, Ericssion cycle and Atkinson cycle, Mean effective pressure and efficiencies, Four stroke petrol and diesel engine, Two stroke Petrol and diesel engine.

UNIT 5

Properties of steam, phase change process, use of steam table & molier char. Rankine cycle, Reheat cycle, Regenerative cycle, cogeneration vapour compression refrigeration cycle.

3ME4: MANUFACUTRING PROCESSES

3L+0T MM: 100 Ex Hrs: 3

UNIT 1

Importance of manufacturing, economic and technological definition of manufacturing, survey of manufacturing processes.

Foundry Technology: Patterns practices: Types of patterns, allowances and material used for patterns, moulding materials, moulding sands, Moulding sands; properties and sand testing; grain fineness; moisture content, clay content and permeability test, core materials and core making, core print; core boxes, chaplets, gating system design. Moulding practices**:** Green, dry and loam sand moulding, pit and floor moulding; shell moulding; permanent moulding; carbon dioxide moulding.

Casting practices: Fundamental of metal casting, sand casting, Shell-Mould casting, mold casting (plaster and ceramic), investment casting, vacuum casting, Permanent mould casting, slush casting, pressure casting, die casting, centrifugal casting, continuous casting, squeeze casting, casting alloys, casting defects, design of casting, gating system design, and riser design. Melting furnaces-rotary, pit electric, tilting and cupola.

UNIT 2

Metal Joining Processes: Principle of welding, soldering, brazing and adhesive bonding. Survey of welding and allied processes. Arc welding: power sources and consumables. Gas welding and cutting: Processes and equipments. Resistance welding: principle and equipments. Spot, projection and seam welding process. Atomic hydrogen, ultrasonic, plasma and laser beam welding, electron beam welding, and special welding processes e.g. TIG, MIG, friction and explosive welding, welding of C.I. and Al, welding defects. Electrodes and Electrode Coatings

UNIT 3

Forming and Shaping Processes: Metal working, elastic and plastic deformation, concept of strain hardening, hot and cold working, rolling, principle and operations, roll pass sequence, forging, forging operations, extrusion, wire and tube drawing processes. Forging: Method of forging, forging hammers and presses, principle of forging tool design, cold working processes-Shearing, drawing, squeezing, blanking, piercing, deep drawing, coining and embossing, metal working defects, cold heading, riveting, thread rolling bending and forming operation.

UNIT 4

Powder Metallurgy: Powder manufacturing, mechanical pulverization, sintering, Electrolytic Process, chemical reduction, atomization, properties of metal powders, compacting of powders sintering, advantages and applications of P/M.

Rapid Prototyping Operations: Introduction, subtractive processes, additive processes, Virtual Prototyping and applications

UNIT 5

Plastic Technology: Introduction, Classification of Plastics, Ingredients of Moulding compounds, General Properties of Plastics, Plastic part manufacturing processes such as compression moulding, transfer moulding, injection moulding, extrusion moulding, blow moulding, calendaring, thermoforming, slush moulding, laminating

3ME5: OBJECT ORIENTED PROGRAMMING IN C++

3L+0T MM: 100 Ex Hrs: 3

UNIT 1

Introduction to Object Oriented Programming: Basic concepts: Class, Object, Method, Message passing, Inheritance, Encapsulation, Abstraction, Polymorphism.

UNIT 2

Basics of C++ Environment: Variables; Operators; Functions; user defined, passing by reference, passing an array to the function, inline function, scope, overloading; Pointers: objects and lvalue, arrays and pointers, the new and delete operators, dynamic arrays, arrays of pointers and pointers to arrays, pointers to pointers and functions; Strings: String I/O, character functions in ctype.h, string functions in string.h.

UNIT3

Object oriented concepts using C++: Classes: Member functions, Friend functions, Constructors, Access functions, Private member functions, class destructor, static data and function members; Overloading: inline functions, this operator, overloading various types of operators, conversion operators; the String Class; Composition and Inheritance: Hierarchy and types of inheritance, protected class members, private versus protected access, virtual functions and polymorphism, virtual destructors, abstract base classes.

UNIT 4

Templates and Iterators: function and class templates, container classes, subclass templates, iterator classes; Libraries: standard C++ library, contents of a standard C headers, string streams, file processing: Files and streams classes, text files, binary files, classification of files, the standard template library.

UNIT 5

Data Structures Using C++: Linked lists – Singly linked list, Doubly linked lists, Circular lists, Stacks and Queues priority Queues, Stacks, Queues.

3ME6: ADVANCED ENGINEERING MATHEMATICS

2L+1T MM: 100 Ex Hrs: 3

Unit- 1 Fourier Series and method of separation of variables (Boundary value problems)

Expansion of simple functions in Fourier series, half range series, change of interval, Harmonic analysis. Application to the solution of wave equation and diffusion equation in one dimension and Laplace's equation in two dimensions by method of separation of variable

Unit-2 Laplace Transform

Laplace Transform with its simple properties . Inverse Laplace transform convolution Theorem (without proof) solution of ordinary differential equation with constant coefficient .

Unit-3 Special functions.

Bessel's function of first kind, simple recurrence relations, orthogonal property. Legendre's function of first kind simple recurrence relations, orthogonal property , Rodrigue's formula.

Unit –4 Numerical Analysis

Finite differences , Difference operators , forward, Backward, central & average operators. Newton's forward and backward interpolation formula, Stirling's central difference formula Lagrange's interpolation formula for unequal interval. Solution of non linear equations in one variable by Newton Raphson's and Regula falsi's method .

Unit-5 Numerical Analysis

Numerical solution of simultaneous algebric equation by Gauss elimination and Gauss seidel method. Numerical differentiation , Numerical integration trapezoidal rule , Simpson's one third and three eight rule. Numerical solution of ordinary differential equation of first order: Picards method, Euler's , and modified Euler's ,method, Milne's methods and Runga Kutta fourth order method..

3ME7: STRENGTH OF MATERIALS LAB 2 Periods MM: 50

1. 1. Izod Impact testing.
2. 2. Rockwell Hardness Testing.
3. 3. Spring Testing
4. 4. Column Testing for buckling
5. 5. Torsion Testing
6. 6. Tensile Testing
7. 7. Compression Testing
8. 8. Shear Testing
9. 9. Brinell Hardness Testing

10. 10. Bending Test on UTM.
11. 11. Study of Fatigue Testing Machine.

3ME8: MATERIAL SCIENCE AND HEAT TREATMENT LAB 2/2 Periods MM: 50

1. 1. Study of Engineering Materials and crystals structures. Study of models BCC, FCC, HCP and stacking sequence, tetrahedral and octahedral voids.
2. 2. To calculate the effective number of atoms, co-ordination number, packing factors, c/a ratio for HCP structure.
3. 3. Study of brittle and ductile fracture.
4. 4. To prepare metallic samples for metallographic examination and to study the principle and construction of the Metallurgical Microscope.
5. 5. Study of the following Micro structures: Hypo, Hyper and Eutectoid Steel, Grey, White, Nodular and Malleable Cast Iron.
6. 6. Annealing of Steel -Effect of annealing temperatures and time on hardness.
7. 7. Study of Microstructure and hardness of steel at different rates of cooling. Microstructure examination of white cast iron.
8. 8. Hardening of steel, effect of quenching medium on hardness.
9. 9. Effect of Carbon percentage on the hardness of Steel.
10. 10. Study of various crystal structures and dislocations through models.
11. 11. Study of Iron-Carbon Equilibrium Diagram and sketch the various structures present at room temperature.

3ME9: THERMAL ENGINEERING LAB 1 2 Periods MM: 50

1. 1. Comparative study of four stroke diesel and petrol engines.
2. 2. Comparative study of two stroke petrol and diesel engines.
3. 3. Studies of fuel supply systems of diesel and petrol engines.
4. 4. Study of cooling, lubrication and ignition system in diesel and petrol engines.
5. 5. To study various types of Boilers and to study Boiler mounting and accessories.
6. 6. To study various types of Dynamometers.
7. 7. To study Multi Stage Air Compressors.
8. 8. To find the BHP, Thermal efficiency of four stroke diesel engine.
9. 9. Study of Brakes, Clutches, and Transmission System.
10. 10. To prepare a comparison sheet of various automobiles (4 Wheeler and 2 Wheeler).

3ME10: PRODUCTION PRACTICE I 3 Periods MM: 75

. Study of lathe machine, lathe tools cutting speed, feed and depth of cut.
. To perform step turning, knurling and chamfering on lathe machine as per drawing.
. Taper turning by tailstock offset method as per drawing.
. To cut metric thread as per drawing.
. To perform square threading, drilling and taper turning by compound rest as per drawing.
. To study shaper machine, its mechanism and calculate quick return ratio.

Foundry Shop
1. 1. To prepare mould of a given pattern requiring core and to cast it in aluminium.
2. 2. Moisture test and clay content test.
3. 3. Strength Test (compressive, Tensile, Shear Transverse etc. in green and dry conditions) and Hardness Test (Mould and Core).
4. 4. Permeability Test.
5. 5. A.F.S. Sieve analysis Test.

3ME11: COMPUTER PROGRAMMING LAB I 2 Periods MM: 75

List of programs in C:

1. 1. Program for revising control statements, arrays and functions.
2. 2. Program using string handling and various functions described in string.h, ctype.h.
3. 3. Program using structures and sorting algorithm (Insertion, Selection, Quick, Heap sort) and functions described in math.h.
4. 4. Program using file handling and related functions defined in stdio.h, io.h.
5. 5. Program using pointers, array and pointers, pointers to structures, dynamic memory allocation.

List of Programs in C++

1. 6. Program using basic I/O and control statements.
2. 7. Program using class, objects, objects as function parameters.
3. 8. Program using functions and passing reference to a function, inline functions. Program using Inheritance and virtual base class.
4. 9. Program using pointers, arrays, dynamic arrays. Program using functions defined in ctype.h and string.h.
   10. Program using constructors, destructors. Program using function and operator over loading

   List of program in C++ implementing Data Structures
5. 11. Creating and managing (add, delete, print, insert) nodes of a Linked list.
6. 12. Creating and managing (create, pop, push etc.) stacks and queues.

