

## (APPENDIX-I)

### SYLLABUS FOR B.TECH. (4YEARS)/ BIOTECHNOLOGY- DUAL DEGREE (B.TECH / M.TECH) & B.SC.NURSING

#### PHYSICS

##### **Unit 1: Units and Measurement**

Units for measurement, system of units-S.I., fundamental and derived units. Dimensions and their applications.

##### **Unit 2: Description of Motion in One Dimension**

Motion in a straight line, uniform and non-uniform motion, their graphical representation. Uniformly accelerated motion, and its application.

##### **Unit 3: Description of Motion in Two and Three Dimensions**

Scalars and vectors, vector addition, a real number, zero vector and its properties. Resolution of vectors. Scalar and vector products, uniform circular motion and its applications projectile motion.

##### **Unit 4: Laws of Motion**

Force and inertia-Newton's Laws of Motion. Conservation of linear momentum and its applications, rocket propulsion, friction-laws of friction.

##### **Unit 5: Work, Energy and Power**

Concept of work, energy and power. Energy-Kinetic and potential. Conservation of energy and its applications, Elastic collisions in one and two dimensions. Different forms of energy.

##### **Unit 6: Rotational Motion and Moment of Inertia**

Centre of mass of a two-particle system. Centre of mass of a rigid body, general motion of a rigid body, nature of rotational

motion, torque, angular momentum, its conservation and applications.

Moment of inertia, parallel and perpendicular axes theorem, expression of moment of inertia for ring, disc and sphere.

##### **Unit 7:- Gravitation**

Acceleration due to gravity, one and two-dimensional motion under gravity. Universal law of gravitation, variation in the acceleration due to gravity of the earth. Planetary motion, Kepler's laws, artificial satellite-geostationary satellite, gravitational potential energy near the surface of earth, gravitational potential and escape velocity.

##### **Unit 8: Solids and Fluids**

Inter-atomic and Inter-molecular forces, states of matter.

(A) Solids: Elastic properties, Hook's law, Young's modulus, bulk modulus, modulus of rigidity.

(B) Liquids : Cohesion and adhesion. Surface energy and surface tension. Flow of fluids, Bernoulli's theorem and its applications. Viscosity, Stoke's Law, terminal velocity.

##### **Unit 9: Oscillations**

Periodic motion, simple harmonic motion and its equation of motion, energy in S.H.M., Oscillations of a spring and simple pendulum.

##### **Unit 10: Waves**

Wave motion, speed of a wave, longitudinal and transverse waves, superposition of waves, progressive and standing waves, free and forced Oscillations, resonance, vibration of strings and air-columns, beats, Doppler effects.

##### **Unit 11: Heat and Thermodynamics**

Thermal expansion of solids, liquids and gases and their specific heats, Relationship between  $C_p$  and  $C_v$  for gases, first law of thermodynamics, thermodynamic processes. Second law of thermodynamics, Carnot cycle efficiency of heat engines.

### **Unit 12: Transference of Heat**

Modes of transference of heat. Thermal conductivity. Black body radiations, Kirchoff's Law, Wien's law, Stefan's law of radiation and Newton's law of cooling.

### **Unit 13: Electrostatics**

Electric charge-its unit and conservation, Coulomb's law, dielectric constant, electric field, lines of force, field due to dipole and its behaviour in a uniform electric field, electric flux, Gauss's theorem and its applications. Electric potential, potential due to a point charge. Conductors and insulators, distribution of charge on conductors. Capacitance, parallel plate capacitor, combination of capacitors, energy of capacitor.

### **Unit 14: Current Electricity**

Electric current and its unit, sources of energy, cells-primary and secondary, grouping of cells resistance of different materials, temperature dependence, specific resistivity, Ohm's law, Kirchoff's law, series and parallel circuits. Wheatstone Bridge with their applications and potentiometer with their applications.

### **Unit 15 : Thermal and Chemical Effects of Currents**

Heating effects of current, electric power, simple concept of thermo-electricity-Seebeck effect and thermocouple, Chemical effect of current-Faraday's laws of electrolysis.

