

**MATHEMATICS**

**Unit 1: Sets, Relations and Functions:** Sets and their representation: Union, intersection and complement of sets and their algebraic properties; Power set; Relation, Type of relations, equivalence relations, functions; one- one, into and onto functions, the composition of functions.

**Unit 2: Complex Numbers:** Complex numbers in the form  $a+ib$  and their representation on a plane. Argand diagram. Algebra of complex numbers, Modulus and argument (or amplitude) of a complex number.

**Unit 3: Permutations and Combinations:** Fundamental principle of counting; Permutation as an arrangement and combination as selection, simple applications.

**Unit 4: Binomial Theorem:** Binomial theorem for positive integral indices. General and middle terms in binomial expansions, simple applications.

**Unit 5: Sequences and Series:** Arithmetic and Geometric progressions. Insertion of Arithmetic and Geometric means between two given numbers. Relation between A.M. and G.M.

**Unit 6: Matrices and Determinants:** Determinants and matrices of order two and three, Properties of determinants. Evaluation of determinants. Addition and multiplication of matrices, adjoint and inverse of matrix. Solution of simultaneous linear equations using determinants.

**Unit 7: Quadratic Equations:** Quadratic equations in real and complex number system and their solutions. Relation between roots and coefficients, Nature of roots, Formation of quadratic equations with given roots.

**Unit 8: Trigonometry:** Trigonometrical identities and equations. Inverse trigonometric functions and their properties. Properties of triangles including centroid, incentre, circumcentre and orthocentre, Solution of triangles. Heights and distances.

**Unit 9: Statistics:** 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 10: Probability:** Probability of an event, addition and multiplication theorems of probability and their applications; Conditional probability; Bayes' theorem, Probability distribution of a random variate.

**Unit 11: Limit, Continuity and Differentiability:** Polynomials, rational, trigonometric, logarithmic and exponential 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; Maxima and Minima of functions one variable, tangents and normal.

**Unit 12: 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 a limit of sum; Properties of definite integrals. Evaluation of definite integral; Determining areas of the regions bounded by simple curves.

**Unit 13: Differential Equations:** Ordinary differential equations, their order and degree; Formation of differential equation; Solutions of differential equations by the method of separation of variables; Solution of Homogeneous and linear differential equations of first order.

**Unit 14: Co-ordinate Geometry:** Review of Cartesian system of rectangular co-ordinates in a plane, distance formula, area of triangle, condition for the collinearity of three points, slope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axes.

**Unit 15: The Straight Line and Pair of Straight Lines:** 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.

**Unit 16: Circles and Family of Circles:** Standard form of equation of a circle, general form of the equation of a circle, its radius and centre, equation of a circle in the parametric form, equation of a circle when the end points of a diameter are given, points of intersection of a line and circle with the centre at the origin

**Unit 17: Conic Sections:** Sections of cones, equations of conic sections (parabola, ellipse and hyperbola) in standard forms, conditions for  $y = mx + c$  to be a tangent and point(s) of tangency.

**Unit 18: Vector Algebra:** Vector and scalars, addition of two 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 19: Three-Dimensional Geometry:** Distance between two points. Direction cosines of a line joining two points. Cartesian and vector equation of a line. Coplanar and skew lines. Shortest distance between two lines. Cartesian and vector equation of a plane. Angle between (i) two lines

## PHYSICS

### **Unit 1: Units and dimensions:**

Units for measurement, system of units, SI, fundamental and derived units, dimensional analysis.

### **Unit 2: Kinematics:**

Uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity- time, position-time graph, relations for uniformly accelerated motion, Scalars and Vectors, Vector. Addition and subtraction, zero vector, scalar and vector products, Unit Vector, Resolution of a Vector. Relative Velocity, Motion in a plane, Projectile Motion, Uniform Circular Motion.

### Unit 3: Mechanics

Newton's laws of motion, conservation of linear momentum, Friction; Work-Energy theorem, kinetic energy, potential energy, conservation of energy; elastic collision in one and two dimensions.

Center of mass of a system of particles, centre of mass of a rigid body, rotational motion and torque, angular momentum and its conservation, moments of inertia for various geometries, parallel and perpendicular axes theorem.

Universal law of gravitation, acceleration due to gravity, planetary motion, Kepler's laws, Satellites, gravitational potential and potential energy and escape velocity.

### Unit 4: Solids and Fluids

**Solids:** Elastic properties, Hooke's law, Young's modulus, bulk modulus, rigidity modulus.

**Liquids:** Cohesion and adhesion; surface energy and surface tension; flow of fluids; Bernoulli's theorem and applications; viscosity, Stoke's law, terminal velocity

### Unit 5: Oscillations and Waves

**Oscillations:** Oscillatory motion - periodic and non-periodic motion; simple harmonic motion (SHM), angular SHM, linear harmonic oscillator – both horizontal and vertical; combination of springs

– series and parallel, simple pendulum; Expression of energy – potential energy, kinetic energy and total energy; Graphical representation of SHM. waves simple pendulum derivation of expression for its time period

**Wave Motion:** Properties of waves; Transverse and Longitudinal, speed of travelling wave – displacement relation for a progressive wave, Superposition of waves, Progressive and Standing waves; Vibration of strings and air columns, organ pipes – fundamental mode and harmonics, beats,

### Unit 6: Heat and Thermodynamics

Heat, work and temperature; Ideal gas laws; Specific heat capacity, Thermal expansion of solids, liquids and gases, Relationship between  $C_p$  and  $C_v$  for gases; Newton's law of cooling, black body, Kirchhoff's law, Stefan's law and Wein's law, thermodynamic processes.

### Unit 7: Electrostatics, Current Electricity and Magnetostatics

**Electric charges and Fields:** Electric Charge; Conductors and Insulators, Charging by Induction, Basic Properties of Electric Charge, Coulomb's Law, Forces between Multiple Charges, Electric Field, Electric Field Lines, Electric Flux, Electric Dipole, Dipole in a Uniform External Field, Continuous Charge Distribution, Gauss's Law, Applications of Gauss's Law.

**Electrostatic potential and Capacitance:** Electrostatic potential, Potential due to a point charge,

electric dipole, system of charges. Equipotential surfaces; Potential energy of a system of charges, potential energy in an external field, Electrostatics of conductors, Dielectric and Polarization, Capacitors and Capacitance, parallel plate capacitor, effect of dielectric on capacitance combination of capacitors, energy stored in a capacitor.

**Current Electricity:** Electric current, electric currents in conductors, Ohm's law, drift of electrons and the origin of Resistivity, temperature dependence of resistivity, electrical energy, power, combination of resistors, series and parallel, cells, emf, internal resistance, cells in series and in parallel, Kirchhoff's Rules, Wheatstone bridge, Meter bridge.

**Magnetic effects:** BiotSavart's law, magnetic field due to a straight wire, circular loop and solenoid, force on a moving charge in a uniform magnetic field (Lorentz force), forces and torques on a current carrying conductor in a magnetic field, force between current carrying wires, moving coil galvanometer and conversion to ammeter and voltmeter.

**Magnetostatics:** Bar magnet, magnetic field, lines of force, torque on a bar magnet in a magnetic field, earth's magnetic field; para, dia, and ferro magnetism, magnetic induction and magnetic susceptibility.

## **Unit 8: Electromagnetic Induction and Electromagnetic Waves**

**Electromagnetic Induction:** Induced e. m. f: Magnetic flux, Faraday's law, Lenz's Law and Conservation of Energy, self and mutual inductance.

**Alternating Current:** Impedance and reactance; power in AC circuits; AC voltage applied to resistor, inductor, capacitor, LCR circuits and resonance, transformer and AC generator.

**Electromagnetic Waves:** Electromagnetic waves characteristics, electromagnetic spectrum from gamma to radio waves.

**Unit 9: Kinetic Theory of Gases:** Equation of state of a perfect gas, work done on compressing a gas, Kinetic theory of gases - assumptions, the concept of pressure. Kinetic energy and temperature: RMS speed of gas molecules: Degrees of freedom. Law of equipartition of energy, applications to specific heat capacities of gases; Mean free path. Avogadro's number.

## **Unit 10: Ray and Wave Optics**

**Ray Optics and optical instruments:** Reflection and refraction of light by plain spherical mirrors - Total Internal Reflection; optical fiber; deviation and dispersion of light by a prism; lens formula; magnification and resolving power; microscope and telescope.

**Wave Optics:** Huygens principle: Wave nature of light, interference of light waves and Young's experiment, thin films, Newton's rings, Diffraction – single slit, grating, Polarization and applications.

## **Unit 11: Modern Physics**

**Dual nature of radiation and matter:** De Broglie relation, Electron emission, photoelectric effect, experimental study, Einstein's photoelectric equation: Energy quantum of radiation; particle nature

of light, the photon, wave nature of matter.

**Atoms:** Alpha-particle scattering and Rutherford's nuclear model of atom, atomic spectra, Bohr model of the hydrogen atom; the line spectra of the hydrogen atom.

**Nuclei:** Atomic masses and composition of nucleus; size of the nucleus; mass-energy and nuclear binding energy; nuclear force; radioactivity; nuclear energy

**Semiconductor materials, devices and simple circuits:** Energy bands in solids; classification of metals, conductors and semiconductors.

## CHEMISTRY

**Unit 1 – Basic Chemical calculations:** Density - mole concept - empirical and molecular formula – stoichiometry - volumetry, equivalent and molecular masses, percentage composition

**Unit 2 - Atomic structure & periodicity:** Atomic models, sub-atomic particles, orbital shapes, Pauli's exclusion, Hund's rule, Aufbau principle, de-Broglie relation, Heisenberg's uncertainty, electronic configuration and periodic properties.

**Unit 3 - Chemical bonding:** Ionic bonding, lattice energy – Born-haber cycle, covalent bond - Fajan's Rule – VSEPR theory - hybridization, valence bond and molecular orbital theory, coordinate, metallic and hydrogen bonding

**Unit 4 - P-block elements:** Boron - borax, boranes, diboranes, Carbon - allotropes, oxides, carbides, halides and sulphides of carbon group- silicon and silicates – silicones, Nitrogen – Fixation – compounds of nitrogen- Phosphorous

– allotropes and compounds. Oxygen - oxides and peroxide. Sulphur – its compounds - inter-halogen compounds.

**Unit 5 - d and f block elements:** d-block elements configuration and properties - transition elements, chromium, copper, zinc, silver, interstitial compounds and alloys, f - block elements and extraction, lanthanides and actinides

**Unit 6 - Coordination compounds:** Terminology in coordination- isomerism, Werner, VBT, CFT theories - Bio- coordination compounds.

**Unit 7 - Solutions:** Lowering of vapour pressure, Depression of freezing point, Elevation in boiling point, Osmotic pressure, abnormality - dissociation and association

**Unit 8 – Electrochemistry:** Faraday's laws - specific, equivalent and molar conductances, Kohlraush's law and applications- electrode potentials - EMF, electrochemical and, galvanic cells, Nernst equation, batteries, fuel cells, corrosion and its prevention.

**Unit 9 -Thermodynamics:** First and second law- internal energy, enthalpy, entropy, free energy changes– specific heats at constant pressure and constant volume – enthalpy of combustion, formation and neutralization, Kirchoff law

– Hess's law - bond energy

**Unit 10 - Equilibrium:** Law of chemical equilibrium, homogenous and heterogeneous equilibrium, Le Chatelier's principle, equilibrium constants, factors affecting- Ionic equilibrium, ionization of acids and bases, buffer solutions, pH -solubility of sparingly soluble salts

**Unit 11 - Chemical kinetics:** Order, molecularity, rate and rate constant – first and second order reactions - temperature dependence, factors influencing rate of reaction, integrated rate equation, collision theory of chemical reaction

**Unit 12 - Basic Organic chemistry** General introduction, methods of purification, qualitative and quantitative analysis, classification and IUPAC nomenclature. Electronic effects : inductive effect, electromeric effect, resonance and hyper conjugation. Homolytic and heterolytic fission: free radicals, carbocations, carbanions, electrophiles and nucleophiles, types of organic reactions.

**Unit 13 - Hydrocarbons:** Classification of Hydrocarbons: Alkanes, Alkenes, Alkynes - Nomenclature, Structure, Methods of preparation, isomerism, conformation (ethane only), physical properties, halogenation, pyrolysis, geometrical isomerism, addition of hydrogen, halogen, water, hydrogen halides, water to alkenes and alkynes (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition, acidic character of alkynes. Aromatic Hydrocarbons: Introduction, IUPAC nomenclature, benzene: resonance, aromaticity, chemical properties: mechanism of Nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation, directive influence of functional group in monosubstituted benzene. Carcinogenicity and toxicity

**Unit 14 - Organic halogen compounds:** Nature of C-X bond- preparation - properties and reactions of alkyl and aryl halides- polyhalogen compounds - substitution and elimination – mechanism- Grignard reagents.

**Unit 15 - Organic functional groups – hydroxyl, carbonyl compounds and ethers:** Nomenclature, preparation, properties and uses of alcohols, ethers, aldehydes, ketones, aliphatic carboxylic acids, benzoic acid - salicylic acid.

**Unit 16 - Biomolecules:** Carbohydrates, proteins, amino acids - enzymes, vitamins, and nucleic acids - lipids.

## ENGLISH

Articles, Synonyms, Antonyms, Preposition, Verbs.

### Note:

This handbook contains general information and rules regarding the Amrita Engineering Entrance Examination 2024 and other relevant details. Candidates are required to go through the handbook carefully and acquaint themselves with the procedures relating to the admission. The contents of the handbook are subject to modification, as may be deemed necessary, by the University. The decision of the University will be final and binding on any issue related to the admission.