Note: Students should submit and present a minor project at the end of the lab.

3ME12: MACHINE DRAWING 3 Periods MM: 50

Detail drawings:
Couplings: Pin-type flexible coupling etc,
IC. Engine parts: connecting rod, crank shaft, etc,

Boiler Mountings: Steam stop valve/ feed check-valve/ safety valve /three way stop valve blow off-cock.
Bearings: Swivel bearing
Machine Tool Parts: Shaper tool head, Lathe Tail Stock, Turret Tool Post, Turret Bar feeding Mechanism / Universal Dividing Head, Swivel machine vice.
Miscellaneous: Screw jack and drill-press vice.
Free Hand Sketches: Pipes and Pipe fittings, clutches, bearings, bearing puller, valve gear mechanisms, machine arbor and cutter, universal dividing head, jigs and fixtures, Step less drive , sliding gear box.

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Syllabus for 4Semester (II Year) B.Tech. (Mechanical Engineering)

4ME1 : DESIGN OF MACHINE ELEMENTS

3L+0T MM : 100 Ex. Hrs. : 3

UNIT -1
Materials: Properties and IS coding of various materials, Selection of material from properties and economic aspects.

Manufacturing aspects in Design : Selection of manufacturing processes on the basis of design and economy, Influence of rate of production, standard size, Influence of limits, fits tolerances and surface finish. Change in the shape of the designed element to facilitate its production, Design of castings, working drawing.

UNIT -2
Design for strength: Allowable stresses, detailed discussion on factor of safety (factor of ignorance): Stress concentration. Causes & mitigation. Introduction of various design considerations like strength, stiffness, weight, cost, space etc. Concept of fatigue failures. Design of machine elements subjected to direct stress, Pin, cotter and keyed joints, Design of screw fastening.

UNIT -3
Design of members in Bending: Beams, levers and laminated springs.

UNIT -4
Design of members in torsion : Shafts and shaft couplings.

UNIT -5
Design of shafts, brackets under combined stresses, Calculation of transverse & torsional deflections. Screw fasteners subjected to eccentric loading.

4ME2 : AUTOMOBILE ENGINEERING

3L+0T MM : 100 Ex. Hrs. : 3

UNIT -1
FRAME & BODY: Layout of chassis, types of chassis frames and bodies, their constructional features and materials.

TRANSMISSION SYSTEM**:** Clutch; single plate, multiplate, cone clutch, semi centrifugal, electromagnetic, vacuum and hydrautic clutches. Fluid coupling.

UNIT -2

Gear boxes, Sliding mesh, constant mesh, synchromesh and epicyclic gear boxes, Automatic transmission sytem; Hydraulic torque converter; overdrive, propeller shaft, universal joints, front wheel drive, differential; Rear axle drives. Hotchkiss and torque tube drives; rear axle types; Two wheel and four wheel drive.

UNIT -3

RUNNING GEAR: Types or wheels and tyres. Tyre construction; tyre inflation pressure, tyre wear and their causes; re-treading of the tyre, 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 suspension system; objects and requirements, suspension spring, front and rear suspension systems, Independent suspension system shock absorber. BRAKES ; Classification and function; Mechanical, hydraulic, vacuum air and self engineering brakes; Brake shoes and lining materials.

UNIT -4

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.
Ignition System : magneto and coil ignition systems, System components and requirements, Automotive lighting : Wiring systems Electrical instruments; head lamp, electric horn, fuel level indicator.

UNIT -5

AUTOMOTIVE AIR CONDITIONING: Introduction, Loads, Air conditioning system Components, Refrigerants, Fault Diagnosis. AUTOMOTIVE SAFETY: Safety requirements, Safety Devices, Air bags, belts, radio ranging, NVS (Night Vision System) GPS (Global Positioning System) etc.

4ME3: FLUID MECHANICS

3L + 1T MM : 100 Ex. Hrs. : 3

UNIT -1

Basic Definitions and Fluid Properties ; Definition of Fluid, Incompressible and compressible fluids, Fluid as a continuum, Mass, Density, specific weight, relative density, specific volume, Bulk modulus, velocity of sound Ideal fluid Viscosity. Newtonian and Non Newtonian fluid, Kinematic viscosity, Effect of temperature and pressure on viscosity, surface tension capillarity,

vapour pressure and cavitation.

Fluid Statics : General differential equation, Hydrostatics Manometry, Fluid forces on submerged surfaces. Curved surfaces, Aerostatics, Isothermal atmosphere, polytropic atmosphere. The international standard atmosphere, static stability The international standard atmosphere submerged bodies. Floating bodies.

UNIT -2

Kinematics and conservation of Mass : Flow classifications. Fluid velocity and acceleration, streamlines and the stream function. Pathlines and streak lines. Deformation of a fluid element, verticity and circulation. Irrotational and Rotational flow. Flownet, Laplace equation. Conservation of mass and the continuity equation for three dimensions.

Fluid Momentum : The Momentum theorem Applications of the momentum theorem Equation of motion, Euler's equation of motion Integration of Euler's equation of motion.

Bernoulli's equation. Applications of Bernoulli's Pitot tube, Equation of motion for Viscous fluid, Navier Stoke's equation.

UNIT -3

Orifice discharging free, Jet, vena contracts, co-efficient of contraction, velocity and discharge, coefficient of resistance. Orifices and mouthpieces Nozzles and weires.

Flow Through Pipes : Reynold's experiment Darcy's Weisback equation. Loss of head due to sudden enlargements, contraction, entrance, exit obstruction, bend, pipe fittings. Total and Hydraulic grandient lines, Flow through pipe line. Pipes in series, parallel Transmission of power through pipes.

UNIT -4

Laminar Flow: Simple solution of Navier Stokes equations. Hagen – Poiseuille flow. Plans Poiseuille flow and coutte flow.

Turbulent Flow; Variation of friction factor with Reynold's number. The Prandt Mixing length hypothesis applied to pipe flow, velocity distribution in smooth pipes, sough pipes. The Universal pipe friction laws, Colebrook. White formula.

Dimensional Analysis: Buckingham variables, Model Similitude, Force ratio, Reynolds, Froude's Mach, Weber and Euler numbers and their applications. Undistorted model distorted model scale effect.

UNIT -5

The Boundary Layer: Description of the boundary layer. Boundary Layer thickness boundary

layer separation and control. The Prandtl boundary layer equation. Solution for cominar boundary layer. The momentum equation for the boundary layer. The flat plate in uniform free stream with no pressures gradients. Approximate momentum analysis laminar boundary Aerofoils Theory.

Flow round a body ; Drag skin friction drag, pressure drag, combined skin friction & pressure drag (Profile drag) wave drag, lift induced drag. Flow past sphere & Cylinder.

4ME4 : MACHINING AND MACHINE TOOLS

3L+0T MM: 100 Ex Hrs: 3

UNIT 1

Classification of metal removal process and machines Mechanics of metal cutting: Geometry of single point cutting tool and tool angles. Tool nomenclature in ASA, ORS, NRS and interrelationship. Mechanism of chip formation and types of chips, chip breakers. Orthogonal and oblique cutting, cutting forces and power required, theories of metal cutting. Thermal aspects of machining and measurement of chip tool interface temperature. Friction in metal cutting.

UNIT 2

Machinability: Concept and evaluation of machinability, tool life, mechanisms of tool failure, tool life and cutting parameters, machinability index, factors affecting machinability. Cutting fluids: Types, properties, selection and application methods
General Purpose Machine Tools: Classification and constructional details of lathe, drilling, milling, shaping and planning machines. Tooling, attachments and operations performed, selection of cutting parameters, calculation of forces and time for machining. Broaching operation.

UNIT 3

Special Purpose Machine Tools: Automatic lathes, capstan and turret lathe machines. Swiss automatic, operational planning and turret tool layout, sequence of operations. Tracer attachment in Machine Tools: mechanical-copying machines; Hydraulic Tracing Devices; Electric Tracing systems; Automatic tracing.

Abrasive processes: Abrasives; natural and synthetic, manufacturing, nomenclature. Selection of grinding wheels, wheel mounting and dressing, characteristic terms used in grinding. Machines for surface and cylindrical grinding, their constructional details and processes. Surface finishing: Honing, lapping, superfinishing, polishing and buffing processes.

UNIT 4

Thread Manufacturing: casting; thread chasing; thread cutting on lathe; thread rolling, die threading and tapping; thread milling; thread grinding.

Gear Manufacturing Processes: hot rolling; stamping; powder metallurgy; extruding etc. Gear generating processes: gear hobbling, gear shaping. Gear finishing processes: shaving, grinding, lapping, shot blasting, phosphate coating, Gear testing.

UNIT 5

High Velocity Forming Methods: (High-energy rate forming processes) Definition; Hydraulic forming, Explosive forming, Electro-hydraulic forming, Magnetic pulse forming.

Industrial Safety: Human factor in machine equipment safety; reducing industrial noise; precautions to be taken by operators for safe working on different machine tools.

4ME5 : KINEMATICS OF MACHINES

3L + 1T MM : 100 Ex. Hrs. : 3

UNIT -1

Kinematics: Elements, pairs , mechanisms, four bar chain and its inversions, velocity and acceleration, Klein's construction, coriolis component, instantaneous center method, synthesis of mechanisms, panto graph, scott-Russel, Tchbeicheff straight line, indicator diagram mechanisms.

UNIT -2

Automotive vehicle mechanisms: Overhead valve mechanism, Davis and Ackerman steering mechanism, Trifler suspension and Hookes joint.

Power transmission: Belts and ropes, effect of centrifugal force, creep, chain drive.

