

SYLLABUS FOR THE CET

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Syllabus for the Common Entrance Test, Karnataka :

Physics : [Second Yr](#) | [First Yr](#)

Chemistry : [Second Yr](#) | [First Yr](#)

Mathematics : [Second Yr](#) | [First Yr](#)

Biology : [Second Yr](#) | [First Yr](#)

PHYSICS

1. WAVES AND SOUND

- Waves: formation of waves, types of waves, wave amplitude, frequency, wave length and velocity - relation $n = f \lambda$ - equation for progressive wave, intensity, super position of waves. Problems
- Sound: Properties, velocity in gases, Newton - Laplace formula, factors affecting velocity - intensity and loudness, units, Noise and Music beats as an example of superposition of waves, Doppler effect, formula for general case, discussion for individual cases. Problems
- Stationary waves: Modes of vibration in pipes, laws of vibration of stretched strings, sonometer, Problems.
- Ultrasonics: Production (mention of methods), properties and applications
- Acoustics of buildings: reverberation, Sabine's formula (mention), requisites for good acoustics and methods of achieving them.

2. PHYSICAL OPTICS

- Introduction to theories of light
- Interference of light: Coherent sources, Young's double slit experiment, expression for path difference, conditions for constructive and destructive interference, width of interference fringes. Problems
- Diffraction of light: Fresnel and Fraunhofer diffraction, Fraunhofer diffraction through a single slit (qualitative explanation), limit of resolution, Rayleigh's criterion, resolving powers of telescopes and microscope. Problems
- Polarisation of light: transverse nature of light waves, methods of producing plane polarised light, Brewster's law, double refraction, dichroism, polaroids and their applications, optical activity and specific rotation. Problems.

3. ELECTROSTATICS

- Electric charge: Coulomb's law, dielectric constant, SI unit of charge, electric intensity and potential, relation connecting them, derivation of expression for potential at a point due to an isolated charge. Gauss theorem and applications, intensity at a point (a) due to a charged spherical conductor (b) near the surface of a charged conductor, Problems
- Capacitors: parallel plate, spherical, cylindrical, expressions for the capacitances, principle of a capacitor, effect of dielectric, energy stored in a capacitor, combination of capacitors, uses, Problems

4. CURRENT ELECTRICITY

- Different effects of electric current: potential difference, resistance, colour code, Ohm's law and its limitations, variation of resistance of a conductor with length- area of cross section

and temperature, resistivity, superconductivity, thermistor and its applications, combination of resistors, EMF of a cell, current in a circuit, branch currents, grouping of cells, expression for different cases, potentiometer, problems

- Kirchhoff's laws: Condition for balance of a Wheatstone's bridge, metre bridge, Problems
- Magnetic effect of current: direction of field, right hand clasp rule and magnitude - Laplace's law, force on a charged particle moving across a magnetic field (qualitative), magnetic field strength, flux density, magnetic flux density at a point on the axis of (a) a circular coil carrying current (derivation), (b) a solenoid carrying current (without derivation), tangent law, tangent galvanometer (with theory), Problems
- Force on a current carrying conductor in a magnetic field: Fleming's left hand rule, force between two parallel conductors carrying current, definition of ampere, suspended coil galvanometer (with theory), conversion of galvanometer into ammeter and voltmeter, Problems
- Magnetic materials: Intensity of Magnetising field (H), intensity of magnetisation (I) and magnetic induction (B) - relation connecting them, permeability and susceptibility, properties of dia, para and ferromagnetic substances, hysteresis cycle and its significance, retentivity and coercivity, uses of magnetic materials.
- Electromagnetic induction: Laws, self and mutual induction, induction coil (principle), principle and working of a generator, expression for sinusoidal emf, peak, mean and rms values, impedance, current in R, L & C and RLC circuits, power factor, choke and transformer (principle), principles of a ac meters (moving iron and hot wire types) Problems.

5. MODERN PHYSICS

- Introduction to modern physics: types of spectra, E. M. spectrum, types of electron emission.
- Quantum theory of radiation: Explanation and applications of photoelectric effect, atom models, Bohr's theory of hydrogen atom, derivation of expressions for orbital radius, orbital velocity, energy of electron and wave number, spectral series, energy level diagram, de Broglie matter waves, Problems.
- Nuclear Physics: Nuclear size, charge, mass and density, constituents, amu in terms of electron volts, magnetic moment and nuclear forces, mass defect and binding energy, nuclear fission, chain reaction, critical size, nuclear reactor, nuclear fusion, stellar energy, radiation hazards, Problems.
- Radioactivity: Properties of radioactive radiations, decay law, decay constant, Soddy's group displacement law, half life and mean life, expression for half life, radio isotopes and their uses, Problems.
- Solid state electronics: Band theory of solids (qualitative), classification into conductors, insulators and semi conductors, p-type and n-type semi conductors, characteristics of p-n junction, rectifying action of diode, half wave and full wave rectifiers. Transistors, pnp and npn, characteristics, relation between alpha and beta transistors as an amplifier (qualitative - npn in CE mode)

Syllabus from PUC-I/ XI Std. or equiv.

