

**ADMISSIONS to 4-year MD, 6-year MD, 5-year DDS, 6-year PHARMD and 3-year  
PHYSIOTHERAPY PROGRAMS for the academic year 2014/2015**

**TOPICS TO PREPARE FOR WRITTEN TEST AND INTERVIEW**

**BIOLOGY**

**1. The Structure and Function of Large Biological Molecules.**

The diversity of polymers. Carbohydrates. Proteins. Nucleic acids. Lipids.

**2. Prokaryotic cell structure and function.**

Cell surface structures. Motility. Internal organization and DNA (nucleoid, plasmids). Binary fission and conjugation in bacteria.

**3. Eukaryotic cell structure and function.**

Plasma Membrane. Compartmentalization. Cytoskeleton. Endomembrane system: endoplasmic reticulum, Golgi Apparatus and lysosomes. The Nucleus. Ribosomes. Mitochondria.

**4. Cell communication.**

Cell junctions. Local and long distant signaling. Chemical messengers. Receptors. The stages of cell signaling.

**5. Cell cycle.**

Mitosis and meiosis. Cellular organization of genetic material. Phases of cell cycle. The mitotic spindle. Cytokinesis. Cellular organization of genetic material. The stages of mitosis and meiosis. A comparison of Mitosis and Meiosis. Origins of genetic variation among offspring.

**6. Cellular respiration and fermentation.**

Catabolic pathways and production of ATP. The stages of cellular respiration (glycolysis, oxidation of pyruvate, citric acid cycle, oxidative phosphorylation). Anaerobic respiration. Types of fermentation.

**7. Viruses.**

Structure of viruses. General features of viral replication cycles. Viroids and prions. Viral diseases. Emerging viruses.

**8. Bacteria and Archaea.**

Cell surface structures. Motility. Internal organization. Reproduction and adaptation. Diverse nutritional and metabolic adaptation – oxygen and nitrogen metabolism, cooperation. The role in the biosphere (chemical recycling, ecological interactions). Beneficial and harmful impacts of Prokaryotes on humans.

**9. Protists**

Structural and functional diversity in Protists. Role of Protists in ecological communities.

**10. Fungi.**

Nutrition and Ecology. Body structure. Sexual and asexual reproduction. Fungi as pathogens. Practical uses of fungi.

**11. Chromosomal and Molecular Basis of Inheritance.**

The chromosomal basis of sex. Inheritance of X- and Y-linked genes. Alternation of chromosome number and structure. Human disorders due to chromosomal alternation. Inheritance of organelle genes. DNA as genetic material. Structural model of DNA. Chromosomes' structure.

**12. Genetic mechanisms.**

The flow of genetic information. Replication: base pairing to a template strand, synthesis of new DNA strands. Transcription: molecular components of transcription, posttranscriptional modifications (alternation of mRNA ends, RNA splicing). Translation: molecular components of the process. Building of polypeptide. Genetic code. Type of mutations.

Regulation of Gene Expression (promoters, transcription factors).

**13. Tissues and body membranes.**

Structure and physiology of: connective, muscle, epithelial and nervous tissue; serous, mucous, synovial and cutaneous membranes.

**14. Senses.**

Hearing and equilibrium. Visual perception. Taste. Smell. Types of sensory receptors.

**15. Nervous system.**

Organization of nervous system. The central nervous system. The organization of human brain. Peripheral nervous system: motor and autonomic nervous system. Glia. Blood-brain barrier. Nervous system disorders.

**16. Neurons, synapses and signaling.**

Neurons structure and function. Resting and action potential. Conduction of action potentials. Postsynaptic potential. Neurotransmitters.

**17. Hormones and endocrine system.**

Intercellular communication. Endocrine tissues and organs. Chemical classes of hormones. Multiple effects of hormones. Simple hormone pathways. Feedback regulation.

**18. Immune system. Innate and adaptive immunity.**

Antigen. Antibody. The humoral immune response. The cell-mediated immune response. Inflammatory response. Immunological memory. Allergies. Immunization (vaccination).

**19. Cardiovascular system.**

Organization of human circulatory system. Heart and heart's rhythmic beat. Blood vessels structure and function. Blood pressure. Blood composition and function.

**20. Respiratory system.**

Organization of human respiratory system. Negative pressure breathing. Hemoglobin.

**21. Digestive system and nutrition.**

Essential nutrients. Dietary deficiencies. Organization of human digestive system. Chemical digestion in the human digestive system. Dental adaptation.

**22. Human reproduction and development.**

Female and male reproductive anatomy. Hormonal control of reproductive system. Gametogenesis. Conception. Embryonic development. Birth.

**23. Osmoregulation and excretion.**

Excretory organs. Kidney structure. Nephron organization and function. Kidney function, water balance and blood pressure.

