

SYLLABUS FOR MECHANICAL ENGINEERING

MATHEMATICS (50 Marks)

Unit-I: Matrices

Matrices of 3rd order: 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 methods.

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

Unit-II: Trigonometry

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

Complex Numbers: Properties of Modulus, amplitude and conjugate of complex numbers, arithmetic operations on complex number—Modulus-Amplitude form (Polar form)-Euler form (exponential form)-Properties- De Moivre's Theorem and its applications.

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. Standard forms of equations of Parabola, Ellipse and Hyperbola – simple properties.

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 – Derivative as rate measure -Errors and approximations - 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 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.

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 $\frac{dy}{dx} + Py = Q$, Bernoulli's equation, nth order linear differential equation with constant coefficients both homogeneous and non homogeneous and finding the Particular Integrals for

the functions e^{ax} , x^m , $\sin ax$, $\cos ax$.

Unit-VII: Laplace Transforms and Fourier series

Laplace Transforms and Inverse Laplace Transforms of Elementary functions. Shifting Theorems of LTs and ILTs.

Define Fourier series, Euler's Formulae Over the interval $(C, C+2\pi)$. Even and odd functions and their Fourier series

Unit-VIII: Probability and Statistics

Define Probability, addition Theorem, conditional Probability, Mean, Median, Mode, Mean deviation and standard deviation.

PHYSICS (25 Marks)

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 and its cases-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- expressions for maximum height, time of ascent, time of descent, time of flight, velocity on reaching the point of projection in vertical motion--motion of a body projected from the top of a tower-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, a smooth inclined plane and a rough inclined plane-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-second's 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 - Acoustics of buildings-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-external work done by a gas-isothermal process-adiabatic process-first law of thermodynamics and its applications to

isothermal process and adiabatic process-two specific heats of a gas-relation between C_p and C_v - problems-second law of thermodynamics and its applications.

Unit-VII: Modern physics

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

CHEMISTRY (25 Marks)

Unit – I: Fundamentals of chemistry:

Atomic structure: Introduction-Fundamental particles – Bohr's theory – Quantum numbers – Aufbau principle – Hund's rule – Pauli's exclusion principle- Electronic configurations of elements up to atomic number 20, 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 H_2 , O_2 , N_2 , HCl , characteristics of covalent compounds-Coordinate covalent bond- Metallic bond .

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

Unit-II: Solutions: Introduction solution 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 - p^H 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

Basic Workshop tools and Operations (carpentry, fitting and sheet metal) Metrology – linear, angular speed-temperature, pressure and flow. Working and operations of lathe, Drilling, Shaper, slotter, Planner and milling machines – Capstan and turret lathes – copying lathes – surface finishing operations – Honing, lapping, super finishing, electro plating, metal spraying. Basic components of NC, CNC, and DNC machines – FMS and robotics, CNC part programming- Manual and Computer assisted.

Unit II: Welding, Forging, Foundry and Conventions in drawing

Equipment used in arc and gas welding. Modern welding methods – Submerged arc, atomic, hydrogen, CO₂, and ultrasonic welding. Forging processes and tools - Cold and hot working processes. Pattern types – types of moldings and their properties - Defects in casting and welding. Conventional representations in machine drawing – production drawing – limits, fits & Tolerances – surface finish – Specifications of standard components like Bolts, Nuts, Bearings etc.

Unit III: 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 Non ferrous 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, Basic Link Mechanisms.

Unit IV : Mechanics of Solids

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.

Unit V: Design of Machine Elements

Principal Stresses - Theories of failure - Design of Bolts – Power Screws – Shafts - Keys, Couplings – Bearings, design of Belt-Chain and Gear drives – Flywheels – Governors – Cams- Brakes and Clutches.

Unit VI: Thermodynamics

Basic thermodynamics and Laws of Perfect gases, Thermodynamic processes, Air standard Cycles, fuels and combustion, I.C Engines - two and four stroke engines – Petrol and Diesel engines, Indicated and brake powers, Indicated and brake thermal efficiencies, Air Compressors, Gas turbines and Jet propulsion.