1. INTRODUCTION

Introduction to Physics SI units - dimensions - dimensional formulae - dimensional analysis - limitations Scalars and vectors - unit vector - vector addition - resolution of a vector - scalar and vector products

2. DYNAMICS

Motion of a particle in one dimension - derivations of equations of motion velocity - time curve.
 - Problems Newton's laws of motion, $f=ma$ derivation - conservation of momentum (statement and to arrive at) - illustrations - problems Motion in two dimensions - equation for the trajectory of a projectile - range, height and time of flight - uniform circular motion - centripetal acceleration (derivation of expression) - centripetal and centrifugal forces with illustrations - problems Work, energy and power - work done - F.S. - expressions for potential and kinetic energy - conservation of energy (statement with illustrations - problems) Gravitation - Law of gravitation - variation of g with altitude, depth and latitude - motion of planets and satellites - statement of Kepler's laws, orbital velocity - escape velocity - weightlessness - problems Rotational motion of rigid body - angular displacement, velocity, acceleration and

momentum, torque - equations for angular motion - moment of inertia - radius of gyration, comparison of linear and rotational motions - problems Elasticity - stress and strain - Hooke's law - moduli of elasticity - expression for Young's modulus in the case of stretching Simple harmonic motion - characteristics - examples and equation for SHM ($y = a \sin \omega t$)

3. STATICS

Coplanar concurrent forces - resultant of two forces - magnitude and direction (derivation) equilibrium of three forces - law of triangle of forces - Lami's theorem - problems Moment of a force - law of moment (statement) - application to find the resultant of two parallel forces - couple - statement of conditions of equilibrium of parallel forces - problems

4. HYDROSTATICS AND HYDRODYNAMICS

Hydrostatics - fluid thrust and pressure - atmospheric pressure (units) pressure at a point due to a liquid - Archimedes' principle (statement) - problems Hydrodynamics - streamline and turbulent flow - Bernoulli's theorem - explanation with examples Surface tension - cohesion and adhesion - surface tension and angle of contact - capillary rise (without derivation) Viscosity - velocity gradient - co-efficient of viscosity - Poiseuille's formula for the flow of a liquid through a capillary tube and Stoke's law (without derivation)

5. HEAT

Heat and temperature - measurement of temperature - Mention of different thermometers - effect of heat like expansion and change of state Gas laws - absolute scale of temperature - perfect gas equation - isothermal and adiabatic changes - mention of equations of state - problems Absorption of heat - specific heat - thermal capacity - principle of calorimetry - latent heat - specific heat - specific heats of gases - ($C_p - C_v$) and their relation ($C_p - C_v = R$) - degrees of freedom - equipartition of energy - importance of g Conduction of heat - steady state - temperature gradient - thermal conductivity - problems Radiation - emissive and absorptive powers - Stefan's law - Prevost's theory of exchanges - Kirchhoff's law - Wien's displacement law - Plank's law - solar constant - temperature of the sun (qualitative treatment of the topics without derivation) - problems Thermodynamics - relation between heat and work (first law) - heat engine - efficiency - reversible and irreversible process - Carnot's cycle - pV diagram - efficiency of a Carnot engine (without derivation) (Second Law) - problems

6. GEOMETRICAL OPTICS

Introduction to light - optical medium - rectilinear propagation of light Reflection of light - laws of reflection - reflection at curved surfaces - image formation in the case of spherical mirrors - mirror formula (without derivation) - sign convention - problems Refraction at a plane surface - laws of refraction - absolute and relative refractive indices (Symbol n to be used for R_1) - refraction through multiple refracting media - lateral shift and normal shift (expressions without derivation) - total internal reflection - conditions for total internal reflection - relation between critical angle and refractive index (n) - applications of optical fibres and total reflecting prisms - problems Refraction through a prism - derivation of the expression for the refractive index (n) of the material of a prism in terms of A and D - dispersion through a prism - deviation produced by a thin prism - dispersive power - prism combination for dispersion without deviation - problems Refraction at spherical surfaces - derivation of the relation connecting n, u, v and r for refraction at a spherical surface (concave towards point object in denser medium) - refraction through a lens - lens maker's formula - power of a lens - Image formation in the case of thin lenses, linear magnification - lenses in contact - problems Spherical and chromatic aberrations - qualitative discussion - achromatic combination of lenses Optical instruments - microscopes, telescopes, prism binoculars, direct vision spectroscope and spectrometer (qualitative) Photometry - basic concepts - units - principle of photometry - problems

