

ECET-2020 SYLLABUS: MATHEMATICS (50 Marks)
(Common for Diploma)

Unit-I: 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 nonsingular 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 Principle - 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 values, 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 non-homogeneous and finding the Particular Integrals for the functions e^{ax} , $\sin ax$, $\cos ax$, x^m (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 s, ILT by using partial fractions and convolution theorem. Applications of LT 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 $(-\pi, \pi)$.

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MODEL QUESTIONS FOR MATHEMATICS

1. Find the value of $\begin{vmatrix} 1 & 1 & 1 \\ 1 & 1+x & 1 \\ 1 & 1 & 1+y \end{vmatrix}$

- 1) $x+y$ 2) xy 3) 0 4) 1

2. Find a_0 if $f(x)=x$ in $(-\pi,\pi)$ is expanded as Fourier series

- 1) 1 2) 0 3) -1 4) none

3. If $\frac{x}{(x+1)^2} = \frac{A}{x+1} + \frac{B}{(x+1)^2}$ then (A,B)

- 1) $(1,-1)$ 2) $(1,1)$ 3) $(-1,0)$ 4) $(0,1)$

4. P.I. of $(D^2 + 9)y = \cos 3x$

- 1) $\frac{x \sin 3x}{3}$ 2) $\frac{x \sin 3x}{6}$ 3) $\frac{x \cos 3x}{3}$ 4) $\frac{x \cos 3x}{6}$

5. $L^{-1} \left\{ \frac{1}{s(s-1)} \right\} =$

- 1) $e^t + 1$ 2) $e^t - 1$ 3) $e^{2t} + 1$ 4) $e^{2t} - 1$

ECET-2020 SYLLABUS: PHYSICS (25Marks)
(Common for Diploma)

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 for physical quantities -dimensionless quantities-principle of homogeneity in dimensions- applications and limitations of dimensional analysis.

Unit-II: 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 , examples for super conducting materials – and applications.

Unit-III: Heat and Thermodynamics: 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 and second law of thermodynamics - two specific heats of a gas-relation between C_p and C_v -problems.

Unit-IV: Elements of vectors: Scalar and vector quantities-examples-types of vectors-addition and subtraction of vectors-triangle law-parallellogram law- expression for magnitude direction in case of parallelogram 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-V: Kinematics: Equations of motion-acceleration due to gravity-equations of motion under gravity- projectile motion-examples-horizontal and oblique projections- expression for path of projectile in case of oblique projection - expressions for maximum height, time of ascent, time of flight, horizontal range in case of oblique projections - problems.

Unit-VI: Friction: Friction- causes and types of friction-normal reaction-laws of friction-coefficients of friction-angle of friction-methods to reduce friction-advantages and disadvantages of friction-expression for acceleration of a body over a rough horizontal surface – expressions for displacement and time taken to come to rest over a rough horizontal surface - problems.

Unit-VII: Work, Power and Energy: Work, power and energy-definitions and units-potential and kinetic energies-examples and expressions-work-energy theorem – relation between kinetic energy and momentum - law of conservation of energy in case of freely falling body -problems.

Unit-VIII: Simple harmonic motion: Definition-conditions of SHM - examples of SHM - expressions for displacement, velocity, acceleration, time period, frequency and phase of SHM-expression for time period of a simple pendulum- laws of simple pendulum -seconds pendulum-problems.

Unit-IX: Sound: Sound- longitudinal wave and transverse wave - musical sound and noise-noise pollution-Effects and methods to control Noise Pollution-Beats and echo’s and their applications -Doppler effect– Explanation, and Applications –Reverberation time -Sabine’s formula-characteristics of a good auditorium - problems.

Unit-X: Properties of matter: Define terms - elasticity, plasticity – stress and strain – units – Hooke’s law – definition of surface tension, examples – explanation on the basis of molecular theory – angle of contact , capillarity and examples – formula for surface tension based on capillarity –viscosity and examples- Newton’s formula for viscosity- Poiseuille’s equation for coefficient for viscosity- effect of temperature on viscosity of liquids and gases- problems.

Unit-XI: Electricity and Magnetism: Ohm’s law –Specific resistance, Conductance and their units- state and explain kirchoff’s laws- expression for balancing condition of Wheat stone’s bridge- concept of meter bridge-coulomb’s inverse square law in magnetism- magnetic field – magnetic lines of force- magnetic induction field strength and units – moment of couple acting on a bar magnet placed in uniform magnetic field – problems.

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MODEL QUESTIONS FOR PHYSICS

- 1) Dimensional formula for pressure
 - 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) Volume of gas is doubled at constant temperature. If initial pressure of gas is 40 cm of Hg, find final pressure of gas.
 - 1) 80 cm of Hg
 - 2) 40 cm of Hg
 - 3) 60 cm of Hg
 - 4) **20 cm of Hg**
- 4) If two vectors $A=3i+3j-xk$ and $B=2i+2j+k$ are perpendicular find the ‘x’ value
 - 1) 30
 - 2) **12**
 - 3) 10
 - 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

Unit I: Fundamentals of Chemistry: Atomic structure: Introduction-Fundamental particles of an atom – 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** orbitals.

Chemical Bonding: Introduction – Types of chemical bonds – Ionic bond - NaCl and MgO – Characteristics of ionic compounds - Covalent bond - H₂, O₂, N₂ - Characteristics of covalent compounds - Coordinate covalent bond –Definitions and examples, [NH₄⁺], [NH₃BF₃].

Oxidation-Reductions: Electronic concept of Oxidation and Reduction - Oxidation number and its calculations - Differences between oxidation number and valency.

Unit-II: Solutions: Introduction – Definition of solution, solute and solvent - Classification of solutions based on physical state - Mole concept - Molecular weight, equivalent weight of acids, bases and salts - Molarity, Normality and numerical problems.

Unit-III: Acids and Bases: Introduction – Theories of acids and bases – Arrhenius theory - Bronsted – Lowry theory – Lewis theory – Ionic product of water - pH and related numerical problems pertaining to strong acids and bases – Definition of buffer – Types of buffer – Acidic buffer (Acetate buffer) – Basic buffer (Ammonia buffer) - 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 by froth floatation process – Roasting, calcination, smelting – Alloys – Composition and uses of brass, German silver and nichrome.

Unit-V: Electrochemistry: Conductors - Metallic and electrolytic conductors- Insulators, electrolytes (strong and weak) - Arrhenius theory of electrolytic dissociation – Electrolysis of fused NaCl – Faraday's laws of electrolysis- Numerical problems – Galvanic cell – Electrode potential - Standard electrode potential – Electro chemical series – emf and numerical problems on emf of a cell.

Unit –VI: Corrosion: Introduction – Definition of corrosion - Factors influencing rate of corrosion - Electrochemical theory of corrosion- Composition cell, stress cell and concentration cell - Rusting of iron and its mechanism – Prevention of corrosion by (a) protective coatings (b) cathodic protection (sacrificial anode method and impressed voltage method).

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 – Characteristics 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 6. Bakelite – Rubber – Natural rubber – Processing of rubber from latex – Vulcanization – Elastomers – Butyl 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 – Lithosphere, hydrosphere, atmosphere biosphere, 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.

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MODEL QUESTIONS FOR CHEMISTRY

- Which one of the following is non directional orbital.
1) s 2) p 3) d 4) f
- Units of molarity.
1) gram equivalents/litre **2) moles/litre** 3) moles/Kg 4) Grams/litre
- Standard electrode potential of Hydrogen electrode is
1) 1.0 V 2) 2.0 V **3) 0.0V** 4) 1.5V
- Which among the following is not a fuel?
1) Natural Gas 2) Water Gas **3) N₂ Gas** 4) Bio Gas
- pH value of 0.001M HCl solution is
1) 2 2) 1 **3) 3** 4) 4

ECET-2020 SYLLABUS:
METALLURGICAL ENGINEERING
(100 Marks)

UNIT I : ELEMENTARY PRINCIPLES OF METALLURGY: Introduction to metallurgy – ores & ore dressing, Methods of ore sampling – Comminution – sizing- concentration. Principles and processes of Pyro, hydro and electrometallurgy – Minerals of commercially important metals.

UNIT II : FUELS, REFRACTORIES AND PYROMETRY: Classification of solid, liquid and gaseous fuels – Testing and properties of important fuels-Manufacture and characteristics of Metallurgical Coke – Gasification of solid fuels
- Combustion of fuels – Properties, manufacture and selection of Refractories, Principles and operation of important pyrometers- Heat transfer.

UNIT III : METALLURGICAL THERMODYNAMICS: Introduction and applications of thermodynamics – First Law of thermodynamics - Thermo chemistry - Second Law of thermodynamics - Ellingham diagrams - Fugacity, activity and equilibrium constant - Phase equilibria – Solutions. Fundamentals of Reaction Kinetics.

UNIT IV : PHYSICAL METALLURGY: Structure of Metals and Alloys – Solidification – Binary thermal equilibrium diagrams - Iron-carbon diagram - important non- ferrous binary alloy systems – Microscopic and macroscopic examination of metals and alloys.

UNIT V : HEAT TREATMENT TECHNOLOGY: Heat treatment of plain carbon steels - Annealing, Normalizing, Hardening and tempering of steels – TTT diagrams – Hardenability - Grain size, Quenching media. Alloy steels & Effect of alloying elements on plain carbon steels – Stainless steels, tool steels – Case hardening techniques. Special heat treatment techniques such as Austempering, Martempering, sub-zero treatment - Heat treatment of Non-ferrous metals and alloys – Age hardening - Heat Treatment Furnaces and Furnace atmospheres – Heat treatment defects.

UNIT VI : FERROUS EXTRACTIVE METALLURGY: Iron ores and preparation of iron ores – Burden distribution – Blast furnace profile - Blast furnace plant and equipment – blast furnace reactions - irregularities and recent trends - sponge iron & methods of production – Ferroalloys – types and applications. Steel making by Bessemer, LD, Kaldo, Oxygen Lime (LDAC) process, Open hearth and Electric furnaces – Secondary steel making process – Vacuum treatment of liquid steel - Ingot defects - Continuous casting.

UNIT VII : NON-FERROUS EXTRACTIVE METALLURGY: Extraction of copper – Pyro and hydrometallurgical methods & refining – Aluminum - Extraction, Anode effect, Refining - Zinc and Lead - Pyro and hydrometallurgical extraction and refining. Extraction of Magnesium by Dows and pidgeon processes - Extraction of Titanium by Kroll's process - Refining of Titanium by Van arnell's process-Extraction of Thorium and Zirconium.

UNIT VIII : MATERIAL TESTING: Tension test. Stress - strain relationships, necking phenomenon. Hardness tests - principles and types. Impact testing - Notched bar impact tests. Transition temperature. Fatigue, Stress cycles, S-N diagram, Factors affecting Fatigue. Creep

testing - creep curve, Stress - rupture test. Non-destructive testing- Principles, methods and applications of liquid penetrant, Radiography, Ultrasonic Magnetic particle and Eddy current test.

UNIT IX : MECHANICAL METALLURGY: Plastic deformation of metals – lattice defects – Slip and Twinning - CRSS –Strengthening mechanisms. Strain hardening - Hot and Cold working - Recovery, recrystallisation and grain growth. Metal forming processes - Rolling, Forging, Extrusion & Sheet metal forming processes and defects.

UNIT X : FOUNDRY TECHNOLOGY: Patterns: Types, materials and pattern allowances, Moulding Sands - properties and Testing, Moulding Processes and equipment: Sand casting, Die casting, Shell moulding, Centrifugal casting, Investment casting and CO₂ process-Cores: Types of Cores and properties, pouring and feeding of castings. Cast irons – types, Melting of cast irons - Grey, S.G and Malleable iron. Aluminum, Copper and Steel Foundry practices. Defects in Castings. Cleaning & Salvage of Castings.

UNIT XI : WELDING TECHNOLOGY: Basic concepts of Welding - Principles and processes of various welding techniques such as Oxy-acetylene, Shield Arc welding, Inert gas welding- TIG and MIG - Special welding processes - Plasma, resistance, electro slag, electron beam, thermit and Laser. Soldering and brazing– Weld ability, factors affecting weld ability – Heat affected zone, Microstructure
– Post weld treatments – Welding defects – Inspection and testing.

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MODEL QUESTIONS FOR METALLURGICAL ENGINEERING

1. Angle of NIP associated with which of the following crusher

- 1) Jaw crusher 2) Gravity crusher 3) cone crusher 4) **Roll crusher**

2. The C/A ratio in ideal H.C.P. structure is

- 1) 1.568 2) **1.633** 3) 1.856 4) 2

3. The reduction of iron ore in the blast furnace taken place by

- 1) Coke 2) **Carbon monoxide** 3) Carbon dioxide 4) Hydrogen

4. This is the last part of solidification in casting.

- 1) Runner 2) sprue 3) Ingate 4) Riser

5. Cobalt – 60 is used a source of the following in industrial radiography.

- 1) X-rays 2) Alpha-rays 3) Beta-rays 4) **Gamma-rays**
