APPLIED PHYSICS

1. UNITS & DIMENSIONS

Fundamental & derived units in SI System - Dimensions of Physical quantities - Principle of homogeneity -Dimensional equations - Applications of dimensional analysis - Checking the correctness of physical equations - derivation of simple physical relations - conversion of units.

 Limitations of dimensional analysis.

2. FORCE & MOTIONS

Scalar & vector quantities with examples - force & its units (in SI) - Resolution of forces into rectangular components (Simple Problems) - composition of forces by parallelogram law - parabolic motion - Horizontal projection and projection at an angle - time of flight - horizontal range and maximum horizontal range - Simple problems - centripetal acceleration - centripetal and centrifugal forces - Concept of friction and its application - application to banking of roads.

3 WORK, POWER & ENERGY

Work & its units - Work done on bodies moving on horizontal & inclined planes (consider frictional forces also) - Concept of power & its unit - Calculation of Power (simple cases) - Concept of kinetic energy & potential energy - Expressions for P.E. & K.E - Conservation of energy in the case of freely falling bodies - Principle of conservation of energy.

4. ROTATIONAL & SIMPLE HARMONIC MOTIONS

Definition of moment of inertia, Torque & angular momentum & their inter relation, Principles of Conservation (angular momentum & its application), Kinetic energy of rolling body, S.H.M. – derivation of displacement, velocity, acceleration time period & frequency (Motion of cantilever). Free, forced & resonant vibrations (No derivation).

5. TEMPERATURE & ITS MEASUREMENT

Concept of heat & temperature on the basis of K. E. of molecules. Unit of heat. Basic Principles of measurement of temperature. Thermo couple, bimetallic & resistance, thermo-meters. Ranges of these thermometers. Criteria for the selection of a thermometer.

6. EXPANSION OF SOLIDS

Coefficient of linear, surface and cubical expansions and relations amongst them. Thermal stresses (qualitative only) and their applications.

7. HEAT TANSFER

Three modes of transfer of heat. Coefficient of thermal conductivity, its determination by Searle's method and Lee's disc method. Conduction through compound media (series and parallel for two materials only), Heat radiation, Characteristics of heat radiations. Prevost's theory of heat exchange. Black body radiations, Emissivity and absorptivity Kirchhoff's law and Stefan's law of radiation.

8. WAVES

Generation of waves by vibrating particles, wave motion and its parameters. Equation of a wave, Energy transfer by particle and wave; superposition of waves and interference (graphical); Sound and light as waves – frequencies, wave length and velocities and their relationship; Electromagnetic spectrum.

9 APPLICATIONS OF SOUND

ULTRASONICS

Production of ultrasonic waves by using magneto-striction and piezo-electric methods; applications to drilling, cold welding, cleaning, flaw detection and exploration (sonar).

ACOUSTICS

Reflection, refraction and absorption of sound waves by surface; Echo and reverberation; Reverberation time and its control.

10. APPLICATIONS OF LIGHT

Refraction & refractive index; Defects in image formation (Qualitative), Simple and Compound Microscopes, Astronomical telescopes and their magnifying powers.

11. ELECTROSTATICS

Coulomb's law. Unit charge; Electric field and electric lines of force; Concept of electric potential, Unit of potential; Electric potential due to point charge and sphere. Electric intensity due to charged straight coil and plane sheet; Capacitance and its units. Parallel plate coil; Grouping of capacitors in series and parallel problems; Dielectric constant – its functions.

12 D.C. CIRCUITS

Ohm's law; Kirchhoff's law; Wheatstone bridge principle; Simple problems on series and parallel circuits.

13. ELECTROMAGNETISM

Magnetic fields and its units; magnetic fields around a current carrying conductor; circular loop and solenoids; Force on a moving charge & current in a magnetic field; Force between two current carrying parallel conductor; Moving coil galvanometer; Conversion of galvanometer into Ammeter & Voltmeter; Permeability; Dia, para & Ferro magnetic metal.

14. Introduction to Laser, its characteristics & important applications.

APPLIED MATHEMATICS

1.   VECTOR ALGEBRA

Definition, notation & rectangular resolution of algebra vector; Addition and subtraction of vectors; Scalar & vector products of 2 vectors only; Simple problems related to work, moment and Angular velocity.

2.   MATRICES

Definition and types of matrices; Addition and subtraction of matrices, multiplication of matrices; Inverse of a 3 x 3 matrix by adjoint matrix method; Solution of linear equations containing up to three unknowns only.

3.   ELEMENTARY NUMERICAL ANALYSIS

Newtons forward & backward differences, Shift operation; Difference table; Newton-Gregory forward & backward interpolation formulae; Lagranges' interpolation formulae.

4.   COORDINATE GEOMETRY

POINT

Cartesian & polar co-ordinates and their conversion. Distance between two points, internal and external division formulae, coordinates of centroid and its centre. Area of Triangle, condition of collinearity of points, simple problems on locus.

