MIDNAPORE CITY COLLEGE

SYLLABUS OF WRITTEN TEST FOR PhD ADMISSION
(For Admission to Ph.D Programme under Research Centre of Midnapore City College affiliated to Vidyasagar University)

W.E.F. 2021-2022

Examination Pattern: Multiple Choice Question
Full Marks: 50; each questions carry one mark. There are no negative marks for unsuccessful attempt.
Time: 1 hr.

The candidate has to choose any one subject from the following:
Physics, Computer Sciences, Mathematics, Geography, Botany, Zoology, Microbiology, Nutrition, Medical Laboratory Technology, English, Bengali.

Physics

1. **Mathematical Methods of Physics:** Vector algebra and vector calculus. Linear algebra, Matrices, Linear ordinary differential equations of first & second order, Special functions (Hermite, Bessel and Legendre functions) Fourier series, Fourier and Laplace transforms. Elementary Complex Analysis, Green's Function, Partial Differential Equation (Laplace, Wave and Heat equations in two and three dimensions).
2. **Classical Mechanics:** Newton's laws. Dynamical systems, Phase space dynamics, stability analysis. Central force motions. Poisson brackets and canonical transformations. Two body Collisions - scattering in laboratory and Centre of mass frames. Rigid body dynamics, moment of inertia tensor. Non-inertial frames and pseudoforces. Variational principle. Generalized coordinates. Lagrangian and Hamiltonian formalism and equations of motion. Conservation laws and cyclic coordinates. Periodic motion: small oscillations, normal modes. Special theory of relativity, Lorentz transformations, relativistic kinematics, and mass–energy equivalence.
3. **Electromagnetic Theory:** Electrostatics: Gauss's law and its applications, Laplace and Poisson equations, boundary value problems. Magnetostatics: Biot-Savart law, Ampere's theorem. Electromagnetic induction. Maxwell's equations in free space and linear isotropic media; boundary conditions on the fields at interfaces. Scalar and vector potentials, gauge invariance. Electromagnetic waves in free space. Dielectrics and conductors. Reflection and refraction, polarization, Fresnel's law, interference, coherence, and diffraction. Electrodynamics of charged particles in static and uniform electromagnetic fields. Dispersion relations in plasma. Lorentz invariance of Maxwell's equation. Transmission lines and wave guides. Radiation from a moving charge, radiation from a dipole, Retarded potential.
4. **Quantum Mechanics:** Wave-particle duality. Schrödinger equation (time-dependent and time-independent). Eigenvalue problems (particle in a box, harmonic oscillator, etc.). Tunneling through a barrier. Wave-function in coordinate and momentum representations. Commutators and Heisenberg uncertainty principle. Dirac notation for state vectors. Motion in a central potential: orbital angular momentum, angular momentum algebra, spin, addition of angular momenta; Hydrogen atom. Stern-Gerlach experiment. Time independent perturbation theory and applications. Variational method. Time dependent perturbation theory and Fermi's golden rule, selection rules. Identical particles, Pauli exclusion principle, spin-statistics connection. Spin-orbit coupling, fine structure. WKB approximation. Born approximation. Relativistic quantum mechanics: Klein-Gordon and Dirac equations. Elementary theory of scattering in a central potential, Phase shifts.
5. **Thermodynamics and Statistical Physics:** Laws of thermodynamics and their consequences. Thermodynamic potentials, Maxwell relations, Chemical potential, Phase equilibria. Phase space, micro- and macro-states. Micro-canonical, canonical and grand-canonical ensembles and partition functions. Free energy and its connection with thermodynamic quantities. Classical and quantum statistics. Ideal Bose and Fermi gases. Principle of detailed balance. Blackbody radiation and Planck's distribution law. First- and second-order phase transitions. Diamagnetism, paramagnetism, and ferromagnetism. Ising model. Bose-Einstein condensation. Diffusion equation. Random walk and Brownian motion.
   Introduction to nonequilibrium processes.
6. **Electronics:** Physics of p-n junction, Diode as a circuit element; clipping, clamping; Rectification, Zener regulated power supply: Transistor as a circuit element: CC, CB, and CE configuration, 'Transistor as a switch, OR, AND NOT gates. Feedback in Amplifiers. Operational amplifier and its applications:

inverting, non-inverting amplifier, adder, integrator, differentiator, wave form generator, comparator, & Schmidt trigger. Digital integrated circuits-NAND & NOR gates as building blocks, X-OR Gate, simple combinational circuits, Half & Full adder, Flip-flop, shift register, counters. Basic principles of A/D & D/ A converters; Simple applications of A/D & D/A converters. Semiconductor devices (diodes, junctions, transistors, field effect devices, homo- and hetero-junction devices), device structure, device characteristics, Opto-electronic devices (solar cells, photodetectors, LEDs).

7. **Atomic and Molecular Physics:** Quantum states of an electron in an atom. Electron spin. Spectrum of helium and alkali atom. Relativistic corrections for energy levels of hydrogen atom, hyperfine structure and isotopic shift, width of spectrum lines, LS & JJ couplings. Zeeman, Paschen-Bach & Stark effects. Electron spin resonance. Nuclear magnetic resonance, chemical shift. Frank-Condon principle. Born-Oppenheimer approximation. Electronic, rotational, vibrational and Raman spectra of diatomic molecules, selection rules. Lasers: spontaneous and stimulated emission, Einstein A & B coefficients. Optical pumping, population inversion, rate equation. Modes of resonators and coherence length.
8. **Condensed Matter Physics:** Bravais lattices. Reciprocal lattice. Diffraction and the structure factor. Bonding of solids. Elastic properties, phonons, lattice specific heat. Free electron theory and electronic specific heat. Response and relaxation phenomena. Drude model of electrical and thermal conductivity. Hall effect and thermoelectric power. Electron motion in a periodic potential, band theory of solids: metals, insulators and semiconductors. Superconductivity: type-I and type-II superconductors. Josephson junctions. Superfluidity. Defects and dislocations. Ordered phases of matter: translational and orientational order, kinds of liquid crystalline order. Quasi crystals.
9. **Nuclear and Particle Physics:** Basic nuclear properties: size, shape and charge distribution, spin and parity. Binding energy, semiempirical mass formula, liquid drop model. Nature of the nuclear force, form of nucleon-nucleon potential, charge-independence and charge-symmetry of nuclear forces. Deuteron problem. Evidence of shell structure, single-particle shell model, its validity and limitations. Rotational spectra. Elementary ideas of alpha, beta and gamma decays and their selection rules. Fission and fusion. Nuclear reactions, reaction mechanism, compound nuclei and direct reactions. Classification of fundamental forces. Elementary particles and their quantum numbers (charge, spin, parity, isospin, strangeness, etc.). Gellmann-Nishijima formula. Quark model, baryons and mesons. C, P, and T invariance. Application of symmetry arguments to particle reactions. Parity non-conservation in weak interaction. Relativistic kinematics.

