Entrance Examination for Five Year Integrated M.Sc. in Molecular Biology Syllabus

(Based on Karnataka state Pre University Course Syllabus Both 1st and 2nd year)

Duration of Entrance Examination: 1 Hour

Pattern: **50 Multiple Choice Questions** of one mark each

Biology -30, Chemistry -10, Physics -5 and Mathematics -5 questions

Biology

UNIT I: CELL: STRUCTURE AND FUNCTION - Cell and its three major parts: Cell Membrane, cytoplasm, nucleus - Cell theory and the cell as the basic unit of life - Structure of the Prokaryotic and eukaryotic cell - Plant cell and animal cell (brief) - Cell Organelles: Cell envelope, cell membrane, cell wall structure and function: mitochondria, Golgi bodies / dictyosomes, endoplasmic reticulum, ribosomes, lysosomes, vacuoles, plastids, microbodies - Cytoskeleton, cilia, flagella, centrioles (Ultrastructure and function) - Nucleus: nuclear membrane, chromatin, nucleolus - Chemical constituents of living cells - Biomolecules: Structure and functions of carbohydrates, proteins, fats, lipids and nucleic acids - Enzymes: types, properties, function and enzyme action - Cell division: Cell cycle, significance and differences between Mitosis and Meiosis.

UNIT II: PLANT PHYSIOLOGY Movement of water, food, nutrients and gases - Absorption of water, gases and nutrients - Cell to Cell transport - Diffusion, facilitated diffusion, active transport - Plant-Water Relations - Imbibition, water potential, osmosis, plasmolysis - Long Distance Transport - Apoplast, symplast, root pressure, transpiration pull - Transportation and Guttation - Opening and closing of stomata - Role of K^+ ions -Uptake of mineral and their translocation - Transportation through xylem and phloem -Plants and mineral nutrition - Essential minerals, macro- and micronutrients and their role - Deficiency symptoms - Mineral toxicity - Elementry idea of Hydroponics as a Method to study mineral nutrition - Nitrogen metabolism: Nitrogen cycle, biological nitrogen fixation -Plants Respiration - Exchange of gases - Cellular respiration: glycolysis, fermentation (anaerobic) - Energy Relation: Number of ATP molecules generated - Amphibiotic pathways - Respiratory quotient of nutrient - Photosynthesis - Autotropic nutrition - Site of photosynthesis - Photosynthetic pigments (Elementary idea) - Photosynthetic and biosynthetic phases of photosynthesis - Cyclic and non-cyclic photophosphorylation - Chemiosmotic hypothesis - Photorespiration - C_3 and C_4 pathways.

Factors affecting photosynthesis - Law of Limiting Factors -Plant Growth and Development - Phases of plant growth and plant growth rate - Condition for Growth - Differentiation, dedifferentiation and redifferentiation - Sequence of developmental process in a plant cell - Growth regulators: auxin, gibberellin, cytokinin, ethylene, ABA - Photomorphogenesis including brief account of phytochromes (Elementary Idea) - Seed germination - Seed dormancy - Vermalization, Photoperiodism

UNIT III: HUMAN PHYSIOLOGY: Digestion and Absorption - Human alimentary canal and Digestive glands - Role of digestive enzymes and gastrointestinal hormones - Peristalsis - Digestion, absorption and assimilation of proteins, carbohydrates and fats - Calorific value of proteins, carbohydrates and fats - Egestion - Nutritional and digestive disorders – P E M, indigestion, constipation, vomiting, jaundice Breathing and Respiration - Respiratory organs in animals (Recall only) - Respiratory system in humans - Mechanism of Breathing and its regulation in humans - Exchange of gases, transport of

gases and regulation of respiration in humans - Respiratory volumes - Disorders related to respiration – Asthma, Emphysema, Occupational Respiratory disorders Body fluids and Circulation - Composition of blood, Blood groups, Coagulation of blood - Composition of Lymph and function - Human circulatory system - Structure of human heart and blood vessels - Cardiac cycle, Cardiac output, ECG - Double circulation - Regulation of cardiac activity - Disorders of circulatory system - Hypertension, Coronary artery disease, Angina pectoris, heart failure Excretory products and their elimination - Modes of excretion - Ammonotelism, ureotelism, uricotelism - Human excretory system-structure and function - Urine formation, Osmoregulaion. Regulation of kidney function, Renin-angiotensin, Antinatriuretic factor, ADH and Diabetes insipidus - Role of other organs in excretion - Disorders - Uremia, Renal failure, Renal calculi, Nephritis - Dialysis and artificial kidney Locomotion and Movement - Types of movement – ciliary, flagellar, muscular - Skeletal muscle _ contractile proteins and muscle contraction - Skeletal system and its functions. (to be dealt with the relevant practical of practical syllabus) - Joints - Disorders of muscular and skeletal system – Myasthenia gravis, Tetany, Muscular dystrophy, Arthritis, Osteoporosis Gout.