UNIT -3

Friction: Laws of static, dynamic and rolling friction, dry and viscous friction, inclined plane and screw jack, ,pivots and friction axis, bearing, Clutches. Theory of film lubrication.

UNIT -4

Brakes and dynamometers: Band, block and band & block brakes, braking action, absorption and transmission type dynamometers, prony, rope and hydraulic dynamometers braking system of automobiles.

UNIT -5

Cams: Type of cams, displacement, velocity and acceleration curves for different cam followers, consideration of pressure angle and wear, analysis of motion of followers for cams with specified contours.

4ME6 : MECHANICAL MEASURMENTS & CONTROL

3L+0T MM : 100 Ex. Hrs. : 3

UNIT -1

System configuration, basic characteristic, calibration, classification and performance characteristics of a instrumentation system, Specification and testing of dynamic response. Strain Measurement : Electric Strain Gauges -Types ; Selection and Installation, Strain gauge circuits; temperature compensation and calibration; Use of Strain Gauges on Rotating Shafts, Load Cells, Mechanical and Optical Strain Gauges.

UNIT -2

Various Mechanical, Electro-Mechanical & Photoelectrical Sensors for sensing of Displacement, Velocity, Acceleration, Torque, Force, Temperature from Low to High Range, flow, level of fluid , pressure, angular speed, voltage, frequency and current.

UNIT -3

Introduction to Multi-Channel Data-Acquisition System, Measurement Pods, Interface Hardware, Data Analysis Software, Interfacing.

Concepts and examples of automatic control systems, systems by differential equations, transfer function, block diagram, open and feed back control systems, signal flow graphs & its constructions. Control System components, error sensing devices and servo motors.

UNIT -4

Control for mechanical systems & processes ; speed control system for steam/gas turbines. A constant tension ;reeling system, Electro-mechanical systems. Thermal systems, Pneumatic systems; Mathematical Models of physical systems, Feed back characteristics of Control Systems. Time response analysis; transient response analysis, time response specifications, steady state-error.

UNIT -5

Concepts of stability, Routh-Hurwiz stability criterion, relative stability. The root locus technique,

use of construction rules without any derivation. Frequency response analysis, Polar plots; stability in frequency domain, Bode / Logrithmic plots. Nyquist stability criterion.

4ME7 : DYNAMICS OF MACHINES LAB.

2 Periods **MM : 75**

1. 1. To study inversion of four bar chain
2. 2. Coupling Rod
3. 3. Beam Engine
4. 4. Steering Mechanism

 .(a) Study of quick return mechanism.(Crank and Slotted lever mech.)
 .(b) To draw velocity and acceleration diagram for Crank and slotted lever mechanism.

1. 5. Study of inversion of Double slider chain

Oldhan Coupling
Scotch Yoke
Elleptical Trammel

2. 6. To plot displacement v/s θcurve for various cams.
3. 7. Study of various cam-follower arrangements.
4. 8. To determine co-efficient of friction.
5. 9. Study of various types of dynamometers, Brakes and Clutches.
6. 10. To determine moment of inertia of the given object using of Trifler suspension.

4ME8 : FLUID MECHANICS LAB.

2 Periods **MM : 50**

NAME OF EXPERIMENTS

1. 1. Determine Metacentric height of a given body.
2. 2. Determine Cd, Cv & Cc for given orifice.
3. 3. Determine flow rate of water by V-notch.
4. 4. Determine velocity of water by pitot tube.
5. 5. Verify Bernoulli's theorem.
6. 6. Determine flow rate of air by Venturi meter
7. 7. Determine flow rate of air by orifice meter
8. 8. Determine head loss of given length of pipe.
9. 9. Determine flow rate of air by nozzle meter.
10. 10. Study of Pelton, Kaplan Turbine models.

4ME9 : THERMAL ENGINEERING LAB. – II

3 Periods **MM : 75**

1. Disassembling and assembling of multi-cylinder petrol and diesel engines and study of their parts.

1. 2. To disassemble and assemble a 2-stroke petrol engine.
2. 3. To disassemble and assemble a 4-stroke motor cycle engine and study of various engine parts.
3. 4. Load test on a single cylinder 4-stroke diesel engine using a rope brake dynamometer and calculate volumetric and thermal efficiency and draw a heat balance-sheet.
4. 5. Study of carburettors and MPFI system and disassembling and assembling of their parts.
5. 6. To calculate valve timing of a multi-cylinder petrol engine and valve tappets adjustment.
6. 7. Disassemble all the parts of a fuel injection pump and its parts study.
7. 8. To disassemble the governor and study its various parts.

4ME10 : MECHANICAL MEASURMENTS & CONTROL LAB. 2 Periods

MM : 75 INSTRUMENTATION LAB. SESSIONAL

1. 1. Displacement Measurement using Capacitive Pick -up System
2. 2. Displacement Measurement Using Inductive Pick-up System
- .3. Displacement Measurement Using Light Dependent Register Set up
- .(i) Displacement v/s Registance at Constant Voltage
- .(ii) Voltage v/s Registance at Constant Displacement
- .4. Study of Speed Measurement System
- .(i) Magnetic Pick-up
- .(ii) Strobometer
3. 5. Study of Load Measurement System Load Cell + Load Indicator
4. 6. Calibration of Thermocouple Wire.

CONTROL LAB. SESSIONAL

1. 1. Problems on
2. 2. Block diagram reduction technique
3. 3. Block diagram formation for Control Systems.
4. 4. Root Locus Plot
5. 5. Bode Plot
6. 6. Polar plot & Nyquist Stability Criterion Experiments on

- .(1) Hydraulic System
- .(2) Control System

4ME11 : MACHINE DESIGN LAB -I 3 Periods MM : 75

1. 1. Selection of material & IS coding
2. 2. Selecting fit & assigning tolerances
3. 3. Examples of Production considerations.

Problems on

1. 1. Knuckle & Cotter joints
2. 2. Torque : Keyed joints & shaft couplings

3. 3. Design of screw fastening
4. 4. Bending : Beams, Levers etc.
5. 5. Combined stresses : Shafts, brackets, eccentric loading.
6. 6. Design for rigidity (Transverse / Torsional)

V SEM MECHANICAL 5ME1: ADVANCED MECHANICS OF SOLIDS

3L+1T MM: 100 Ex.Hrs. : 3

UNIT 1:-

Analysis of stress in 3-Dimensions: Body force, surface force and stress vectors, state of stress at a point, normal shear stress components, stress component on arbitrary plane, principal stresses in 3-Dimentions, stress invariants, decomposition of stress matrix into hydrostatic and pure shear states, Lame's stress ellipsoid, differential equations of equilibrium.

UNIT 2:-

Analysis of strain in 3-Dimensions: introduction, deformation in neighborhood of a point, change of length of linear element, state of strain at a point, principal axes of strain and principal strains, compatibility conditions.

UNIT 3:-

Stress strain relations for linearity elastic bodies, generalized Hooke's law, stress-strain relations for anisotropic, orthotropic and isotropic materials.

UNIT 4:-

Bending of curved beams (Winkler-Bach formula); unsymmetrical bending of beams, shear centre.

UNIT 5:-

Stresses in thick cylinders, shrink fit stresses, stresses in rotating discs.

5ME2: HEAT TRANSFER

3L+1T MM: 100 Ex. Hrs: 3

UNIT 1:-

Introduction to 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.

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.

UNIT 2:-

Heat transfer from finned surfaces; fin efficiency and effectiveness, two dimensional steady state heat conduction using analytical and numerical methods, periodic heat conduction.

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.

UNIT 3:-

Natural convection: Dimensional analysis, Granhoff number, boundary layers in external flows (flow over a flat plate only), boundary layer equations and their solutions, heat transfer correlations.

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.

UNIT4:-Heat exchanger: Different 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.

UNIT 5:-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.

5ME3: FUNDAMENTALS OF AERODYNAMICS

3L MM: 100 Ex. Hrs : 3

UNIT 1:-

Aerodynamic forces and moments over the body surface, concept of lift and drag, dimensionless force and moment coefficient, centre of pressure of an aerofoil, nomenclature of aerofoil, angle of attack, circulation and lift over an-aerofoil, Kutta condition, Kelvin's circulation theorem.

UNIT 2:-

Blade theory; Symmetrical and non-symmetrical aerofoil. Energy transfer in terms of lift and drag, cascade nomenclature, turbine cascade nomenclature, cascade lift and drag coefficient.

UNIT3:-

Isentroic Flow: Velocity of sound; Mach angle; Mach number, steady isentropic flow through ducts; use of isentropic tables; condition for maximum discharge; choked flow; flow through convergent and convergent-divergent nozzle, supersaturated flow in nozzle.

UNIT 4:-

Adiabatic flow and flow with Heat Transfer: Adiabatic flow; Fanno line tables; entropy change; choking due to friction; flow through long ducts; Diabatic flow ; Rayleigh line; use of tables; change in entropy; effect of change in stagnation temperature.

UNIT 5:-

Normal Shock: Plane stationary normal shock; Ranking-Hugoniot relations; increase in entropy; Prandtl's relations; change in stagnation pressure across the shock.

5ME4: INDUSTRIAL ENGINEERING 3L+OT

MM: 100 Ex. Hrs : 3

UNIT l:-

Management Theory and Functions: Evolution of management, scientific management, Contribution to scientific management: Reactions and criticisms of Taylor, Fayol, Mayo, Levels of 'Management Administration and Management, functions of management. Decision-making.

UNIT 2:-

Business Forms and Organization:

Forms of Business:(i)Single proprietorship (ii) Partnership (iii) Joint stock company (iv) Private Ltd- Companies and public limited companies
Forming Joint Stock Companies (a) Registration (b) issue of Prospectus

 .(c) Commencement Certificate (iv) co-operative Society choice of Business forms
 .(v) State undertaking. Organization meaning. Types of organization; (i) Line organization
 .(ii) Functional Organization (iii) Line Staff organization (iv) Line Staff Committee organization, span of control.

