GOVERNMENT OF TRIPURA
DIRECTORATE OF HIGHER EDUCATION

TRIPURA BOARD OF JOINT ENTRANCE EXAMINATION

Syllabi of
Tripura Joint Entrance Examination

For Admission to
Engineering, Technological & Other Professional Degree Courses

Tripura Board of Joint Entrance Examination
Grownd Floor, Siksha Bhavan, Office Lane
Agartala, West Tripura District
Pin: 799001

PHYSICS

MODULE – 1

Physics: Scope and excitement; nature of physical laws; Physics, technology and society.

Need for measurement: Units of measurement; systems of units; SI units, fundamental and derived units. Length, mass and time measurements;

Accuracy and precision of measuring instruments; errors in measurement; significant figures

Dimensions of physical quantities, dimensional analysis and its applications

Frame of reference (inertial and non-inertial frames), Motion in a straight line; Position-time graph, speed and velocity

Uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity-time and position-time graphs, for uniformly accelerated motion (graphical treatment), Elementary concepts of differentiation and integration for describing motion

Scalar and vector quantities: Position and displacement vectors, equality of vectors, multiplication of vectors by a real number; addition and subtraction of vectors, Unit vector, Zero Vector, Resolution of a vector in a plane, Scalar and Vector products of Vectors, Relative velocity

Motion in a plane, Cases of uniform velocity and uniform acceleration, projectile motion, Uniform circular motion

MODULE – 2

Force and inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; Newton's third law of motion, Law of conservation of linear momentum and its applications, Problems using free body diagrams

Equilibrium of concurrent forces, Static and Kinetic friction, laws of friction, rolling friction

Dynamics of uniform circular motion, Centripetal force, examples of circular motion (vehicle on level circular road, vehicle on banked road)

Work done by a constant force and a variable force; kinetic and potential energies, work energy theorem, power

Potential energy of a spring, conservation of mechanical energy, conservative and non-conservative forces; Elastic and inelastic collisions in one and two dimensions, motion in a vertical circle

Centre of mass of a two-particle system, Centre of mass of a rigid body, momentum conservation and motion of centre of mass, centre of mass in some symmetric bodies.

Basic concepts of rotational motion; moment of a force, torque, angular momentum, conservation of angular momentum and its applications; moment of inertia, radius of gyration, Values of moments of inertia for simple geometrical objects, parallel and perpendicular axes theorems and their applications to some problems,Equilibrium of rigid bodies, rigid body rotation, equations of rotational motion

MODULE – 3

Kepler's laws of planetary motion, the universal law of gravitation
Acceleration due to gravity and its variation with altitude, depth and rotation of earth
Gravitational potential energy; gravitational potential, escape speed
Orbital velocity, time period and mechanical energy of an artificial satellite, Geo-stationary satellites
Elastic behavior, Stress-strain relationship, Hooke's law, Young modulus, bulkModulus, modulus of rigidity, poison's ratio; elastic strain energy
Pressure due to a fluid column; Pascal's law and its applications (hydraulic liftand hydraulic brakes), Effect of gravity on fluid pressure
Viscosity, Newton's law of viscous force, co-efficient of viscosity, Stoke's law, terminal velocity, Reynold's number, streamline and Turbulent flow, Critical velocity,Bernoulli's theorem and its applications.
Idea of cohesive and adhesive forces, Surface energy and surface tension, angle of contact, excess Pressure for liquid drop, liquid bubble and air bubble, capillary rise

MODULE – 4

Heat, temperature, thermal expansion; thermal expansion of solids, liquids, and gases, anomalous expansion of water and its effect, specific heat capacity at constant pressure and constant volume and their inter-relation, Calorimetry, change of state – idea of latent heat

Heat transfer- conduction and thermal conductivity, convection and radiation, Qualitative ideas of Black Body Radiation, absorptive and emissive powers, Kirchhoff's law, Wien's displacement law, Newton's law of cooling and Stefan's law, Green House effect

Thermal equilibrium and definition of temperature (Zeroth law of Thermodynamics), Heat, work and internal energy

First law of thermodynamics, various thermodynamic processes viz. isothermal, adiabatic, isobaric, isochoric processes, work done in thermodynamic process (both isothermal and adiabatic)

Second law of the thermodynamics, Reversible and irreversible processes, Idea of heat engine, Carnot's engine and its efficiency

Ideal gas laws, equation of state of a perfect gas,

Assumptions of kinetic theory of gases, concept of pressure, r. m. s. speed of gas molecules, Kinetic energy and temperature; degrees of freedom, law of equipartition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro's number

MODULE – 5

Periodic motion - period, frequency, displacement as a function of time, Periodic functions, Simple harmonic motion (S.H.M.) and its equation; phase; mechanical energy in S.H.M.,Simple pendulum - expression for its time period; oscillations of a spring -restoring force and force constant; some other examples of SHM
Free, forced and damped oscillations (quantitative ideas only), simple examples, resonance

Wave motion, Longitudinal and transverse waves, speed of a wave,Expression for displacement of a plane progressive wave, relation between particle and wave velocity, Principle of superposition of waves, reflection of waves, Standing waves in strings and organ pipes, fundamental mode and harmonics, Beats, Doppler effect in sound

MODULE – 6

Frictional electricity, Electric charge and its conservation, Coulomb's law-forces between two point charges, forces between multiple charges; dielectric constant, superposition principle and continuous charge distribution