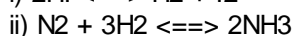
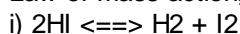
Chemistry

1. THERMODYNAMICS AND THERMOCHEMISTRY

Law of conservation of energy - Mechanical work done. Isothermal and adiabatic changes - concept of enthalpy - enthalpy of reaction, formation, solution, combustion, transition and neutralisation - constancy of enthalpy of neutralisation of a strong acid and a strong base
Thermochemical equations - Laplace - Lavoisier law - Hess's law. Problems

2. CHEMICAL EQUILIBRIUM

Law of mass action, application of law of mass action to the following systems:



Derivation of KP for both reactions

Le-Chatelier's principle and its application to the synthesis of Ammonia.

Free energy change - standard free energies - Idea of a system tending to attain a state of minimum free energy and maximum entropy. Relationship between free energy change and equilibrium constant. Problems

3. REACTION KINETICS

Order and molecularity of a reaction. Derivation of the equation for the velocity constant of a first order reaction - Half life period - Relationship between half life period and order of the reaction - Experimental study of the acid hydrolysis of methyl acetate.

Influence of temperature on the velocity of a reaction - Arrhenius theory - Arrhenius factor and energy of activation. Problems

4. SURFACE CHEMISTRY

· Adsorption - Distinction between adsorption and absorption. Types of adsorption - adsorption of gases on solids.

· Colloids - Distinction between colloids and crystalloids - classification, preparation of colloids (electrical and chemical methods, one method each), Purification by dialysis -

Properties: Tyndall effect and Brownian movement. Application in food, medicine, precipitation of smoke.

· Catalysis - Characteristics - Influence of catalyst on reaction path. Theories of catalysis (Intermediate compound theory and adsorption theory)

5. ELECTROCHEMISTRY

· Arrhenius theory of electrolytic dissociation - merits and demerits. Ionic conduction by migration. Definition of specific, equivalent and molar conductivities - strong and weak electrolytes.

· Acids and bases - Bronsted - Lowry concept - Lewis concept. Acid-Base equilibrium, Hydrogen ion concentration - pH scale - pK values.

· Buffers - Buffer equation (Henderson's equation to be assumed). Importance of buffer solutions.

· Ionic equilibrium - solubility product, common ion effect. Applications of solubility product in qualitative analysis.

· Electrode potential - Nernst equation to be assumed, Standard electrode potential - Hydrogen electrode - Electro-chemical series and its significance - corrosion of metals.

· Problems

6. SOLIDS

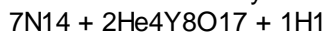
Types of solids - radius ratio (r_+/r_-), coordination number - unit cell. Structure of ionic crystals. Ionic radii - imperfections in solids - superconductivity.

7. RADIOACTIVITY

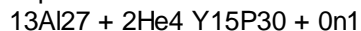
· Natural radioactivity - Properties of alpha, beta and gamma radiations - rate of disintegration

- Half life period - Isotopes - separation by thermal diffusion method.

· Artificial radioactivity - Rutherford's artificial nuclear reaction.



Explanation of artificial radioactivity using



Preparation and uses of artificial radioactive isotopes - Co60, I131, P32 and Na24

Radioactive dating, Elementary account of fission and fusion.

8. METALLURGY

General principles of metallurgy - Concentration of ores (gravity process, magnetic separation and froth flotation) - Extraction of crude metal (pyrometallurgy, hydrometallurgy and electro-metallurgy), Refining (Liquation, poling, electrolytic method)

Occurrence, extraction, properties and uses of Sodium, Copper, Aluminium and Iron. Role of iron

and sodium in biological systems. Manufacture of steel by LD process, Properties of steel (carbon content) Heat treatment - alloy steels.

9. COORDINATION COMPOUNDS

Postulates of Werner's theory - Sidgwick's interpretation - concept of EAN using Potassium ferrocyanide, potassium ferricyanide and cuprammonium sulphate.