UNIT 3:-

Finance & Financial Statements: Introduction, Needs of Finance, Kinds of Capital Sources of fixed capital, Shares - (i) Ordinary Shares (ii) Preference Shares. Borrow capital. Surplus profits. Sources of Working capital. Management of working capital. Financial Institutions. Profit & Loss Statement, Balance Sheet, Financial ratio: Liquidity ratio, Profits investment ratio, equity ratio, inventory ratio.

UNIT4:-

Interest and Depreciation: interest meaning, Compound interest. Annuities capital recovery Annuity present worth annuity sinking funds annuity compound Amount Annuity Nominal and effective rate of interest. Depreciation Meaning and causes. Need of Depreciation calculation, Methods of Depreciation. Straight line Methods. Sinking funds methods. Declining Balance Method, sum of years digits method (Syd Method).

UNIT 5:-

Labour relations and legislation: Profit sharing, fringe benefits etc.Trade Unions. Methods of setting disputes (i) Collective bargaining (ii) Conciliation (iii) Mediation (iv) Arbitration industrial disputes in India, Machinery for setting disputes. Trade Disputes Acts. The factory Act 1944, payment of wages act. Workman's compensation act.

5ME5: DYNAMICS OF MACHINES 3L+1T MM: 100

Ex. Hrs : 3

UNIT l:-

Governors: Watt, Porter, Proell, Hartnell and spring controlled governors, governor effort, power, stability, inertia effects.

UNIT 2:-

Gyroscope: Principle of gyroscopic couple, effect of gyroscopic couple and centrifugal force on vehicle taking a turn, stabilization of sea vessels.

Inertia force analysis: Velocity and acceleration of slider crank and four bar mechanism, inertia force, piston thrust and forces on connecting rod, turning moment diagram, flywheel.

UNIT 3:-

Gears: Law of gearing, terminology, tooth form, standard interchangeable tooth profile, minimum number of teeth on pinion in contact with gear or rack, interference and undercutting, bevel, helical and spiral gears.

UNIT 4:-

Gear trains: Simple, compound, reverted and epicyclic gear trains, analytical, tabular, graphical and vector methods for velocity ratio, gear boxes- sliding and constant mesh for automobiles.

UNIT 5:- Balancing: Balancing of rotating masses, balancing of reciprocating masses, locomotives, IC engines, balancing machines.

5ME6: PRINCIPLES OF TURBOMACHINES

3L+1T MM: 100 **Ex. Hrs. : 3**

Unit 1:-

Basic concepts of turbomachines: Definition of Turbomachine, classification; Basic laws and governing equations; continuity equation, steady flow energy equation(1^{sl} law of thermodynamics),2^{nci} law of thermodynamics applied to turbomachines, Newton's 2^{nd} law of motion applied to turbomachines - Euler's pump equation and Euler's turbine equation, dimensional analysis applied to hydraulic machines, power coefficient, flow coefficient, head coefficient, non-dimensional specific speed; Range of 'specific speeds for various turbomachines. Dimensional analysis applied to compressible flow machines, pressure ratio as a Function of temperature ratio, mass flow rate parameter and speed parameter.

Unit 2:-

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.

Unit 3:-

Axial flow pumps; Description, velocity triangles, work done on the fluid, energy transfer, axial pump characteristics, cavitation.

Unit 4:-

Centrifugal compressors and fans: Components and description, velocity diagrams, 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.

Unit5:-

Axial flow compressors and fans: Basic constructional features; turbine v/s compressor blades; 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.

5ME7: PROD. ENGG. LAB. - I

3 Periods **MM : 100**

Perform any twelve experiments :

1. 1. Study of single point cutting tool geometry & grind the tool as per given tool geometry.
2. 2. Study the milling machine, milling cutters, indexing heads and indexing methods.
3. 3. Prepare a gear on milling machine.
4. 4. Prepare a hexagonal / octagonal nut using indexing head on milling m/c and to cut BSW/METRIC internal threads on lathe.
5. 5. To cut multi-start square / metric threads.
6. 6. To cut external metric threads & to meet it with the nut
7. 7. To prepare the job by eccentric turning on lathe machine.
8. 8. To prepare a job on shaper from given MS rod.
9. 9. To study the various crystal structures and dislocations through models.
10. 10. To study the Iron-Iron Carbide Equilibrium Diagram and sketch the various structures present at room temps.
11. 11. Study of capstan lathe and its tooling and prepare a tool layout & job as per given drawing.
12. 12. Study the principle & construction of the Metallurgical Microscope.
13. 13. Prepare metallic samples for metallographic examination for study of

Microstructure

14. 14. Study the hardening of steel in different medium and at different cooling rates.
15. 15. Study the effect of Carbon percentage on the hardness of Steel.

5ME8: AUTOMOBILE ENGG. LAB

2 Periods MM: 75

1. 1. Valve refacing and valve seat grinding and checking for leakage of valves
2. 2. Trouble shooting in cooling system of an automotive vehicle
3. 3. Trouble shooting in the ignition system, setting of contact breaker points and spark plug gap
4. 4. Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle performance.
5. 5. Trouble shooting in braking system with specific reference to master cylinder, brake shoes, overhauling of system and the adjusting of the system and its testing.
6. 6. Fault diagnosis in transmission system including clutches, gear box assembly and differential.
7. 7. Replacing of ring and studying the method of replacing piston after repair.

5ME9: DYNAMICS OF MACHINES LAB. - II

2 Periods MM: 75

1. 1. To verify the relation $T=I\omega\omega_p$ for gyroscope.
2. 2. To plot force vs. radius and lift vs. speed curves for governors.
3. 3. To plot pressure distribution curves on a journal bearing.
4. 4. To perform wheel balancing.
5. 5. To perform static and dynamic balancing on balancing set up.
6. 6. To determine mass moment of inertia of a flywheel. 1- Study of a lathe gear box.
7. 8. Study of a sliding mesh automobile gear box.
8. 9. Study of a planetary gear box.

5ME10: MATLAB AND COMPUTER GRAPHICS

3 Periods MM: 100

 .(A) MATLAB: Use of MATLAB and its application to Mechanical Engineering problems.
 .(B) Turbo C Graphics: To make C programs to animate different mechanisms and system: Such as Slider Crank Mechanism, Quick Return Mechanism, Cam Follower, Solar system, ball motion in billiard, Rolling of wheel from inclined plane, Seesaw motion, Projectile motion of a wheel, etc.

5ME11: DISC & ECA

0 Periods MM: 50

Rajasthan Technical University (RTU)
Mechanical Engineering

Mechanical Sixth Semester

6ME1 & 6PI1: DESIGN OF MACHINE ELEMENTS- II

3L+1T MM 100 Ex. Hrs: 3

Unit 1

Fatigue Considerations in Design: Variable load, loading pattern, Endurance stresses, influence of size, surface finish, notch sensitivity & stress concentration. Goodman line, Soderberg, Design of machine members subjected to combined, steady and alternating stresses. Design for finite life. Design of Shafts under Variable Stresses.

Unit 2

Pre loading of bolts; effect of initial tension & applied loads, Bolts subjected to variable stresses. Design of members which are curved like crane hook, body of C-clamp, machine frame etc. Power screws like lead screw, screw jack.

Unit 3

Design of helical compression, tension, torsional springs. Springs under variable stresses. Design of belt, rope and pulley drive system, selection of chain & sprocket drive systems.

Unit 4

Design of gear teeth, Lewis and Buckingham equations; wear and dynamic load considerations, Design and force analysis of spur, helical, bevel and worm gears. Bearing reactions due to gear tooth forces.

Unit 5

Design of sliding & journal bearing; method of lubrication, hydrodynamic, hydrostatic, boundary
etc. Minimum film thickness and thermal equilibrium.
Selection of anti-friction bearings for different loads and load cycles. Mounting of the bearings.
Method of lubrication, selection of oil seals.

Rajasthan Technical University (RTU) Mechanical Engineering

6 ME 2: INTERNAL COMBUSTION ENGINES AND DIESEL POWER PLANT

3 L + 0T MM 100 Ex. Hrs: 3

Unit 1
Introduction : Historical & Modern Development, Nomenclature, Classification & Comparison : SI & CI, 4 stroke – 2 stroke, First Law analysis, Energy Balance.

Testing & Performance : Performance parameters, Measurement of operating parameters e.g. speed, fuel & air consumption, Powers IHP, BHP, FHP, Efficiencies Thermal, Mechanical, Volumetric, Emission Measurement, Numerical problems, India & International standards of Testing, Emission.

Unit 2

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.

Fuel:- Conventional : Petroleum, structure, Refusing Fuels for SI & CI engines, Knock rating, Additives, Fuels for Turbine & Jet Propulsion.

Alternative : Methanol, Ethanol, Comparison with gasoline, Manufacturing, Engine performance with pure Methanol, Ethanol & blends, Alcohols with diesel engine, Vegetable oils, Bio gas.

Unit 3

Engine Systems & Components
Fuel Systems :
SI Engine : Combustion & Injection, process & parameters properties of A/F mixture, Requirements of A/F per different operating conditions, Carburetion & Carburetors, types, Aircraft carburetor, comparison of carburetion & injection, F/A ratio calculations, Numerical problems.

CI engine : Mixture requirements & constraints, Method of injection, Injection systems, CRDI
etc. system components, pumps injectors.

Rajasthan Technical University (RTU) Mechanical Engineering

Ignition system : Conventional & Modern ignition systems Magneto v/s Battery, CB point v/s Electronic ignition, Fuel Ignition Energy requirements. Spark galvanic, centrifugal, vacuum Firing order, spark plugs.

Unit 4

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.

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.

Unit 5
Dual & Multi fuel engines : Principle, fuels, Combustion, performance Advantages, Modification in fuel system.

Working principles of . Rotary, Stratified charge, Free piston, Variable compression ratio engines.