Electric field, Electric field due to a point charge, Electric field lines, Electric dipole, Electric field intensity at various positions due to an electric dipole, Torque on an electric dipole in a uniform electric field, Potential energy of an electric dipole

Electric flux, Gauss's law and its applications to find field due to infinitely long uniformly charged straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside)

Electric potential, potential difference, Electric potential for a point charge, electric dipole and system of charges; Equipotential surfaces, Electrical potential energy of a system of two point charges in an electrostatic field

Conductors and insulators, free charges and bound charges inside a conductor, Dielectrics and electric polarization, capacitor and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, Energy stored in a capacitor, Van de Graff generator

MODULE – 7

Electric current, flow of electric charges in a metallic conductor, drift velocity and mobility, and their relation with electric current; Ohm's law, electrical resistance, *V-I* characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity, Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance, Internal resistance of a cell, potential difference and e. m. f. of a cell, combination of cells in series and in parallel, elementary idea of secondary cell.

Kirchhoff's laws and their applications, Wheatstone bridge, Metre Bridge, Potentiometer-principle and applications to measure potential difference, and for comparing e. m. f. of two cells; measurement of internal resistance of a cell.

Concept of magnetic field, Oersted's experiment, Biot-Savart's law and its application to current carrying circular loop.

Ampere's circuital law and its applications to infinitely long straight wire, straight and toroidal solenoids, Force on a moving charge in uniform magnetic and electric fields, Cyclotron

Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere, Torque experienced by a current loop in a magnetic field; moving coil galvanometer, current sensitivity and voltage sensitivity, conversion of galvanometer to ammeter and voltmeter.

MODULE – 8

Current loop as a magnetic dipole and its magnetic dipole moment, Magnetic dipole moment of a revolving electron

Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis, Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements

Para-, dia-and ferro-magnetic substances, with examples

Electromagnets and factors affecting their strengths, Permanent magnets

Electromagnetic induction; induced e. m. f. and current, Faraday's law, Lenz's Law, Eddy currents, self and mutual inductance

Alternating currents, peak and r. m. s. value of alternating current/ voltage; reactance and impedance; LC oscillations (qualitative treatment only), LCR series circuit, resonance; power in AC circuits and power factor, wattles current, AC generator and transformer

Displacement current and its need, electromagnetic waves and their characteristics (qualitative ideas only), transverse nature of electromagnetic waves, electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, x-rays, gamma rays) including elementary facts about their uses.

MODULE – 9

Reflection of light, spherical mirrors, mirror formula

Refraction of light, total internal reflection and its applications, optical fibers, Refraction at spherical surface, lenses, thin lens formula, lens-maker's formula. Newton's relation: Displacement method to find position of images (conjugate points) Magnification, power of a lens, combination of thin-lenses in contact, combination of a lens and a mirror, Refraction and dispersion of light through a prism.

Scattering of light - blue colour of the sky and reddish appearance of the sum at sunrise and sunset, Elementary idea of Raman Effect

Optical instruments: Human eye, image formation and accommodation, correction of eye defects (myopia, hypermetropia, presbyopia and astigmatism) using lenses, Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.

Wave optics: Wave front and Huygen's principle, reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygen's Principle

Interference, Young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light.
Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes,
Polarisation, plane polarised light; Malus law, Brewster's law, uses of plane polarised light and Polaroids.

MODULE – 10

Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation- particle nature of light

Matter waves- wave nature of particles, de Broglie relation, Davisson-Germer experiment
Alpha- particle scattering experiments; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum Composition and size of nucleus, atomic masses, isotopes, isobars; isotones.
Radioactivity- alpha, beta and gamma rays and their properties decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number, nuclear fission and fusion
Energy bands in solids (qualitative ideas only), conductors, insulators and semiconductors (intrinsic and extrinsic); semiconductor diode, I-Vcharacteristics in forward and reverse bias, diode as a rectifier; I-Vcharacteristics of LED, photodiode, solar cell, and Zener diode; Zener diode as a voltage regulator
Junction transistor, transistor action, characteristics of a transistor; transistor as an amplifier (common emitter configuration) and oscillator, Logic gates (OR, AND, NOT, NAND and NOR gates) and their applications
Propagation of electromagnetic waves in the atmosphere; Sky and space wave propagation, Need for modulation, Amplitude and Frequency Modulation, Bandwidth of signals, Bandwidth of Transmission medium, Basic Elements of a Communication System

CHEMISTRY

MODULE – 1

I. Some Basic Concepts of Chemistry :

General Introduction: Importance and scope of Chemistry. Historical approach to particulate nature of matter, laws of chemical combination. Dalton's atomic theory: concept of elements, atoms and molecules.Atomic and molecular masses, Mole concept and molar mass; percentage composition, empirical and molecular formula; chemical reactions, stoichiometry and calculations based on stoichiometry.

II. Structure of Atom:

Discovery of electron, proton and neutron; atomic number; isotopes and isobars. Rutherford's model and its limitations. Bohr's model and its limitations, concept of shells and sub-shells, dual nature of matter and light. de Broglie's relationship.Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals - Aufbau principle, Pauli exclusion principle and Hund's rule, electronic configuration of atoms, stability of half-filled and completely filled orbitals.

III. Classification of Elements and Periodicity in Properties:

Significance of classification, brief history of the development of periodic table.Modern periodic law and the present form of periodic table, periodic trends in properties of elements- atomic radii, ionic radii. Ionization enthalpy, electron gain enthalpy, electro negativity, valence, Nomenclature of elements with atomic number greater than 100.