Unit IV: Neural control and coordination - Neural and nerves - Nervous system in humans - Central Nervous system, Peripheral Nervous system and Visceral Nervous system - Generation and conduction of nerve impulse - Reflex action - Sensory Perception - Elementary structure and function of eye and ear and general idea of other sense organs Chemical coordination and regulation - Endocrine glands and hormones - Human endocrine system – Hypothalamus, Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Pancreas, Gonads - Mechanism of hormone action (Elementary Idea) - Role of hormones as messengers and regulators - Hypo- and hyperactivity and related disorders, (Common disorders eg. Dwarfism, Acromegaly, Cretinism, goiter, exophthalmic goiter, diabetes, Addison's disease)

Unit V: GENETICS AND EVOLUTION - Heredity and variation - Mendelian Inheritance - Deviations from Mendelism, incomplete dominance Co-dominance, Multiple alleles and Inheritance of blood group, pleiotropy. Elementary idea of Polygenic Inheritance - Chromosome theory of inheritance - Chromosomes and genes. Sex determination - In humans, birds, honey bee. Linkage and crossing over. Sex linked inheritance - Haemophilla, Colour blindness. Medellin disorders in humans - Chromosomal disorders in humans. Down's syndrome, Turner's and klinefelter's syndromes. Search for genetic material and DNA as genetic material. Structure of DNA and RNA - DNA packaging - DNA replication - Central dogma - Transcription, genetic code, translation. Gene expression and regulation. Genome and human genome project. DNA finger printing.
EVOLUTION - Origin of life, Biological evolution and evidences for biological evolution (Paleontological from comparative anatomy and embryology and molecular evidence) - Darwin's contribution/Modern Synthetic theory of Evolution - Hardy – Weinberg's principle. Mechanism of evolution – Variation (Mutation & Recombination) and Natural Selection with examples drift types of natural selection - Gene flow and genetic - Adaptive Radiation Human evolution

Unit VI: **ECOLOGY AND ENVIRONMENT -** Meaning of ecology, environment, habitat and niche - Organisms and environment. Population and ecological adaptations - Population Interactions – mutualism, competition, predation, parasitism. - Population attributes – growth, brith rate and death rate, Age distribution. Ecosystems Patterns, components, energy flow, nutrient cycling (carbon and phosphorous), decomposition and producitivity - Pyramids of number, biomass, energy. Ecological succession - Ecological Services: Carbon fixation, Pollination, Oxygen release Biodiversity and its conservation - Threats to and need for biodiversity conservation. - Hotspots, endangered organisms,

extinction, Red Data Book. - Biodiversity conservation- biosphere reserves, national parks and sanctuaries.
Environmental Issues - Air Pollution and its control - Water pollution and its control - Agrochemicals and their effects - Solid waste management - Radioactive waste management - Greenhouse effect and global warming - Ozone depletion, deforestation. - Any three case studies as success stories addressing environmental issues.

Chemistry

Unit VII: Atomic Structure: Thomson's model, Rutherford's model, Bohr's model and their limitations. Concept of shells/subshells, dual nature of matter and light, de Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, Quantum numbers and their significance, shapes of orbitals. Aufbau principle, Pauli Exclusion Principle, Hund's rule, electronic configuration, stability of half filled and completely filled orbitals.
Periodic table: Classification of Elements, periodicity, modern periodic law. Periodic trends of elements -atomic radii, ionic radii. Ionization energy, electron affinity and electronegativity.
Chemical Bonding: Ionic bond, covalent bond: bond parameters. Lewis structures, polar character of covalent bond, covalent character of ionic bond, valence bond theory, geometry of covalent molecules, VSEPR theory and hybridization. MOT of homo nuclear diatomic molecules, hydrogen bond.