Diesel Power plant: Requirements, capacity, operation, safety, Engine Generator Coupling, Electrical load, Switching

Rajasthan Technical University (RTU) Mechanical Engineering

6 ME 3: MANUFACTURING SCIENCE AND TECHNOLOGY

3L + 1T MM100 Ex. Hrs: 3

Unit 1

JIGS AND FIXTURES:-Introduction, definition and difference; usefulness of jigs and fixtures; design considerations; materials used; principles and methods of location; clamping elements; jig bushes; drilling jigs; fixtures for milling turning, boring and welding; assembly fixtures; indexing devices; economics of jigs and fixtures; complete design of a jig and a fixtures; complete design of a jig and a fixtures.

Unit 2 NEW MACHINING METHODS: Types of machining methods; hot machining; electric discharge machining (E.D.M.) ultrasonic machining (U.S.M.) ; Electron beam machining (E.B.M.) laser beam Machining (L.B.M.); abrasive jet machining (A.J.M.) ; plasma arc machining (PAM); economics of machining! ,

Unit 3

Precision Measurement : Standards of linear measurements; linear and angular measurements; screw thread measurement; measurement of effective diameter, pitch and thread angles; Gear measurement, measurement of tooth profile, tooth thickness and pitch, Measurement of surface roughness. Quantitative methods of roughness measurements, Stylus and profilograph methods.

Precision Measuring Instruments: Comparators types; working principles applications and limitations of various comparators; optical flat; autocollimator indicators, slip gauges, bevel protector.

Unit 4

DESIGN OF SINGLE POINT CUTTING TOOLS: Introduction; functions of various tool angles; design of single point turning too]; parting tool; empirical determination of force components; optimum value of tool angles. **DESIGN OF Multipoint Cutting tool:**

Introduction; angle of contact; force analysis; approach through dimensional analysis; force and power consumption; tooth forn1 and cutter design.

Unit 5 Design of Machine Tool Element
Design of Lathe bed, Material and construction feature, various bed section, designing for torsional rigidity, use of reinforcing stiffener in lathe bed. Theoretical aspect of design of guide ways, Material and construction features, Antifriction guide ways.

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Rajasthan Technical University (RTU)
Mechanical Engineering

6ME4: NOISE, VIBRATION & HARSHNESS

3L+1T MM 100 Ex. Hrs: 3

Unit 1
Sound level and subjective response to sound; Frequency dependent human response to sound, Sound pressure dependent human response. Decibel scale; Decibel addition, subtraction and averaging. Relationship among sound power, sound intensity and sound pressure level. Sound spectra. Octave band analysis. Loudness. Noise: Effects, Ratings and Regulations; Non-auditory effects of noise on people, Auditory Effects of noise, Noise standards and limits in India. Major sources of the noise; Industrial noise sources. Industrial noise control-strategies; Noise control at the source, Noise control along the path, Acoustic barriers, Noise control at the receiver.

Unit 2
Scope of vibration, important terminology and classification, Degrees of freedom, Harmonic motion; vectorial representation, complex number representation, addition. 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. Damped vibrations of single degree of freedom systems. Viscous damping; underdamped, critically damped and overdamped systems, Logarithmic decrement. Vibration characteristics of Coulomb damped and Hysteretic damped systems.

Unit 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. Vibration Isolation and transmissibility; Force transmissibility, Motion transmissibility. Forced vibration with rotating and reciprocating unbalance. Materials used in vibration isolation.

Unit 4
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. Many degrees of freedom systems: exact analysis.
Unit 5
Many degrees of freedom systems: approximate methods; Rayleigh's, Dunkerley's, Stodola's and Holzer's methods. Vibrations of continuous systems; Transverse vibration of a string, Longitudinal vibration of a bar, Torsional vibration of a shaft.

Rajasthan Technical University (RTU)
Mechanical Engineering

6 ME 5: HYDRAULIC MACHINES AND HYDRO ELECTRIC POWER PLANT

3 L + 1T MM 100 Ex. Hrs: 3

Unit 1 Review of fundamentals
Euler's turbine equation, principles of similarity applied to hydraulic machines, non-dimensional specific speed. Classification of turbines on the basis of non-dimensional specific speed. Unit and specific quantities.
Impact of Free Jets
Impulse momentum principle, force exerted by the jet on stationary flat and curved plate, hinged plate, moving plate and moving curve vanes.

Unit 2 Impulse Turbine
Classification of turbine, impulse turbines, Pelton wheel, Construction, working. Work done, head, efficiency and design aspects. Governing of impulse turbine.

Unit 3 Reaction Turbine
Radial flow reaction turbine, Francis turbine: construction and working. Work done, efficiency, design aspects.
Axial flow reaction turbine
Propeller and Kaplan turbine, bulb or tubular turbine- construction and working. Draft tube, governing of reaction turbine.
Performance characteristics and comparison of all the turbines.

Cavitation Phenomenon in hydraulic machines

Unit 4 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.

Fluid system
Hydraulic accumulator, Hydraulic intensifier, Hydraulic Press, hydraulic crane, hydraulic lift, hydraulic Ram, hydraulic coupling, hydraulic torque converter, air lift pump, jet pump.

Unit 5 Hydro Electric power station (HEPP) – Advantages and disadvantages of water power, selection of site for HEPP, hydrological cycle, hydrographs, essential elements of HEPP. Types of dams, conduits, spillways, surge tanks. Classification of HEPP. Major, mini and micro power plants- present scenario in Rajasthan and India. Selection of turbine.

Rajasthan Technical University (RTU) Mechanical Engineering

6 ME 6: NUMERICAL METHODS AND APPLIED STATISTICS

3 L + 0T MM 100 Ex. Hrs: 3

Unit 1
Errors and significant digits, Roots of algebraic equations Bisection method, secant method, Newton Raphson method, Graff's root- squaring method, Iterated synthetic division with quadratic factors method for finding complex roots,

Unit 2
Solutions of systems of equations (Gauss elimination, Gauss Jordan, and Partition method for linear system of equations, power method for partition, method for linear system of equations, power method for finding eigen values), Forward, backward , central and Divided differences, Newton's formula of interpolation for equal and unequal intervals. Lagrange's interpolation formula, Stirling's and Bessell's formula,

Unit 3
Numerical differentiation, Numerical Integration:- Trapezoidal, Simpson's rule and Gaussian integration (only formula applications) Differential equations and their solutions. Numerical methods for ordinary differential equations (Picard method, Taylor series method, Euler's method, Ranga Kutta Method, Predictor- corrector method, Adams- Bashforth method).

Unit 4

Sampling theory: Introduction: Moments, Moment generating functions, Skewness, Kurtosis, Correlation and Regression, Normal sampling distributions; Binomial distribution, Poisson distribution, Normal distribution; Sampling distribution of the means; sampling distribution

of the differences of the means; sampling distributions of proportions.

Unit 5
Tests of Significance; t-distributions, chi square distributions, F-distributions.
Regression And Correlation; Linear regression; correlation, multiple correlation & partial correlation Confidence Limits; Large samples, small samples, error bands in regression

Rajasthan Technical University (RTU)
Mechanical Engineering

6 ME 7: HEAT TRANSFER LAB 3 P MM 100

EXPERIMENTS TO BE PERFORMED (MINIMUM TEN NUMBERS)
1. 1. To Determine Thermal Conductivity of Insulating Powders.
2. 2. To Determine Thermal Conductivity of a Good Conductor of Heat (Metal Rod).
3. 3. To Measure the thermal Conductivity of Liquid.
4. 4. To determine the transfer Rate & Temperature Distribution for a Pin Fin.
5. 5. To Measure the Emmissivity of the Test plate Surface.
6. 6. To Determine Stefan Boltzman Constant of Radiation Heat Transfer.
7. 7. ToDetermine the Surface Heat Transfer Coefficient For Heated Vertical Cylinder in Natural Convection.
8. 8. Determination of Heat Transfer Coefficient in Drop Wise & Film Wise condensation.
9. 9. To Determine Critical Heat Flux in Saturated Pool Boiling.
10. 10. To Study Performance of Simple Heat Pipes.
11. 11. To Study and Compare LMTD and Effectiveness in Parallel and Counter Flow Heat Exchangers.
12. 12. To Find the Heat transfer Coefficient in Forced Convection in a tube.
13. 13. To determine the total thermal conductivity and thermal resistance of the given compound resistance in series.
14. 14. Tofind out the thermal conductivity of given slab material.
15. 15. To determine the individual thermal conductivity of different lagging in a lagged pipe.
16. 16. To study the rates of heat transfer for different materials and geometries
17. 17. To understand the importance and validity of engineering assumptions through the lumped heat capacity method.
18. 18. Testing and performance of different heat insulators.

6 ME 8: TURBOMACHINERY LAB

2 P MM 75

1. 1. Determination of Mechanical and volumetric efficiency of Reciprocating Air Compressor.
2. 2. Testing of Reciprocating Air Compressor.
3. 3. Determination of efficiency and Pressure distribution of Axial Flow Compressor.
4. 4. Performance testing of Axial Flow Compressor.
5. 5. Study and Performance of Simple Steam Turbine
6. 6. Performance characteristics of Pelton wheel turbine.
7. 7. Performance characteristics of Francis turbine.
8. 8. Performance characteristics of Kaplan turbine.
9. 9. Performance characteristics of variable speed centrifugal pump.

Rajasthan Technical University (RTU) Mechanical Engineering

1. 10. Performance characteristics of rated speed centrifugal pump.
2. 11. Performance characteristics of multistage centrifugal pump.