MODULE – 2

I. Chemical Bonding and Molecular Structure:

Valence electrons, ionic bond, bond parameters, covalent bond: Born Haber Cycle.
Lewis structure, polar character of covalent bond, covalent character of ionic-bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s, p and d- orbitals and shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules and hydrogen bond.

II. Chemical Thermodynamics:

Concepts of System, types of systems, surroundings, Work, heat, energy, extensive and intensive properties, state functions. First law of thermodynamics-internal energy change (ΔU) and enthalpy change (ΔH), Hess's law of constant heat summation, enthalpy of; bond dissociation, Combustion, formation, atomization, sublimation, phase transformation, ionization, and solution. Introduction of entropy as a state function, Gibbs energy change for spontaneous

and non-spontaneous processes, criteria for equilibrium. Second and third laws of thermodynamics.

III. Chemical Kinetics:

Rate of reaction (average and instantaneous), factors affecting rates of reaction; concentration, temperature, catalyst; order and molecularity of a reaction; rate law and specific rate constant, integrated rate equations and half-life (only for zero and first order reactions); concept of collision theory (elementary idea, no mathematical treatment), activation energy, Arrhenius equation.

MODULE – 3

I. States of Matter: Gases and Liquids:

Three states of matter, Intermolecular interactions, types of bonding, melting and boiling points, Role of gas laws in elucidating the concept of the molecule, Boyle's law. Charles' law, Gay Lussac's law, Avogadro's law. Ideal behaviour, empirical derivation of gas equation, Avogadro's number. Ideal gas equation, Derivation from ideal behaviour, liquefaction of gases, critical temperature, kinetic energy and molecular speeds (elementary ideal). Liquid State : Vapour pressure, viscosity and surface tension (qualitative idea only, No mathematical derivations).

II. Equilibrium:

Equilibrium in physical and chemical processes, dynamic nature of equilibrium, Law of mass action, equilibrium constant, factors affecting equilibrium -Le Chatelier's principle; ionic equilibrium - ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of polybasic acids, acid strength, concept of pH Henderson Equation, hydrolysis of salts (elementary idea). Buffer solutions, solubility product, common ion effect (with illustrative examples).

III. Solid State:

Classification of solids based on different bindings forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea), unit cell in two dimensional and three dimensional lattices, packing efficiency, calculation of density of unit cell, packing in solids, voids, number of atoms per unit cell in a cubic unit cell,point defects, electrical and magnetic properties. Band theory of metals conductors,semiconductors and insulators and n- & p-type semiconductors.

MODULE – 4

I. Redox Reactions :

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions in terms of loss and gain of electrons and change in oxidation numbers.

II. Solutions :

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties – relative lowering of vapour pressure, Raoult's law, elevation of boiling point, depression of freezing point, osmot pressure determination of molecular masses using colligative properties, abnormal molecular mass, van't Hoff factor and calculations involving it.

III. Electrochemistry :

Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and laws of electrolysis (elementary idea), dry cell – electrolytic cells and Galvanic cells; lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and emf of a cell, fuel corrosion.

IV. Surface Chemistry :

Adsorption – Physisorption and chemisorption; factors affecting adsorption of gas on solids; catalysis : homogeneous and heterogeneous, activity and selectivity : enzyme catalysis; colloidal state : distinction between true solutions, colloids and suspensions; lyophilic, lyophobic, multimolecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation; emulsion – types of emulsions, Elementary idea of nanomaterials.

MODULE – 5

I. Hydrogen :

Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen; hydrides – ionic, covalent and interstitial; physical and chemical properties of water, heavy water; hydrogen peroxide-preparation, properties, structure and
use; hydrogen as a fuel.

II. p-Block Elements :

General Introduction to p-Block Elements:

Group 13 elements: General introduction, electronic configurations, occurrence.

Variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group; Boron-physical and chemical properties, some important compounds; borax, boric acid, boron hydrides, Aluminium : reactions with acids and alkali and uses.

Group 14 elements : General introduction, electronic configurations, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behavior of first element, Carbon-catenation, allotropic forms, physical and chemical properties; uses of some important compounds; oxides. Important compounds of silicon and a few uses; silicon tetrachloride, silicones, silicates and zeolites, their uses and structure of silicates.

Group 15 elements : General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties, nitrogen - preparation, properties and uses; compounds of nitrogen : preparation and properties of ammonia and nitric acid, oxides of nitrogen (structure only) : Phosphorus-allotropic forms, compound of phosphorus : preparation and properties of phosphine, halides (PCl_3, PCl_5) and oxoacids (elementary idea only).

Group 16 elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; dioxygen : preparation, properties and uses, classification of oxides, Ozone. Sulphur-allotropic forms; compound of sulphur: preparation, properties and uses of sulphur dioxide; sulphuric acid : industrial process o manufacture, properties and uses, other oxides and oxoacids of sulphur (structures only).
Group 17 elements: General introduction, electronic configuration, oxidation states, occurrence, trend in physical and chemical properties; compounds and halogens : preparation, properties and uses of chlorine and hydrochloric acid, inter-halogen compounds, oxoacids of halogens (structures only).
Group 18 elements: General introduction, electronic configuration, Occurrence, trends in physical and chemical properties, uses.

