# TS ECET-2021

**SYLLABUS: 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 nonsingular matrices-Adjoint and multiplicative inverse of a square matrix-System of linear equations in 3 variables-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, sub multiple angles – Transformations of Products into sum or difference and vice versa.Properties of triangles:  sine rule, cosine rule, tangent rule and projection rule. Solving a triangle when (i) three sides (SSS), (ii) two sides and an included angle(SAS), (iii) one side and two angles are given(SAA).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,  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, $2^{nd}$ order linear differential equation with constant coefficients both homogeneous and non-homogeneous and finding the Particular Integrals for the functions $e^{ax}$, $\sin ax$, $\cos ax$, $ax^2+bx+c$ (a,b,c are real numbers)

## 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 (I LT)-shifting theorem, change of scale property, multiplication and division by s, ILT by using partial fractions and convolution theorem. Applications of LT to solve linear 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 $(-\pi, \pi)$.

***

# TS ECET-2021

## MODEL QUESTIONS FOR MATHEMATICS

1. If the determinant of the transpose of the matrix $\begin{bmatrix} 2 & 2 & 2 \\ 2 & 2+x & 2 \\ 2 & 2 & 2+y \end{bmatrix}$ is positive, then the point ( x,y ) lies in

    1) I and II quadrants **2) I and III quadrants** 3) II and IV quadrants    4) III and IV quadrants

2. If f(x)=x² in (-π,π) and $f(x) = \sum_{n=0}^{\infty}(a_n cosnx + b_n sinnx )$, then $a_1 =$

    1)4        **2) -4**             3) - 4π            4) 4π

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

    **1) 0**           2) 3          3) 2        **4) 1**

4. The general solution of the corresponding Homogeneous differential equation of $(D^2 + 9)y = cos3x$ is

    **1) A cos 3x + B sin3x**    2) A cos 3x + B x sin3x     3) $\frac{xcos3x}{3}$    4) $\frac{xsin3x}{6}$

5. If $L^{-1}\left\{\frac{1}{s(s^2+1)}\right\} = \int_0^t f(t)dt$, then f(t)=

    **1) $sint$**    2) 1-cost    3) arc Tan t    4) 1+sint

                           ****

# TS ECET-2021

## SYLLABUS: PHYSICS                                                    (25Marks)

**Unit-I: Units and dimensions:** Physical quantity-fundamental and derived physical quantities-units-fundamental and derived units-SI units-advantages of SI units-dimensions and dimensional formulae for physical quantities -principle of homogeneity in dimensions

**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- Basic concept of super conductivity , examples of super conducting materials and their 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- statements of first law and second law of thermodynamics - two specific heats of a gas-relation between   Cp and Cv-problems.

**Unit-IV: Elements of vectors:**  Scalar and vector quantities-examples-types of vectors-triangle law-parallelogram law- expression for magnitude and direction of resultant of two vectors using parallelogram law -resolution of a vector-unit vectors (i,j,k)-dot product and cross product of two vectors- properties of dot and cross products-examples- problems.

**Unit-V: Kinematics:** 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 projection - problems.

**Unit-VI: Friction:** Friction- causes and types of friction-normal reaction-laws of friction-coefficients 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 by a body to come to rest over a rough horizontal surface - problems.

**Unit-VII: Work and Energy:**  Work and energy-definitions and units-potential and kinetic energies-examples and expressions-Work-Energy theorem – law of conservation of energy in the case of freely falling body -problems.

**Unit-VIII: Simple harmonic motion:**  Definition-conditions of Simple Harmonic Motion (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 - noise pollution-Effects and methods to control Noise Pollution-Beats and echo and their applications -Doppler effect - statement– Physical explanation and applications –Reverberation time -Sabine's formula-characteristics/conditions 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 – angle of contact , capillarity and examples – formula for surface tension based on capillarity (no derivation) –viscosity and examples- Newton's formula for viscosity- Poiseulle's equation for co-efficient of 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- statements and explanation of kirchoff's laws- expression for balancing condition of Wheatstone bridge- Working principle 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 a uniform magnetic field – problems.

*****

# TS ECET-2021

## MODEL QUESTIONS FOR PHYSICS

1)  Dimension of mass in Universal gravitational constant

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

2)  If $\vec{F} = 2\hat{\imath} + 3\hat{\jmath} - 4\hat{k}$ and $\vec{S} = 4\hat{\imath} - 2\hat{\jmath} + n\hat{k}$ then the work done is zero. The value of n is

    1) 0        **2) $\frac{1}{2}$**        3) $\frac{3}{2}$        4) 1

3)  The nature of velocity-time graph of a freely falling body is

    1) parabola                 2) ellipse

    **3) straight line passing through the origin**    4) straight line with +ve y axis intercept

4)  A particle is performing SHM with a time period T. Then the time taken by the particle to reach half the amplitude from its mean position is

    **1) $\frac{T}{12}$**        2) $\frac{T}{3}$        3) $\frac{T}{6}$        4) $\frac{T}{2}$

5)  A given mass of gas at $27^0$ is heated in a glass flask at constant pressure so that its volume is doubled. Then the final temperature of the gas is

    **1) $327^0C$**        2) $227^0C$        3) $430^0C$        4) $530^0C$

****

# TS ECET-2021

## SYLLABUS:   CHEMISTRY                                    (25 Marks)

**Unit I: Fundamentals of Chemistry: Atomic structure**: Introduction- Atomic number – atomic mass number – Bohr's theory – Aufbau's principle – Hund's rule – Pauli's exclusion principle- Electronic configurations of elements up to atomic number 30, Differences between orbit and orbital - shapes of **s**, **p**, **d** orbitals.