Computer Sciences

1. **Discrete Structures and Optimization:** Mathematical Logic, Sets and Relations, Counting, Mathematical Induction and Discrete Probability, Group Theory, Graph Theory, Boolean Algebra, Optimization: Linear Programming,
2. **Computer System Architecture**: Digital Logic Circuits and Components, Data Representation, Register Transfer and Microoperations: Basic Computer Organization and Design, Programming the Basic Computer, Microprogrammed Control, Central Processing Unit, Pipeline and Vector Processing, Input-Output Organization, Memory Hierarchy, Multiprocessors,
3. **Programming Languages and Computer Graphics:** Language Design and Translation Issues, Elementary Data Types Programming in C, Object Oriented Programming, Programming in C++, Web Programming: Computer Graphics, 2-D Geometrical Transforms and Viewing, 3-D Object Representation, Geometric Transformations and Viewing.
4. **Database Management Systems:** Data Modeling, SQL, Normalization for Relational Databases, Enhanced Data Models, Data Warehousing and Data Mining, Big Data Systems
5. **System Software and Operating System:** System Software, Basics of Operating Systems, Threads, CPU Scheduling, Deadlocks, Memory Management, Storage Management, File and Input/ Output Systems, Security, Virtual Machines, Linux Operating Systems, Windows Operating Systems, Distributed Systems,
6. **Software Engineering:** Software Process Models, Software Requirements, Software Design, Software Quality, Estimation and Scheduling of Software Projects, Software Testing.
7. **Data Structures and Algorithms:** Data Structures, Performance Analysis of Algorithms and Recurrences, Design Techniques, Lower Bound Theory, Graph Algorithms, Complexity Theory, Selected Topics, Advanced Algorithms.
8. **Theory of Computation and Compilers:** Theory of Computation, Regular Language Models, Context Free Language, Turing Machines (TM), Unsolvable Problems and Computational Complexity, Syntax Analysis, Semantic Analysis, Run Time System, Intermediate Code Generation, Code Generation and Code Optimization.
9. **Data Communication and Computer Networks:** Data Communication, Computer Networks, Network Models, Functions of OSI and TCP/IP Layers, World Wide Web (WWW), Network Security, Mobile Technology, Cloud Computing and IoT.
10. **Artificial Intelligence (AI):** Approaches to AI, Knowledge Representation, Planning, Natural Language Processing, Multi Agent Systems, Fuzzy Sets, Genetic Algorithms (GA), Artificial Neural Networks (ANN).

Chemistry

a. Inorganic Chemistry

1. **Chemical periodicity:** Periodic properties.
2. **Structure and bonding**: Homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory), VBT, MOT.
3. **Coordination chemistry:** Structure and isomerism, theories of bonding (VBT, CFT, and MOT). Energy level diagrams in various crystal fields, CFSE, applications of CFT, Jahn-Teller distortion. Electronic spectra of transition metal complexes: spectroscopic term symbols, selection rules, Orgel diagrams, charge-transfer spectra. Magnetic properties of transition metal complexes.
4. **Acids and bases:** Concepts of acids and bases, Hard-Soft acid base concept, non-aqueous solvents.
5. **Main group elements and their compounds:** Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
6. **Transition elements and coordination compounds:** structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
7. **Inner transition elements:** spectral and magnetic properties, redox chemistry, analytical applications.
8. **Organometallic compounds:** synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
9. **Cages and clusters:** Structure and bonding of boranes, carboranes, silicones, silicates.
10. **Bioinorganic chemistry:** photosystems, porphyrins, metalloenzymes, oxygen transport, electron-transfer reactions; nitrogen fixation, metal complexes in medicine.
11. **Nuclear chemistry:** nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

b. Physical Chemistry

1. **Quantum mechanics:** Postulates of quantum mechanics; Time dependent and time independent Schrödinger equations; Born interpretation; Particle in a box; Harmonic oscillator; Rigid rotor; Hydrogen atom; Multi-electron atoms; orbital approximation; Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
2. **Structure:** Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.
3. **Molecular spectroscopy:** Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.
4. **Chemical thermodynamics:** Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
5. **Statistical thermodynamics:** Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems. BE and FD statistics.
6. **Electrochemistry:** Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations. Primary and secondary solvation, salting in and salting out effect, Debye Huckel theory, Laws of diffusion, Debye-Huckel-Onsager equation, transport properties. Fuel cell, photoelectrochemistry and solar cells.

