

Department of Life Sciences  
**University of Calicut**

## MODEL QUESTION PAPER

Ph.D. Physiology Entrance examination, 2023

Time: 2 hours

Maximum marks: 100

**A. Underline the correct answer.****(25 X 2 marks = 50)**

- Asthma is due to the
  - Elasticity reduced.
  - degeneration of alveolar wall.
  - Bronchioles constrict due to muscle spasm.
  - damage in the diaphragm.
- Motor neurons electrically stimulate nearby muscle fibres at
  - creatine phosphate.
  - Actin filament.
  - cross bridges.
  - Neuromuscular junction.
- Chemical ions responsible for muscle contraction are
  - Na<sup>+</sup> and Ca<sup>+</sup>.
  - Na<sup>+</sup> and K<sup>+</sup>.
  - Ca<sup>2+</sup> and K<sup>+</sup>.
  - Ca<sup>2+</sup> and Mg<sup>2+</sup>.
- Respiration centre is located in
  - Alveoli.
  - Cerebellum.
  - Medulla oblongata.
  - Hypothalamus.
- Patients suffering from cholera are given a saline drip because
  - Na<sup>+</sup> help in the retention of H<sub>2</sub>O in the body tissues.
  - Na<sup>+</sup> help in stopping nerve impulses and hence sensation of pain.
  - NaCl furnishes most of the fuel required for cellular activity.
  - NaCl is an important component of energy source.
- Action potential in nerve fibre is produced when positive and negative charges inside and outside the axon membrane are reversed because
  - All K<sup>+</sup> leave the axon.
  - More K<sup>+</sup> enters the axon as compared to Na<sup>+</sup> ions leaving.
  - More Na<sup>+</sup> enters the axon as compared to K<sup>+</sup> ions leaving.
  - All Na<sup>+</sup> enters the axon.
- If vagus nerve in a man is damaged, which of the following will not be affected?
  - Pancreatic secretion.
  - GI movement.
  - Cardiac movement.
  - tongue movement.
- The function of vagus nerve innervating the heart is to
  - initiate heart beat.
  - decrease heart beat.
  - accelerate heart beat.
  - maintain constant heart beat.
- Cornea transplant in humans is almost never rejected because
  - it is a non living layer.
  - its cells are least penetrable by bacteria.
  - it has no blood supply.
  - it is composed of enucleated cells.
- Two protein molecule, closely associated with actin filaments are ----- and -----
  - actin and myosin.
  - actin and tropomyosin.
  - Tubulin and tropomyosin.
  - troponin and tropomyosin.
- The types of muscles present in our
  - thigh are striated and voluntary.
  - upper arm are smooth muscle fibres.
  - heart are involuntary and unstriated muscles.
  - intestine are striated & involuntary.
- Homeostasis refers to
  - maintaining a stable external environment.
  - maintaining internal environment.
  - unwavering control of a physiological set point.
  - both a and b.
- The site where most ATP generated, in a cell is
  - nucleus.
  - plasma membrane.
  - endoplasmic reticulum.
  - mitochondria.



Scheme and syllabus

# **M.Sc. Human Physiology**



DEPARTMENT OF LIFE SCIENCES

UNIVERSITY OF CALICUT

2022 admissions onwards

## Scheme and syllabus for M.Sc. Human Physiology

**Eligibility:** A candidate seeking admission to M. Sc Human Physiology must have B. Sc in Physiology/ Paramedical sciences/ Biological sciences with at least 50 % marks for the optional subjects concerned, excluding subsidiaries as per University rules.

**Curriculum:** Course of study consists of two academic years with four semesters.

### Course structure and distribution of marks

Part	No. of papers	External	Internal	Max. marks	Total marks
<b>Theory</b>	13	50	50	100	1300
<b>Practical</b>	6	50*	50	100	600
<b>Dissertation*</b>					100
	<b>Grand total for the course</b>				<b>2000</b>

Each Practical Examination should be conducted by one external examiner in the subject and one internal examiner who actually imparted instruction in the particular semester.

### Internal assessment:

Theory Paper	Marks	Practical Paper	Marks
a. Attendance*	5	a. Lab skill/ Quality of records	10
b. Seminar	5	b. Practical test	30
c. Assignment	5	c. Viva-voce	10
d. Test paper	30		
e. Viva-Voce / Field work	5		
Total marks	50	Total marks	50

\*90 % and above: 5 marks; 80 to 89 %: 3 marks; 75 to 79 %: 1 mark; below 75 %: nil.