MODULE – 6

I. s-Block Elements (Alkali and Alkaline earth metals) :

Group 1 and Group 2 elements : General introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of, properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens; uses.
Preparation and properties of some important compounds: Sodium carbonate, sodium hydroxide and sodium hydrogen carbonate, biological importance of sodium and potassium. CaO, $CaCO_3$ and industrial use of lime and limestone, biological importance of Mg and Ca

II. General Principles and Processes of Isolation of Elements :

Principles and methods of extraction - concentration, oxidation, reduction electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and iron.

III. d and f Block Elements :

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals – metallic character, ionization, enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation. Preparation and Properties of $K_2Cr_2O_7$ & $KMnO_4$.
Lanthanoids: Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and its consequence.
Actinoids: Electronic configuration, oxidation states and comparison with lanthanoids.

IV. Coordination Compounds :

Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds, bonding (Werner' theory. VBT and CFT): structural and stereo isomerism, importance of coordination compounds (in qualitative inclusion of analysis, extraction of metals and biological systems).

MODULE – 7

I. Organic Chemistry - Some Basic Principles and Techniques :

General introduction, methods of qualitative and quantitative analysis, classification and IUPAC nomenclature of organic compounds. Electronic displacements in a covalent bond: inductive effect, electromeric effect, resonance and hyper-conjugation. Homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions; electrophiles and nucleophiles, types of organic reactions.

II. Hydrocarbons :

Classification of hydrocarbons :

Alkanes – Nomenclature, isomerism, conformations (ethane only), physical properties, chemical reactions including halogenation, free radical mechanism, Combustion and pyrolysis.

Alkenes- Nomenclature, structure of double bond (ethene) geometrical isomerism, physical properties, methods of preparation; chemical reactions : addition of hydrogen, halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.

Alkynes – Nomenclature, structure of triple bond (ethyne), physical properties.Methods of preparation, chemical reactions; acidic character of alkynes, addition reaction of hydrogen, halogens hydrogen halides and water.

Aromatic hydrocarbons: Introduction, IUPAC nomenclature; Benzene: resonance; Aromaticity; chemical properties: mechanism of electrophilic substitution- nitration sulphonation, halogenation, Friedel Craft's alkylation and acylation carcinogenicity and toxicity.

III. Haloalkanes and Haloarenes :

Haloalkanes : Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions. Stability of carbocations, R-S and D-L configurations.

Haloarenes: Nature of C-X bond, substitution reactions (directive influence of halogen for mono-substituted compounds only, stability of carbocations R-S and D-L configurations).Use and environmental effects of – dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

MODULE – 8

I. Alcohols, Phenols and Ethers :

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only): Identification of primary, secondary and tertiary alcohols; mechanism of dehydration, uses of methanol and ethanol.

Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of Phenols, electrophilic substitution reaction, uses of Phenols.

Ether: Nomenclature, methods of preparation, physical and chemical properties, uses

II. Aldehydes, Ketones and Carboxylic Acids :

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties and mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes; uses.

Carboxylic Acids : Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

MODULE – 9

I. Environmental Chemistry :

Environmental pollution – air, water and soil pollution, chemical reactions in atmosphere, smog, major atmospheric pollutants; acid rain, ozone and its reactions, effects of depletion of ozone layer, green house effect and global warming- pollution due to industrial wastes; green chemistry as an alternative tool for reducing pollution, strategy for control of environmental pollution.

II. Organic Compounds Containing Nitrogen :

Nitro Compounds: General methods of preparation and chemical reactions.

Amines : Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

Cyanides and Isocyanides: General methods of preparation, chemical properties, comparison

Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

III. Polymers :

Classification - natural and synthetic, methods of polymerization (addition and condensation), copolymerization. Some important polymers: natural and synthetic like polythene, nylon, polyesters, bakelite, rubber, biodegradable and non-biodegradable polymers.

MODULE – 10

I. Biomolecules :

Carbohydrates: Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L Configuration, oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); importance of Carbohydrates.

Proteins :Elementary idea of α-amino acids, peptide bond, polypeptides, proteins, primary structure, secondary structure, tertiary structure and quaternary structure (qualitative idea only), denaturation of proteins; enzymes. Lipids and hormones, their classification and functions.

Vitamins: Classification and function

Nucleic Acids: DNA & RNA.

II. Chemistry in Everyday life :

Chemicals in medicines: analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines.

Chemicals in food: preservatives, artificial sweetening agents, elementary idea of antioxidants.

Cleansing agents: Soaps and detergents, cleansing action.

III. Principles Related to Practical Chemistry:

Detection of extra elements (N, S, halogens) in organic compounds; Detection of the following functional groups: Unsaturation, alcoholic, phenolic, aldehydic, ketonic, carboxylic and amino (primary) groups in organic compounds.

Chemistry involved in the preparation of the following:

Inorganic compounds- Mohr's salt,Potash alum; organic compounds- Acetanilide, aniline yellow or 2- Napthol aniline dye, iodoform.

Chemistry involved in the titrimetric exercises- Acids bases and the use of indicators, oxalic acid vs $KMnO_4$, Mohr's salt vs $KMnO_4$.

Chemical principles involved in the qualitative salt analysis:

Cations **:** Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{3+}, Ni^{2+}, Zn^{2+}, Co^{2+}, Ca^{2+}, Ba^{2+}, Mg^{2+}, NH_4^+

Anions **:** CO_3^{2-}, S^{2-}, SO_4^{2-}, NO_3^- , Cl^-, Br^-, I^-, CH_3COO^- (Insoluble salts excluded).

Chemical principles involved in the following experiments: i) preparation of lyophilic and lyophobic sols, ii) enthalpy of dissolution of $CuSO_4$, enthalpy of neutralization of strong acid and strong base.