7. **Chemical kinetics:** Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions; electron transfer reactions (outer and inner sphere), redox reactions.
8. **Surfaces and Interfaces:** Physisorption and chemisorption; Langmuir; Freundlich and BET isotherms; Surface catalysis: Langmuir-Hinshelwood mechanism; Physical chemistry of colloids; micelles and macromolecules.
9. **Solid state:** Crystal structures; Bragg's law and applications; band structure of solids.
10. **Polymer chemistry:** Molar masses; kinetics of polymerization.

c. Organic Chemistry

1. **IUPAC nomenclature**: IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. **Principles of stereochemistry:** Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity, asymmetric induction and synthesis.
3. **Aromaticity:** Benzenoid and non-benzenoid compounds – generation and reactions.
4. **Organic reactive intermediates:** Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
5. **Organic reaction mechanisms:** Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
6. **Named reactions:** Common named reactions and rearrangements – applications in organic synthesis.
7. **Organic transformations and reagents**: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.
8. **Concepts in organic synthesis**: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.
9. **Pericyclic reactions**: Electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
10. **Heterocyclic Chemistry:** Synthesis and reactivity of common heterocyclic compounds containing one and two heteroatoms (O, N, S).
11. **Chemistry of natural products:** Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
12. **Spectroscopic techniques in characterization of organic molecules:** Theory, instrumentation and applications of (a) UV-Vis (b) FTIR, (c) NMR and (d) mass spectrometric techniques.

Mathematics

1. **Analysis:** Elementary set theory, finite, countable and uncountable sets, real number system as a complete ordered field, Archimedean property, supremum, infimum, sequences and series, convergence, limsup, liminf, Bolzano Weierstrass theorem, Heine Borel theorem, continuity, uniform continuity, differentiability, mean value theorem, sequences and series of functions, uniform convergence, Riemann sums and Riemann integral, improper Integrals, monotonic functions, types of discontinuity, functions of bounded variation, functions of several variables, directional derivative, partial derivative, derivative as a linear transformation, metric spaces, compactness, connectedness, completeness, Bare category theorem.
2. **Linear Algebra:** Vector spaces, subspaces, linear dependence, basis, dimension, algebra of linear transformations, algebra of matrices, rank and determinant of matrices, linear equations, eigenvalues and eigenvectors, Cayley-Hamilton theorem, matrix representation of linear transformations, change of basis, canonical forms, diagonal forms, triangular forms, Jordan forms, inner product spaces, orthonormal basis, quadratic forms, reduction and classification of quadratic forms.
3. **Complex Analysis:** Algebra of complex numbers, the complex plane, polynomials, power series, transcendental functions such as exponential, trigonometric and hyperbolic functions. Analytic functions, Cauchy-Riemann equations, contour integral, Cauchy's theorem, Cauchy's integral formula, Liouville's theorem, maximum modulus principle, Schwarz lemma, open mapping theorem, Taylor series, Laurent series, calculus of residues, conformal mappings, Mobius transformations.
4. **Abstract Algebra:** Fundamental theorem of arithmetic, divisibility in Z, congruences, Chinese Remainder Theorem, Euler's Ø- function, primitive roots, groups, subgroups, normal subgroups, quotient groups, homomorphisms, cyclic groups, permutation groups, Cayley's theorem, class equations, Sylow theorems, rings, ideals, prime and maximal ideals, quotient rings, unique factorization domain, principal ideal domain, Euclidean domain, polynomial rings and irreducibility criteria, fields, finite fields, field extensions.
5. **Functional Analysis:** Normed linear spaces, Banach spaces, Hahn-Banch theorem, open mapping and closed graph theorems, principle of uniform boundedness, boundedness and continuity of linear transformations, dual space, embedding in the second dual, Hilbert spaces, projections, orthonormal basis, Riesz-representation theorem, Bessel's inequality, Persaval's identity, self-adjoined operators, normal operators, unitary operators.
6. **Topology:** Elements of topological spaces, continuity, convergence, homeomorphism, compactness, connectedness, separation axioms, first and second countability, separability, sub- spaces, product spaces, quotient spaces, subspaces, product spaces, quotient spaces, Tychonoff's theorem, Urysohn's metrization theorem.
7. **Measure Theory:** Algebra and sigma algebra, inner and outer measures, measurable and measure species, extension of measure, signed measure, Lebesgue measure, Lebesgue integral, Jordan-Hahn decomposition theorems, integration, monotone convergence theorem, Fatou's lemma, dominated convergence theorem, absolute continuity, Radon-Niiodym theorem, product measures, Fubinl's theorem.
8. **Discrete Mathematics:** Partially ordered sets, lattices, complete lattices, distributive lattices, complements, Boolean algebra, Boolean expressions, application to switching circuits, elements of graph theory, Eulerian and Hamiltonian graphs, planar graphs, directed graphs, trees, permutations and combinations, Pigeon-hole principle, principle of inclusion and exclusion, derangements.

9. **Probability & Statistics:** Sample space, discrete probability, independent events, Bayes theorem, random variables and distribution functions (univariate and multivariate), expectation and moments, independent random variables, marginal and conditional distributions, characteristic functions, probability inequalities (Tchebyshef, Markov, Jensen), modes of convergence, weak and strong laws of large numbers, central limit theorems, Markov chains with finite and countable state space, classification of states, limiting behavior of n-step transition probabilities, stationary distribution, standard discrete and continuous univariate distributions, sampling distributions, standard errors and asymptotic distributions, distribution of order statistics and range, methods of estimation, properties of estimators, confidence intervals, tests of hypotheses: most powerful and uniformly most powerful tests, likelihood ratio tests, analysis of discrete data and chi-square test of goodness of fit, large sample tests, simple non-parametric tests for one and two sample problems, rank correlation and test for independence, elementary Bayesian inference.
10. **Ordinary Differential Equations (ODEs):** Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations, singular solutions of first order ODEs, system of first order ODEs, general theory of homogenous and non-homogeneous linear ODEs, variation of parameters, Sturm-Liouville boundary value problem, Green's function.
11. **Partial Differential Equations (PDEs):** Lagrange and Charpit methods for solving first order PDEs, Cauchy problem for first order PDEs, classification of second order PDEs, general solution of higher order PDEs with constant coefficients, method of separation of variables for Laplace, Heat and Wave equations.
12. **Numerical Analysis:** Numerical solutions of algebraic equations, method of iteration and Newton-Raphson method, rate of convergence, solution of systems of linear algebraic equations using Gauss elimination and Gauss-Seidel methods, finite differences, Lagrange, Hermite and spline interpolation, numerical differentiation and integration, numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.
13. **Calculus of Variations:** Variation of a functional, Euler-Lagrange equation, necessary and sufficient conditions for extrema, variational methods for boundary value problems in ordinary and partial differential equations.
14. **Transforms and Integral Equations:** Laplace transforms, inversion formula of laplace transform, fourier transforms; sine and cosine transform, inverse fourier transform, transform of elementary functions, transform of derivatives, inverse transform, convolution theorem, application, ordinary and partial differential equations, application to ordinary and partial differential equations, linear integral equation of the first and second kind of Fredholm and Volterra type, solutions with separable kernels, characteristic numbers and eigenfunctions, resolvent kernel.
15. **Classical Mechanics:** Generalized coordinates, Lagrange's equations, Hamilton's canonical equations, Hamilton's principle and principle of least action, two-dimensional motion of rigid bodies, Euler's dynamical equations for the motion of a rigid body about an axis, theory of small oscillations.
16. **Mathematical Programming:** Linear programming, simplex method, duality in linear programming, sensitivity analysis and parametric linear programming, transformation and assignment problems, two person-zero sum games, equivalence of rectangular game and linear programming, elementary queuing and inventory models, steady-state solutions of Markovian queuing models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space, M/G/1, Kuhn-Tucker conditions of optimality, quadratic programming, methods due to Beale and Wofle, duality in quadratic programming, self-duality, integer programming, multi-objective non-linear programming.