### Project evaluation

Sl #	Particulars	Weightage (%)
1.	Review of literature and formulation of the research problem objective	20
2.	Methods and description of the techniques used	15
3.	Analysis and discussion of results	30
4.	Presentation of the report, organization, linguistics style references, etc.	15
5.	Viva voce examination based on the dissertation	20

	<b>Total</b>	<b>100</b>
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The valuation shall be jointly done by the supervisor of the project in the department and an external expert from the approved panel.

\*Audit courses are mandatory as per the PG regulations for which the student can register without earning credits during the first and second semesters. Audit courses include ability enhancement courses and professional competency courses related to the core area.

### Credits (Work load per week per semester)

Semester	Theory		Practical		Library/ Assignment/ Tutorial/ Project	Project Credit	Total		
	Credit	Hours (Credit x 1)	Credits	Hours (Credit x 3)			Credits	Hours	Marks
First	3x4=12	12	2x2=4	12	6	-	16	30	500
Second	3x4=12	12	3x2=6	18	-	-	18	30	600
Third	4x4=16	16	2x1=2	6	8	-	18	30	500
Fourth	3x4=12	12	-	-	18	8	20	30	400
<b>Total</b>	<b>52</b>	<b>52</b>	<b>12</b>	<b>36</b>	<b>32</b>	<b>8</b>	<b>72</b>	<b>120</b>	<b>2000</b>

### Ability Enhancement Course (AEC)

**2 credits**

**Recommended courses – Publications/ Book review/ Seminar presentation**

### Theoretical knowledge required

Academic writing in science - Types of research papers, structure of research paper, reading a research paper and basics of writing a research paper.

Language aspects of research paper, revising the paper, responding to peer reviews etc.

Ethical aspects of research writing, plagiarism.

**Evaluation method:**

Theoretical knowledge assessed through written test.

Paper published in UGC approved peer reviewed journals/Book reviews submitted by the student in the concerned subject area/seminar paper/poster presentation in state level/national/international seminars based on original works.

**Professional Competency Course (PCC)****2 credits****Practical knowledge required**

Application of different softwares such as SPSS/Design expert/ or any statistical software. Data analysis and graph preparation.

Application of bibliography management softwares such as mendley and zotero.

Systematically searching the literature for systematic reviews, Evidence Based Case Reports etc.

Preparing effective presentations, power point/impress etc.

**Evaluation method**

Practical knowledge assessed by performance test.

**M.Sc. Human physiology course structure**

#	Code	Paper name	Marks	Credits
<b>First semester:</b>			500 marks and 16 credits	
1	PSG1C01	General anatomy, general physiology and blood	100	4
2	PSG1C02	Microbiology, immunology and infectious diseases	100	4
3	PSG1C03	General biochemistry and metabolism	100	4
4	PSG1C04	Practical I (PSG1C02)	100	2
5	PSG1C05	Practical II (PSG1C03)	100	2
<b>Second semester:</b>			600 marks and 18 credits	
6	PSG2C06	Digestive and excretory system	100	4
7	PSG2C07	Cardiovascular and respiratory system	100	4
8	PSG2C08	Biostatistics and bioinformatics	100	4
9	PSG2C09	Practical III (Paper PSG1C01 & PSG2C06)	100	2
10	PSG2C10	Practical IV (Paper PSG2C07)	100	2
11	PSG2C11	Practical V (Paper PSG2C08)	100	2
<b>Third semester:</b>			500 marks and 18 credits	
12	PSG3C12	Muscle physiology, nervous system and special senses	100	4
13	PSG3C13	Endocrine system and reproductive system	100	4
14	PSG3C14	Practical VI (Paper PSG3C12)	100	2
15	PSG3E01	Molecular biology	100	4
16	PSG3E02	Biotechnology	100	4
17	PSG3E03	Instrumentation and enzymology	100	4
18	PSG3E04	Behavioral physiology	100	4
19	-----	Open elective (from the same/ other department)	100	4
<b>Fourth semester:</b>			400 marks and 20 credits	
19	PSG4C15	Advances in neuroscience	100	4
20	PSG4C16	Dissertation/ project work and viva voce	100	8
21	PSG4E05	Diet and nutrition		4
22	PSG4E06	Metabolic disorders and management	100	4
23	PSG4E07	Sports physiology	100	4
24	PSG4E08	Toxicology	100	4