MATHEMATICS

MODULE-1

SETS, RELATION AND MAPPING

1. Sets: Sets and their representations. Empty set. Finite & Infinite sets. Equal sets. Subsets of the set of real numbers especially intervals (with notations). Power set. Universal set.Venndiagrams. Operations on set, Union and intersection, Difference of sets, Complement of a set.

Properties of complement sets.Simple problems on union and intersection on not more than three sets.

2. Relations & Mapping:

Ordered pairs.Cartesian product of sets.Number of elements in the Cartesian product of two finite sets. Cartesian product of the reals with itself (upto R x Rx R).Different types of relations, pictorial diagrams, domain, co-domain and range of a relation. Function as a special kind of relation from one set to another. Pictorial representation of a function, domain, co-domain & range of a function.Real valued functions of real variables, domain and range of these functions. Different types of functions.Graphs of function.Sum, difference, product and quotients of functions.

MODULE-2

SEQUENCE AND SERIES (FINITE AND INFINITE), COMPLEX NUMBERS AND QUADRATIC EQUATIONS, PERMUTATIONS & COMBINATIONS

1. Sequence and Series:

Arithmetic progression (A.P).arithmetic mean (A.M) Geometricprogression (G.P), Geometric mean(G.M).Sum of n terms of A.Pand G.P., Relation between A.M. and G.M of two real numbers. Arithmetic, Geometric and Arithmetricogeometric series. Sum to n terms of the special series Σn ,Σn^2 and Σn^3.Infinite G.P and its sum.

2. Complex Numbers:

Complex numbers as ordered pair of reals, representation of a complex number in form of a+ ib. Polar form and conjugate of a complex number, Argand diagram, algebra of complex numbers, modulus and argument of a complex number. Square and cube root of complex numbers and their properties, triangle inequality, simple problems**.**

3. Quadratic Equations: Its rational, irrational and complex roots, relation between roots and coefficients of a quadratic equation, nature of roots, formation of quadratic equation, symmetric

functions of the roots, quadratic expressions, its maximum and minimum values. Simple applications.

3. Permutations & Combinations:

Fundamental theorem of counting, permutation as arrangement and combination as selection. Permutation and combination of like and unlike things. Circular permutation is to be excluded. Simple applications.

MODULE-3

BINOMIAL THEOREM, MATRICES AND DETERMINANT

1. Binomial Theorem:

Binomial theorem for positive integral indices, general and middle term, term independent of x and greatest term in binomial expansion, simple applications.

2. Matrices and Determinant:

Matrices of order ≤ 3, algebra of matrices, types of matrices, determinant up to 3^{rd} order. Properties of determinants, evaluation of determinants, area of triangle by using determinant, Adjoint and evaluation of inverse of a square matrix using determinant and by elementary transformations test of consistency and solution of simultaneous linear equations using inverse of a matrix and determinants(Cramer's rule).

MODULE-4

TRIGONOMETRY

1. Trigonometric ratios of associated angles, compound angles, multiple and submultiple angles, conditional identities, general solution of trigonometric equations, inverse circular functions, simple applications.

2. Properties of triangles: Sine, Cosine, Tangent rules, formula for semi angels, expression for area of a triangle, circum radius.

MODULE-5

TWO DIMENSIONAL GEOMETRY

1. **Straight Line:**

Cartesian co-ordinate system, translation of co-ordinate axes, Locus of a point, Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, two-point form, intercept form and normal form. General equation of

a line, concurrence of three straight lines. Equation of family of lines passing through the point of intersection of two lines. Distance of a point from a line. Equation of internal and external bisectors of angles between two intersecting lines, Centroid, orthocenter, circum centre of a triangle.

2. Conic Sections:

Standard form of equation of circle, general form of the equation of a circle, its radius and centre, equation of a circle when the end points of a diameter are given. Point of intersection of a line and a circle with the centre at origin and condition for a line to be tangent to a circle, Equation of the tangent and simple properties.

3. **Conics**:

Parabola,ellipse, hyperbola in standard form, condition for y = mx+c to be a tangent and their simple properties.

MODULE-6

VECTORS AND THREE DIMENSIONAL GEOMETRY

1. Vectors:

Idea of vectors and scalars, types of vector, components of a vector in two and three dimensional space, Triangle and parallelogram laws of vectors, scalars and vector products, scalar triple product.

Geometrical representation of product of vectors. Simple applications.

2. Three dimensional Geometry:

Direction angles,direction cosines / ratios of a line joining two points. Orthogonal projection of a line segment on a straight line. Cartesian and vector equation of a line, coplanar and skew lines, shortest distance between two lines Cartesian and vector equation of a plane in Cartesian and vector forms. Angle between (i) two lines, (ii) two planes, (iii) a line and a plane. Distance of a line and plane from a point. Condition of co-planarity of two straight lines, condition for a straight line to lie on a plain and simple applications.

MODULE-7

DIFFERENTIAL CALCULUS

1. Continuity and Differentiability

Limit, Continuity and differentiability of function, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivate of implicit functions, concept of exponential and logarithmic functions. Logarithmic functions as inverse of exponential functions. Derivatives of different types of functions.

Second order derivatives. Rolle's Theorem and Lagrange's Mean value theorems (without proof) and their geometric interpretations and simple applications. Indeterminate forms using L'Hospital rule.