Geography

UNIT I (Geomorphology)

1. Geological Time Scale
2. Global Tectonics
3. Fundamental Concepts
4. Weathering and Mass Wasting
5. Fluvial Processes and Landforms
6. Cycle of Erosion (Davis, Penck, King & Hack)
7. Theories and Process of Slope Development

UNIT II (Climatology)

1. Nature and Composition of Atmosphere
2. Pressure Belts and Wind System
3. Climatic Classification of Koppen & Thornthwaite
4. Tropical Disturbances
5. Monsoon
6. El Nino and La Nina
7. Climate Change & Global Warming

UNIT III (Hydrology and Oceanography)

1. Global Hydrological Cycle
2. Runoff, Infiltration, Evapotranspiration
3. Ground Water: Occurrence and Storage
4. Major Relief Features of the Ocean Floor
5. Air-sea Interactions, Ocean Circulation, Wave and Tide
6. Ocean Temperature and Salinity
7. Sea Level Change

UNIT IV (Ecology and Environment)

1. Biosphere and Environment
2. Basic Principles of Ecology
3. Food Chain, Food Web and Energy Flow
4. Biomes
5. Biodiversity
6. Human Ecology
7. Environmental Programmes and Polices (National and International)

UNIT V (Cultural, Social and Political Geography)

1. Concept of Culture, Cultural Heritage and Cultural Ecology
2. Cultural Convergence, Social Structure and Processes
3. Social Well-being and Quality of Life, Social Exclusion
4. Spatial distribution of social groups in India (Tribe, Caste, Religion and Language)
5. Geostrategic Views: Heartland and Rimland
6. Regional Organizations of Cooperation (SAARC, ASEAN, OPEC, EU)
7. Neopolitics of World Natural Resources

UNIT VI (Development and Planning)

1. Concept of Region
2. Concept of Development and Planning
3. Concept of Rural and Urban Development
4. Settlement Types and Patterns
5. Population Growth and Policy

UNIT VII (Geographical Thought)

1. Contributions of Greek, Roman, Arab, Chinese and Indian Scholars
2. Major Geographic Traditions (Earth Science, man-environment relationship, area studies and spatial analysis)
3. Dualisms in Geographic Studies (physical vs. human, regional vs. systematic, qualitative vs. quantitative, ideographic vs. nomothetic)
4. Paradigm Shift, Perspectives in Geography (Positivism, Behaviouralism, Humanism, Structuralism, Feminism and Postmodernism)

UNIT VIII (Remote Sensing and GIS)

1. Basics of Remote Sensing (Electromagnetic Spectrum, Sensors and Platforms, Resolution and Types, Elements of Air Photo and Satellite Image Interpretation and Photogrammetry)
2. GPS Components (space, ground control and receiver segments) and Applications
3. GIS Database (raster and vector data formats and attribute data formats)
4. Digital Image Processing and Classification

Botany

1. **Microbiology**: General characteristics, classification, distribution, structure, reproduction and importance of viruses, mycoplasmas, bacteria and Archea; Brief account of viroid's and prions; Bacterial locomotion; Quorum sensing; Microbial Growth curve; Mathematical expression of exponential growth phase; Synchronous growth; Bacterial culture; Microbial metabolism; Bacterial biofilm and biofouling; Mechanism of microbial pathogenicity; Nonspecific defense of host; Antigen antibody interaction ; Humoral and cell mediated immunity; Vaccines; passive immunization; Human diseases caused by viruses and bacteria; Applied microbiology- Microbiology of milk, water and food, methods of food preservation, food poisoning and toxicity; Industrial production of ethanol, wine, citric acid, penicillin, bio fertilizers and bio insecticides; *Azatobacter, Rhizobium*, *Bacillus thurengensis* and NPV
2. **Algae**: General characteristics, distribution, classification, structure, reproduction, evolutionary trends and economic importance of Algae; Physiology and biochemistry of algal cell; Endosymbiotic theory of origin of chloroplasts; Salient features of Cyanobacteria, Chlorophyta, Heterokontophyta (Xanthophyceae, Bacillariophyceae, Phaeophyceae) and Rhodophyta;

   Fungi: Physiological and molecular basis of mating systems. Somatic structures, reproduction; Mating system of Ascomycota and Basidiomycota; Development and types of ascocarps, basidiocarps and spore dispersal Mechanism; Aflatoxins & phytoalexins.