**Total 2000 marks and 72 credits**

## SYLLABUS CONTENT

### **PSG1C01 General anatomy, general physiology and blood**

Course objectives and outcomes:

- Students will get a basic idea about the body position, joints and its movements, muscles, tissue, cartilages and bones.
- Locate and identify the major skeletal muscle regions of the body.
- will be able to explain how an impulse generation by the central nervous system results in the contraction of skeletal muscle
- Understand the blood supply and innervation of skeletal muscle and microscopic structure of skeletal muscle tissue.
- Can describe the composition and volume of whole blood, composition of plasma and discuss its importance in the body, the cell types making up the formed elements and describe the major functions, various disorders related to blood cell counts and possible causes for the same.
- Blood Groups and Transfusions and to describe the ABO and Rh blood groups, the basis for a transfusion reaction.
- To explain the immunity and its classification, Role of T cells and B cells in immunity.

- 1 Anatomical terms. Body positions, standing erect, supine, prone. Anatomical planes median plane, Sagittal planes, coronal planes, horizontal planes oblique planes. Terms of relationship superior, inferior (caudal), anterior (ventral), posterior (dorsal), medial, lateral.
- 2 Terms of comparison- proximal, distal, superficial, deep, external, internal, central, peripheral, visual, ipsilateral, contralateral, evagination, invagination.
- 3 Terms describing movements of joints –flexion, extension, abduction, rotation, medial rotation, lateral rotation, circumduction, eversion, inversion, pronation, supination, protrusion, retraction.
- 4 Terms related to muscle – origin, insertion, belly, tendon, aponeurosis, raphe. Terms related to blood vessels, Arteries, veins, arterioles, venules, capillaries.
- 5 Tissues of body: Tissue - definition – types – epithelial, connective muscular nervous. Epithelial tissue –Functions types of epithelium simple, pseudostratified columnar, Stratified-subtypes - glandular epithelium. Connective tissue – components cells – matrix - cell types Fibre types-collagen, elastic and reticular.
- 6 Cartilage and bones: Cartilage – general features. Types – distribution, hyaline cartilage, elastic cartilage, fibro cartilage. Bone: Functions, classification of bones. According to position – Axial, appendicular. According to shape- Long, short, flat, Irregular. According to gross structure. Compact, sponger, diploic. According to development, membranous, cartilagenous, special types of bones – pneumatic bone, seasmoid bone. Microscopic



- structure of bone, Bone marrow, bone cells – osteoblasts, osteoclasts- Ossifications.  
Muscles: Skeletal, cardiac and smooth - Structure of skeletal muscle.
- 7 Joints: Types – Synarthroses, Diarthroses. Fibrous joints – types- sutures, syndesmosis, Gomphosis, cartilaginous joints- primary secondary. Synovial joints – structure, types of synovial joints - plane, hinge, pivot condylar ellipsoid, saddle, ball and socket, blood supply and nerve supply to synovial joints.
  - 8 Movements of synovial joints: Angular movements – Flexion, extension, abduction, adduction, circular movements, rotation, circumduction.
  - 9 Structure of artery, Structure of vein capillaries, sinusoids, anastomosis, structure of lymph node.
  - 10 General physiology: Introduction to physiology. Homeostasis – Definition, negative and positive feedback mechanisms.
  - 11 Cell-Physiology – Structure and functions of cellular organelles, Junctional complexes. Cellular receptors, intercellular and intracellular communication. Transport across cell membrane – Active and passive transport. Vesicular transport process. Resting membrane potential, action potential – Phases, ionic basis, properties. Osmolarity, Osmolality, Nernst equation, Gibbs – Donnan membrane equilibrium. Dehydration, overhydration, apoptosis. Cell division- Mitosis and meiosis.
  - 12 Blood and Body fluids: Introduction, properties composition and functions of blood. Plasma proteins: Types and functions.
  - 13 Red Blood Cells: Morphology, normal count, physiological variation and functions. Erythropoiesis: Definition, sites, hemopoietic stem cells, stages of erythropoiesis. Factors influencing erythropoiesis. Regulation of erythropoiesis – erythropoietin and other hemopoietic factors. Hemoglobin: Normal level. Physiological variations, Structure, Types, compounds of hemoglobin, fate of Hb. White Blood Cells: Classification of WBC, normal values, morphology, functions, variations, Leukopoiesis, Leukaemia. Platelet: Platelet structure, normal value, production, functions. Purpura and bleeding time.
  - 14 Hemostasis: Major steps – Primary and Secondary, Coagulation factors. Extrinsic and intrinsic mechanisms of coagulation. Physiological mechanisms preventing intravascular coagulation – Endogenous anticoagulant systems. Endogenous fibrinolytic systems, Intravascular blood coagulation, Disseminated intravascular coagulation. Anticoagulants – Types, mechanism of action and uses. Bleeding and clotting disorders – von Willebrand disease, hemophilia, Vitamin K deficiency. Clotting time, bleeding time, prothrombin time.
  - 15 Blood Group: Physiological basis for blood groups, The ABO system. The Rh system – Hemolytic Disease of Newborn (HDN). Other minor blood group systems. Blood transfusion: Indications, collection, precautions to be taken – cross matching, screening for infections. Consequences of mismatched transfusion, Hazards of blood transfusion. Blood bank.