10. MANUFACTURE, properties, uses of Sodium hydroxide (Nelson's cell), Sodium Carbonate - Alum.

11. ORGANIC CHEMISTRY

· Preparation, Properties and Uses of the following:

- Alkyl halides 1) Ethyl bromide and isopropyl chloride 2) Vinyl chloride
- Aromatic halogen compounds: 1) Chlorobenzene and benzyl chloride, comparison of reactivities with alkyl halides. 2) Grignard reagent and its synthetic applications.
- Alcohols - Ethyl alcohol (Manufacture from molasses), Benzyl alcohol
- Phenol
- Aldehydes and ketones - Formaldehyde, Acetaldehyde, Benzaldehyde, Acetone, Acetophenone.
- Acids - Formic, Acetic, Benzoic, Salicylic acids.
- Esters - Ethyl acetate, Ethyl benzoate
- Amines - Methylamine, Aniline

12. POLYMERS

Classification - Synthetic and natural, preparation and uses of polythene, nylon, terylene.

Natural rubber.

13. CARBOHYDRATES

Classification - Monosaccharides - open and ring structure of glucose, fructose, galactose

Oligosaccharides - Ring structure of sucrose, maltose and lactose

Polysaccharides - Partial representation of structure of cellulose, starch and glycogen -

Carbohydrates as a source of energy.

14. OILS AND FATS

Chemical nature of fatty acids - saturated and unsaturated fatty acids - Examples. Triglycerides

- General structure of triglycerides - Hydrolysis with acid and saponification.

Rancidity - Refining and hydrogenation of oils - drying oils.

15. PROTEINS

Amino acids as building units of proteins. General structure of amino acids such as glycine, alanine, serine, cysteine, aspartic acid, lysine, tyrosine, peptide linkage. Functional properties of proteins as enzymes, antibodies, transport agents, biochemical messengers (hormones-insulin and oxytocin) and structural material.

16. NUCLEIC ACIDS

Types - DNA and RNA - Components - purine and pyrimidine bases, sugars and phosphates -

Biological importance of nucleic acids.

17. CHEMOTHERAPY

Antipyretics - Aspirin, Antibiotics - Penicillin, Analgesics - Paracetamol

Antiseptic - chloroxylenol (dettol), Antimalarial - chloroquine Tranquilizers - Barbituric acid

· Structure and uses of the above.

Chemistry - Syllabus from PUC-I/XI. Std or equiv.

1. KINETIC THEORY OF GASES

Postulates, Derivation of expression for pressure of a gas. ($PV = \frac{1}{3}mnc^2$) Deduction of gas laws, Boyle's law, Charles's law, Graham's law of diffusion and Dalton's law of partial pressures.

Expression for Kinetic energy and RMS velocities of gases (problems based on these) Ideal and real gases. Deviation of real gases from ideal behaviour. Derivation of Van der Waal's equation.

2. STOICHIOMETRY

Mole concept and Avogadro number (Problems)

Atomic weight: Definition with evaluation of atomic weight by Dulong and Petit's law (problems)

Equivalent weight of elements ; definition, methods of determination (hydrogen displacement, oxide and chloride methods) (problems)

Equivalent weights of acids and bases, oxidising, reducing agents. Concept of normality, molality and molarity.

Volumetric analysis: Calculations involving acid-base and red-ox titrations. (Problems)

Empirical and Molecular formula from % composition (problems) Relation between vapour density and molecular weight.

Molecular weight of oxygen and carbon dioxide and volatile liquids (Victor Meyer's method) (problems)

3. ATOMIC STRUCTURE

Fundamental particles (electron, proton & neutron) Rutherford's model of the atom. Bohr's theory-postulates (derivation of expression of energy and radius to be omitted) spectrum of Hydrogen Balmer, Lyman and Brackett series. Explanation on the basis of Bohr's theory. Quantum numbers - Orbital concepts. Shape of s.p.d. orbital, Pauli's exclusive principle. Hund's rule. Electronic configuration of atoms (elements upto atomic number 30)

4. LONG FORM OF PERIODIC TABLE

Based on electronic configuration of elements-periodic properties - ionisation energy and electron affinity, atomic and ionic radii.

5. CHEMICAL BONDING

Types of bonding (ionic, covalent, coordinate & hydrogen bonding) Covalent bond - orbital overlap, p-p (Cl_2), s-s (H_2). Sigma & Pi bonds. Hybrid orbital. Shapes of molecules (CH_4 , C_2H_4 and C_2H_2)

Hydrogen bonding - anomalous properties of water.

6. SPECIFIC MATTER

Ozone: Preparation and properties, Ozon layer.

Hydrogen peroxide: preparation, concentration, properties and uses.

Sulphur: Preparation, properties and uses of SO_2 , Manufacture of H_2SO_4 by contact process, properties and uses.