6 ME 9 & 6 PI 8: COMPUTER ORIENTED NUMERICAL METHODS LAB

2 P MM 75

1. To develop computer program to determine roots of a given equation using method of
 .a. False position
 .b. Newton -Raphson method,

2. To develop computer programs for solution of system of simultaneous linear equations using:
 .a. Gauss Elimination Technique, without and with specified boundary conditions, for full as well as bounded symmetric and unsymmetrical matrices
 .b. Gauss Shield iterative technique Successive over Relaxation(S.O.R) Technique

1. 3. Linear and Non-Linear curve fitting technique
2. 4. Numerical Integration with Simpson's rule and Gaussian Integration
3. 5. Solution of ordinary differential equations by (i) Eular Method (ii) Runge-Kutta Method (iii) Taylor Series Methods
4. 6. Solution of partial differential equations using S.O.R. Technique with special reference to heat conclusion equation.

6ME10: MACHINE DESIGN – II SESSIONAL

3 P MM 100

Problems on

1. 1. Fatigue loading
2. 2. Helical compression, tension and torsional springs design
3. 3. Curved Beams
4. 4. Preloaded bolts and bolts subjected to variable stresses
5. 5. Belt, Rope and Chain drive system
6. 6. Gear Design
7. 7. Sliding contact bearing design
8. 8. Anti-friction bearing selection

Rajasthan Technical University (RTU)
Mechanical Engineering

Mechanical Engineering Seventh Semester

7 ME 1 & 7 PI 6.3: COMPUTER AIDED DESIGN

3L+0T 100 Marks Ex. Hrs: 3

UNIT I.

Overview of Computer Graphics, Picture representation, Coordinate Systems, Output Graphcis Display devices. Raster Scan Graphics : DDA for line generation and Bresenham's algorithm for line and circle generation.

UNIT II

Wire frame models, Parametric representation of curves, Plane curves : line, circle, ellipse, parabola and hyperbola. Space curves : Cubic spline curve, Bezier Curve and B Spline Curves. Blending of Curves.

UNIT III

Surface models and entities Parametric representation of Hermite Bicubic surfaces,

Bezier surfaces and B-spline surfaces. Solid Models and entities, Solid Representation : B-rep. and CSG. Comparison between three types of models**.**

UNIT IV

Two and three dimensional transformation of Geometric models: Translation, Scaling Reflection, Rotation and Shearing. Homogeneous Representation, Combined Transformation. Projection of Geometric models: Parallel and Perspective Projection.

UNIT V

Clipping : Point clipping, Line clipping, Cohen- Sutherland algorithm etc. Viewing Transformation, Hidden Line and surface Removal : Techniques and Algorithms.

Rajasthan Technical University (RTU) Mechanical Engineering

7 ME 2: REFRIGERATION AND AIR CONDITIONING

3L+ 1T 100 Marks Ex. Hrs: 3

Unit 1 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, liquid vapour heat exchangers, actual refrigeration cycle.

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.

Unit 2 Gas cycle Refrigeration

Limitation of Carnot cycle with gas, reversed Brayton cycle, Brayton cycle with regenerative H.E.

Air cycle for air craft

Necessity of cooling of air craft, Basic cycle, boot strap, regenerative type air craft refrigeration cycle.

Unit 3 Vapour Absorption System

Simple Vapour absorption system, Electrolux Refrigerator, Analysis of Ammonia absorption refrigeration system, Lithium Bromide Absorption Refrigeration System.

Refrigerants

Classification, Nomenclature, selection of Refrigerants, global warming potential of CFC

Refrigerants.
Refrigeration Equipments
Compressor, condenser, evaporator, expansion devices – types & working.

Unit 4 Psychrometry
Psychrometric properties, psychometric relations, pyschrormetric charts, psychrometric processes, cooling coils, By-pass factor and air washers.
Human Comfort
Mechanism of body heat losses, factors affecting human comfort, effective temperature, comfort chart.

Unit 5 Cooling load calculations
Internal heat gain, system heat gain, RSHF, ERSHF, GSHF, cooling load estimation, heating load estimation, psychrometric calculation for cooling, selection of air conditioning, apparatus for cooling and dehumidification, Air conditioning system

7 ME 3: OPERATIONS RESEARCH

3L+ 1T 100 Marks Ex. Hrs: 3

Unit 1 Linear Programming-
Introduction & Scope, Problem formulation, Simplex methods, primal & dual problem dual Simplex, sensitivity analysis

Unit 2
Transportation, Transshipment & Assignment problems
Dynamic Programming-
Multistage decision problems & solution, Principle of optimality.

Unit 3 Decision theory-
Decision under various conditions.
Game Theory-
Minimax & maximum strategies. Application of linear programming.
Integer Programming-
Cutting Plane method and Branch & Bound method

Unit4 Deterministic and Stochastic inventory models-
Single & multi period models with continuous & discrete demands, Service level & reorder policy

Unit 5 Simulations-
Simulation V/S mathematical modeling, Monte Carlo simulation, simulation language ARENA, Example & cases.
Queing models-
Introduction Model types, M.M. 1 & M/M/S system cost consideration

Rajasthan Technical University (RTU)
Mechanical Engineering

7 ME 4: STEAM TURBINES AND STEAM POWER PLANT

3L+ 1T 100 Marks Ex. Hrs: 3

Unit 1 Steam Turbines:
Principle and working of steam turbines, type of turbines, impulse and reactions, compounding for pressure and velocity. Velocity triangles for various types.

Unit 2
Stage efficiency, diagram efficiency, steam speed to blade, speed ratio for optimum performance. Energy losses in steam turbine, turbine performance at various loads and governing of steam turbines. Constructional details and description of steam turbine components in brief.

Unit 3 Regenerative feed heating cycles:
Introduction : Most Ideal Regenerative feed heating cycle. Regenerative feed 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. Other types of feed heating arrangements. Optimum feed water temperature and saving in Heat Rate. Feed Heaters, Direct Contact Heaters, Surface Heaters
Reheating – Regenerative and Regenerative water – Extraction Cycles.
Reheating of steam, Practical reheating and Non- reheating cycles, advantage & disadvantages of reheating, regenerative water extraction cycles, practical feed heating arrangements.

Unit 4
Governing and performance of Steam Turbines.
Description of back pressure Turbines, pass-out Turbines and Mixed Pressure Turbines.

Unit 5 Steam Power Plant

Steam power plants selection of location, working medium. Fuels and fuel handling equipments, ash handling equipments. Air pre-heater, feed water treatment. Methods of combustion and various type of combustors. Types of boilers. Modern developments in steam boilers. Description of cooling tower.

Rajasthan Technical University (RTU)
Mechanical Engineering

7 ME 5: PRODUCT DEVELOPMENT AND LAUNCHING

3L+ 0T 100 Marks Ex. Hrs: 3

Unit 1 Importance of new product-Definition-importance-Development Process.
Importance of new product for growth of enterprise. Definition of product and new product. Responsibility for new product development. Demands on product development team. Classification of products from new product development. Point of view- Need based/Market pull products, Tech. push, Platform based, Process based and customized products. New product development process and organization. Generic product development process for Market Pull Products. Modification of this process for other types of products.

Unit 2 Need analysis- Problem Formulation
Establishing economic existence of need, Need Identification and Analysis, Engineering Statement of Problem, Establishing Target Specification.

Unit 3 Generation of Alternatives and Concept Selection
Concept generation- a creative process, Creativity, Road Elects to creative thinking-Fear of criticism and Psychological set. Tools of creativity like brain storming, Analogy, Inversion etc.,
Creative thinking Process.
Concept feasibility and Concept Selection, Establishing Engineering Specification of Products.

Unit 4 Preliminary & detailed design- Design Review
Preliminary design- Identification of subsystems, Subsystem specifications, Compatibility. Detailed design of subsystems, component design, Preparation of assembly drawings. Review of product design from point of view of Manufacturing, Ergonomics and aesthetics.

Unit 5 Management of New Product – development and Launch.
New Product Management's Challenges – Maintaining focus, Promotion of Right Culture, Management of Creativity, Top Management attention.

Design Team Staffing and Organization. Setting key mile stone, Identification of Risk Areas, Project Execution and Evaluation Product Launch Strategies.
Project Planning – Project Task matrix, estimation of time & resources, project scheduling.

Rajasthan Technical University (RTU)
Mechanical Engineering

7 ME 6.1: ROBOTICS

3L+ 0T 100 Marks Ex. Hrs: 3

Unit 1 Introduction to Robotics
Evolution of Robots and Robotics, Laws of Robotics, What is and What is not a Robot, Progressive Advancement in Robots, Robot Anatomy, Human Arm Characteristics, Design and Control Issues, Manipulation and Control, Sensors and Vision, Programming Robots, The Future Prospects, Notations.

Unit 2 Coordinate Frames, Mapping and Transforms
Coordinate Frames, Description of Objects in Space, Transformation of Vectors, Inverting a Homogeneous Transform, Fundamental Rotation Matrices

Unit 3 Symbolic Modeling of Robots – Direct Kinematic Model
Mechanical Structure and Notations, Description of Links and Joints, Kinematic Modeling of the Manipulator, Denavit – Hartenberg Notation, Kinematic Relationship between Adjacent Links, Manipulator Transformation Matrix. Introduction to Inverse Kinematic model

Unit 4 Robotic Sensors and Vision
The Meaning of Sensing, Sensors in Robotics, Kinds of Sensors used in Robotics, Robotic vision, Industrial Applications of Vision-Controlled Robotic Systems, Process of Imaging, Architecture of Robotic Vision Systems, Image Acquisition.

Unit 5 Robot Applications
Industrial Applications, Material Handling, Processing Applications, Assembly Applications, Inspection Application, Principles for Robot Application and Application Planning, Justification of Robots, Robot Safety, Non-Industrial Applications.

Rajasthan Technical University (RTU)
Mechanical Engineering

7 ME 6.2 & 7 PI 6.2: MECHATRONICS

3L+ 0T 100 Marks Ex. Hrs: 3

Unit 1
Introduction about Mechatronics, scope of Mechatronics, application, process control automation and N/c Machines.

Unit 2 Sensors and Transducers
Introduction, classification, specification, characteristics of transducers, type of transducers displacement, strain, vibration pressure, flow, temperature, force & torque, tactile.