Unit VIII: **Electrochemistry** - Redox reactions, conductance in electrolytic solutions, specific and molar conductivity variations with concentration, Kohlrausch's Law, electrolysis and laws of electrolysis (elementary idea), dry cell-electrolytic cells and Galvanic cells, lead accumulator, EMF of a cell, standard electrode potential. Nernst equation and its application to chemical cells, Relation between Gibbs energy change and emf of a cell, fuel cells, corrosion.
Co-ordination compounds: Introduction, ligands, co-ordination number, colour, magnetic properties and shapes, IUPAC nomenclature. Bonding (Werner's theory, VBT and CFT); Structural and stereo isomerism, importance of co-ordination compounds (in qualitative inclusion of analysis, extraction of metals and biological systems).
Biomolecules: Carbohydrates-Classification and their importance, D-L configuration. Proteins: Elementary idea of α-amino acids and peptide bond. Polypeptides; proteins- primary, secondary and tertiary structure of proteins. Denaturation of proteins and enzymes. Lipids and hormones-classification and functions. Vitamins-Classification and functions. Nucleic Acids: DNA & RNA

Physics

Unit IX: Laws of Motion Intuitive concept of force. Inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; Newton's third law of motion. Law of conservation of linear momentum and its applications. Equilibrium of concurrent forces. Static and kinetic friction, laws of friction, rolling friction. Dynamics of uniform circular motion: Centripetal force, examples of circular motion (vehicle on level circular road, vehicle on banked road)
Work, Energy and Power Scalar product of vectors. Work done by a constant force and a variable force; kinetic energy, work-energy theorem, power. Notion of potential energy, potential energy of a spring, conservative forces: conservation of mechanical energy (kinetic and potential energies); non-conservative forces: elastic and inelastic collisions in one and two dimensions.

Optics Ray Optics (Geometric Optics): Reflection of light, spherical mirrors, mirror formula. Refraction of light, total internal reflection and its applications, optical fibers, refraction at spherical surfaces,

lenses, thin lens formula, lens-maker's formula. Newton's relation: Displacement method to find position of images (conjugate points) Magnification, power of a lens, combination of thin lenses in contact, combination of a lens and a mirror. Refraction and dispersion of light through a prism.

Scattering of light-blue colour of the sky and reddish appearance of the sun at sunrise and sunset. Elementary idea of Raman effect. Optical instruments: Human eye, image formation and accommodation, correction of eye defects (myopia, hypermetropia, presbyopia and astigmatism) using lenses. Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers. Wave optics (Physical Optics): Wave front and Huygens principle, reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygens, principle interference.
Young's double slit experiment and expression for fringe width, coherent sources and sustained interference of light. Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and astronomical telescopes. Polarization, plane polarized light; Brewster's law, uses of plane polarized light and polaroids.

Mathematics
Unit X: Straight Lines: Brief recall of 2D from earlier classes. Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope-intercept form, twopoint form, intercepts form and normal form. General equation of a line. Distance of a point from a line.
Mathematical Reasoning: Mathematically acceptable statements. Connecting words/ phrases - consolidating the understanding of "if and only if (necessary and sufficient) condition", "implies", "and/or", "implied by", "and", "or", "there exists" and their use through variety of examples related to real life and Mathematics. Validating the statements involving the connecting words difference between contradiction, converse and contrapositive.

STATISTICS & PROBABILITY 1. Statistics: Measure of dispersion; mean deviation, variance and standard deviation of ungrouped/grouped data. Analysis of frequency distributions with equal means but different variances. 2. Probability: Random experiments: outcomes, sample spaces (set representation). Events: occurrence of events, 'not', 'and' and 'or' events, exhaustive events, mutually exclusive events Axiomatic (set theoretic) probability, connections with the theories of earlier classes. Probability of an event, probability of 'not', 'and' & 'or' events.

MODEL ENTRENCE EXAM QUESTION PAPER

PART - A Biology

1. Cell theory states that
   a. All cell has nuclei
   b. All cells are living
   c. Cell reproduce by mitosis and meiosis
   d. Cells are fundamental structural units of plants and animals

2. Prokaryotic cell does not possess
   a. Cell wall
   b. Nuclear membrane
   c. Cytoplasm
   d. Plasma membrane

3. Extra nuclear DNA is found in
   a. Chloroplast
   b. Endoplasmic reticulum
   c. Ribosomes
   d. Nucleus

4. Ribose is a pentose sugar found in
   a. DNA
   b. RNA
   c. Lipids
   d. Proteins

5. Which of the following is a polysaccharide
   a. Glucose
   b. Lactose
   c. Fructose
   d. Glycogen

6. Diffusion is the movement of molecules from
   a. An area of low concentration to an area of high concentration
   b. An area of high concentration to an area of low concentration
   c. An area of equilibrium to an area of high concentration
   d. No movement at all

Space for Rough Work

7. What is the most common way that nitrogen fixation occurs?
    a. Lightning
    b. Nitrogen fixing bacteria
    c. Fossil fuel combustion
    d. Forest fires

8. What are the products of photosynthesis?
    a. Carbon dioxide and water
    b. Glucose and oxygen
    c. Lactic acid
    d. Proteins and lipids