### **Unit 16: Magnetic Effects of Currents**

Oersted's experiment, Bio-Savart's law, magnetic field due to straight wire, circular loop and solenoid, force on a moving charge in a uniform magnetic field ( Lorentz force), force and torques on currents in a magnetic field, force between two current carrying wires, moving coil

galvanometer and conversion to ammeter and voltmeter.

### **Unit 17: Magneto statics**

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, magnetic susceptibility.

### **Unit 18: Electromagnetic Induction and Alternating Currents**

Induced e.m.f., Faraday's Law, Lenz's Law, Self and Mutual Inductance, alternating currents, impedance and reactance, power in a.c. Circuits with L.C. And R Series Combination, resonant circuits. Transformer and A.C. generator.

### **Unit 19: Ray Optics**

Reflection and refraction of light at plane and curved surfaces, total internal reflection, optical fibre; deviation and dispersion of light by a prism; Lens formula, magnification and resolving power, microscope and telescope.

### **Unit 20: Wave Optics**

Wave nature of light; Interference- Young's double slit experiment. Diffraction-diffraction due to a single slit. Elementary idea of polarization.

### **Unit 21: Electromagnetic Waves**

Electromagnetic waves and their characteristics, Electromagnetic wave spectrum from gamma to radio waves-propagation of EM waves in atmosphere.

### **Unit 22: Electron and Photons**

Charge on an electron,  $e/m$  for an electron, photoelectric effect and Einstein's equation of photoelectric effect.

### **Unit 23: Atoms, Molecules and Nuclei**

Alpha particles scattering experiment, Atomic masses, size of the nucleus; radioactivity; Alpha, beta and gamma particles/rays and their properties, radioactive decay law, half life and mean life of radio-active nuclei, binding energy,

mass energy relationship, nuclear fission and nuclear fusion.

#### **Unit 24: Solids and Semi-Conductors**

##### **Devices**

Energy bands in solids, conductors, insulators and semi-conductors, pn junction, diodes, diode as rectifier, transistor action, transistor as an amplifier.

### **CHEMISTRY**

#### **Unit 1: Some Basic Concepts:**

Measurement in chemistry (Precision, significant figures, S.I. units, Dimensional analysis). Laws of chemical combination. Atomic Mass, Molecular Mass, mole concept, Molar Mass, determination of Molecular formula. Chemical equation, stoichiometry of Chemical reactions.

#### **Unit 2 : States of Matter**

Gaseous state, measurable properties of gases, Boyle's Law, Charles's Law and absolute scale of temperature, Avogadro's hypothesis, ideal gas equation, Dalton's law of partial pressures.

Kinetic molecular theory of gases (the microscopic model of gas), deviation from ideal behaviour.

The solid state ( classification of solids, X-ray studies of crystal lattices and unit cells, packing of constituent particles in crystals). Imperfection in solids, electrical, magnetic and dielectric properties of solids. Liquid state (Properties of liquids, Vapour pressure, Surface tension, Viscosity).

#### **Unit 3: Atomic Structure**

Constituents of the atom (discovery of electron, Rutherford model of the atom).

Electronic structure of atoms-nature of light and electromagnetic waves, atomic spectra, Bohr's model of hydrogen, shortcomings of the Bohr model.

Dual nature of matter and radiation. de-Broglie relation. The uncertainty principle, Quantum Mechanical Model of the atom, Orbitals and

Quantum numbers. Shapes of orbitals. Aufbau principle, Pauli Exclusion principle, Hund's Rule, Electronic Configuration of atoms.

#### **Unit 4: Solutions**

Types of solutions, Units of concentration, Vapour-pressure of solutions and Raoult's law. Colligative properties. Determination of molecular mass. Non-ideal solutions and abnormal molecular masses. Volumetric analysis-concentration unit.