**24. Evolution.**

Evolution of population. Evolution of human being. The Origin and Evolution of Vertebrates. Phylogeny and the Tree of Life.

**25. Ecology**

Biotic and abiotic factors, habitats, niches, levels of organization, symbiosis, mutualism, parasitism, commensalism, trophic levels, nutrient cycles (water, carbon and nitrogen), food chains, primary producers, types of consumers, energy and biomass pyramids, limiting factors, tolerance, carrying capacity, adaptation, succession, climax community, pioneer species, biomes.

**26. Genetics of population.**

Genetic drift and effective population size, bottleneck effect, adaptation and phenotypic variance, Hardy-Weinberg equilibrium, maximum likelihood and Bayesian analysis.

## CHEMISTRY

**1. Atoms**

Atomic theory

Elements and atomic number

Isotopes and atomic weight

## 2. The Periodic Table

The periodic table and some characteristics of different groups

Electronic structure of atoms and electron configurations

Electron configurations and the periodic table

Electron-dot symbols

## 3. Ionic Compounds

The octet rule ions and ionic bonds

Periodic properties, ion formation formulas, naming ionic compounds

Some properties of ionic compounds

H<sup>+</sup> and OH<sup>-</sup> ions: an introduction to acids and bases

## 4. Molecular Compounds

Covalent bonds and the periodic table

Multiple covalent bonds and coordinate covalent bonds

Characteristics of molecular compounds

Molecular formulas and Lewis structures

Polar covalent bonds and electronegativity, polar molecules

Naming binary molecular compounds

## 5. Classification and Balancing of Chemical Reactions

Classes of chemical reactions

Chemical equations and balancing chemical equations

Acids, bases, and neutralization reactions

Redox reactions

## 6. Mole and Mass Relationships

The mole and Avogadro's number

Gram-mole conversions

## 7. Reaction Rates and Chemical Equilibria.

Endothermic and exothermic chemical reactions

Factors that influence chemical reaction rates

Chemical equilibrium

Equilibrium constants

## 8. Nuclear Chemistry

Radioactivity

Radioactive half-life

## 9. Physical quantities

Metric system of units

Metric units of length

Metric units of mass

Metric units of volume

Significant figures

## 10. Fundamental Chemical Laws

Law of conservation of mass

Law of definite proportions

Law of multiple proportions

## 11. Chemical Calculations

Mole concept and chemical formulas

Calculations involving chemical equations

Calculations involving volume and concentration

## 12. Solutions

Mixtures and solutions

Units of concentration

Dilution

Ions in solution: electrolytes

### 13. Acids and Bases

Acids and bases in aqueous solution, some common acids and bases  
The Brønsted–Lowry definition of acids and bases  
Acid dissociation constants. Acid and base strength  
Some common acid–base reactions  
Acidity and basicity of salt solutions

### 14. Buffers

Measuring acidity in aqueous solution: pH  
Buffer solutions  
Titration

### 15. Introduction to Organic Chemistry: Alkanes

The nature of organic molecules  
The structure of organic molecules: alkanes and their isomers  
Drawing organic structures  
The shapes of organic molecules  
Naming alkanes  
Properties of alkanes  
Reactions of alkanes

### 16. Cycloalkanes

Drawing and naming cycloalkanes

### 17. Alkenes and Alkynes

Alkenes and alkynes  
Naming alkenes and alkynes  
The structure of alkenes: cis–trans isomerism  
Properties of alkenes and alkynes  
Types of organic reactions  
Reactions of alkenes and alkynes

### 18. Aromatic Compounds

Alkene polymers  
Aromatic compounds and the structure of benzene  
Naming aromatic compounds  
Reactions of aromatic compounds

### 19. Alcohols

Some common alcohols  
Naming alcohols  
Properties of alcohols, acidity of alcohols  
Reactions of alcohols

### 20. Phenols

Some common phenols  
Acidity of phenols

### 21. Some Compounds with Oxygen, Sulfur, or a Halogen

Ethers  
Thiols and disulfides  
Halogen-containing compounds

### 22. Amines

Amines  
Properties of amines  
Heterocyclic nitrogen compounds  
Basicity of amines  
Amine salts

### **23. Aldehydes**

The carbonyl group  
Naming aldehydes  
Properties of aldehydes  
Some Common aldehydes  
Oxidation of aldehydes  
Reduction of aldehydes

### **24. Ketones**

Naming ketones  
Properties of ketones  
Some Common ketones  
Reduction of ketones

### **25. Carboxylic Acids and their Derivatives**

Carboxylic acids and their derivatives: properties and names  
Some common carboxylic acids  
Acidity of carboxylic acids  
Reactions of carboxylic acids: ester and amide formation  
Hydrolysis of esters and amides

### **26. Amino Acids and Proteins**

Amino acids structures  
Acid–base properties of amino acids  
Chemical properties of proteins