9. What does xylem carry?
    a. Water
    b. Blood
    c. Carbohydrates
    d. Soil

10. What is the purpose of the human genome project?
    a. The data will answer all questions regarding human evolution.
    b. The data will be used to create artificial life.
    c. The data will help researchers devise new diagnostics and treatments for genetic diseases.
    d. The data helps to know the progenies

11. Blood clotting is due to presence of
    a. RBC
    b. WBC
    c. Blood platelets
    d. Lymph

12. Short sightedness is due to
    a. Weaker muscles
    b. Shifting of iris
    c. Elongation of eye balls
    d. Weakening of retina

Space for Rough Work

13. Saliva helps in digestion of
    a. Proteins
    b. Fats
    c. Fibres
    d. Starch

14. Joint between human skull bones is called
    a. Cartilaginous joint
    b. Hinge joint
    c. Fibrous joint
    d. Synovial joint

15. What is cardiac arrest?
    a. Blood clot in the heart
    b. Heart Disease
    c. Sudden, abrupt loss of heart function
    d. Abrupt loss of brain function

16. Concentration of urine depends upon which organ
    a. Bowman's capsule
    b. Length of Henle's loop
    c. P.C.T
    d. Network of capillaries arising from glomerulus

17. Hypothllamus and Thalamus are in
    a. Cerebellum
    b. Cerebrum
    c. Limbic system
    d. Diencephalon

18. Which vitamin is present in Rhodopsin
    a. Vit A
    b. Vit B
    c. Vit C
    d. Vit D

Space for Rough Work

19. Human eyeball consists of three layers and it encloses
    a. Lens, iris, optic nerve
    b. Lens, aquoushumor, vitreous humor
    c. Cornea, lens, iris
    d. Cornea, lens, optic nerve

20. Number of cranial and spinal nerves in man.
    a. 12-21
    b. 11-21
    c. 21-31
    d. 12-31

21. Which topic in mathematics did Mendel use to help explain heredity?
    a. Algebra
    b. Calculus
    c. Probability
    d. Geometry

22. Which process separates chromosomes?
    a. Chemosynthesis
    b. Inheritance
    c. Pedigree
    d. Meiosis

23. The enzymes that break hydrogen bonds and unwind DNA are
    a. Primers
    b. Forks
    c. Helicases
    d. Polymerases

24. If a DNA molecule is found to be composed of 40% thymine, what percentage of guanine would be expected
    a. 10%
    b. 20%
    c. 40%
    d. 80%

Space for Rough Work

25. Which of the following is NOT a component of the Theory of Evolution by Natural Selection?
    a. Competition for food and space
    b. Variation among species
    c. Inheritance of acquired characteristics
    d. Survival and reproduction

26. DDT is a
    a. Green house gas
    b. Non-degradable pollutant
    c. Degradable pollutant
    d. A herbicide

27. A population with equal number of births and death will show
    a. Acceleration phase of growth
    b. Plateau phase
    c. Exponential growth phase
    d. Initial phase of growth

28. The role of an organism in the ecological system is known as
    a. Niche
    b. Habitat
    c. Herbivory
    d. Interaction

29. Energy flow in ecosystem is
    a. Bidirectional
    b. Multidirectional
    c. Unidirectional
    d. All round

30. Red data book contains data of
    a. All plant species
    b. All animal species
    c. Economically important species
    d. Threatened species

Space for Rough Work

PART –B Chemistry

31. Choose the correct statement among the following.

a. A node is a point in space around nucleus where the wave function Ψ has zero value.

b. As per Thompson model, in an atom electrons are revolving around the nucleus only in stationary path.

c. Cathode rays were a stream of fast moving positively charged particles.

d. Simultaneous measurement of both momentum and position of sub atomic particles like electron is possible.