Nitrogen: Nitric acid - Manufacture by Ostwald's process, properties and uses. Nitrogenous fertilizers - manufacture of ammonium sulphate from gypsum, CAN, urea, Nitrogen cycle.

Halogens: Preparation, properties and uses of fluorine. Manufacture of chlorine (Nelson cell) - properties and uses. Bromine from sea water. Iodine from sea weeds.

Carbon: Activated carbon. Commercial production, properties and uses of carbon monoxide.

Silicon: Occurrence, preparation, semiconducting properties (n and p type), silicate glasses.

Phosphorus: Occurrence, manufacture (electrothermal process) Structure of oxyacids of phosphorus. Super phosphate of lime.

Ceramics: Clay properties - white pottery (porcelain's process or china process) Applications.

7. ORGANIC CHEMISTRY

(IUPAC nomenclature to be adopted)

Aliphatic hydrocarbons: saturated and unsaturated hydrocarbons. Preparation, properties and uses of methane, ethylene and acetylene - homologous series

Isomerism - chain, functional and position

Concepts of free radicals - electrophiles and nucleophiles to be illustrated with the study of mechanism involving -

1) chlorination of methane

2) addition of bromine to ethylene and

3) addition of hydrogen chloride to propylene (Markownikoff's rule)

Petroleum - Theory of formation, cracking (catalytic and thermal) fractionation, synthetic petrol

Destructive distillation of coal - separation of benzene, toluene, naphthalene from coal

tar. Structure of benzene. Properties of benzene and toluene. Mechanism of halogenation, nitration, sulphonation and Friedel - craft's alkylation

Biogas- Production and uses.

8. ENVIRONMENTAL POLLUTION

· Pollutants, definition - types of pollution, air - Automobile exhaust smoke, CO, oxides of nitrogen and lead. water - Industrial effluents with relevance to paper and rayon industries.

Mathematics

ALGEBRA

- Set theory: Recapitulation of sets. Relations and functions. Problems.
- Mathematical Logic: Proposition and truth values, connectives, their truth tables, inverse, converse, contrapositive of a proposition. Tautology and contradiction, Logical Equivalence-standard theorems. Examples of switching circuits. Truth tables. Problems.
- Matrices and determinants: Recapitulation of types of matrices and problems. Determinant of a square matrix defined as mappings
 $D : M(2, R) \rightarrow R$ and $D : M(3, R) \rightarrow R$
 Properties of determinants including $D(AB) = D(A) D(B)$. Problems.
 Minor and cofactor of an element of a square matrix, adjoint, singular and non-singular matrices.
 Inverse of a matrix, proof of $A(\text{adj}A) = (\text{adj}A)A = |A| I$ and hence formula for A^{-1} .
 Problems.
 Solution of a system of linear equations in two and three variables - (i) Matrix method, (ii) Cramer's rule. Problems.
 Characteristic equation of a square matrix.
 Characteristic roots of a square matrix, Cayley Hamilton theorem (statement only), Verification of Cayley Hamilton theorem for square matrices of order 2 and 3 only. Finding A^{-1} by Cayley Hamilton theorem. Problems.
- Vector: Recapitulation of a vector as directed line segment, magnitude and direction of a vector, equal vectors, unit vector, position vector of a point. Problems.

Two and three dimensional vectors as ordered pair and ordered triplet respectively of real numbers-components of a vector, Addition, subtraction, scalar multiplication of a vector. Problems.

- Position vector of the point dividing a given line segment in the given ratio.
- Scalar (dot) product, Vector (Cross) product of two vectors, Scalar triple (Box) product of three vectors, vector triple product of three vectors and their properties. Application of these to the area of a parallelogram, area of a triangle, Volume of a parallelepiped, orthogonal vectors and coplanarity of three vectors, projection of one vector on another vector. Problems.
- Work done, moment of a force about a point, moment of a couple about a point, the diagonals of a parallelogram bisect each other, angle in a semi circle is a right angle, medians of a triangle are concurrent. Derivations and problems.
- Groups: Binary operation, Algebraic structures. Definition of semigroup, group, Abelian group
- Examples from real and complex numbers. Finite and infinite groups, order of a group, composition tables, modular systems, modular groups, group of matrices - Problems.

Permutations, symmetric group of order 3. Proof of "The set of all permutations of the set $S = \{1, 2, 3\}$ form a non-abelian group w.r.t. product of permutations"

Square roots, cube roots and fourth roots of unity from abelian groups w.r.t. multiplication (with proof)

Proofs of the following properties

- Identity of a group is unique.
- The inverse of an element of a group is unique.
- $(a^{-1})^{-1} = a$ $\forall a \in G$ where G is a group.
- $(a * b)^{-1} = b^{-1} * a^{-1}$ in a group.
- Left and right cancellation laws.
- Solution of $a * x = b$ and $y * a = b$ exist and are unique in a group.