   Archegoniates: Structure and evolution of gametophytes and sporophytes. Stelar evolution ptreidophytes. Heterospory and seed habit. Brief account of fossil bryophytes, fossil pteridophytes and fossil gymnosperms.

3. **Plant pathology**: Classification of plant diseases, Host-pathogen interaction, Defence mechanism of host, plant disease epidemiology and disease forecasting; Symptoms, etiology, epidemiology and management of Downy mildew and powdery mildew of crop plants, Black stem rust of wheat, Loose smut of wheat, Brown spot and bacterial bight and blast of rice, Wilt of pigeon pea, Anthracnose of jute, Crown gall diseases, Scab of potato; Methods of plant disease management, Biopesticide and its mode of action, Integrated control of plant diseases.
4. **Plant Taxonomy**: Introduction to the Angiosperms, Taxonomic History; Categories of classification, Botanical Nomenclature; ICBN and ICN, Principles of Priority; Phylogenetics; Keys for identification of plants; Salient features, evolutionary trends and phylogeny in Magnoliidae, Hamamelidae, Caryophyllidae, Rosideae, Asteridae, Alismatidae and Liliidae (sensu lato Cronquist, 1981) and Outline concept of APG System of plant classification, concepts of palaeoherbs, eudicots. Economic importance of cereals, pulses, oil yielding crops, fiber yielding crops, spices, beverages and medicinal plants; Herbarium, IUCN threat categories: methods of assessment; strategies of *in situ* and *ex situ* conservation; CITES and TRAFFIC; General idea about Red Data Book, Ethnobotany.
5. **Paleobotany, Palynology and Reproductive Biology of Angiosperms**: types, nomenclature, modes of preservation of fossils; Outline of Standard Geologic time Scale; Origin and evolution of early life forms ; Continental Drift Hypothesis and Plate Tectonics; Types of datings. Microspore tetrads and polarity of spores and pollen grains, Spore-pollen morphology, NPC System of pollen-spore classification, exine stratification, surface structures and sculptures of sporoderm; structure and function of Sporopollenin; Application of palynology, Aeropalynology and allergy. Types of pollination; Pollen dispersal units; contrivances for cross-and self-pollination; pollen vectors, pollination modes and floral organization, microsporogenesis, megasporogenesis, fertilization, embryo and endosperm development, polyembryony and apomixis, Breeding systems, self-incompatibility and compatibility control with reference to pollen-pistil interactions.

6. **Plant anatomy and Pharmacognosy**: Classification and cytological characteristics of meristems, secondary growth, ecological anatomy, nodal anatomy, seed anatomy and pathological anatomy. Secretory tissues in plants; Types, Development and Ultrastructure of Bark, Transfer cells; Structure and Commercial importance of wood and plant fibres; Scope of pharmacognosy crude plant drugs; Secondary metabolites of plants and their significance; Types and production of secondary metabolites; Classification, sources and uses of Alkaloids and Glycosides; Adulteration of drugs and detection.
7. **Plant Physiology and Biochemistry**: Plant Water Relation, Stomatal physiology, Signal transduction in guard cell; Solute Transport; Photochemistry and Photosynthesis- Photosynthetic pigments, Absorption and transformation of radiant energy, Light harvesting complexes, ETS, photo inhibition, O_2 and H_2O evolution, Regulation of Calvin cycle, RUBISCO activity, Photorespiration, CAM and C4 pathway; Respiration: EMP pathway, TCA cycle, PPP, Glyoxylate cycle, Mitochondrial ETS, Gluconeogenesis, Synthesis and utilization of ATP; Photoperiodism- Photoperiodic classes, Photoperiodic induction, phytochrome; Biosynthesis and action mechanism of: Auxins, Gibberellins, (GA), Cytokinins, Ethylene, Abscissic Acid; Metabolic changes during flowering, maturity and fruiting , fruit ripening; Biochemical and molecular basis of dormancy, Hormonal regulation of dormancy and germination of seed; Regulation of senescence ; cytological, physiological and biochemical changes during abscission; programmed cell death in life cycle of plants. Biotic and abiotic stresses, heat stress and salt stress. Enzymology- classification, Isozymes, Factors affecting enzyme activity, Enzyme Kinetics, Competitive, uncompetitive and non-competitive inhibition, Allosteric mechanism; Structure, functions and metabolism of Carbohydrates, Protein, Lipids and nuclic acids; Nitrogen metabolism; Secondary metabolites- Phenolics, Flavonoids, terpenoids, Alkaloids, pigments.
8. **Cell Biology and Genetics**: Nature, structure and function of cell and its organelles, Molecular organization of chromosome; Chromosome banding; Mechanism of replication, mutation, repair, transposition, Cell division, Cell cycle- Biochemical and molecular events and cell cycle regulation. Organization of genetic material and concept of gene; Genetic code, Regulation of gene expression with special reference to two component gene regulatory system; RNA processing, Mendelian genetics, Gene interactions and modified Mendelian ratios, linkage, crossing over, chromosome mapping, molecular basis of recombination, Extranuclear inheritance; Sex determination and dosage compensation; Population genetics: Hardy-Weinberg Hypothesis, factors affecting allelic frequency in population. Genetic drift, inbreeding depression.
9. **Biotechnology**: Recombinant DNA technology- Plasmids, Cosmids, Phagemids, BACs, YACs; Plasmid isolation, restriction enzymes, digestion, agarose gel electrophoresis and transformation; Cloning strategies & screening of recombinant clones: Lac operon: Blue/white selection; Applications of recombinant DNA in agriculture and medicine; Gene library; CRISPR-CAS discovery, mode of action and application.
10. **Plant Breeding and Tissue Culture**: Plant introduction, Methods of plant breeding- pure line selection, back cross, pedigree selection, mass selection and clonal selection; Composite and Synthetic varieties, hybridization technique, Heterosis and hybrid vigor, Applications of plant breeding for crop improvement. Marker Assisted Selection, QTL analysis.Morphogenesis, Plant growth and development, Polarity, Photo morphogenesis, Cellular basis, Relative and abnormal growth, Differentiation and regeneration; History of tissue culture and importance, Basic requisites, MS and White's media; Roles of nutritional inputs; Totipotency, Principle, methodology and applications of callus culture, organogenesis, embryo, endosperm and meristematic tip, anther, protoplast and suspension culture, micropropagation, secondary metabolite production.
11. **Ecology and Environmental Science**: Concept of ecology; Habitat and niche concept; Ecosystem organization- structure and functions, ecological pyramids, food chains and food webs, primary

production; Energy dynamics; Concept of community and continuum; Ecological succession and climax concept; Major biome of the world; Ecological plant adaptations; Population concepts, life history strategies (r and k selection).