#### **Unit 5: Chemical Energetics and Thermodynamics**

Energy changes during a chemical reaction, Internal energy and Enthalpy, Internal energy and Enthalpy changes, Origin of Enthalpy change in a reaction, Hess's Law of constant heat summation, numericals based on these concepts. Enthalpies of reactions (Enthalpy of neutralization, Enthalpy of combustion, Enthalpy of fusion and vaporization).

Sources of energy (conservation of energy sources and identification of alternative sources, pollution associated with consumption of fuels. The sun as the primary source).

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.

#### **Unit 6: Chemical Equilibrium**

Equilibria involving physical changes (solid-liquid, liquid-gas equilibrium involving dissolution of solids in liquids, gases in liquids, general characteristics of equilibrium involving physical processes)

Equilibria involving chemical systems (the law of chemical equilibrium, the magnitude of the equilibrium constant, numerical problems).

Effect of changing conditions of systems at equilibrium (change of concentration, change of temperature, effect of catalyst-Le Chatelier's principle).

Equilibria involving ions- ionization of electrolytes, weak and strong electrolytes, acid-base equilibrium, various concepts of acids and bases, ionization of water, pH scale, solubility product, numericals based on these concepts.

### **Unit 7: Redox Reactions and Electrochemistry**

Oxidation and reduction as an electron transfer concept. Redox reactions in aqueous solutions-electrochemical cells. e.m.f. of a galvanic cell. Dependence of e.m.f. on concentration and temperature (NERNST) equation and numerical problems based on it. Electrolysis, Oxidation number (rules for assigning oxidation number, redox reactions in terms of oxidation number, nomenclature). Balancing of oxidation-reduction equations.

Electrolytic conduction. Molar conductivity, Kohlrausch's Law and its applications, Voltaic cell, Electrode potential and Electromotive force, Gibb's energy change and cell potential. Electrode potential and products of electrolysis, Fuel cells, corrosion and its prevention.

### **Unit 8: Rates of Chemical Reactions and 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. Effect of light of rates of reactions. Elementary reactions as steps to more complex reactions. How fast are chemical reactions?

Rate law expression. Order of a reaction (with suitable examples). Units of rates and specific rate constant. Order of reaction and effect of concentration ( study will be confined to first order only). Temperature dependence of rate constant – Fast reactions (only elementary idea). Mechanism of reaction ( only elementary idea). Photochemical reactions.

### **Unit 9: Surface Chemistry**

Surface : Adsorption – physical and chemical adsorption, adsorption isotherms.

Colloids-Preparation and general properties, Emulsions, Micelles.

Catalysis : Homogeneous and heterogeneous, structure of catalyst, Enzymes, Zeolites.

### **Unit 10: Chemical Families Periodic Properties**

Modern periodic law, Types of elements – Representatives elements ( s & p block, Transition elements – d-block elements, inner transition elements-f-block elements. Periodic trends in properties-ionization enthalpy, electron gain enthalpy, atomic radii, valence, periodicity in properties of compounds).

### **Unit 11: Chemical Bonding and Molecular Structure**

Chemical bonds and Lewis structure, shapes of molecules ( VSEPR theory), Quantum theory of the covalent bond, hydrogen and some other simple molecules, carbon compounds, hybridization, Boron and Beryllium compounds.

Coordinate covalent bond, ionic bond as an extreme case of polar covalent bond, ionic character of molecules and polar molecules. Bonding in solid state ionic, molecular and covalent solids, metals. Hydrogen bond, Resonance.

Molecules : Molecular orbital. Theory-bond order and magnetic properties of  $H_2, O_2, N_2, F_2$  on the basis of MOT. Hybridisation involving s, p and d orbitals (including shapes of simple organic molecules), Dipole moment and structure of molecules.

### **Unit 12: Chemistry of Non-Metals - 1**

Hydrogen (unique position in periodic table, occurrence, isotopes, properties, reactions and uses), Hydrides-molecular, soline and interstitial

Oxygen (occurrence, preparation, properties and reactions, uses), simple oxides; ozone

Water and hydrogen peroxide, structure of water molecule and its aggregates, physical and chemical properties of water, hard and soft water, water softening, hydrogen peroxide-preparation, properties, structure and uses.