### **27. Enzymes and Vitamins**

Catalysis by enzymes  
How enzymes work  
Vitamins and minerals

### **28. Carbohydrates**

Classification of carbohydrates  
The D and L families of sugars: drawing sugar molecules  
Structure of glucose  
Disaccharides, structure of maltose  
Some important polysaccharides  
Properties of carbohydrates

### **29. Lipids**

Structure and classification of lipids  
Fatty acids and their esters  
Properties of fats and oils

### **30. Nucleic Acids and Protein Synthesis**

DNA, chromosomes, and genes  
Composition of nucleic acids  
The structure of nucleic acid chains  
Base pairing in DNA: the Watson–Crick model

## **PHYSICS**

### **1. Dynamics**

Force, mass, Newton's 1st, 2nd and 3rd law  
Free-body diagrams  
Contact forces: normal force and friction force  
Linear momentum, impulse, conservation of momentum  
Elastic and inelastic collisions, center of mass, translational motion

## **2. Electric currents**

Electric current,  
Ohm's law , electrical resistance and resistors  
Electric power  
EMF and terminal voltage.  
Resistors in series and parallel, Kirchhoff's rules

## **3. Electric field**

Electric charge, static electricity, induced charge, electric field, field lines, electric potential, equipotential lines, voltage,  
Coulomb's law  
Electric field, conductors and dielectrics, charge distribution  
Capacitance, storage of electric energy, capacitors in series and in parallel

## **4. Elements of kinematics and dynamics of circular and rotational motion**

Angular velocity, angular acceleration, torque and rotational inertia  
Angular momentum, conservation of angular momentum  
Period, frequency, centripetal acceleration , centripetal force  
Condition of equilibrium  
Stability and balance

## **5. Elements of modern Physics: early quantum theory and models of the atom**

Photon theory of light, photon energy, Planck's constant  
Photoelectric effect  
Early models of the atoms, atomic spectra, the Bohr model: energy levels, transitions, absorption and emission  
Wave-particle duality: the de Broglie hypothesis

## **6. Fluids and solids**

Mass and weight, specific density and specific gravity  
Pascal's principle , pressure, hydraulic lift  
Archimedes' principle, buoyancy and buoyant force  
Elasticity, stress, strain, Hook's law and Young's modulus

## **7. Geometrical optics and wave nature of light**

The ray model of light  
Reflection of light, formation of image by plane mirrors and spherical mirrors, total internal reflection, fibre optics  
Refraction, Snell's law index of refraction  
Thin lenses, focal point, focal length, optical power, ray tracing: converging and diverging lenses  
The thin lenses equation; magnification, combination of lenses, lensmaker's equation,  
Magnifying glass, eye and corrective lenses  
Huygens principle, diffraction, diffraction grating, interference, polarization

## **8. Kinematics**

Vectors and scalars, vector components, addition of vectors  
Frames of reference and displacement  
Velocity and acceleration  
Motion at a constant acceleration; falling objects  
Projectile motion

## **9. Magnetism and electromagnetic induction, electromagnetic waves**

Magnets and magnetic fields.  
Magnetic field of straight wires and coils supplied with electric current  
Force on an electric current in a magnetic field and on electric charge moving in a magnetic field  
Faraday's law of induction; Lenz's law, electric generators, transformers and transmission of power  
Electromagnetic waves and the electromagnetic spectrum, production of electromagnetic waves

## **10. Nuclear Physics and radioactivity**

Structure and properties on the nucleus, nuclear size  
Binding energy and nuclear forces  
Radioactivity: alpha, beta and gamma decay; conservation of nucleon number and charge  
The law of radioactive decay; the half-life time

Nuclear reactions and transmutation of elements  
Nuclear fission and fusion, nuclear reactors

### **11. Sounds**

Characteristics of sound  
Sound intensity and intensity level, ear, sound loudness  
Doppler effect  
Sources of sound: vibrating strings and air columns, standing waves

### **12. Temperature and kinetic theory of gases**

Temperature, kinetic theory of gases and molecular interpretation of temperature  
Thermal Equilibrium and the Zero-the Law of Thermodynamics  
The Ideal Gas Law  
Heat and internal energy, First Law of Thermodynamics  
Specific heat and latent heat  
Heat engines, Second Law of Thermodynamics

### **13. Vibration and waves**

Simple harmonic motion (SHL), energy in the SHL, conservation of energy in the SHL,  
Simple pendulum, resonance, forced vibration  
Wave motion, transverse and longitudinal waves  
Energy transported by waves  
Propagation of waves: reflection, refraction and diffraction

### **14. Work, power and energy**

Work, kinetic energy, potential energy, power  
Conservative and non-conservative forces  
Conversion of mechanical energy, energy transformations  
Work-energy principle