Unit VII: Fluid Mechanics and Hydraulic Machines

Properties of Fluids, Flow through pipes, Impact of Jets, Hydraulic turbines, Governing, Working principles and operation of reciprocating and centrifugal pumps, Hydraulic and pneumatic Circuit devices, Air cylinders and Hydro Pneumatic Systems.

Unit VIII : Energy sources and Power Plant Engineering

Concept of Renewable source of energy – Solar – Wind-Bio-Tidal. Thermal and Nuclear Power Plants. Properties of Steam, Working, Performance of Boilers, Steam nozzles, Condensers – Condition for maximum discharge – steam turbines – classification.

Unit IX: Refrigeration – Air Conditioning and Automobile Engineering

Fundamentals of Refrigeration Air Conditioning - Vapor Compression and Vapor Absorption Refrigeration Systems. Methods of refrigeration. Refrigerants – Refrigeration equipment and Applications, Refrigerants Leak detection methods, Psychometry.
Concept of Automobiles, Concept of Transmission and Suspension systems – Function of propeller shaft – Steering and Brakes.

Unit X: Industrial Management and Engineering

Principles and functions of management, organization structures, Production and materials management, financial management, entrepreneurial development, Marketing and sales, Principles of ISO 9000, Work study, Inspection and Statistical Quality Control, Fundamentals of Estimation and Costing. Work study and Method study.

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MODEL QUESTIONS FOR MECHANICAL ENGINEERING

MATHEMATICS

1. If $\begin{bmatrix} x & 1 & 1 \\ 2 & 3 & 4 \\ 1 & 1 & 1 \end{bmatrix}$ is a singular matrix, then the value of x is.
1) -4 2) -3 3) -2 4) 1
2. The number of solutions of the equation $\tan^2 \theta = \frac{1}{3}$ are
1) 2 2) 3 3) 4 4) None
3. The focus of the parabola $y^2 - x - 2y + 2 = 0$ is
1) $(\frac{1}{4}, 0)$ 2) (1, 2) 3) $(\frac{3}{4}, 1)$ 4) $(\frac{5}{4}, 1)$
4. $\int_0^{\frac{\pi}{2}} \log \tan x \, dx =$
1) 1 2) 0 3) $2\log 2$ 4) none

PHYSICS

1. Dimensional formula for Energy is
1) MLT^{-2} 2) ML^2T^{-2} 3) ML^2T^2 4) MLT^2
2. A body is thrown up vertically with a velocity of 19.6m/s. The maximum height reached by the body is ($g=9.8m/s^2$)
1) 19.6m 2) 19.6m/s 3) 19.8m 4) 19.8m/s.
3. Gases obey Boyle's law
1) at high temperature and low pressures only
2) at low temperature and high pressures only
3) at high temperature and high pressures only
4) at all temperatures and all pressures
4. A work done by a man in carrying a load of 30kg over his head when he travels a distance 5m in horizontal direction is ($g=9.8m/s^2$)
1) 1470J 2) 0 J 3) 1470m 4) 150 J

CHEMISTRY

1. Which of the following orbital has less energy
1) 3P 2) 3d 3) 4d 4) 4f
2. Which of the following element has stable electronic configuration?
1) H 2) He 3) Li 4) Be
3. The pH of 0.001M NaOH is
1) 1 2) 3 3) 11 4) 14
4. Brass is an alloy of
1) Cu +Sn 2) Cu +Zn 3) Cu +Zn +Ni 4) Fe +Cr + Ni

MECHANICAL ENGINEERING

1. Which operation is used for enlarging a hole
1) Drilling 2) Reaming 3) Boring 4) counter Boring
2. The metals most suitable for sheet metal work.
1) Cast Iron 2) Steel 3) Tin 4) Aluminum
3. Which of the following is a vector Quantity?
1) Mass 2) Distance 3) Speed 4) Velocity
4. Name the boiler accessory among the following
1) Pressure Gauge 2) Water level indicator 3) blow off cock 4) economizer

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