Nitrogen- Preparation, properties, uses, compounds of Nitrogen-Ammonia, Oxides of Nitrogen, Nitric Acid-preparation, properties and uses.

### **Unit 13: Chemistry of Non-metals-II**

Boron-occurrence, isolation, physical and chemical properties, borax and boric acid, uses of boron and its compounds.

Carbon, inorganic compounds of carbon-oxides, halides, carbides, elemental carbon.

Silicon- occurrence, preparation and properties, oxides and oxyacids of phosphorus, chemical fertilizers.

Sulphur – occurrence and extraction, properties and reactions, oxides, Sulphuric acid – preparation, properties and uses, sodium thiosulphate.

Halogens- occurrence, preparation, properties, hydrogen halides, uses of halogens.

Noble gases- discovery, occurrence and isolation, physical properties, chemistry of noble gases and their uses.

### **Unit 14: Chemistry of Lighter Metals**

Sodium and Potassium- occurrence and extraction, properties and uses. Important compounds-NaCl,  $\text{Na}_2\text{CO}_3$ ,  $\text{NaHCO}_3$ , NaOH, KCl, KOH.

Magnesium and calcium-occurrence and extraction, properties and uses. Important compounds  $\text{MgCl}_2$ ,  $\text{MgSO}_4$ , CaO,  $\text{Ca(OH)}_2$ ,  $\text{CaCO}_3$ ,  $\text{CaSO}_4$  Plaster of paris, Bleaching Powder.

Aluminium –occurrence, extraction properties and uses, compounds- $\text{AlCl}_3$ , alums.

Cement.

Biological role of Sodium, Potassium, Magnesium and Calcium.

### **Unit 15:- Heavy Metals**

Iron – Occurrence and extraction, compounds of iron, oxides, halides, sulphides, sulphate, alloy and steel.

Copper and Silver- occurrence and extraction, properties and uses, compounds-sulphides, halides and sulphates, photography.

Zinc and Mercury- occurrence and extraction, properties and uses, compounds-oxides, halides; sulphides and sulphates.

Tin and Lead- occurrence and extraction, properties and uses, compounds-oxides, sulphides, halides.

### **Unit 16: Chemistry of Representative Elements**

Periodic properties- Trends in groups and periods (a) Oxides-nature (b) Halides-melting points (c) Carbonates and sulphates-solubility.

The chemistry of s and p block elements, electronics configuration, general characteristic properties and oxidation states of the following:-

Group 1 elements	- Alkali metals
Group 2 elements	- Alkaline earth metals
Group 13 elements	- Boron family
Group 14 elements	- Carbon family
Group 15 elements	- Nitrogen family
Group 16 elements	- Oxygen family
Group 17 elements	- Halogen family
Group 18 elements	- Noble gases & Hydrogen

### **Unit 17: Transition Metals Including Lanthanides**

Electronic configuration : General characteristic properties, oxidation states of transition metals. First row transition metals and general properties of their compounds-oxides, halides and sulphides.

General properties of a second and third row transition elements ( Groupwise discussion).

Preparation and reactions, properties and uses of Potassium dichromate Potassium permanganate.

Inner Transition Elements: General discussion with special reference to oxidation states and lanthanide contraction.

### **Unit 18: Coordination Chemistry and Organo Metallics**

Coordination compounds, Nomenclature: Isomerism in coordination compounds; Bonding in coordination compounds, Werner's coordination theory. Applications of coordination compounds.

### Unit 19: Nuclear Chemistry

Nature of radiation from radioactive substances. Nuclear reactions; Radio-active disintegration series; Artificial transmutation of elements; Nuclear fission and Nuclear fusion: Isotopes and their applications: Radio carbon-dating.

### Unit 20: Purification and Characterisation of Organic Compounds

Purification (crystallization, sublimation, distillation, differential extraction, chromatography).

Qualitative analysis, detection of nitrogen, sulphur, phosphorus and halogens.

Quantitative analysis- estimation of carbon, hydrogen, nitrogen, halogens, sulphur, phosphorus ( basic principles only)

Determination of molecular mass-Silver salt method, chloroplatinate salt method

Calculation of empirical formula and molecular formula.

Numerical problems in organic quantitative analysis, modern methods of structure elucidation.

### Unit 21: Some Basic Principles

Classification of Organic Compounds.

Tetravalency of Carbon, Homologous series. Functional groups-  $C=C$ -,  $-C=C$ -, and groups containing halogen, oxygen, 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 of 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 Common types of organic reactions-Substitution, addition, elimination and rearrangement reactions. Illustration with examples.

### Unit 22: Hydrocarbons

Classification. Sources of hydrocarbons:

Alkanes- General methods of preparation (from unsaturated hydrocarbons, alkylhalides, aldehydes, ketones and carbonylic 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-Markovnikoff'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. Directive influence of substituents.

Petroleum – Hydro Carbons from Petroleum, Cracking and reforming, quality of gasoline-Octane number, gasoline additives.

### Unit 23: Organic Compound Containing Halogens

( Haloalkanes and Haloarenes)

Methods of preparation, physical properties and reactions. Preparation, properties and uses of Chloroform and Iodoform.

### Unit 24 : 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.

### **Unit 25: 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.

### **Unit 26: Synthetic and Natural Polymers**

Classification on Polymers, natural and synthetic polymers (with stress on their general methods of preparation) and important uses of the following.

Teflon, PVC, Polystyrene, Nylon-66, terylene, Bakelite)

### **Unit 27: Bio Molecules and Biological Processes**

The Cell and Energy Cycle  
Carbohydrates: Monosaccharides, Disaccharides, Polysaccharides

Amino acids and Peptides- Structure and classification.  
Proteins and Enzymes-Structure of Proteins, Role of enzymes.

Nucleic Acids-DNA and RNA

Biological functions of Nucleic acids-Protein synthesis and replication.

Lipids – Structure, membranes and their functions.

### **Unit 28: Chemistry In Action**

Dyes, Chemicals in medicines (antipyretic, analgesic, antibiotics & tranquilisers), Rocket propellants.  
( Structural formulae non-evaluative)

### **Unit 29: Environmental Chemistry**

Environmental pollutants; soil, water and air pollution; major atmospheric pollutants; acid rain, Ozone and its reactions causing ozone layer depletion, effects of the depletion of ozone layer, industrial air pollution.

### **(APPENDIX-II)**

### **SYLLABUS FOR B.TECH. (4YEARS)/ BIOTECHNOLOGY- DUAL DEGREE (B.TECH / M.TECH) MATHEMATICS**

#### **Unit 1:- 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 2: 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 3: Matrices and Determinants**

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

#### **Unit 4: Quadratic Equations**

Quadratic equations in real and complex number system and their solutions. Relation

between roots and co-efficients, nature of roots, formation of quadratic equations with given roots; Symmetric functions of roots, equations reducible to quadratic equations-application to practical problems.

### **Unit 5 : Permutations and Combinations**

Fundamental principle of counting; Permutation as an arrangement and combination as selection, Meaning of P (n,r) and C (n,r). Simple applications.

### **Unit 6: Binomial Theorem and Its Applications**

Binomial Theorem for a positive integral index; general term and middle term; Binomial

Theorem for any index. Properties of Binomial Co-efficients. Simple applications for approximations.

### **Unit 7: Sequences and Series**

Arithmetic, Geometric and Harmonic progressions. Insertion of Arithmetic Geometric and Harmonic means between two given numbers. Relation Between A.M., G.M. and H.M. Special series:  $S_n, S_n^2, S_n^3$ . Arithmetico-Geometric Series, Exponential and Logarithmic series.

### **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.

### **Unit 9:- Integral Calculus**

Integral as an anti-derivative. Fundamental integrals involving algebraic, trigonometric,

exponential and logarithmic functions. Integration by substitution, by parts and 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.

### **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 homogeneous and linear differential equations, and those of the type

$$\frac{d^2y}{dx^2} = f(x)$$

### **Unit 12:- Two Dimensional Geometry**

Recall of Cartesian system of rectangular coordinates in a plane, distance formula, area of a triangle, condition of 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.

### **The straight line and pair of straight lines**

Various forms of equations of a line, intersection of line, 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, orthocenter 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.

### **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 a circle with the centre at the origin and conditions for a line to be tangent to the circle, length of the tangent, equation of the tangent, equation of a family of circles through the intersection of two circles, condition for two intersecting circles to be orthogonal.

### **Conic Sections**

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

### **Unit 13: Three Dimensional Geometry**

Coordinates of a point in space, distance between two points; Section formula, direction ratios and direction cosines, angle between two intersecting lines. Skew lines, the shortest distance between them and its equation. Equations of a line and a plane in different forms; intersection of a line and a plane, coplanar lines, equation of a sphere, its centre and radius. Diameter form of the equation of a sphere.

### **Unit 14: 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 15: 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 16: Probability**

Probability of an event, addition and multiplication theorems of probability and their application; Conditional probability; Bayes' Theorem, probability distribution of a random

variate; Binomial and Poisson distributions and their properties.

### **Unit 17: Trigonometry**

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

## **(APPENDIX-III)**

## **BIOTECHNOLOGY- DUAL DEGREE (B.TECH / M.TECH) & B.SC.NURSING**

### **BIOLOGY (BOTANY AND ZOOLOGY)**

#### **Unit : 1 Diversity in Living World**

Biology – its meaning and relevance to mankind

What is living; Taxonomic categories and aids (Botanical gardens, herbaria, museums, zoological parks); Systematics and Binomial system of nomenclature.

Introductory classification of living organisms (Two-kingdom system, Five-kingdom system); Major groups of each kingdom alongwith their salient features (Monera, including Archaeobacteria and Cyanobacteria, Protista, Fungi, Plantae, Animalia); Viruses; Lichens

Plant kingdom – Salient features of major groups (Algae to Angiosperms);

Animal kingdom – Salient features of Nonchordates up to phylum, and Chordates up to class level.

#### **Unit : 2 Cell : The Unit of Life ; Structure and Function**

Cell wall; Cell membrane; Endomembrane system (ER, Golgi apparatus/Dictyosome, Lysosomes, Vacuoles); Mitochondria; Plastids; Ribosomes; Cytoskeleton; Cilia

and Flagella; Centrosome and Centriole; Nucleus; Microbodies. Structural differences between prokaryotic and eukaryotic, and between plant and animal cells. Cell cycle (various phases); Mitosis; Meiosis.

Biomolecules – Structure and function of Carbohydrates, Proteins, Lipids, and Nucleic acids.

Enzymes – Chemical nature, types, properties and mechanism of action.

### **Unit : 3 Genetics and Evolution**

Mendelian inheritance; Chromosome theory of inheritance; Gene interaction; Incomplete dominance; Co-dominance; Complementary genes; Multiple alleles; Linkage and Crossing over; Inheritance patterns of hemophilia and blood groups in humans.

DNA –its organization and replication; Transcription and Translation; Gene expression and regulation; DNA fingerprinting.

Theories and evidences of evolution, including modern Darwinism.

### **Unit : 4 Structure and Function – Plants**

Morphology of a flowering plant; Tissues and tissue systems in plants; Anatomy and function of root, stem(including modifications), leaf, inflorescence, flower (including position and arrangement of different whorls, placentation), fruit and seed; Types of fruit; Secondary growth;

Absorption and movement of water (including diffusion, osmosis and water relations of cell) and of nutrients; Translocation of food; Transpiration and gaseous exchange; Mechanism of stomatal movement.

Mineral nutrition – Macro- and micro-nutrients in plants including deficiency disorders; Biological nitrogen fixation mechanism.

Photosynthesis – Light reaction, cyclic and non-cyclic photophosphorylation; Various pathways of carbon dioxide fixation; Photorespiration; Limiting factors.