Environmental pollution, types of pollutants, effect of pollution on ecosystems; Greenhouse effect and global warming; Biomonitoring of pollution; Central and State pollution control board; Environmental awareness, law and acts; Environmental movements in India; Earth summits; Biodiversity and conservation, CBD and Ramsar sites.

12. **Methods in Plant Sciences**: Microscopy: Phase contrast microscope, Confocal microscope, fluorescent microscope, scanning and transmission electron microscope, Principles, types and applications of Chromatography, UV/visible & fluorescence, Spectroscopy, Electrophoresis, Centrifugation; Autoradiography, flow cytometry, chromosome banding and karyotyping; blotting techniques; DNA Sequencing; PCR, RFLP, AFLP, RAPD and ELISA, RIA, FISH and GISH.

Zoology

1. **Animal world:** Animal diversity, zoo geographical realms, barriers and dispersal, discontinuous distribution, systematics: principles of classifications, different species concept, classification of animals, phylogenetic relationships with reference to Onychophora, Hemichordata, Branchiostoma, Rhyncocephalia, Monotremata and Marsupialia).
2. **Evolution:** Origin and history of life on earth, theories of evolution (*Neo Darwinism, punctuated equilibrium hypothesis, evolution and tinkering, Kimura's concept of neutral mutation, molecular drive hypothesis*), natural selection and types of selection, genetic drift and bottle neck effect, Founder principle, adaptation (cursorial, fossoreal, arboreal, desert), allopatric, sympatric and parapatric speciation.
3. **Genetics:** Mendalian principles of inheritance, molecular basis of heredity, sex determination and sex-linked characteristics in *Drosophila* and human, cytoplasmic inheritance in *Paramoecium* and snail, linkage and crossing over, Bacterial recombination, genes mapping in eukaryotes, dosage compensation in Drosophila and human, Population genetics. Genetics of Cancer, Gene Therapy (RNAi, Si RNA, hnRNA, *in vivo* gene therapy), population genetics and epidemiology.
4. **Biochemistry and Molecular Biology:** Structure, function and metabolism of carbohydrates, proteins, lipids and Nucleic acids; DNA replication, transcription and translation in prokaryots and eukaryots; *Operon* concept, regulation of eukaryotic gene organization and expression, formation of urea, Oxidation of fatty acids*, de novo* synthesis of fatty acids,. Electron transport chain, Mechanism of enzyme catalysis, Inhibition, Allosterism, hormones and their synthesis, mode of actions and biological importance (protein, steroid and thyroid hormones), hormonal disorders (T2DM, T1DM, hypo and hyper thyroidism, virilism), vitamins (source, functions and deficiency signs).
5. **Cell Biology:** Biomembrane Structure with reference to carbohydrate, protein and lipid asymmetry, and membrane fluidity, Transmembrane Transport, Structure and functions of cellular organelles (neucleus, mitochondria, Golgi body, lysosome, ER, peroxisome), chromosomes and chromatin structure, cell division, Cell cycle & its regulation, Signal Transduction
6. **Methods in Biology:** PCR,,Cloning Vector, Recombinant DNA technology, DNA finger printing, Bioremediation , Phytoremediation, Cryopreservation. Principles of Electrophoresis (1D and 2D), Agarose, SDS-PAGE, immune electrophoresis, Cell fractionation, Ultracentrifugation, Blotting techniques, Chromatography, Flow Cytometry, FISH.
7. **Animal Anatomy and Physiology:** Comparative anatomy of heart, kidney and brain in vertebrates, swim bladder and accessory respiratory organs in fish, ruminant stomach, Oxidative stress, Free radical biology, thermoregulation and osmoregulation.
8. **Parasitology and Immunology:** Types of parasites and hosts, host-parasite interactian, protozoan and helminthic parasites, Epidemiology and transmission of parasitic diseases, Vector biology, Cells and organs involved in Immune System, cellular and humoral immune response, Major Histocompatibility Complex (MHC), Mechanism of immune response, Complement system, ELISA, RIA, Immunohistochemistry, vaccination development and passive immunization.
9. **Development Biology:** Cellular differentiation, gametogenesis, mechanism of fertilization, prevention of polyspermy, embryonic induction, Organogenesis (heart, kidney, eye, placentation), Metamorphosis (progressive and retrogressive), Genetic basis of development, Stem cells and their application. Regeneration in animals, parthenogenesis (natural and artificial)
10. **Ecology:** Biosphere and Ecosphere (concept of food chain and food web, nodes, links, linkage density, connectance and chain length), types of ecosystem and habitats, population dynamics (age pyramids, survivorship curve, life table, *r* & *k* selection, Lotka-Volterra model of completion and prey predator

relation), types of species (key stone species, foundation species, flagship species), ecotone and edge effects, habitat and niche concept, competitive exclusion principle, ecological guild, ecological succession, Hamilton's theory of inclusive fitness model, types of biogeochemical cycles, conservation biology (importance, approaches and management).

11. **Environmental biology and Ecotoxicology:** Environmental pollutions (air, water, soils, plastic and noise), sustainable environmental management, EIA, greenhouse effect, global warming, acid rain, ecodegradation and conservation, Green movements. Classification and properties of Xenobionts, mechanism of action, concept of LC_{50} and LD_{50}, Heavy metal toxicity, Immunotoxicology, Environmental genotoxicity studies (tools and techniques) with special references to aquatic organisms.

