



KALASALINGAM UNIVERSITY

(Kalasalingam Academy of Research & Education)

(Under Section 3 of UGC Act, 1956)

Anand Nagar, Krishnankoil – 626 190

Srivilliputhur(via), Virudhunagar (Dt.), Tamil Nadu

Phone : 04563 289042 - 44, Fax: 04563 289322

Website: www.kalasalingam.ac.in e-mail: info@kalasalingam.ac.in

SYLLABUS FOR ENGINEERING ENTRANCE EXAMINATION

MATHEMATICS

UNIT 1 : MATRICES AND DETERMINANTS

Determinants and matrices of order two and three, properties of determinants, Evaluation of determinants. Rank of a matrix. Addition and multiplication of matrices, adjoint and inverse of matrix. Test of consistency and solution of simultaneous linear equations using determinants and matrices

UNIT 2 : TRIGONOMETRY

Trigonometrical identities and equations. Inverse trigonometric functions and their properties. Properties of triangles, including centroid, incentre, circum- centre and orthocentre, solution of triangles. Heights and Distances

UNIT 3 : VECTOR ALGEBRA

Vectors and Scalars, addition of vectors, components of a vector in two dimensions and three dimensional space, scalar and vector products, scalar and vector triple product. Application of vectors to plane geometry

UNIT 4 : COMPLEX NUMBERS

Complex numbers in the form $a+ib$ and their representation in a plane. Argand diagram. Algebra of complex numbers, Modulus and Argument (or amplitude) of a complex number, square root of a complex number. Cube roots of unity, triangle inequality

UNIT 5 : TWO DIMENSIONAL GEOMETRY

Recall of Cartesian system of rectangular co-ordinates in a plane, distance formula, area of a triangle, condition for the collinearity of three points and section formula, centroid and in-centre of a triangle, locus and its equation, translation of axes, slope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axes.

UNIT 6 : STRAIGHT LINE

Various forms of equations of a line, intersection of lines, angles between two lines, conditions for concurrence of three lines, distance of a point from a line. Equations of internal and external bisectors of angles between two lines, coordinates of centroid, orthocentre and circumcentre of a triangle, equation of family of lines passing through the point of intersection of two lines, homogeneous equation of second degree in x and y , angle between pair of lines through the origin, combined equation of the bisectors of the angles between a pair of lines, condition for the general second degree equation to represent a pair of lines, point of intersection and angle between two lines.

Unit 7 : CONIC SECTIONS

Sections of cones, equations of conic sections (parabola, ellipse, hyperbola and rectangular hyperbola) in standard forms, chords, tangents & normals, condition for $y = mx + c$ to be a tangent and point(s) of tangency. Parametric representation, asymptotes.

UNIT 8 : DIFFERENTIAL CALCULUS

Polynomials, rational, trigonometric, logarithmic and exponential functions. Inverse functions. Graphs of simple functions. Limits, Continuity, differentiation of the sum, difference, product and quotient of two functions. Differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit functions; derivatives of order upto two. Applications of derivatives: Rate of change of quantities, monotonic - increasing and decreasing functions, Maxima and minima of functions of one variable, tangents and normals, Rolle's and Lagrange's Mean Value Theorems. Partial differentiation.

UNIT 9 : INTEGRAL CALCULUS

Integral as an anti-derivative. Fundamental integrals involving algebraic, trigonometric, exponential and logarithmic functions. Integration by substitution, by parts and by partial fractions. Integration using trigonometric identities. Integral as limit of a sum. Properties of definite integrals. Evaluation of definite integrals: Determining areas of the regions bounded by simple curves, length of arc of a curve, surface and volume of revolution.

UNIT 10 : DIFFERENTIAL EQUATIONS

Ordinary differential equations, their order and degree. Formation of differential equations. Solution of differential equations by the method of separation of variables. Solution of first order homogeneous and linear differential equations, second order homogeneous with constant coefficients. Geometrical application involving slope, tangent normal etc. Simple applications involving movement of a particle, Radioactive decay, Heat conduction, Electric circuits.

UNIT 11 : MEASURES OF CENTRAL TENDENCY AND DISPERSION

Calculation of Mean, median and mode of grouped and ungrouped data. Calculation of standard deviation, variance and mean deviation for grouped and ungrouped data.