Unit 3 Hydraulic Pneumatic & Electrical actuators
Pumps & Compressors, control valves & accessories, actuators, fluid power symbols, fluid power systems, switching devices, solenoids, motors.

Unit 4 Data Acquisition and Control System
Introduction, Quantitizing theory, Analog to Digital Conversion, Digital to Analog (D/A) conversation, transfer function, transient response & frequency response & frequency response, stability criteria.

Unit 5 Design of Mechatronic systems
Introduction, Automatic front and book and cutting in steel rolling mill, lift control system, CNC lathe, temperature control of a heat treatment furnace, EOT crane control panel, Grey grain separators, electrode arm control in electric arc furnace.

Rajasthan Technical University (RTU) Mechanical Engineering

7 ME 6.3: COMPUTER INTEGRATED MANUFACTURING

3L+ 0T 100 Marks Ex. Hrs: 3

Unit 1
Introduction: Overview of manufacturing processes, types of manufacturing systems, the product cycle, computer's role in manufacturing, sources and types of data used in manufacturing.

The Beginning of CAM: Historical Background, Basic components of NC systems, NC Procedure, NC coordinate system and machine motions, applications and economics of NC.

Unit 2
Part programming- manual and computer assisted such as APT Language. Computer Controls In NC Systems: Problems with conventional NC computer numerical control, Direct numerical control, combined CNC/ DNC systems, adaptive control machining system computer process interfacing, New development and latest trends.

Unit 3
Computer Aided Process Planning: Traditional Process Planning, Retrieval process planning system, Generative Process Planning, Machinability data system, computer generated time standards. Group Technology: Introduction, part families, part classification and coding, coding system and machining cells.

Unit 4
Compuer 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. Computer Aided Quality Control: Computer in quality control, contact inspection methods, Non contact inspection methods, optical and non optical computer aided testing. Computer Aided Material Handling: Computer control on material handling, conveying, picking. Ware house control, computerized material handling for automated inspection and assembly.

Unit 5
Computer Integrated Manufacturing Systems: Introduction, types special manufacturing systems, flexible manufacturing systems (FMS). Collabarative Engineering**:** Introduction, Faster Design throughput, Web based design, Changing design approaches, extended enterprises, concurrent engineering, Agile and lean manufacturing.

Rajasthan Technical University (RTU) Mechanical Engineering

7ME7: P.E. LAB.-II

3 P MM 100

Minimum any ten experiments can be performed

1. 1. By using lathe tool dynamometer measure the cutting forces in all directions and calculate the following: a) Shear plane angle b) Coefficient of friction c) Power consumption
2. 2. By using the drill dynamometer measure the torque, and thrust in Drilling operation.
3. 3. By using the tool work thermocouple, measure the tool chip interface temp
4. 4. To determine chip reduction coefficient in turning.
5. 5. To study the different mechanisms of tool wear and their measurements.
6. 6. To determine Taylor Tool life exponents by Facing test

7. 7. To study the effect of cutting variables on surface finish in any cutting (Turning, Drilling, Milling, Shaping, grinding etc) operation
8. 8. Study of the effect of clearance and shear angle on the blanking and piercing operations
9. 9. To determine the effect of percentage of reduction and the semicone angle of the die on the drawing load.
10. 10. To find the effect of percentage of reduction and the die geometry on extruding force.
11. 11. Experimental determination of coefficient of friction for metal forming.
12. 12. Study of the drop forging operation (flow ability, forging load etc by plasticine model.
13. 13. To determine roll load in the sheet rolling process.
14. 14. Students will be given at least one practical problem regarding design and fabrication of Jig, Fixture or Press tool.
15. 15. To measure a gap with help of slip gauges
16. 16. Measurement of angle/taper using a sine bar.
17. 17. Study and use of a bore gauge.
18. 18. Flatness testing of a surface pate and machine tool bed by using a sensitive spirit level.
19. 19. Measurement of screw thread elements by tool Makers microscope and Inspection of various elements of screw thread by optical projector.
20. 20. To measure flatness and surface defects in the given test piece with the help of monochromatic check light and optical flat.
21. 21. Measurement of chordal thickness of Gear tooth by Gear tooth vernier caliper.
22. 22. Use of three-wire method to determine the effective diameter of external threads.
23. 23. To study the capstan lathe, tool holders and attachments and to prepare the given job as per given drawing.
24. 24. Cutting forces measurement during milling using milling dynamometer.
25. 25. Measurement of flatness and roundness of a given machine/ground/lapped flat and round surface respectively using dial gauge.

Rajasthan Technical University (RTU) Mechanical Engineering

7ME8: MECHANICAL VIBRATIONS LAB.

2 P **MM 50**

1. 1. To verify relation $T = 2\pi / (l/g)$ for a simple pendulum.
2. 2. To determine radius of gyration of compound pendulum.
3. 3. To determine the radius of gyration of given bar by using bifilar suspension.
4. 4. To determine natural frequency of a spring mass system.

5. 5. Equivalent spring mass system.
6. To determine natural frequency of free torsional vibrations of single rotor system.
(a) Horizontal rotor (b) Vertical rotor
6. 7. To verify the Dunkerley's rule.
7. 8. Study of free damped torsional vibration to performing the experiment to find out damping co-efficient.
8. 9. To conduct experiment of trifler suspension.
9. 10. Harmonic excitation of cantilever beam using electro-dynamic shaker and determination of resonant frequencies.
10. 11. Study of Vibration measuring instruments.

7 ME 9: I. C. Engine Lab. 2 P MM 50

Perform any 10 experiments

1. 1. Study of IC Engine models
2. 2. Study of working of four stroke petrol engine and four stroke diesel engine with the help of cut section models.
3. 3. Study of working of two stroke petrol and two stroke diesel engine with the help of cut section models.
4. 4. Study of fuel supply system of a petrol engine (fuel pump and simple carburetor)
5. 5. Study of complete carburetor (Solex carburetor)
6. 6. Study of Petrol Injection System.
7. 7. Study of fuel supply system of a Diesel engine (fuel pump and fuel injector)
8. 8. Study of Ignition systems of an IC Engine (Battery and Magneto ignition system) and Electronic ignition system.
9. 9. Study of Lubrication system of an IC Engine (mist, splash and pressure lubrication)
10. 10. Study of cooling systems of an IC Engine (air cooling and water cooling)
11. 11. To conduct a performance test on diesel engine to draw heat balance sheet for given load and speed
12. 12. To determine friction power of diesel engine by Willan's line or fuel rate extrapolation method.
13. 13. To conduct a performance test on the variable compression ratio engine and to draw the heat balance sheet for given compression ratio, speed and load and plot the performance curves.

1. 14. To conduct a performance test on a four cylinder four stroke petrol engine and to draw the heat balance sheet and performance curves.

2. 15. To calculate the indicated power, friction power and mechanical efficiency of four stroke four cylinder petrol engine at full load and rated speed by Morse test.
3. 16. To draw the valve timing diagram of a Four stroke S.I. or C.I. Engine using experimental setup.
4. 17. Analysis of engine exhaust gases using Orsat apparatus / gas analyzer.

Rajasthan Technical University (RTU)
Mechanical Engineering

Mechanical Engineering Eight Semester Syllabus

8ME1: RENEWABLE ENERGY TECHNOLOGY

4L+ 0T 100 Marks Ex. Hrs: 3

Unit 1
Global and National scenarios, Form and characteristics of renewable energy sources
Solar Energy
Solar radiation, its measurements and prediction. Solar thermal collectors, flat plate collectors, concentrating collectors. Basic theory of flat plate collectors, solar heating of buildings, solar still, solar water heaters, solar driers; conversion of heat energy in to mechanical energy, solar thermal power generation systems.
Solar Photovoltaic
Principle of photovoltaic conversion of solar energy, types of solar cells and fabrication. photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping, power generation schemes

Unit 2 Wind Energy
Atmospheric circulations, classification, factors influencing wind, wind shear, turbulence, wind speed monitoring, Betz limit, WECS: classification, characteristics, applications.

Unit 3 Ocean Energy
Ocean energy resources, ocean energy routes. Principles of ocean thermal energy conversion systems, ocean thermal power plants. Principles of ocean wave energy conversion and tidal energy conversion.

Unit 4 Other Sources:
Nuclear fission and fusion; Geothermal energy: Origin, types of geothermal energy sites, site selection, geothermal power plants; Magneto-hydro-dynamic (MHD) energy conversion. Formation of biomass, photosynthesis; Biomass resources and their classification; Chemical constituents and physicochemical characteristics of biomass; Biomass conversion processes;

Unit 5 Fuel Cells
Thermodynamics and electrochemical principles; Basic design, types, applications.
Hydrogen Energy
Economics of hydrogen; Production methods.

Rajasthan Technical University (RTU)
Mechanical Engineering

8ME2: OPERATIONS MANAGEMENT

3L+ 1T 100 Marks Ex. Hrs: 3

Unit 1
Introduction: Scope of Operations Management, operations manager and the management process. Operations Strategy, Competitiveness and Productivity. Demand Forecasting: components of forecasting demand, Approaches to forecasting: Qualitative methods, Time series methods, Regression methods, Accuracy and control of forecasts, Selection of forecasting technique.

Unit 2
Products and Services, Process, Types of Production Systems: Mass, Batch, Job shop production. Product and process matrix. Process planning and Process analysis. Capacity Planning: Defining and measuring capacity, steps in capacity planning process, determining capacity requirements, Capacity alternatives, Evaluation of alternatives-Cost- Volume analysis etc.