Microbiology

1. **Microbiology:** Characteristics of Bacteria, Morphology-structure of a typical bacterial cell- size, shape, arrangement; ultrastructures- flagella, pili, cell-wall, cytoplasmic membrane, spore, capsule, prokaryotic cellular reserve materials; Sterilization and Disinfection.
2. **Growth and cell division:** Measurement of growth, cell division, growth yields, steady state growth, batch and continuous growth.
3. **Cultivation of microbes:** aerobic, anaerobic and facultative. Pure culture and its characteristics; Nutritional types, culture media. Measurement of growth (direct and indirect) and factors affecting growth.
4. **Fungi:** Morphology & reproduction of fungi.
5. **Virus:** General properties of viruses, Classification of viruses, Morphology: Virus structure; Herpesvirus, Poliovirus, SV40 and Adeno Virus, Poxviruses, Hepatitis viruses, A, B, C, D, E; coronaviruses, Retroviruses.COVID-19, Bacteriophage.
6. **Medical microbiology:** Microbes as causal agents of human and animal diseases; Immunology: basic concepts, vaccines, immunotherapy, Cells and organs involved in Immune System, cellular and humoral immune response, Major Histocompatibility Complex (MHC), Mechanism of immune response, Complement system, ELISA, RIA, Immunohistochemistry, vaccination development and passive immunization.
7. **Application of microbes in fermentation processes/Industrial microbiology:** Types, design and maintenance of bioreactors, application of fermentation technology in industry, Applied microbiology-Microbiology of milk, water and food, methods of food preservation, food poisoning and toxicity; Industrial production of ethanol, wine, citric acid, penicillin, bio fertilizers and bio insecticides; *Azatobacter*, *Rhizobium*, *Bacillus thurengensis* and NPV
8. **Laboratory techniques:** Biosafety Level Criteria (BSL-1-4). Handling, transfer and shipment of specimen. Decontamination and disposal. Treatment and disposal technologies for health- care waste. Safety equipment & Safety signs. Cleaning and decontamination of glassware and laboratory waste materials. Sterilization techniques. Microscopy-type and application. UV-VIS spectroscopy, NMR spectroscopy. Centrifugation-principle, type & application. Chromatography-principle, types, and application. Electrophoresis- Agarose and PAGE. ELISA and Auto-analyser. PCR, RT-PCR- principle & Application. Blotting techniques. Cell culture, Immunohistochemistry, Flow cytometry.
9. **Cell and molecular Biology:** Cell & its Organelles - Structure and Function; Cell Cycle; Transport across Cell Membranes. Molecular structure of genes and chromosomes Replication –Transcription – genetic code – Translation, DNA damage and repair. Recombinant DNA Technology. Molecular basis of genetic diseases. Gene therapy.
10. **Microbial genetics:** Conjugation, transformation, transduction, recombination, regulation of gene expression in microbes.

Nutrition

A. Community Nutrition and Public Health

1. Nutritional Epidemiology

i. Levels of epidemiologic research (primary, secondary and tertiary prevention)

ii. Observational studies-cross-sectional, case control, cohort(prospective, retrospective, time-series)

iii. Types of analysis-eg., incidence rate, prevalence rate

2. Experimental studies

i. Pre-Clinical studies-laboratory based in vitro and animal studies

ii. Clinical studies-Human intervention trials. Types-Randomized controlled trials (RCT), Non Randomized trial.

3. Global Nutrition Scenario- Determinants of Nutritional status, prevalence of deficiencies in different age groups, country wise comparison and differences

4. Food Security

5. National Nutrition Policy and programmes, organizations/ associations working in the area of Food Science and Nutrition

B. Food commodities and processing

1. Primary, secondary and tertiary processing, historical perspective, traditional technologies used in food processing.

2. Effects of processing on components, properties and nutritional value of foods,

3. Processing (Types, composition, cooking & processed products) of wheat, Rice, Millets, Legume, Oilseeds, Fruits and vegetables.

C. Sensory evaluation of foods: Texture, Colour, Aroma, flavour etc. of different foods.

D. Health modulating nutrients: Nutrients on Endurance & Performance modulators: Bio-energetics & Metabolism in exercise, Hormonal response & Exercise, Ergogenic aid, Body composition & Performance, Formulated foods: Definition, Criteria, Applied value Polymeric foods: Types, characters and application, Monomeric foods: Types, characters and application, Drug-Nutrient Interaction-Pharmacokinetics, Pharmacodynamics, Role of drug on nutrient absorption, transportation, bioavailability and vice-versa. Role of nutrient on drug absorption, bioavailability, metabolism, and transportation and vice-versa. Inborn Error of Metabolism Phenylketonuria, MSU, Galactosemia, Albunism, Nutrients & Cardiovascular activities including pathophysiology : Biogenesis of cardiovascular activities like TG, TC, HDL, LDL & VLDL, Atherosclerosis, Role of nutrients for its protection, Role of PUFA & MUFA on cardiovascular disease.

E. Cell and molecular Biology: Cell & its Organelles - Structure and Function; Cell Cycle; Transport across Cell Membranes. Molecular structure of genes and chromosomes Replication –Transcription – genetic code – Translation, DNA damage and repair. Recombinant DNA Technology. Molecular basis of genetic diseases. Gene therapy.