STRAIGHT LINE

Equation of a straight line in various standard forms. Angle between straight lines, perpendicular distance formula.

CIRCLE

The equation of circle in standard & general form, finding the equation of circle when – its centre and radius are given & any three points on it are given.

CONICS

Definitions of conics, parabola, ellipse and hyperbola & their standard equations; Finding the equation of a parabola when its focus and directrix or focus and vertex are given; Finding the equation of an ellipse or hyperbola when focus, directrix and eccentricity are given; Given the standard equation of conic, to find its focus, directrix, vertex, axis, eccentricity and the length of latus rectum.

5.   DIFFERENTIAL CALCULUS
LIMITS
Concept of a function, its value and limit; Evaluation of limits, four standard limits only namely;

$$\underset{x \to 0}{Lt} \frac{Sin\ x}{x} \ ; \qquad \underset{x \to 0}{Lt} (1 + x)^{1/x}$$

$$\underset{x \to a}{Lt} \frac{x^n - a^n}{x - a} \ ; \qquad \underset{x \to 0}{Lt} \frac{a^x - 1}{x}$$

DIFFERENTIATION

Definition, its physical meaning as rate measure and its geometrical meaning;

Differentiation from first principles of x^n, $\log_a X$, $\sin x$, $\cos x$, $\tan x$, only;

Differentiation of Cot x, Sec x, Cosec x & inverse functions; Differentiation of sum, product and quotient functions; Differentiation of function of a function ; Logarithmic differentiation.

APPLICATIONS

Rate Measurer; Calculation of Errors; Newton's method of solving equations; Tangent and Normal to a curve for explicit functions only; Maxima and minima.

6.   INTEGRAL CALCULUS

Indefinite integrals; Physical meaning of integration; Integration as inverse process of differentiation; Integration by substitution, by parts and by partial fractions; Integration of rational and irrational quadratic expressions viz

$$\int \frac{dx}{ax^2+bx+c} \; , \qquad \int \frac{dx}{\sqrt{ax^2+bx+c)}} \; , \qquad \int \sqrt{(ax^2+bx+c)}$$

Definite integrals:- Evaluation of Definite integrals; Simple problems of Integration

$$\int_{0}^{\Pi/2} \sin^n x \, dx, \qquad \int_{0}^{\Pi/2} \cos^n dx, \qquad \int_{0}^{\Pi/2} \sin^m x \cos^n x \, dx$$

(without proof)

Numerical integration by Simpson's Rule; Applications;

Simple problems on the area bound by a curve and axle and volume of a solid formed by revolution of an area.

7.   DIFFERENTIAL EQUATIONS

Definition; Formation of differential equations; Solutions of differential equations of first order and first degree:- Variables separable; Homogeneous differential equations; Linear differential equations.

APPLIED CHEMISTRY
DETAILED CONTENTS

1. STRUCTURE OF ATOM

Rutherford model of the structure of atom, Bohr's theory of H atom and equation deduced. Quantum numbers and their significance, de-Broglie equation and uncertainty principle. Electronic configuration of 1 to 30 elements.

2. PERIODIC PROPERTIES OF ELEMENTS

Periodic law, periodic table, periodicity in properties like atomic radii & volume, ionic radii, ionization energy and electron affinity, Division of elements into s,p,d, and f blocks.

3. CHEMICAL BONDS

Electrovalent, covalent and coordinate bond and their properties. Metalic bonding (electron cloud model) & properties (like texture, conductance, lusture, ductility and malleability). Orbital concept of covalence, Hybridisation (Simple treatment).

4. FUEL & THEIR CLASSIFICATION

Definition, characteristics, classification into solid, liquid and gaseous fuel, petroleum and brief idea of its refining into various fraction and their characteristics and uses. Calorific value of fuel, gaseous fuels-preparation, properties, composition and use of producer gas, water gas and oil gas.

5. WATER

Impurities in water, methods of their removal, hardness water, its types, causes and removal, disadvantages of hard water in boilers, pH value and its determination by colorimetric method.

6. Problems based on Gravimetric and Volumetric Analysis.

7. METALS

Cast iron & its properties, effect of sulphur, silicon & phosphorous as impurities in cast iron. Elementary knowledge of heat treatment of steels hardening, tempering, annealing, normalizing and case hardening.

8. ALLOYS

Definition, classification & necessity for making alloys. Composition, properties and uses of following alloys: Brass, Bronze, Gun-metal and Duralumin. Effect of carbon, nickel, chromium, manganese on steel.

9. CORROSION

Its meaning, theory of corrosion, prevention of corrosion by various methods using metallic and non metallic coatings.

10. PLASTICS AND POLYMERS

Plastic, thermo plastic and thermo setting. Introduction of Polythene, PVC, Nylon, synthetic rubber and phenol-form aldehyde resin. Their applications in industry.