Subgroups, proofs of necessary and sufficient conditions for a subgroup.

- A non-empty subset H of a group G is a subgroup of G iff

i) " $a, b \in H, a * b \in H$ and

ii) for each $a \in H, a^{-1} \in H$

- A non-empty subset H of a group G is a subgroup of G iff

$a, b \in H, a * b^{-1} \in H$ - Problems

Problems of the type

- i) If $(ab)^{-1} = a^{-1} b^{-1}$, then G is abelian
- ii) If every element of a group is its own inverse, then G is abelian.

iii) In a group of even order there exists an element $a \in K$ such that $a^{-1} = a$

ANALYTICAL GEOMETRY

· Circles: Definition, equation of a circle, with centre $(0,0)$ and radius r , with centre (h,k) and radius r . Equation of a circle with (x_1, y_1) and (x_2, y_2) as the ends of a diameter, general equation of a circle, centre and radius. Derivations of all these. Problems.

Equation of the tangent to a circle - Derivation. Problems

Condition for $y = mx + c$ to be the tangent to the circle $x^2 + y^2 = r^2$ Derivation. Problems.

Length of the tangent from an external point to a circle - Derivation, Problems.

Power of a point, radical axis of two circles, radical centre of a system of three circles - Derivation, Problems.

Condition for a point to be inside or outside or on a circle. Proof and problems. Proof of "The radical axis of two circles is perpendicular to the line joining their centres." Problems.

Orthogonal circles - Derivation of the condition. problems.

Co-axial system, limiting points, conjugate system. Problems.

Conic Sections: Definition by focus - directrix property, eccentricity, definition of Parabola, Ellipse, Hyperbola, Rectangular hyperbola.

Derivation of standard equation of ellipse. Equation of other forms of ellipse (statements only).

Standard properties of parabola. Problems.

Derivation of standard equation of ellipse. Equation of other forms of ellipse (statements only).

Standard properties of ellipse. Problems.

Derivation of standard equation of hyperbola. Equations of other forms of hyperbola (statements only) Standard properties of hyperbola. Problems.

Equations of tangent and normal to Derivations and problems.

TRIGONOMETRY

· Inverse Trigonometric Functions: Definition of inverse trigonometric functions, domain and range. Derivations of standard formulae. Problems.

Solutions of inverse trigonometric equations. Problems.

· General Solutions of trigonometric equations:

General Solutions of $\sin x = k$, $\cos x = k$, $(-1 \leq k \leq 1)$,

$\tan x = k$, $a \cos x + b \sin x = c$, derivations. Problems.

Complex Numbers: Definition of a complex number as an ordered pair, real and imaginary parts, modulus and amplitude of a complex number, equality of complex numbers. Algebra of complex numbers, polar form of a complex number, Argand Diagram. Exponential form of a complex number. Problems.

De Moivre's theorem - statement and proof, method of finding square roots, cube roots and fourth roots of a complex number and their representation in the Argand diagram. Problems.

CALCULUS

· Continuity and differentiation: Continuity of a function, sum of two functions, polynomial, trigonometric function, exponential function, inverse trigonometric function. Problems.

· Differentiation - Differentiability. Derivative of a function by first principles.

Differentiability implies continuity by the converse is not true (proof and example respectively). Derivatives of sum, difference, product of a constant and a function, constant, product of two functions, quotient of two functions by first principles.

Derivatives of

x^n , e^x , a^x , $\sin x$, $\cos x$, $\tan x$, $\operatorname{cosec} x$, $\sec x$, $\cot x$, $\log x$ by first principles. Problems.

· Derivatives of inverse trigonometric functions by first principles hyperbolic and inverse hyperbolic functions and their derivatives w.r.t. x . Problems.

· Composite functions - Chain rule. Problems.

· Differentiation of inverse trigonometric functions by substitution. Problems.

· Differentiation of implicit functions, parametric functions, a function w.r.t. another function, logarithmic differentiation. Problems.

· Successive differentiation - Problems of finding second derivatives, deriving second order differential equations.

· Applications of Derivatives: Geometrical meaning of dy / dx , Equations of tangent and normal, angle between two curves. Problems.