**Chemical Bonding**: Introduction – Electronic theory of valency - Types of chemical bonds – Ionic bond - NaCl and MgO – Characteristics of ionic compounds - Covalent bond - $H_2$, $O_2$, $N_2$ ( Lewis dot model) - Characteristics of covalent compounds - Coordinate covalent bond – Definition and examples, $[NH_4^+]$, $[NH_3BF_3]$ .

**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)  without buffer action – Applications without explanation.

**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 –Electrolytic refining of copper - Faraday's laws of electrolysis- Numerical problems – Galvanic cell – Electrode potential - Standard electrode potential – Electro chemical series – Significance of electro chemical series without explanation - emf and numerical problems on emf of a cell ( based on $EMF = E_R - E_L$ formula).

**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 - Metallic (anodic and cathodic coatings), Inorganic and Organic coatings ( only examples)   (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 in industries  – Degree of hardness, units (ppm and mg/litre) and Numerical problems on hardness of water – 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 stetting 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 – Definitions of pollutant, contaminant- receptor, sink, particulate with examples, Definition and significance (without explanation) of DO, BOD, Threshold limit value, COD - Forest resources, uses and over exploitation -  Deforestation - Air pollution - Causes-Effects- - Acid rain - Green house effect – Ozone depletion – Control of Air pollution ( Basic level only) – Water pollution – Causes – Effects – Control measures of water pollution ( Basic level only) - Renewable and Non Renewable energy sources with examples – Concept of ecosystem – Producers, consumers and decomposers – Biodiversity, threats to Biodiversity.

\*\*\*

# TS ECET-2021

## MODEL QUESTIONS FOR CHEMISTRY

1.   The number of unpaired electrons present in sulphur.

   **1)**   3      **2) 2**         3) 1          4) 4

2.   What is the conjugate base of $H_2O$.
      1) $H_3O^+$      2) $H^+$         **3) OH⁻**         4) $O^{2-}$

3.   Which one of the following cause temporary hardness to water?
      1)  $CaCl_2$          2) $MgSO_4$                3) NaCl              **4) $Ca(HCO_3)_2$**

4.   0.4 grams of NaOH is added to 100 ml of 0.1 M NaOH solution and the volume of solution is made to 200ml by adding water. Calculate the molarity of the resulting solution?

   1)  **0.1M**      2) 0.2M          3) 0.3M          4) 0.4M

5.   Monomers used for the preparation of Bakelite

   1)   Urea and formaldehyde            2)  aniline and formaldehyde
   **3)  Phenol and formaldehyde**            4)  Phenol and urea

\*\*\*

**SYLLABUS:**          **CHEMICAL ENGINEERING**          **(100Marks)**

**UNIT I: Material technology:** Mechanical properties of metals and Testing of materials–thermal equilibrium diagram-Production of Iron- plain carbon steels, alloy steels–Non ferrous metals & their alloys - Aluminium, copper, nickel, lead, tin, zinc-Miscellaneous materials – Glass, carbon, graphite, rubber, elastomers – glass fibers, Nano materials – Corrosion-causes, types, methods of prevention.

**UNIT II: Mass and Energy Balance**: Determination of molarity, molality &normality, analysis of solids, liquids and gases on dry and wet basis- Daltons law, ideal gas, equation of state, vapor pressure, Material balances with and without chemical reactions - Material balance problems related to evaporation, distillation, drying and mixing, Bypass and Recycle streams–limiting component, excess reactant, percentage conversion & yield and degree of completion - Law of conservation of energy, heat of reaction, heat of formation and heat of combustion – related problems, gross and net calorific values, theoretical air and excess air calculations – Proximate and ultimate analysis**.**

**UNIT III: Organic Chemical Technology**: Coal chemicals, coking of coal, coal tar distillation, **-**carbonization-petroleum refining - atmospheric distillation and vacuum distillation, fluid catalytic cracking, catalytic reforming, petrochemicals from methane and ethylene- Pulp and paper industry, Kraft process - Oils, fats and soaps-sugar and fermentation–synthetic fibres - rubber industries.