MODULE-8

INTEGRAL CALCULUS AND DIFFERENTIAL EQUATIONS
INTEGRAL CALCULUS:

Integration as inverse process of differentiation.Integration of a variety of functions by substitution, by partial fractions and by parts. Only simple integrals of the following type to be evaluated.

$\int \frac{dx}{x^2 \mp a^2}, \int \frac{dx}{a^2 \mp x^2}, \int \frac{dx}{\sqrt{x^2 \mp a^2}}, \int \frac{dx}{\sqrt{ax^2+bx+c}}$, $\int \frac{px+q}{\sqrt{ax^2+bx+c}}\, dx$, $\int \sqrt{x^2 \mp a^2}\, dx, \int \sqrt{ax^2+bx+c}\, dx$, $\int (px+q)\sqrt{ax^2+bx+c} dx$, $\int \frac{(lcosx+msinx)}{pcosx+qsinx+c}\, dx$, $\int \frac{dx}{a+bcosx}$, $\int \frac{dx}{a+bsinx}$, $\int e^{ax}\, sinbx\, dx$, $\int e^{ax}\, cosbx\, dx$, $\int e^x\, [f(x) + f'(x)] dx$.

Definite integrals as a limit of a sum. Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals.

2. Differential Equations:
Definitions, order and degree, general and particular solutions of a differential equation.Formation of different equation whose general solution is given. Solution of differential equations by method of specification of variables, homogeneous differential equations of first order and first degree solutions of linear differential equation of the type: $\frac{dy}{dx} + py = q$, where p and q are functions of x only .

MODULE-9

APPLICATIONS OF DERIVATIVES, APPLICATION OF THE INTEGRALS

1. Applications of derivatives: Rate of change, approximation of functions increasing, decreasing functions,Tangent and normal,maxima and minima. Simple applications.

2. Application of the Integrals: Area of finite region bounded by curves.

MODULE-10

PROBABILITY, STATISTICS, MATHEMATICAL REASONING, LINEAR PROGRAMMING, LINEAR INEQUALITIES
1. Probability: Probability of an event, probability of 'not', 'and' & 'or' events.

Multiplication theorem on probability, Conditional probability, dependent and independent events, total probability, Baye's theorem, Random variable and its probability distribution, mean

and variance of random variable. Repeatedindependent (Bernoulli) trials and Binomial distribution its mean and variance.

2. Statistics:

Measure of dispersion; mean deviation, variance and standard deviation of ungrouped/grouped data. Analysis of frequency distributions with equal means but different variances.

3. Mathematical Reasoning:

Mathematically acceptable statements. Connecting words/phrases- consolidating the understanding of 'if and only if (necessary and sufficient) condition", "implies", "and/or","implied by", "and", "or", "there exists" and their use through variety of examples related to real life and Mathematics. Validating the statements involving the connecting words difference between contradiction. Converse and contrapositive, truth table.

4. Linear Inequalities:

Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line.Graphical solution of linear inequalities in two variables. Solution of system of linear inequalities in two variables-graphically. Inequalities involving modulus function.

5. Linear Programming:

Mathematical formulation of L.P Problems in two variables - diet problem, manufacturing problem, transportation problem, investment problem, graphical method of solution for problems in two variables. feasible and infeasible regions, feasible and infeasible solutions, optimal feasible solutions (upto three non-trivial constraints).

BIOLOGY

Module -1: Diversity of Living Organisms

1) Classification of Living Organism - (a) Concept of diversity (b) Need for classification (c) Taxonomy & Systematics; Concept of species and taxonomic hierarchy (d) Binomial nomenclature (e) Tools for study of taxonomy- Museums, Zoos, Herbaria, botanical gardens (f) Lichens, Virus and viroids

2) Five Kingdom Classification- (a) Salient features and classification of Monera, Protista and Fungi into major groups (b) Salient features and classification of plants into major groups – Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms- three to five salient and distinguishing features of each category and atleast two examples of each (c) Angiosperms – classification up to classes, characteristic features and examples (d) Salient features and classification of animals --- Non chordate up to phyla level and chordate up to classes level (three to five salient features and at least two examples).

Module 2: Structural Organisation in Animals and Plants

1) Tissues in animals and plants.

2) Morphology and modifications of flowering plants- Root, Stem and leaf; functions of different parts of flowering plants, microscopic anatomy of Root, Stem and Leaf.

3) (a) **Inflorescenc**e- Cymose and racemose (b) **Flower** – Different parts of flower, Classification of flower based on symmetry and position of ovary on the thalamus (c) **Fruit** – Types of fruits- Legume, Drupe, Sorosis, Parthenocarpic fruit (d) **Seed** -Structure of Dicot and monocot seed.

4) Morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of an insect (cockroach). (Brief account only).

Module-3: Cell Structure and function

1) Cell theory and cell as the basic unit of life.

2) Structure of a prokaryotic and eukaryotic cell, Plant cell and animal cell. (Brief).

3) Cell envelope, cell membrane, cell wall.

4) Cell organelles - Structure and function : (a) Endomembrane system- endoplasmic reticulum, golgi bodies, Lysosomes, vacuoles (b) **Mitochondria, plastids, ribosomes** (c) **Cytoskeleton, cilia and flagella, centrioles** (Ultra structure and function) (d) **Nucleus** -- nuclear membrane, chromatin, nucleolus.

5) Chemical constituents of living cells- (a) **Biomolecules** - Structure and function of proteins, carbohydrates, fats, nucleic acids (b) **Enzymes** - Types, properties, enzyme action.

6) Cell division -- Cell cycle, mitosis, meiosis and their significance.