- Subtangent and subnormal. Problems.
 - Derivative as the rate measure. Problems.
 - Maxima and minima of a function of a single variable - Problems.
- Also problems involving two dimensional figures only.
- Iteration: Statement of fundamental theorem of integral calculus.
- Interation as the reverse process of differentiation. Standard for mulae, methods of integration (i) substitution (ii) partial fractions (iii) integration by parts. Problems.
- Interals of :

- Definite Integrls: Evaluation of definite integrals, properties of definite integrals. Problems.
- Application of Definite Integrals: Area under a curve, area enclosed between two curves usig definite integrals, standard areas likearea of circle, ellipse, parabola etc. Problems.
- Differential Equations: Definition of order and degree of a differential equation. Formation of a first order differential equation. Problems. solution of first order differential equations by the method of separation of variables. Probles.

Mathematics - Syllabus for PUC-/XI Std. or equiv.

ALGEBRA

1. THEORY OF INDICES AND LOGARITHMS

- Recapitulation of theory of Indices - problems
- Laws of logarithms (with proof) - problems

2. PROGRESSIONS

- Recapitulation of sequences of real numbers, finite and infinite sequences as mappings.
- Definition of infinite series, A.P., G.P., H.P.,. nth term of an AP, GP, HP, sum to n terms of an AP, GP (with proof) - problems
- Sum to infinity of a G.P. when the common ratio r is such that $-1 < r < 1$. Recurring decimal numbers - problems.
- A.M., G.M., H.M. of two numbers a and b . Proofs of $G^2 = AH$ and $A P G P H$, where A, G, H are the A.M., G.M., and H.M. respectively of any two numbers a and b . To insert n arithmetic means, n geometric means and n harmonic means between any two given numbers - problems

3. MATHEMATICAL INDUCTION

- Principle of mathematical induction. Problems on induction including S_n, S_{n2}, S_{n3}

4. THEORY OF EQUATIONS

- Recapitulation of quadratic equations and the formula for the roots of a quadratic equation.
- The equation $x^2 + 1 = 0$ and introducing complex numbers, square roots, cube roots and fourth roots of unity.
- The relations between the roots and coefficients of a quadratic equation, a cubic equation and a biquadratic - equation. Solutions of quadratic, cubic and biquadratic equations given certain conditions and given that the roots are in A.P., G.P., H.P. - problems.
- Symmetric functions of the roots of quadratic, cubic and biquadratic equations - problems.
- Proofs of (i) irrational roots of a polynomial equation occur in conjugate pairs, (ii) complex roots of a polynomial equation occur in conjugate pairs - Problems of solving equations given an irrational root and given a complex root - problems.
- Solution of a standard cubic equation $X^3 + 3HX + G = 0$ by Cardan's method only - problems.

5. PERMUTATIONS AND COMBINATIONS

- Definition of linear permutation, derivation of the formula for nPr from first principles. Formula for the number of permutations when some things are alike of one kind, etc. - problems
- Circular permutation - formula - problems.
- Definition of combination, derivation of the formula for nCr , from first principles. Proofs of $nCr = nC_{n-r}$ and

$nCr-1 + nCr = n+1Cr$ - problems

6. BINOMIAL THEOREM

- Statement and proof of Binomial theorem for a positive integral index by induction. To find the middle terms, terms independent of x and term containing a definite power of x - problems.
- Binomial coefficients - problems.

7. PARTIAL FRACTIONS

- Rational fractions, proper and improper fractions, reduction of an improper fraction into a sum of a polynomial and a proper fraction - problems
- Rules for resolving a proper fraction into partial fractions. - problems

8. ELEMENTS OF NUMBER THEORY AND CONGRUENCES

- Divisibility - Definition and properties of divisibility, statement of Division Algorithm.
- Greatest Common Divisor (G.C.D.) of any two integers, using Euclid's Algorithm., to find the G.C.D. of any two integers. To express the G.C.D. of two integers a and b as $ax + by$ for integers x and y - problems
- Relatively prime numbers, prime numbers and composite numbers, the number of positive divisors of a number and sum of all positive divisors of a number - statements of the formulae without proof - problems.
- Proofs of the following properties
 - (1) The smallest divisor > 1 of an integer > 1 is a prime number.
 - (2) There are infinity of primes.
 - (3) If c and a are relatively prime and $c|ab$ then $c|b$
 - (4) If p is prime and $p|ab$ then $p|a$ or $p|b$
 - (5) If there exist integers x and y such that $ax + by = 1$ then $(a,b) = 1$
 - (6) If $(a,b) = 1$, $(a,c) = 1$ then $(a, bc) = 1$
 - (7) If p is prime and a is any integer then either $(p,a) = 1$ or $p|a$
 - (8) The smallest positive divisor of a composite number " a " does not exceed a
- Congruence modulo m - Definition, Proofs of the following properties
 - (1) " $L \text{ mode } m$ " is an equivalence relation
 - (2) $a L b \pmod{m} \Rightarrow a \text{ ExLbEx } \pmod{m}$ and $ax L bx \pmod{m}$
 - (3) If c is relatively prime to m and $ca Lcb \pmod{m}$ then $a L b \pmod{m}$ - cancellation law
 - (4) If $a L b \pmod{m}$ and n is a positive divisor of m then $a L b \pmod{n}$
 - (5) $a L b \pmod{m} \Rightarrow a$ and b leave the same remainder when divided by m
- Conditions for the existence of the solution of linear congruence $ax L b \pmod{m}$ (statements only). to find the solution of $ax L b \pmod{m}$ - problems