**UNIT IV: Inorganic Chemical Technology:** Water-sources, impurities-treatment-dissolved solids-ion exchange process and Reverse Osmosis (RO) process- Manufacture of chemicals like soda ash, ammonia, Urea, nitric acid, sulphuric acid, phosphoric acid, super Phosphate and industrial Gases ($O_2$, $N_2$, $H_2$, $CO_2$ and acetylene)- Paints, pigments and varnishes, graphite and silicon carbide and cement. Glass, calcium carbide, NPK Fertilizers

**UNIT V: Fluid mechanics:** Flow of incompressible fluids, Newtonian and non-Newtonian fluids, Pressure, viscosity, laminar, Turbulent flow, Mass and momentum balance, Bernoulli's theorem, friction losses, friction factor – pressure drop, flow meters, different types of pumps for transportation of fluids, Centrifugal pump, Displacement pump, Reciprocating pump, Flow past immersed bodies-packed bed and fluidized bed, Fluidization**.**

**UNIT VI: Heat transfer:** Conduction–mechanisms of heat flow–Fourier's law, thermal conductivity, steady state conduction- compound resistances in series, heat flow through a cylinder – related problems. Convection–heat flow in fluids-rate of heat transfer, counter current and parallel flows-Overall heat transfer coefficient–LMTD–Fouling factors– Nusselt Number - Prandtl Number. Heat transfer to fluids with and without phase change. Drop wise and Film wise condensation, Heat transfer to boiling liquids, Radiation, emission of radiation, laws of black body radiation – radiation between surfaces – Stefan's law-view factor- Heat Exchange Equipment – types of heat exchange equipment, Evaporation – types of evaporators, evaporator economy, Boiling point Elevation, single and multiple effect evaporators– related problems**.**

**UNIT VII: Mechanical unit operations:** Size reduction methods, laws of size reduction-crushers and grinders. Different types of equipments for mixing liquids, viscous masses, dry powders, Differential and cumulative screen analysis, screen effectiveness, average particle size, storage of solids, conveyers, mechanical separations - Screening, froth floatation, electrostatic precipitator, scrubber, cyclone separators, filtration, filtration equipment, sedimentation.

**UNIT VIII: Thermodynamics and Reaction Engineering:** Basic units of thermodynamics, state and path functions, $1^{st}$ law of Thermodynamics, PVT relationships for gases-ideal gas-isobaric-isochoric, isothermal and adiabatic processes – cubic equations of state - $2^{nd}$ law of Thermodynamics, Carnot cycle-entropy - refrigeration and liquefaction, chemical reaction equilibria-determination of equilibrium constant and conversion, Temperature effect on reactions- Gibbs free energy - chemical kinetics - classification of reactions - order & molecularity - working of batch, tubular and stirred tank reactors, catalysis - types of catalysts - industrial reactors - space time - space velocity.

**UNIT IX: Mass Transfer:** Principles of diffusion, Fick's law of diffusion – molecular diffusion, eddy diffusion - Diffusion in gases - inter phase mass transfer, two resistance theory -wet bulb & dry bulb temperature - Distillation, simple, steam and continuous distillation - Rayleigh's equation reflux ratio– McCabe Thiele method - bubble cab & sieve tray columns-absorption- tower packing, channeling, loading & flooding- Adsorption – adsorbents - humidification, extraction and leaching, drying - drying rate curves, time of drying, equipment for drying – crystallization – equipment.

**UNIT X: Instrumentation & Process control:** Static and dynamic characteristics of an instrument-step input, linear input, sinusoidal input, measurement of temperature, pressure, vacuum, liquid levels, viscosity, density and composition – thermocouples - types of pressure gauges & vacuum gauges for distillation column, evaporator, reactor and extractor. Process instrumentation & Instrumentation diagrams - Process control - components of pneumatic system - hydraulic system - different types of controllers, P, PI, PD & PID Controllers.

**UNIT XI: Environmental Studies:** Scope and importance of environmental studies, Effect of human being on environment and vice-versa –bio diversity.
**Water pollution**: causes & effects of water pollution, methods of control of water pollution
**Air pollution**: Classification of air pollutants, causes & effects of air pollution, green house effect - ozone layer depletion and acid rains, methods of control of air pollution

**UNIT XII: Energy Technology:** Classification of energy sources – types & analysis of Solid, Liquid and Gaseous fuels – propellant **-** Combustion principles of fuels, Refractories & Furnaces - Blast Furnace, LD Converter – Non-conventional energy sources (Nuclear Energy, Solar Energy, Wind Energy, Bio-Energy-geothermal energy - Hydel-tidal Energy) – Energy Conservation.


\*\*\*\*\*\*\*\*\*

# TS ECET-2021

## MODEL QUESTIONS FOR CHEMICAL ENGINEERING

-----------------------------------------------------------------------------------------

1.  Soda ash is also called

    1. **Sodium carbonate**               2. Sodium hydroxide

    3. Sodium bicarbonate               4. Sodium oxide

2.  The constituents of synthesis  gas are

    1. CO and $H_2O$        2.  $CO_2$  and $N_2$        3. **CO and $H_2$**        4. CO  and $N_2$

3.  Greenhouse gases are those that absorb and emit infrared radiation. Examples include_____

    1.Nitrogen          2.**Ozone**          3. Argon          4.None of the above

4. Tooth paste is an example of

    1.Dilatants        2. **Bingham plastics**        3.Newtonian fluid      4. None of the above

5. The units of thermal conductivity is

    1. $W/m^2K$          2. **W/mK**        3. $m^2/s$          4. $Kg/m^3$

**\*\*\*\***