Respiration – Anaerobic, Fermentation, Aerobic; Glycolysis, TCA cycle; Electron transport system; Energy relations.

### **Unit : 5 Structure and Function - Animals**

Tissues; Elementary knowledge of morphology, anatomy and functions of different systems of earthworm, cockroach and frog.

Human Physiology – Digestive system - organs, digestion and absorption;

Respiratory system – organs, breathing and exchange and transport of gases. Body fluids and circulation – Blood, lymph, double circulation, regulation of cardiac activity; Hypertension, Coronary artery diseases.

Excretion system – Urine formation, regulation of kidney function

Locomotion and movement – Skeletal system, joints, muscles, types of movement.

Control and co-ordination – Central and peripheral nervous systems, structure and function of neuron, reflex action and sensory reception; Role of various types of endocrine glands; Mechanism of hormone action.

### **Unit : 6 Reproduction, Growth and Movement in Plants**

Asexual methods of reproduction; Sexual Reproduction - Development of male and female

gametophytes; Pollination (Types and agents); Fertilization; Development of embryo, endosperm, seed and fruit (including parthenocarpy and apomixis).

Growth and Movement – Growth phases; Types of growth regulators and their role in seed dormancy, germination and movement; Apical dominance; Senescence; Abscission;

Photo- periodism; Vernalisation; Various types of movements.

### **Unit : 7 Reproduction and Development in Humans**

Male and female reproductive systems; Menstrual cycle; Gamete production; Fertilisation; Implantation; Embryo development; Pregnancy and parturition; Birth control and contraception.

### **Unit : 8 Ecology and Environment**

Meaning of ecology, environment, habitat and niche. Ecological levels of organization (organism to biosphere); Characteristics of Species, Population, Biotic Community and Ecosystem; Succession and Climax.

Ecosystem – Biotic and abiotic components; Ecological pyramids; Food chain and Food web; Energy flow; Major types of ecosystems including agroecosystem.

Ecological adaptations – Structural and physiological features in plants and animals of aquatic and desert habitats.

Biodiversity – Meaning, types and conservation strategies (Biosphere reserves, National parks and Sanctuaries)

Environmental Issues – Air and Water Pollution (sources and major pollutants); Global warming and Climate change; Ozonedepletion; Noise pollution; Radioactive pollution; Methods of pollution control (including an idea of bioremediation); Deforestation; Extinction of species (Hot Spots).

### **Unit : 9 Biology and Human Welfare**

Animal husbandry – Livestock, Poultry, Fisheries; Major animal diseases and their

control. Pathogens of major communicable diseases of humans caused by fungi, bacteria, viruses, protozoans and helminths, and their control. Cancer; AIDS. Adolescence and drug/alcohol abuse; Basic concepts of immunology. Plant Breeding and Tissue Culture in crop improvement. Biofertilisers (green manure, symbiotic and free-living nitrogen-fixing microbes, mycorrhizae); Biopesticides (micro-organisms as biocontrol agents for pests and pathogens); Bioherbicides; Microorganisms as pathogens of plant diseases with special reference to rust and smut of wheat, bacterial leaf blight of rice, late blight of potato, bean mosaic, and root - knot of vegetables.

Bioenergy – Hydrocarbon - rich plants as substitute of fossil fuels.

### **Unit:10 Biotechnology and its Applications**

Microbes as ideal system for biotechnology; Microbial technology in food processing, industrial production (alcohol, acids, enzymes, antibiotics), sewage treatment and energy generation.

Steps in recombinant DNA technology – restriction enzymes, DNA insertion by vectors and other methods, regeneration of recombinants.

Applications of R-DNA technology. In human health –Production of Insulin, Vaccines and Growth hormones, Organ transplant, Gene therapy. In Industry – Production of expensive enzymes, strain improvement to scale up bioprocesses. In Agriculture – GM crops by transfer of genes for nitrogen fixation, herbicide-resistance and pest-resistance including Bt crops