Module 4: Plant Physiology

1) Transport in plants- (a) Means of transport and Plant -- water relations :- Diffusion, facilitated diffusion, active transport. Imbibition, water potential, osmosis, plasmolysis (b) Long distance transport- Apoplast, symplast, root pressure, transpiration pull (c) Transpiration - Opening and closing of stomata (K^+ ion Hypothesis), Guttation (d) Uptake and translocation of mineral nutrients- Phloem transport -Mass flow hypothesis.

2) Mineral nutrition- (a) Essential minerals, macro-and micronutrients and their role; Deficiency symptoms (b) Toxicity of micronutrients c)Elementary idea of Hydroponics as a Method to study mineral nutrition (d) Nitrogen cycle- Non- biological nitrogen fixation, Biological nitrogen fixation.

3) Plant Respiration- (a) Cellular respiration -- Glycolysis , Fermentation (anaerobic), TCA cycle and electron transport system (aerobic), Number of ATP molecules generated (b) Amphibolic pathways c) Respiratory quotient of nutrients

4) Photosynthesis- (a) Autotrophic nutrition, Site of Photosynthesis, Photosynthetic pigments (Elementary idea) (b) Photochemical and biosynthetic phases of photosynthesis, Cyclic and non cyclic photophosphorylation, Chemiosmotic hypothesis (c)Photorespiration, C_3 and C_4 pathways (e) Factors affecting photosynthesis, Law of limiting factors.

5) Plant growth and development- (a) Phases of plant growth and plant growth rate, Conditions of growth, (b) Differentiation, dedifferentiation and redifferentiation (c) Growth regulators (Elementary idea) - Auxin, gibberellin, cytokinin, ethylene, ABA (d) Photoperiodism, Role of Phytochrome in flowering (f) Seed germination**,** Seed dormancy (g) Vernalisation (Elementary idea).

Module 5: Human Physiology

1) Digestion and Absorption-(a)Human alimentary canal and Digestive glands (b) Digestion, absorption and assimilation of proteins, carbohydrates and fats (c) Role of Gastrointestinal hormones (d) Peristalsis (e) Calorific value of proteins, carbohydrates and fats (f) Nutritional and digestive disorders(in brief) -- P E M, indigestion, constipation, vomiting, jaundice.

2) Breathing and Respiration- (a) Respiratory system in humans (b) Mechanism of Breathing (c) Exchange and transport of gases (d) Regulation of respiration in human (d) Respiratory

volumes (e) Disorders related to respiration (in brief) – Asthma, Emphysema, Occupational Respiratory disorders.

3) Body fluids and circulation- (a) Composition of blood, Blood groups, coagulation of blood (b) Composition of Lymph and its function (c) Structure of human heart and blood vessels (d) Cardiac cycle, Cardiac output, ECG (d) Double circulation (e) Regulation of cardiac activity (f) Disorders of circulatory system (in brief) – Hypertension, Coronary artery disease, Angina pectoris, heart failure.

4) Excretory products and their elimination- (a) Modes of excretion – Ammonotelism, ureotelism, uricotelism (b) Human excretory system-structure and function (c) Urine formation, Osmoregulation (d) Regulation of kidney function- Renin-angiotensin, Antinatriuretic factor, ADH and Diabetes insipidus (e) Role of other organs in excretion- Skin, Liver, Lung (f) Disorders(in brief) --- Uraemia, Renal failure, Renal Calculi, Nephritis (g) Dialysis and artificial kidney.

5) Locomotion and Movement- (a) Types of movement in human being --- ciliary, flagellar, muscular (b) Skeletal muscle -- contractile proteins and muscle contraction (c) Skeletal system and its functions (d) Joints (e) Disorders of muscular and skeletal system (in brief) – Myasthenia gravis, Tetany, Muscular dystrophy, Arthritis, Osteoporosis, Gout.

6) Neural control and coordination- (a) Neuron and nerves (b) Nervous system in human: Central Nervous system, Peripheral Nervous system and Visceral Nervous system (c) Generation and conduction of nerve impulse (d) Reflex action (e) Sense organs and Sensory Perception (e) Elementary structure and function of eye and ear.

7) Chemical coordination and regulation- (a) Endocrine glands and hormones (b) Human endocrine system – Hypothalamus, Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Pancreas, Gonads (c) Mechanism of hormone action (Elementary Idea) (d) Role of hormones as messengers and regulators (e) Brief idea on Hypo and hyperactivity and related disorders (Common disorders e.g. Dwarfism, Acromegaly, Cretinism, Goiter, Exopthalmic goiter, Diabetes, Addison's disease).

Module 6: Reproduction

1) Reproduction in Organisms-Reproduction, a characteristic feature of all organisms for continuation of species. Mode of reproduction- Asexual and Sexual.

2) Asexual Reproduction- Binary fission, sporulation, budding, gemmule, fragmentation, regeneration**,** Vegetative propagation in plants.

3) Sexual reproduction in flowering plants- (a) Flower structure, Development of male and female gametophytes (b) Pollination – types, agencies and examples (c) Outbreeding devices (d) Pollen – Pistil Interaction (e) Double fertilization, Post Fertilization events- Development of

endosperm & embryo (f) Development of seed and formation of fruit (g) Special modes – apomixis, parthenocarpy, polyembryony (I) Significance of seed and fruit formation

4) Human Reproduction- (a)Male and female reproductive systems, Microscopic anatomy of testis and ovary (b) Gametogenesis – spermatogenesis & oogenesis (c) Menstrual cycle, Fertilisation, embryo development upto blastocyst formation, implantation (d) Pregnancy and placenta formation (Elementary Idea), Parturition (Elementary Idea), Lactation (Elementary Idea).

5) Reproductive Health –(a) Need for reproductive health and prevention of Sexually Transmitted Diseases-(STD) (b) Birth Control – Need and Methods , Contraception & Medical Termination of Pregnancy (MTP), Amniocentesis (c) Infertility and assisted reproductive technologies – IVF, ZIFT, GIFT (Elementary idea for general awareness).

Module-7: Genetics and Evolution

1) Heredity and variation:- (a) Mendelian Inheritance, Deviations from Mendelism : Incomplete, dominance, co-dominance, Multiple alleles and Inheritance of blood groups, Pleiotropy, Elementary idea of Polygenic Inheritance (b) Chromosome Theory of Inheritance (c) Chromosomes and genes. d)Sex determination- In humans, birds, honey bee (d) Linkage and crossing over (e) Sex linked inheritance-Haemophilia, Colour blindness (f) Chromosomal disorders in humans- Down's syndrome, Turner's and Klinefelter's syndromes.

2) Molecular basis of Inheritance- (a) DNA as genetic material, Structure of DNA and RNA, DNA packaging, DNA replication (b) Central dogma-- Transcription, genetic code, translation (c) Gene expression and regulation (d)Genome and Elementary idea of Human Genome project (e) DNA finger printing.

3) Evolution- (a) Origin of life (b) Biological evolution and evidences for biological evolution from Paleontology, comparative anatomy, embryology and molecular evidence **(**b) Darwin's contribution, Modern Synthetic theory of Evolution (c) Mechanism of evolution – Variation (Mutation & Recombination) and Natural Selection with examples, types of natural selection (d) Gene flow and genetic drift (e) Hardy – Weinberg's principle (f) Adaptive Radiation, Human evolution

Module 8: BIOLOGY AND HUMAN WELFARE

1) Health and Disease- (a)Pathogens and parasites causing human diseases (Malaria, Filariasis, Ascariasis, Typhoid, Pneumonia, common cold, amoebiasis, ring worm (b) Basic concepts of immunology – vaccines; Cancer, HIV and AIDS; Adolescence, drug and alcohol abuse.

2) Insects and human welfare-- Silk, Honey, Lac.

3) Improvement in Food production- (a) Plant breeding, tissue culture, single cell protein (b) Biofortification, Animal husbandary.

4) Microbes in human welfare- - In household food processing, industrial production, sewage treatment, energy generation and as biocontrol agents and biofertilizers

Module 9: Biotechnology and Its Application

1) Principles and process of Biotechnology- Genetic engineering (Recombinant DNA technology).

2) Application of Biotechnology in health and agriculture- (a) Human insulin and vaccine production, gene therapy (b) Genetically modified organisms – Bt crops (c) Biosafety Issues (d) Biopiracy and patents.

Module10: Ecology and Environment

1) Organism and Environment- (a) habitat and niche (**b)** Population and ecological adaptations (c) Population Interactions – mutualism, competition, predation, parasitism (d) Population attributes – growth, birth rate and death rate (e) Age distribution.

2) Ecosystems- (a) , components, Energy flow , Pyramids of number, biomass ,energy, decomposition and productivity (b) nutrient cycling (carbon and phosphorous) (c) Ecological succession (d) Ecological Services : Carbon fixation, Pollination, Oxygen release.

3) Biodiversity and its conservation – (a) Need for biodiversity conservation b) Hotspots, endangered organisms, extinction, Red Data Book (c) Biodiversity conservation – biosphere reserves, national parks and sanctuaries.

4) Environmental Issues- (a) Air Pollution and its control,Water pollution and its control (b) Agrochemicals and their effects, Solid waste management, Radioactive waste management (c) Greenhouse effect and global warming, Ozone depletion, deforestation.

DIRECTORATE OF HIGHER EDUCATION

TRIPURA BOARD OF JOINT ENTRANCE EXAMINATION

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INFORMATION REGARDING QUESTION PATTERN

[1] Question paper for each subject will be of Multiple Choice Question (MCQ) type.

[2] Four different subjects, namely Physics, Chemistry, Mathematics and Biology will have four different question papers. But Physics and Chemistry will have a combined question paper.

[3] The questions of the Examination will be framed on the basis of the Syllabi of Tripura Joint Entrance Examination which is in force w.e.f. 2016 as displayed in the website. The syllabus for each subject is divided into 10 Modules.

[4] There will be 30 (Thirty) compulsory MCQs, taking 3 (Three) questions from each Module for the subject Physics, Chemistry, Mathematics and Biology.

[5] Each question will carry 4 (Four) marks, i.e., total marks for a question paper will be of 120 (30 × 4) for each subject. However, Physics and Chemistry will have a single question paper with 60 (Sixty) questions (30 questions of Physics + 30 questions of Chemistry) which will carry total 240 marks.

[6] Each correct question will carry 4 (Four) marks and for each wrong answer 1 (One) mark will be deducted.

[7] Each question will have four options (i.e., A/B/C/D) out of which the correct/closest answer the candidate will have to fill the corresponding circle (i.e., A/B/C/D) in appropriate space provided in OMR sheet.

[8] Duration of Examination of each paper will be 45 minutes. For the combined question paper the duration would be 90 minutes.

[9] Some previous year's question papers are displayed in the website for awareness of the students' concerned.