F. Laboratory techniques: Biosafety Level Criteria (BSL-1-4). Handling, transfer and shipment of specimen. Decontamination and disposal. Treatment and disposal technologies for health- care waste. Safety equipment & Safety signs. Cleaning and decontamination of glassware and laboratory waste materials. Sterilization techniques. Microscopy-type and application. UV-VIS spectroscopy, NMR

spectroscopy. Centrifugation-principle, type & application. Chromatography-principle, types, and application. Electrophoresis- Agarose and PAGE. ELISA and Auto-analyser. PCR, RT-PCR- principle & Application. Blotting techniques. Cell culture, Immunohistochemistry, Flow cytometry

Medical Laboratory Technology

1. **Cell and molecular Biology:** Cell & its Organelles - Structure and Function; Cell Cycle; Transport across Cell Membranes. Molecular structure of genes and chromosomes Replication –Transcription – genetic code – Translation, DNA damage and repair. Recombinant DNA Technology. Molecular basis of genetic diseases. Gene therapy.
2. **Physiology:** Human Body-an over view. Tissues-Structure, function, visceral organs. Musculoskeletal system-joints and movements, muscle contraction. Circulatory system-Heart, blood pressure, lymphatic system. Respiratory system-gas transport, respiratory volumes & capacities. Digestive System-gastrointestinal secretions & functions. Excretory system- nephron, GFR, urine formation. Reproductive System-male & female. Endocrine System: hormones, functions. Nervous system-Brain, spinal cord, structure of neuron- synapse- transmission of nerve impulse.
3. **Haematology:** Blood cells-types, functions. Haematopoiesis-erythropoiesis. Hb-structure & function. Disorders of RBC, WBC and Hb. ABO blood grouping. Inheritance of the Blood groups. Blood transfusion. Anticoagulant.
4. **Biochemistry:** Biomolecules and their classification; enzymes-Kinetics, activators and inhibitors; Bioenergetics; Metabolism (Glycolysis, TCA and Oxidative phosphorylation); signal transduction.
5. **Microbiology:** Prokaryotic and eukaryotic cell structure; Microbial nutrition, growth and control; Microbial metabolism (aerobic and anaerobic respiration, photosynthesis); Nitrogen fixation; Chemical basis of mutations and mutagens; Microbial genetics (plasmids, transformation, transduction, conjugation); Microbial diversity and characteristic features; Host-pathogen interaction. Opportunistic pathogens. Antibiotics resistance and managements.
6. **Immunology**: Innate and adaptive immunity; Humoral and cell mediated immunity; Primary and secondary lymphoid organ; Antigen; B and T cells and Macrophages; Major histocompatibility complex (MHC); Antigen processing and presentation; Synthesis of antibody and secretion; Molecular basis of antibody diversity; Polyclonal and monoclonal antibody; Complement; Antigen–antibody reaction; Regulation of immune response; Immune tolerance; Hyper sensitivity; Autoimmunity; Graft versus host reaction.
7. **Pathology:** Pathology, etiology, pathogenesis-definition. Mechanism of Cell injury-hypoxia, free radical, ionizing radiation. Apoptosis & necrosis. Inflammation. Neoplacia. Nutritional disorders-PEM, vitamins deficiency. Systemic pathology of blood vessels, heart, respiratory system, bone and joints, muscles and nervous system. Clinical pathology of urine, stool, sputum, semen.
8. **Laboratory techniques:** Biosafety Level Criteria (BSL-1-4). Handling, transfer and shipment of specimen. Decontamination and disposal. Treatment and disposal technologies for health- care waste. Safety equipment & Safety signs. Cleaning and decontamination of glassware and laboratory waste materials. Sterilization techniques. Microscopy-type and application. UV-VIS spectroscopy, NMR spectroscopy. Centrifugation-principle, type & application. Chromatography-principle, types, and application. Electrophoresis- Agarose and PAGE. ELISA and Auto-analyser. PCR, RT-PCR- principle & Application. Blotting techniques. Cell culture, Immunohistochemistry, Flowcytometry.
9. **Biostatistics:** Definition, role of statistics in health science and health care delivery system. Sampling, probability, mean, median, mode, quartiles and percentiles, variance, standard deviation, Standard error of mean, coefficient of variation, Null and alternate hypothesis, type I and type II errors, level of significance, p value. t - Test (paired and unpaired), Chi square test, one way analysis of variance (ANOVA). Correlation coefficient. Linear and multiple regressions
10. **Basic computer knowledge:** MS-office, statistical software-Graph Pad Prism, SPSS, Origin, Statistica.

English

1. British Literature from Chaucer to Present.
2. Postmodern Literature.
3. American and other non-British Literature.
4. Popular Literature, Post Colonial Literature and World Literature.
5. Classical Literature.
6. English criticism from Aristotle to New Criticism.
7. Literary theory from 1950 to Present.
8. History of English Language and fundamentals of English Linguistics.
9. ELT: Language related theories, methods, approaches and techniques.

MIDNAPORE CITY COLLEGE

Department of Paramedical & Allied Health Sciences

PHYSIOLOGY SYLLABUS OF WRITTEN ENTRANCE TEST (WRET) FOR ADMISSION TO Ph.D. (Sc.) PROGRAMME

Cell and molecular Biology: Cell & its Organelles - Structure and Function; Cell Cycle; Transport across Cell Membranes. Molecular structure of genes and chromosomes Replication –Transcription – genetic code – Translation, DNA damage and repair. Recombinant DNA Technology. Molecular basis of genetic diseases. Gene therapy.

Cell signalling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways.

Cellular communication: General principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

Cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

Immunology: Innate and adaptive immunity; Humoral and cell mediated immunity; Primary and secondary lymphoid organ; Antigen; B and T cells and Macrophages; Major histocompatibility complex (MHC); Antigen processing and presentation; Synthesis of antibody and secretion; Molecular basis of antibody diversity; Polyclonal and monoclonal antibody; Complement; Antigen–antibody reaction; Regulation of immune response; Immune tolerance; Hyper sensitivity; Autoimmunity; Graft versus host reaction.

SYSTEM PHYSIOLOGY –

A. Blood and circulation: Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.

B. Cardiovascular System: Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

C. Respiratory system: Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

D. Nervous system: Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.

E. Sense organs: Vision, hearing and tactile response.

F. Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance.

G. Thermoregulation: Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.

H. Stress and adaptation

I. Digestive system: Digestion, absorption, energy balance, BMR.

J. Endocrinology and reproduction: Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation.