TS ECET-2019

SYLLABUS FOR METALLURGICAL 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 in3variables-Solutions by Crammer'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, equitation 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-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-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 Cp and Cv-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 H_2, O_2, N_2, 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 stetting 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.

METALLURGICAL ENGINEERING (100 Marks)

UNIT I : ELEMENTARY PRINCIPLES OF METALLURGY:
Introduction to metallurgy – ores & ore dressing, Methods of ore sampling – Communition – 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 – firing of fuels and pulverization - Combustion of fuels – Properties, manufacture and selection of Refractories, Principles and operation of important pyrometers- Heat transfer – Non-conventional energy resources.

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 - Diffusion – 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 arkell'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 – Thermo mechanical treatments – isoforming and ausforming. Powder metallurgy. Methods of powder production, characterization, Compaction, Sintering and applications of Powder Metallurgy.

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 CO_2 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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TS ECET-2019

MODEL QUESTIONS FOR METALLURGICAL ENGINEERING

MATHEMATICS

1. If ω is a cube root of unity then $\begin{vmatrix} 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \\ \omega^2 & 1 & \omega \end{vmatrix} =$

   1) 0 2) 1 3) -1 4) 2

2   If $\frac{2x+5}{(x+1)^4} = \frac{A}{(x+1)^3} + \frac{B}{(x+1)^4}$ Than (A,B)=

1) (1,2)   2) (1,3)   3) (2,3)   4) (2,4)

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) 2log2   4) None

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

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

PHYSICS

1)   Dimensional formula for stress

1) ML2T-3   2) ML-T-2   3) ML0T-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 m/s2)

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) NH_3

5. Which of the following is not a lew is base

   1) H_2O 2) BF_3 3) NH_3 4) CH_3OH

METALLURGICAL ENGINEERING

1. Which of the following is not a Iron Ore.

   1) Haematite 2) Magnetite 3) rutile 4) Goethite.

2. Which of the following is the softest phase that appears in $Fe-Fe_3C$ Phase diagram?

   1) Austenite. 2) Martensite 3) Cementite 4) Ferrite.

3. Which of the following element improves corrosion resistance of the steel?

   1) Nickel 2) Cobalt 3) Chromium 4) Manganese.

4. Which of the following is a neutral Refractory?

   1) Sillica 2) Alumina 3) Fireclay 4) Chromite.

5. Which of the properties is not required for Refractory sand?

   1) Flowability 2) Refractoriness 3) Ductility 4) Green strength.