32. If the principal quantum number n=3, the total number of orbitals having l=2 is

a. 3

b. 7

c. 5

d. 9

33. The correct order of decreasing ionic radii among the following isoelectronic species is

a. $N^{3-} < O^{2-} < F^{-} < Na^{+}$

b. $O^{2-} < Na^{+} < F^{-} < N^{3-}$

c. $F^{-} < N^{3-} < O^{2-} < Na^{+}$

d. $Na^{+} < F^{-} < O^{2-} < N^{3-}$

34. Which of the following sets of orbitals in a homonuclear diatomic molecule is degenerate?

a. $\sigma 2p_z$ and $\sigma^* 2p_z$

b. $\Pi 2p_x$ and $\sigma 2p_z$

c. $\sigma 1s$ and $\sigma^* 2s$

d. $\Pi^* 2p_x$ and $\Pi^* 2p_y$

35. The total number of σ bond and Π bonds in $CH_3 – CH = CH – C\equiv C- CH_2 – CH \equiv CH$, are

a. 18 σ bonds and 3 Π bonds

b. 13 σ bonds and 8 Π bonds

c. 16 σ bonds and 5 Π bonds

d. 19 σ bonds and 5 Π bonds

Space for Rough Work

36. The electrochemical cell stops working after some time because

a. The reaction starts proceeding in opposite direction

b. Electrode potentials of both the electrodes becomes equal

c. Electrode potentials of both the electrodes becomes zero

d. One of the electrodes is eaten away to some extent

37. Three electrolytic cells are connected in series containing solutions – $AgNO_3$, $CuSO_4$ and $AuCl_3$. If three faradays of electricity is passed through these solutions, then molar ratio of the cations deposited at the cathode will be

a. 1 : 2 : 3

b. 1 : 1 : 1

c. 6 : 3 : 2

d. 3 : 2 : 1

38. Which of the following coordination compounds exhibits linkage isomerism?

a. $[Co(NH_3)_5Cl]Br_2$

b. $[Co(en)_3]Cl_3$

c. $[Co(en)_2NO_2Cl]Br$

d. $[Co(NH_3)_6][Cr(en)_3]$

39. Which one of the statement with respect to biomolecules is wrong?

a. Raffinose is a trisaccharide, on hydrolysis yield only D-glucose units

b. Fructose is a ketoreducing hexose sugar

c. Arginine, isoleucine and lysine are essential amino acids

d. During denaturation of proteins, secondary and tertiary structures are destroyed

40. The pyrimidine bases present in RNA are

a. Cytosine and adenine

b. Cytosine and guanine

c. Cytosine and thymine

d. Cytosine and uracil

Space for Rough Work

PART –C Physics

41. If the force on a rocket, moving with a velocity of 300 ms^{-1} is 210 N, then the rate of combustion of the fuel is
    a. 0.07 kgs^{-1}
    b. 1.40 kgs^{-1}
    c. 0.70 kgs^{-1}
    d. 10.70 kgs^{-1}

42. Aman weighing 60 kg climbs up a staircase carrying a load of 20 kg on his head. The staircase has 20 steps each of height 0.2m. If he takes 10 s to climb, find his power.
    a. 313.6 W
    b. 120.6 W
    c. 510.0 W
    d. 0.0 W

43. What can be the largest distance of an image of a real object from a convex mirror of radius of curvature is 20 cm ?
    a. 20 cm
    b. 10 cm
    c. Infinity
    d. Zero

44. The nearer point of hypermetric eye is 40 cm. The lens to be used for its correction should have the power
    a. +1.5 D
    b. -1.5 D
    c. +2.5 D
    d. +0.5 D

45. The hypermetropia can be corrected by using
    a. Convex lens
    b. Concave lens
    c. Convex mirror
    d. Concave mirror

Space for Rough Work

PART –D Mathematics

46. The points on y-axis whose distance from the line

$\frac{x}{3} + \frac{y}{4} = 1$ is 4 units are ;

a) (0, 4) (0,8) b) (0,8) (0,0)
c) (0,4) (0,-8) d) (0,-4) (0,8)

47. Write the negation of the statement "All birds have wings ".

a) All birds have no wings.

b) There exists a bird which has 2 wings.

c) There exists a bird which has no wings.

d) There exists many birds which have wings.

48. The equation of the line through the point (3, 2) which makes an angle 45^0 with the live x-2y=3 is ;

a) 3x - y = 7 b) 2x - 3y = 0
c) 4x + y = 14 d) 5x - y = 13

49. The mean deviation about the median for the data 3,9,5, 3,10,12, 18,4,7,19,21 is ;

a) 5.27 b) 4.37
c) 9.1 d) 6.43

50. One card is drawn from a well shuffled deck of 52 cards. If each outcome is equally likely the probability that card will be not an ace is ;

a) 1/13 b) 12/13
c) 3/13 d) 4/13

Space for Rough Work

INT. M.Sc. M.B.Entrence ANSWER KEY

Q NO.	ANSWER	Q NO.	ANSWER	Q NO.	ANSWER
1	D	21	C	41	C
2	B	22	D	42	A
3	A	23	C	43	B
4	B	24	A	44	C
5	D	25	C	45	A
6	B	26	B	46	B
7	B	27	B	47	C
8	B	28	D	48	A
9	A	29	C	49	A
10	C	30	D	50	B
11	C	31	A		
12	C	32	C		
13	D	33	D		
14	C	34	D		
15	C	35	C		
16	B	36	B		
17	D	37	C		
18	A	38	C		
19	B	39	A		
20	D	40	D		