

TS ECET-2019

SYLLABUS FOR MECHANICAL ENGINEERING

MATHEMATICS (50 Marks)

Unit-I: Matrices

Matrices: Definition of Matrix, Types of matrices-Algebra of matrices-Transpose of a matrix-Symmetric, skew symmetric matrices-Minor, cofactor of an element-Determinant of a square matrix-Properties-Laplace's expansion-singular and non singular matrices - Adjoint and multiplicative inverse of a square matrix-System of linear equations in 3 variables-Solutions by Cramer's rule, Matrix inversion method,-Gauss-Jordan method.

Partial Fractions: Resolving a given rational function into partial fractions.

Logarithms: Definition of logarithm and its properties, meaning of 'e' exponential function and logarithmic function.

Unit-II: Trigonometry

Properties of Trigonometric functions- Ratios of Compound angles, multiple angles, submultiple angles - Transformations of Products into sum or difference and vice versa- Simple trigonometric equations-Properties of triangles-Inverse Trigonometric functions, Hyperbolic functions.

Complex Numbers: Properties of Modulus, amplitude and conjugate of complex numbers, arithmetic operations on complex numbers-Modulus-Amplitude form (Polar form) - Euler form (exponential form)-Properties.

Unit-III: Analytical Geometry

Straight Lines-different forms of Straight Lines, distance of a point from a line, acute angle between two lines, intersection of two non-parallel lines and distance between two parallel lines. Circles-Equation of circle given center and radius, given ends of diameter-General equation-finding center and radius, center and a point on the circumference, 3 non-collinear points, center and tangent, equation of tangent and normal at a point on the circle.

Unit-IV: Differentiation and its Applications

Functions and limits - Standard limits - Differentiation from the First Principles - Differentiation of sum, product, quotient of functions, function of function, trigonometric, inverse trigonometric, exponential, logarithmic, Hyperbolic functions, implicit, explicit and parametric functions-Derivative of a function with respect to another function-Second order derivatives - Geometrical applications of the derivative(angle between curves, tangent and normal)-Increasing and decreasing functions-Maxima and Minima(single variable functions) using second order derivative only - Partial Differentiation-Partial derivatives up to second order-Euler's theorem.

Unit-V: Integration and its Applications

Indefinite Integral - Standard forms - Integration by decomposition of the integrand, integration of trigonometric, algebraic, exponential, logarithmic and Hyperbolic functions-Integration by substitution -Integration of reducible and irreducible quadratic factors - Integration by parts- Definite Integrals and properties, Definite Integral as the limit of a sum -

Application of Integration to find areas under plane curves and volumes of Solids of revolution— Mean and RMS value, Trapezoidal rule and Simpson's 1/3 Rule for approximation integrals.

Unit–VI: Differential Equations

Definition of a differential equation-order and degree of a differential equation- formation of differential equations-solution of differential equation of the type first order, first degree, variable-separable, homogeneous equations, exact, linear differential equation of the form $dy/dx+Py=Q$, Bernoulli's equation, nth order linear differential equation with constant coefficients both homogeneous and nonhomogeneous and finding the Particular Integrals for the functions e^{ax} , x^m , $\sin ax$, $\cos ax$ or a polynomial of m-th degree($m=1,2$).

Unit–VII: Laplace Transforms

Laplace Transforms (LT) of elementary functions-Linearity property, first shifting property, change of scale property multiplication and division by t-LT of derivatives and integrals, Unit step function, LT of unit step function, second shifting property, evaluation of improper integrals, Inverse Laplace transform(ILT)-shifting theorem, change of scale property, multiplication and division by p, ILT by using partial fractions and convolution theorem. Applications of LT to solve ordinary differential equations to solve ordinary differential equations up to second order only.

Unit–VIII: Fourier Series

Define Fourier series, Euler's formulae over the interval $(C, C+2\pi)$ for determining the Fourier coefficients. Fourier series of simple functions in $(0, 2\pi)$ and $(-\pi, \pi)$. Fourier series for even and odd functions in the interval $(-\pi, \pi)$.

PHYSICS (25Marks)

Unit-I: Units and dimensions:

Physical quantity-fundamental and derived physical quantities-units-fundamental and derived units-SI units-multiples and sub-multiples in SI units-advantages of SI units-dimensions and dimensional formulae-dimensionless quantities- applications and limitations of dimensional analysis-problems.

Unit-II: Elements of vectors:

Scalar and vector quantities-examples-types of vectors-addition and subtraction of vectors-triangle law-parallellogram law-polygon law-resolution of a vector-unit vectors(i,j,k)-dot product and cross product of two vectors- characteristics of dot and cross products-examples- problems.

Unit-III: Kinematics and Friction

Equations of motion-acceleration due to gravity-equations of motion under gravity- projectile motion-examples-horizontal and oblique projections-expressions for maximum height, time of ascent, time of flight, horizontal range, problems. Friction- causes and types of friction-normal reaction-laws of friction-coefficients of friction-angle of friction-methods of reducing friction-

advantages and disadvantages of friction-motion of a body over a rough horizontal surface– problems.

Unit-IV: Work, Power and Energy

Work, power and energy-definitions and units-potential and kinetic energies-examples and expressions-work-energy theorem – law of conservation of energy-problems.

Unit-V: Simple harmonic motion and Sound

Definition-conditions of SHM - examples of SHM - expressions for displacement, velocity, acceleration, time period, frequency and phase of SHM-time period of a simple pendulum-seconds pendulum-problems. Sound-musical sound and noise-noise pollution-Effects and methods of control of Noise Pollution-Beats and echo's-problems-Doppler effect– Explanation, and Applications --Reverberation-Sabine's formula-characteristics of a good building-problems.

Unit-VI: Heat and Thermodynamics

Expansion of gases-Boyle's law-Absolute scale of temperature-Charles laws-Ideal gas equation-Universal gas constant and its value-SI Units-problems-- isothermal process-adiabatic process-first law of thermodynamics - two specific heats of a gas-relation between C_p and C_v - problems-second law of thermodynamics.

Unit-VII: Modern physics

Photo electric effect–explanation and its laws-applications of photo electric effect(photocell)-Einstein's photoelectric equation–critical angle and total internal reflection– optical fibers - principle, working, types and applications-concept of super conductivity – and applications.

CHEMISTRY (25 Marks)

Unit I: Fundamentals of Chemistry:

Atomic structure: Introduction-Fundamental particles – Bohr's theory – Quantum numbers – Aufbau's principle – Hund's rule – Pauli's exclusion principle- Electronic configurations of elements up to atomic number 30, shapes of **s**, **p**, **d** orbital's.

Chemical Bonding: Introduction – types of chemical bonds – Ionic bond taking example of NaCl and MgO –characteristics of ionic compounds and covalent bond taking example H₂, O₂, N₂, HCl, characteristics of covalent compounds-Coordinate covalent bond.

Oxidation-Reductions: concepts of Oxidation-Reduction, Oxidation number and its calculations, differences between oxidation number and Valency.

Unit-II: Solutions:

Introduction classification of solutions, solute, solvent, concentration, mole concept–Molarity – Normality, equivalent weight using acids, bases and salts, numerical problems on Molarity and Normality.

Unit-III: Acids and Bases:

Introduction – theories of acids and bases – Arrhenius, Bronsted – Lowry theory – Lewis acid base theory – Ionic product of water - pH and related numerical problems – buffers solutions – Applications.

Unit – IV: Principles of Metallurgy:

Characteristics of metals and distinction between metals and non-metals. Definitions of metallurgy, ore, gangue, flux, slag–concentration of ore-hand picking, levigation, froth floatation – extraction of crude metal – roasting calcination, smelting – alloys – composition and uses of brass, German silver and nichrome.

Unit-V: Electrochemistry:

Conductors, insulators, electrolytes - Arrhenius theory of electrolytic dissociation – electrolysis – Faraday’s laws of electrolysis- numerical problems – Galvanic cell – standard electrode potential – electro chemical series –emf and numerical problems on emf of a cell.

Unit –VI: Corrosion:

Introduction – factors influencing corrosion - electrochemical theory of corrosion-composition cell, stress cell and concentration cells - rusting of iron and its mechanism – prevention of corrosion by (a) coating methods, (b) cathodic protection (sacrificial and impressive voltage methods).

Unit-VII: Water Technology:

Introduction – soft and hard water – causes of hardness – types of hardness –disadvantages of hard water – degree of hardness, units and Numerical problems– softening methods – permutit process – ion exchange process – qualities of drinking water – municipal treatment of water for drinking purpose - Osmosis and reverse Osmosis, advantages of reverse Osmosis.

Unit-VIII: Polymers:

Introduction – polymerization – types of polymerization – addition, condensation polymerization with examples – plastics – types of plastics – advantages of plastics over traditional materials – Disadvantages of using plastics, thermo plastics and thermo setting plastics– differences between thermo plastics and thermo setting plastics- preparation and uses of the following plastics: 1. Polythene, 2. PVC, 3. Teflon, 4. Polystyrene, 5.Urea formaldehyde – Rubber – natural rubber – processing from latex –Vulcanization – Elastomers – Butyle rubber Buna-s, Neoprene rubber and their uses.

Unit-IX: Fuels:

Definition and classification of fuels based on physical state and occurrence – characteristics of good fuel - composition and uses of gaseous fuels. (a) Water gas, (b) producer gas, (c) natural gas, (d) coal gas, (e) bio gas, (f) acetylene.

Unit-X: Environmental Chemistry:

Introduction – environment – understand the terms lithosphere, hydrosphere, atmosphere bio sphere, biotic component, energy component pollutant, receptor, sink, particulate, DO, BOD, Threshold limit value, COD - Air pollution - causes-Effects- Forest resources, uses and

over exploitation, deforestation acid rain, green house effect –ozone depletion – control of Air pollution – Water pollution – causes – effects – control measures. Renewable and Non Renewable energy sources – concept of ecosystem –producers, consumers and decomposers – Biodiversity, threats to Biodiversity.