UNIT 12 : PROBABILITY AND DISTRIBUTIONS

Probability of an event, addition and multiplication theorems of probability and their applications. Probability distribution of a random variate, Binomial, Poisson and Normal distributions and their properties. Mathematical Expectations

UNIT 13 : SETS, RELATIONS AND FUNCTIONS

Sets and their Representations, Union, intersection and complements of sets, and their algebraic properties. Relations, equivalence relations, mappings, one-one, into and onto mappings, composition of mappings.

Unit 14 : ALGEBRAIC STRUCTURES

Groups, Rings, Integral Domains and fields – definition and examples

PHYSICS

UNIT - 1. ELECTROSTATICS

Frictional electricity, charges and their conservation; Coulomb's law – forces between two point electric charges. Forces between multiple electric charges –superposition principle, Electric field – Electric field due to a point charge, electric field lines, Electric dipole – behavior of dipole in a uniform electric field –application of electric dipole in microwave oven. Electric potential – potential difference – electric potential due to a point charge and due dipole. Equipotential surfaces –Electrical potential energy of a system of two point charges. Electric flux –Gauss's theorem and its applications to find field due to (1) infinitely long straight wire, (2)uniformly charged infinite plane sheet (3)two parallel sheets. Electrostatic induction –capacitor and capacitance – parallel plate capacitor with and without dielectric medium. Applications of capacitor –energy stored in a capacitor. Capacitors in series and in parallel – action of points – Lightning arrester – Vande Graff generator.

UNIT - 2. CURRENT ELECTRICITY

Electric current – flow of charges in a metallic conductor. Drift velocity and mobility and their relation with electric current. Ohm's law, electrical resistance. $V-I$ characteristic, Electrical resistivity and conductivity. Classification of materials in terms of conductivity. Superconductivity (elementary idea), Carbon resistors– colour code for carbon resistors. Combination of resistances – series and parallel, Temperature dependence of Resistance, internal resistance of a cell– Potential difference and emf of a cell. Krichoff's law –illustration by simple circuits. Wheatstone's Bridge and its application for temperature coefficient of resistance measurement, Metre bridge –Special case of wheatstone bridge, Potentiometer – principle -application to measure potential difference and for comparing the emf of two cells, Electric power, Chemical effect of current, Electro chemical cells Primary –(Voltaic, Lechlanche, Daniel)

UNIT - 3. EFFECTS OF ELECTRIC CURRENT

Heating effect. Joule's law –Experimental verification. Thermoelectric effects – Seebeck effect – Peltier effect – Thomson effect –Thermocouple, thermo emf neutral and inversion temperature. Measurement of thermo emf using potentiometer –Thermopile. Magnetic effect of electric current – Concept of magnetic field, Oersted's experiment. Biot-Savart law Magnetic field due to an infinitely long current carrying straight wire and circular coil. Tangent galvanometer –Construction and working. Bar magnet as an equivalent solenoid –magnetic field lines. Ampere's circuital law and its application to straight. Force on a moving charge in uniform magnetic field and Electric field. Force on current carrying conductor in a uniform magnetic field, force between two parallel currents–Carrying conductors –definition of ampere. Torque experienced by a current loop in a uniform magnetic field–moving coil galvanometer, Conversion to ammeter and voltmeter. Current loop as a magnetic dipole and its magnetic dipole moment. Magnetic dipole moment of are revolving electron.

UNIT - 4. ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENT

Electromagnetic induction – Faraday's laws – induced emf and current – Lenz's law. Self induction – Mutual induction – Self inductance of a long solenoid – mutual inductance of two long solenoids. Methods of Inducing emf – (1) by changing magnetic induction (2) by changing area enclosed by the coil and (3) by changing the orientation of the coil (quantitative treatment only). AC generator commercial generator. (Single phase, three phase) .Eddy current –Applications – Transformer Long distance transmission. Alternating current –measurement of AC . LCR series circuit –Resonance and Q– factor: power in AC circuits – LC oscillations –choke coil –Advantages and disadvantages of A.C. over D.C.

UNIT - 5. ELECTROMAGNETIC WAVES AND WAVE OPTICS

Electromagnetic waves and their characteristics. Electromagnetic spectrum Radio, microwaves, Infrared, optical, ultraviolet – x – rays, gamma rays. Emission and Absorption spectrum – Line, Band and continuous spectra .Theories of light –Corpuscular, Wave, Electromagnetic and Quantum theories. Scattering of light– Rayleigh's scattering –Tyndal scattering – Raman effect – Raman spectrum. Blue colour of the sky and reddish appearance of the sun - sun rise and sun set. Wave front and Huygen's principle – Reflection, Total internal reflection and refraction of plane wave at a plane surface using wave fronts. Interference –Young's double slit experiment and expression for fringe width –coherent source interference of light. Formation of colours in thin films – analytical treatment – Newton's rings Diffraction –Differences between interference and diffraction of light. Diffraction grating. Polarization of light waves, Polarization by reflection –Brewster's law -double refraction Nicol prism, Uses of plane polarized light and polaroids – Rotatory polarization – polarimeter.

UNIT – 6. ATOMIC PHYSICS

Atomic structure – Discovery of the electron , (Millikan's oil drop method) and charge the electron. Alpha – scattering – Rutherford's atom model. Bohr's model –Energy quantization – energy and wave number expression – Hydrogen spectrum – energy level diagrams – sodium and mercury spectra - excitation and ionization potentials. Sommerfield's atom model – Fine structure of the spectral line. Magnetic moment – space quantization – Stern and Gerlach experiment – fine structure of sodium D line - wave mechanical concept of the atom. x -rays production properties, detection, absorption, diffraction of x - rays – Lave's experiment Bragg's law, Bragg's x-ray spectrometer – x-ray spectra - continuous and characteristic x – rays spectrum – Moseley's law and atomic number. MASERS and LASERS spontaneous and stimulated emission – Normal population and population inversion – MASER, RUBY Laser, He–Ne Laser –properties and applications of laser light- holography.

UNIT - 7. DUAL NATURE OF RADIATION AND MATTER AND RELATIVITY

Photo-electric effect. Light waves and photons - Einstein's photo –electric equation- Laws of photo – electric emission – Particle nature of energy. Experimental verification of Einstein – photoelectric equation. Work function, Photo cells and their application - Matter waves – wave

nature of particles. – De- Broglie relation – De-Broglie wave length of an electron – Concept of space, time and Mass Frame of reference, Newtonian relativity. Special theory of relativity. Lorentz transformations - Relativity of length - Relativity of time.

UNIT - 8. NUCLEAR PHYSICS

Nuclear properties – Nuclear radii, masses, binding energy, density, charge, isotopes, isobars and isotones. Nuclear mass defect – binding energy. Stability of nuclei-Bain bridge mass spectrometer, Nature of Nuclear forces. Neutron –discovery – properties – Artificial transmutation – particle accelerator Radioactivity – alpha, beta and Gamma radiations and their properties , alpha decay – beta decay and– Gamma decay Radioactive decay law – half life – Mean life. Artificial radioactivity – Radio – Isotopes – effects and uses. Geiger –Muller counter and cloud chamber. Radio carbon dating Biological Radiation hazards, Nuclear fission –chain reaction – Atom bomb – nuclear reactor – Nuclear fusion – Hydrogen bomb – cosmic rays – Elementary particles.

UNIT - 9. SEMICONDUCTOR DEVICES AND THEIR APPLICATIONS

Semiconductor theory. Energy bands in solid – Difference between metals, insulators and semiconductors based on band theory. Semiconductor doping – Intrinsic and Extrinsic semi conductors. Formation of P-N Junction – Barrier potential and depletion layer. P-N Junction diode – Forward and reverse bias characteristics. Diode as a rectifier. Zener diode. Zener diode as a voltage regulator. LED, Seven segment display – Solar cells – photo diode. Junction - transistors - characteristics - transistor as a switch. Transistor as an amplifier – Transistor biasing – RC, LC coupled and transformer coupling in amplifier. Feed back amplifier – positive and negative feed back –advantages of negative feedback amplifier. Oscillator – condition for oscillator – Colpitt oscillator. Logic gates OR, AND, NOT using discrete components – NAND and NOR gates as universal gates Unipolar transistors. FET – Characteristics – Integrated circuits – medium, small and very large scale integration –Fabrication and applications – TTL and CMOS IC's. Laws and theorems of Boolean's algebra. Operational amplifier – parameters – pin out configuration - Basic applications. Inverting amplifiers. Non-inverting amplifiers – summing amplifiers. Measuring Instruments – Cathode Ray oscilloscope – Principle – Functional units – uses. Multimeter – construction and uses.

UNIT - 10. COMMUNICATION SYSTEMS

Modes of propagation, ground wave – sky wave propagation.

Amplitude modulation, merits and demerits – applications – frequency modulation – advantages and applications – phase modulation.

Antennas and directivity.

Radio transmission and reception – AM and FM – superheterodyne receiver.

T.V. transmission and reception – scanning and synchronising.

Vidicon (camera tube) and picture tube – block diagram of a monochrome TV transmitter and receiver circuits.

Radar – principle – applications.

Digital communication – data transmission and reception – principles of fax, modem, satellite communication – wire, cable and Fibre – optical communication.

CHEMISTRY

ATOMIC STRUCTURE

Dual properties of electrons - de-Broglie relation - Heisenberg's uncertainty principle - wave nature of an electron - Schrodinger wave equation (only equation, no derivation) - Eigen values and Eigen function significant only - molecular orbital method - Application to homo diatomic and hetero diatomic molecules - Metallic Bond - Hybridization of atomic orbitals - Types of forces between molecules

PERIODIC CLASSIFICATION

Periodic properties - Calculation of atomic radii - Calculation of ionic radii - Method of determination of Ionisation potential - Factors affecting ionization potential - Effect of nuclear charge, atomic radii and screening effect upon ionisation energy - Method to determine the electron affinity - Factors affecting EA - Various scales on electro negativity values

IMPORTANT ELEMENTS

p - BLOCK ELEMENTS - II

Group -13 - General trends - Potash alum - Preparation, Properties uses - Group 14 - General trends - Silicates - Types and structure - Silicones - Structure and uses - Extraction of lead - Group - 15 - General trends - Phosphorous - Allotropes and extraction - Compounds of phosphorous - Group - 16 - General trends - H_2SO_4 - Manufacture and properties - Group - 17 - General characteristics. Physical and Chemical properties - Isolation of fluorine and its properties - Interhalogen compounds - Group-18 Inert gases - Isolation, properties and uses.

d - BLOCK ELEMENTS

General characteristics of d-block elements - First transition series the extraction of chromium, copper and zinc. Occurrence and principles of extraction - chromium, copper and zinc - Alloys. - Second transition series - Occurrence and principles of extraction of silver- Third transition series - General methods of extraction of gold from gold bearing rocks - Compounds - $K_2Cr_2O_7$, $CuSO_4 \cdot 5H_2O$, $AgNO_3$, Hg_2Cl_2 , $ZnCO_3$, Purple of cassius. Methods of preparation, properties and uses.

f - block elements

General characteristics of f-block elements and extraction. Comparison of Lanthanides and Actinides. Uses of lanthanides and actinides.

COORDINATION COMPOUNDS AND BIO-COORDINATION COMPOUNDS

An introduction - Explanation of simple salts, double salts and complex salts. Terminology in coordination chemistry- IUPAC nomenclature of mononuclear coordination compounds - Isomerism in coordination compounds. Structural isomerism Geometrical isomerism in 4 - coordinate, 6 - coordinate complexes. Theories on coordination compounds. Werner's theory (brief) - Valence Bond theory - Crystal field theory - Uses of coordination compounds. Biocoordination Compounds Haemoglobin and chlorophyll.

NUCLEAR CHEMISTRY

Nuclear Chemistry - nuclear energy, nuclear fission and fusion - Radio carbon dating - Nuclear reaction in sun - uses of radioactive isotopes .

SOLID STATE

Types of packing in crystals. bcc, fcc arrangements - X-Ray crystal structure. Bragg's equation(no derivation) - types of ionic crystals - Imperfections in solids Schotky, Frenkel defects - elementary idea. Properties of crystalline solids - Elementary idea about conducting and super conducting properties. Amorphous solid.

THERMODYNAMICS

First law of thermodynamics; Relation between Internal energy and Enthalpy. application of first law of thermodynamics. Second law of thermodynamics : Entropy, Gibbs energy, Spontaneity of a chemical reaction, Gibbs energy change and chemical equilibrium, Gibbs energy available for useful work.

CHEMICAL EQUILIBRIUM

Applications of law of mass action - Le Chatlier's principle. Applications of Le Chatlier's principle to Haber's process, contact process and Birkeland- Eyde process.

CHEMICAL KINETICS

Rate of reaction, Instantaneous rate of reaction and order of reaction. Factors affecting rates of reactions - factors affecting rate of collisions encountered between the reactant molecules, effect of temperature on the reaction rate, concept of activation energy, catalyst. Rate law expression. Order of a reaction (with suitable examples). Units of rates and specific rate constants. Order of reaction and effect of concentration (study will be confined to first order only). Temperature Dependence of Rate Constant.

SURFACE CHEMISTRY

Surfaces chemistry : Adsorption – Physical and chemical adsorption, adsorption isotherms – Colloids – Preparation and general properties, Emulsions Catalysis : Homogeneous and heterogeneous, structure of catalyst, Enzymes

ELECTROCHEMISTRY

Conductors, insulators and semi conductors – Theory of electrical conductance - Theory of strong electrolytes - Faraday's laws of electrolysis. Statement of laws and their significance – Quantitative calculations on Faraday's laws Specific resistance, Specific conductance, equivalent and molar conductance. Variation of conductance with dilution - Kohlrausch's law - Statement and significance – Ionic product of water, pH and pOH – Buffer solutions – Use of pH values – pH scale - Cells – Electrolytic and Electrochemical cells - Electrodes and electrode potentials - Construction of cell and EMF – Construction of Daniel cell – corrosion and its preventions – Electrochemical corrosion and the concept Electrochemical relations involved in corrosion - Fuel cells Primary, Secondary including fuel cells.

SOME BASIC PRINCIPLES

Classification of Organic Compounds. Tetravalency of Carbon. Homologous series. Functional groups – $-C=C-$, $-C\equiv C-$, and groups containing halogen, oxygen. Classification of Organic Compounds Tetravalency of Carbon. Homologous series. nitrogen and sulphur. General introduction to naming organic compounds – Common names and IUPAC nomenclature of aliphatic, aromatic and cyclic compounds – Illustration with examples of compounds having not more than three same or different functional groups/atoms. Isomerism – Structural and stereoisomerism (geometrical and optical). Chirality – Isomerism in compounds having one and two chiral-centres – enantiomers, diastereoisomers, racemic forms, racemisation & resolution. Covalent bond fission – Homolytic and heterolytic : free radicals carbocations and carbanions. Stability of carbocations and free-radicals – Electrophiles and nucleophiles – Electron displacement in a covalent bond – inductive effect, electromeric effect, resonance effect –Common types of organic reactions – Substitution, addition, elimination and rearrangement reactions. Illustrations with examples

HYDROCARBONS

Classification – Sources of hydrocarbons: Alkanes - General methods of preparation (from unsaturated hydrocarbons, alkylhalides, aldehydes, ketones and carboxylic acids). Physical properties and reactions (Substitution, oxidation and miscellaneous). Conformations of alkanes(ethane, propane, butane and cyclohexane). Sawhorse and Newman projections) – mechanism of halogenation of alkanes. Alkanes and Alkynes - General methods of preparation physical properties, Chemical reactions – Mechanism of electrophilic addition reactions in alkenes – Markownikoff's Rule, peroxide effect. Acidic character of alkynes. Polymerisation of alkenes – Aromatic hydrocarbons - Benzene and its

homologues – Isomerism – Chemical reactions of benzene. Structure of benzene, resonance – Direct influence of substituents

ORGANIC COMPOUNDS CONTAINING OXYGEN

General methods of preparation, correlation of physical properties with their structures, chemical properties and uses of alcohols, polyhydric alcohols, ethers, aldehydes, ketones, carboxylic acids and their derivatives, phenol, benzaldehyde and benzoic acid – their important methods of preparation and reactions – Acidity of carboxylic acids and phenol effect of substituents on the acidity of carboxylic acids.

ORGANIC COMPOUNDS CONTAINING NITROGEN

(Cyanides, isocyanides, nitrocompounds and amines) Nomenclature and classification of amines, cyanides, isocyanides, nitrocompounds and their methods of preparation, correlation of their physical properties with structure, chemical reactions and uses – Basicity of amines.

BIOMOLECULES

Carbohydrates - Classification of carbohydrates – structural elucidation of glucose and fructose – Disaccharides and polysaccharides. Proteins – Sources and their basic chemical units – Amino acids - Peptide linkage and formation of dipeptide – structure of proteins – Nucleic acids – RNA and DNA.