Unit 3
Production Planning: Production planning objective and functions, Bill of material, Capacity and man power requirement planning, Planning levels: long range, Intermediate range and Short range planning, aggregate planning; Objective, Strategies, graphical and mathematical techniques of aggregate planning, master production scheduling, MRP and MRPII Systems

Unit 4
Production Control: Capacity control and priority control, production control functions; Routing, scheduling, dispatching, expediting and follow up. Techniques of production control in job shop production, batch production and mass production systems,

Unit 5
Material Management: Objectives, scope and functions of material management, planning, procurement, storing, ending and inventory control. Purpose of inventory, inventory cost, inventory control systems, Selective inventory control systems, Determination of EOQ, Lead time and reorder point. Methods of physical stock control

Rajasthan Technical University (RTU)
Mechanical Engineering

8ME3: GAS TURBINES AND GAS POWER PLANT

3L+ 1T 100 Marks Ex. Hrs: 3

Unit1
Review of basic principles and fundamentals of rotating machines.
Cycle arrangements, open cycle arrangements, closed cycle arrangements, basic requirement of
the working medium, properties of various working media, applications of gas turbine, comparison of gas turbines with reciprocating engines.
Ideal cycles: simple gas turbine cycle, heat exchange cycle, reheat cycle, reheat and heat exchange cycle, intercooled cycle, intercooled cycle with heat exchanger, intercooled and reheat
cycle, intercooled cycle with heat exchange and reheat. Comparison of various cycles.

Unit 2
Practical cycles and their analysis, effect of variable specific heat, mechanical losses, loss due to incomplete combustion, polytropic efficiency, performance of actual cycles, comparison of ideal vs actual cycles. Jet propulsion cycles.

Unit 3
Thermodynamic cycles, advantages, disadvantages and performance characteristics of Ramjet
engine, pulsejet engine, turboprop engine, turbojet engine, turbofan engine.
Calculation of specific thrust and efficiency.

Unit 4
Combustion systems, combustion theory applied to gas turbine combustor, factors affecting combustion chamber design and performance. Combustion chamber geometry, fuel injection and ignition, use of cheap fuels. Impulse and reaction type gas turbines. Velocity triangles and calculation of work done,efficiency etc..

Unit 5
Advantages of a gas turbine power plant, comparison with steam, diesel and hydel power plant. Performance of GT power plant-part load efficiency, airflow rate, thermal efficiency, gas turbine blading and fuels. Gas turbine materials. Free piston engine plant.

Rajasthan Technical University (RTU)

Mechanical Engineering

8ME4.1: RELIABILITY AND MAINTENANCE ENGINEERING

4L+ 0T 100 Marks Ex. Hrs: 3

Unit 1

Introduction: Maintenance Objectives and Functions; Maintenance Organisation and Administration of Maintenance Systems. Need of planned maintenance. Maintenance policies; Breakdown, time based maintenance: Block replacement, age replacement and periodic replacement policy. Corrective and preventive maintenance. Maintenance planning, Scheduled maintenance. Cost of maintenance versus Cost of equipment and production delays. Inspection: Inspection intervals, Inspection reports, card history system.

Unit 2

Predictive maintenance. Equipment wear records, standards. Equipment used in predictive maintenance. Computerized maintenance, Total Productive Maintenance. Methods of condition monitoring, Non-destructive testing, Liquid Penetrate, Magnetic particles, Ultrasonic testing, and Vibration analysis. Oil analysis, Radiographic testing.

Unit 3

Reliability: Definition, failure data analysis, Mean failure rate, mean time to failure (MTTF), mean time between failures (MTBF) , hazard rate, Bathtub curve. Use of Weibull probability chart foe assessing characteristics life, guarantee period etc.

Unit 4

System reliability: Series, parallel and mixed configuration; Simple problems. Reliability improvement: Techniques, use of Pareto analysis-Design for reliability, redundancy unit and stand by redundancy, Optimization of reliability.

Unit 5

Spare Parts Management: Spare parts, features and categorization of spares, cost considerations, Techniques of cost reduction; Selective controls used in spare parts control; ABC analysis, FSN, XYZ, VED and other approaches. Inventory control of spares.

Rajasthan Technical University (RTU)
Mechanical Engineering

8 ME4.2: COMPUTATIONAL FLUID FLOW AND HEAT TRANSFER

4L+ 0T 100 Marks Ex. Hrs: 3

Unit1

Review of basic fluid mechanics and the governing (Navier-Stokes) equations.
Types of partial differential equations- hyperbolic, parabolic and elliptic.
Traditional solution methods- method of characteristics, separation of variables, Greens function
method.

Unit2

Preliminary computational techniques: Discretisation, converting derivatives to discrete algebric expressions, spatial derivatives, time derivatives. Approximation of derivatives, Taylor series expansion, general techniques. Accuracy of discretisation process-higher order vs lower order formulae.

Unit3

Finite difference method: conceptual implementation, application to transient heat conduction problem.
Convergence, consistency and stability of FD equation.

Unit4
Weighted residual methods: General formulation, Introduction to Finite Volume method. Finite Volume method: Equations with first derivatives and second derivatives. FV method applied to Laplace's equation.

Unit5
Finite Element method: Linear interpolation, quadratic interpolation, two dimensional interpolation. Application to heat transfer problems.

Rajasthan Technical University (RTU)
Mechanical Engineering

8ME4.3: FINITE ELEMENT METHODS

4L+ 0T 100 Marks Ex. Hrs: 3

UNIT I : Introduction

Introduction to FEM and its applicability, Review of mathematics : Matrix algebra, Gauss elimination method, Uniqueness of solution, Banded symmetric matrix and bandwidth. Structure analysis : Two-force member element, Local stiffness matrix, coordinate transformation, Assembly, Global stiffness matrix, imposition of Boundary conditions. Properties of stiffness matrix.

UNIT II : One-dimensional Finite Element Analysis

Basics of structural mechanics : stress and strain tensor, constitutive relation. Principle of minimum Potential. General steps of FEM, Finite element model concept / Discretization, Derivation of finite elements, equations using potential energy approach for linear and quadratic 1-D bar element, shape functions and their properties, Assembly, Boundary conditions, Computation of stress and strain.

UNIT III : Two dimensional Finite Element Analysis :

Finite element formulation using three nodded triangular (CST) element and four nodded rectangular element, Plane stress and Plain strain problems. Shape functions, node numbering and connectivity, Assembly, Boundary conditions. Isoparametric formulation of 1-D bar elements, Numerical integration using gauss quadrature formula, computation of stress and strain.

UNIT IV : Finite Element Formulation from Governiing Differential Equation :

Method of Weighted Residuals : Collocation, Subdomain method, Least Square method and Galerkin's method. Application to one dimensional problems, one-dimensional heat transfer, etc. introduction to variational formulation (Ritz Method.)

UNIT V :

Higher order elements, Lagrange's interpolation formula for one and two independent variable.
Convergence of solution, compatibility, element continuity, static condensation, p and h methods
of mesh refinement, Aspect ratio and element shape.
Application of FEM, Advantages of FEM. Introduction to concept of element mass matrix in dynamic analysis.

Rajasthan Technical University (RTU)
Mechanical Engineering

8 ME 5: CAD LAB. 3 P MM 100

EXPERIMENTS TO BE PERFORMED (MINIMUM FIVE EXPERIMENTS)

1. 1. Introduction & different features of the CAD Software

2. 2. 2-D Drafting
3. 3. 3-D Modeling
4. 4. 3-D Advanced Modeling
5. 5. Assembly modeling
6. 6. Feature Modification and Manipulation
7. 7. Detailing
8. 8. Sheet Metal Operations
9. 9. Surface Modeling
10. 10. One Dimensional problems of Finite Element Method.

(These exercises may be performed by any of the following Advanced CAD Software such as Pro E /Unigraphics/ AotoCAD Inventor)

8 ME 6: CAM AND ROBOTICS LAB. 2 P MM

75

EXPERIMENTS TO BE PERFORMED

CAM (Minimum Five Experiments)

1. 1. To prepare part programming for plain turning operation.
2. 2. To prepare part programming for turning operation in absolute mode.
3. 3. To prepare part program in inch mode for plain turning operation.
4. 4. To prepare part program for taper turning operation.
5. 5. To prepare part program for turning operations using turning cycle.
6. 6. To prepare part program for threading operation.
7. 7. To prepare part program for slot milling operation.
8. 8. To prepare part program for gear cutting operation.
9. 9. Toprepare part program for gear cutting using mill cycle.
10. 10. To prepare part program for drilling operation.
11. 11. To prepare part program for multiple drilling operation in Z-axis.
12. 12. To prepare part program for multiple drilling in X-axis.
13. 13. To prepare part program for multiple drilling in X and Z axis using drilling cycle.

Robotics (Minimum Five experiments)

1. 1. To detect the sensor scanning system to overcome limitation of fixed sensors on various robotic applications, ultrasonic sensor, laser range finders, infrared detectors and miniature.
2. 2. To find the horizontal and vertical movement up to 180o in either direction.
3. 3. To detect objects with infrared ray detector.
4. 4. To determine object distance (3cm – 300cm).
5. 5. Todetect distance (10cm to 80 cm) with infrared object detector.
6. 6. To determine 5 Axis Robotic Arm movement and its degree of rotation.
7. 7. To lift the object and place 100m away in various directions.
8. 8. To find the gripper movement (0 to 50mm).
9. 9. To study various Robotic Arm Configurations.
10. 10. To study Pick and Place Robot

8 ME 7: INDUSTRIAL ENGINEERING LAB. 2 P

MM 75

1. 1. Determination of time standard for a given job using stopwatch time-study.
2. 2. Preparation of flow process chart, operation process chart and man-machine charts for an existing setup and development of an improved process.
3. 3. Study of existing layout of a workstation with respect to controls and displays and suggesting improved design from ergonomic viewpoint.
4. 4. To carryout a work sampling study.
5. 5. To conduct process capability study for a machine in the workshop.
6. 6. To design a sampling scheme based on OC curve.
7. 7. To conduct Shewart's experiments on known population
8. 8. Generation of random numbers for system simulation such as facility planning, job shop scheduling etc.