MECHANICAL ENGINEERING (100 Marks)

Unit I: Workshop Technology, Metrology and Conventions in drawing

Basis Workshop tools and Operations (Carpentry, Fitting, Forging and sheet metal), Forging processes and Tools, Drilling, Mechanical working of Metals- Cold and hot working processes. Foundry-Pattern types, types of mouldings and their properties. Metrology — linear and angular measuring devices pneumatic measurement of surface roughness, interferometry. Conventional representations in machine drawing — production drawing — limits, fits & Tolerances — surface finish - specifications of standard components like Bolts, Nuts, Bearings etc.

Unit II: Engineering Materials and Engineering Mechanics

Mechanical properties of materials —structure of materials- Destructive and Non-destructive testing of materials, Production of Iron and Steel Iron Carbon equilibrium Diagram - Heat treatment processes — Plain Carbon and alloy steels — Ferrous and Nonferrous metals and alloys — Powder metallurgy.

System of forces- Resolution of Forces, Concept of Equilibrium, Lami's Theorem, Couple, Concept of Friction, Geometrical Properties of Sections, Simple Machines, Dynamics- Impulse Momentum Equation, D' Alembert's Principle.

Unit III: Strength of Materials and CAD/CAM

Simple Stresses and Strains, Concept of Strain Energy, Shear Force and Bending Moment diagrams, Concept of Simple Bending and Deflection of Beams - concept of torsion in shafts and springs — Thin cylinders.

Basic components of NC, CNC, and DNC machines — CNC part programming- Manual and Computer assisted-CIMS, FMS and Robotics.

Unit IV: Design of Machine Elements

Principal Stresses- Theories of failure - Basic Link Mechanisms, Design of Bolts-Power screws-Shafts — Keys- Couplings- Bearings, design of Belt-Chain and Gear drives — Flywheels-Governors-Cams- Brakes and Clutches.

Unit V: Production Technology

Working and operations of lathe- Capstan and turret lathes - copying lathes - Shaper, slotter, Planner and milling machines, Broaching machines, Welding-Equipment used in arc and gas welding. Modern welding methods — Submerged arc, atomic, hydrogen, CO₂, and ultrasonic welding. , cutting fluids, coolants and lubricants, Milling and Gear making, -Grinding machines, surface finishing operations — Honing, lapping, super finishing, electro plating, Metal spraying, Modern machining processes, Press tools, Jigs and fixtures.

3. $\tan^{-1}(1/2) + \tan^{-1}(1/3) =$

- 1) 0 2) $\frac{\pi}{3}$ 3) $\frac{\pi}{6}$ 4) $\frac{\pi}{4}$

4. $\int_0^{\frac{\pi}{2}} \log(\cot x) dx =$

- 1) 1 2) 0 3) $2\log 2$ 4) None

5. The differential equation $\frac{dy}{dx} + \frac{ax+by+g}{hx+by+f} = 0$ is called

- 1) Homogenous 2) Linear 3) Exact 4) None

PHYSICS

1) Dimensional formula for stress

- 1) ML^2T^{-3} 2) $ML^{-1}T^{-2}$ 3) ML^0T^{-2} 4) MLT^{-1}

2) On which principle optical fiber works

- 1) Reflection 2) Refraction 3) Total internal reflection 4) Total internal refraction

3) Relation between centigrade and Kelvin scale of temperature

- 1) $T=t+273$ 2) $T=t-273$ 3) $t=T+273$ 4) $t=T-273$

4) Find the dot product of two vectors

$A=2i+3j+4k$ and $B=4i-2j+3k$

- 1) 26 2) 14 3) 22 4) 0

5) A work done by a man in carrying a load of 60 Kg over his head when he travels a distance of 5m in horizontal direction is ($g=9.8 \text{ m/s}^2$)

- 1) 2940 J 2) 0J 3) 2940m 4) 300J

CHEMISTRY

1. The Oxidation number of Mn in MnO_4^- is

- 1) +5 2) +6 3) +7 4) +4

2. The molarity of 10% NaOH solution is
1) 0.025 2) 0.25 3) 2.5 4) 25
3. Galvanic cells are the cells which convert
1) Electrical energy to chemical energy 2) Chemical energy to electrical energy
3) Chemical energy to Mechanical energy 4) Potential energy to Kinetic energy
4. The exhausted cation exchange resin can be regenerated by using
1) NaCl 2) NaOH 3) HCl 4) NH₃
5. Which of the following is not a Lewis base
1) H₂O 2) BF₃ 3) NH₃ 4) CH₃OH

MECHANICAL ENGINEERING

1. The drilled hole is larger than the size reason is
1) too much feed 2) helix angle is not accurate
3) lip clearance is not accurate 4) unequal length of cutting edges
2. The following Mechanical property is used in wire drawing operation
1) Malleability 2) Hardness 3) Ductility 4) Toughness
3. Which one of these is an attachment in a boiler
1) Economiser 2) Pressure gauge 3) Safety valve 4) Fusible plug
4. Surface roughness value for sand casting
1) 21 2) 50 3) 0.05 4) 0.025
5. What is CPM?
1) Critical path Method 2) Controlled path method
3) Critical program method 4) None of the above