ANALYTICAL GEOMETRY AND CALCULUS

9. COORDINATE GEOMETRY

- Coordinate system in a plane (cartesian)
- Distance formula, section formula, mid-point formula, centroid of a triangle, area of a triangle - Derivations, problems
- Locus of a point, problems
- Straight lines, slope of a line $m = \tan q$ where q is the angle made by the line with the positive x -axis, slope of the line joining any two points, general equation of a line. Derivation and problems
- Conditions for parallelism and perpendicularity of two lines - problems
- Various forms of the equation of a straight line : slope - point form, slope - intercept form , two point form, intercept form, Normal form - Derivations - problems
- Angle between two lines, point of intersection of two lines, condition for concurrency of three lines, Length of the perpendicular from the origin and from a point to a line, Equation of the internal and external bisector of the angle between two lines - Derivations, problems
- Pair of lines - Homogeneous equation of second degree, general equation of second degree, derivations of (1) condition for pair of lines, (2) condition for a pair of parallel lines, perpendicular lines and distance between the pair of parallel lines, (3) condition for a pair of coincident lines (4) angle and point of intersections of a pair of lines - problems.

10. CALCULUS

- Functions of a real variable, types of functions, periodic functions, functional value - problems.

- Limit of a function - definition, statements of the algebra of limits - problems
- Standard limits (with proofs)

$$(1) \lim_{x \rightarrow a} \frac{x^n - a^n}{x - a} = n a^{n-1} \text{ when } n \text{ is rational}$$

$$(2) \lim_{q \rightarrow 0} \frac{\sin q}{q} = 1 \text{ when } q \text{ is radians}$$

$$(3) \lim_{q \rightarrow 0} \frac{\tan q}{q} = 1 \text{ when } q \text{ is radians}$$

(4) Statements of the limits

$$(i) \lim_{n \rightarrow \infty} (1 + 1/n)^n = e$$

$$(ii) \lim_{x \rightarrow 0} (1 + x)^{1/x} = e$$

$$(iii) \lim_{x \rightarrow 0} \log_e (1 + x) / x = 1$$

$$(iv) \lim_{x \rightarrow 0} e^x - 1 / x = 1$$

$$(v) \lim_{x \rightarrow 0} a^x - 1 / x = \log_e a$$

Problems on these limits

Evaluation of limits if

$\lim_{x \rightarrow 0} f(x) / g(x)$ OR 0/0 form

$\lim_{n \rightarrow h} f(n) / g(n)$ OR infinity/infinity form

where degree of $f(n)$ \geq degree $g(n)$ problems

TRIGONOMETRY

11. MEASUREMENT OF ANGLES AND TRIGONOMETRIC FUNCTIONS

· Radian measure - Definition. Proofs of

$$(i) p \text{ radians} = 1800$$

(ii) 1 radian is constant

(iii) $s = rq$ where q is in radians

(iv) Area of the sector of a circle given by $A = 1/2 r^2 q$ where q is in radians - problems

· Trigonometric functions - definitions.

· Trigonometric ratios of an acute angle.

· Trigonometric identities (with proofs), problems

· Trigonometric functions of standard angles, problems.

· Trigonometric functions of allied angles, compound angles, multiple angles, submultiple angles and Transformation formulae (with proofs) - problems.

· Heights and distances - Angle of elevation, angle of depression, problems.

· Graphs of Trigonometric functions

12. RELATIONS BETWEEN SIDES AND ANGLES OF A TRIANGLE

· Sine rule, Cosine rule, Tangent rule, Half-angle formulae, area of a triangle, projection rule (with proofs) - problems.

· Solution of triangles given


(i) three sides

(ii) two sides and the included angle

(iii) two angles and a side

(iv) two sides and the angle opposite to one of these sides . Problems.

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