### Significance of blood grouping, Coomb's test.

- 16 Anemia: Definition, etiological and morphological classification. Effects of anemia on physiological systems. Signs and symptoms. Common types of anemia - Iron deficiency anemia, pernicious anemia, sickle cell anemia and thalassemia – their causes and salient features. Polycythemia – Primary and secondary, physiological effects. ESR, PCV, blood indices, osmotic fragility. Blood volume: Normal value, physiological variation, principles of measurement, regulation. Body fluids and compartments, Distribution of total body water (TBW), Principles of measurement of body fluids, reticulo endothelial system, edema.
- 17 Immunity: Definition and types of immunity. Mechanisms: Cell mediated immunity, Humoral immunity. Physiological basis of immunization. Auto immune disease, AIDS, graft rejection.

### References:

- 1 Text Book of Medical Physiology. Hall and Guyton W.B. Saunders Company, London.
- 2 Review of Medical Physiology – Ganong. W.F. McGraw Hill INC. New York.
- 3 Text Book of Anatomy and Physiology – Tortora. Harper Collins College Publications.
- 4 Text Book of Anatomy & Physiology – Patton & Thibodiau – Mosby.
- 5 Text book of Medical Physiology – AP Krishna, Scientific publications, New Delhi.

## **PSG1C02 Microbiology, immunology and infectious diseases**

Course objectives and outcomes will be:

- Able to understand the principles of various types of microscopes, to culture in different media and stain microbes.
- Able to know the mode of action of antibiotics and antimicrobials, about various infections of the respiratory system, digestive system, genito urinary tract, blood and nervous system and its spread.
- Able to know the cellular ontogeny and organ involvement in immunity and the mechanisms involved in immune responses and its types, understand how the immune system functions in both maintaining health and contributing to disease. immune mediated conditions like hypersensitivity, autoimmunity and immunodeficiency diseases.

- 1 General microbiology: Origin of microorganisms. Members of the microbial world. Microscopy: Bright field, dark field, phase contrast, fluorescence and electron microscopy. Ultrastructure of bacterial cell. Spores, sporulation and associated production of useful products. Staining. Microbial growth and reproduction, nutritional requirements, nutritional types, effect of various parameter and environmental factors on growth. Control of microbial growth.
- 2 Cultivation of bacteria, various culture media, culture methods, aerobic and anaerobic culturing. Culture preservation strategies. Control of microbial growth. Antibiotics and antimicrobials –their mode of action.
- 3 Germ theory of disease, Koch's postulates, infection, virulence, factors predisposing to microbial infections, contagious, epidemic, endemic and pandemic diseases. Disease transmission.
- 4 Epidemiology: Principles of epidemiology, epidemiological studies, infectious disease surveillance, Trends in disease, health care associated infections. Infectious disease: infectious disease of respiratory system, digestive system and nervous system. Skin infections, wound infections, genito-urinary infections, blood and lymphatic infections.
- 5 Immunology: Specific immune response. Humoral and cell mediated immune system. Immunoglobulin structure and classes. Isotypes, allotypes and idiotypes. Antigen-antibody reactions and their applications in immunodiagnosis. Complement system, Immunological tolerance. A brief account of immunologic disorders – autoimmune diseases, hypersensitivity reactions and immunodeficiency diseases.

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### References:

- 1 Eli Benjamini, Geoffrey Sunshine, Sydney Leskowitz. Immunology a short course. Wiley Liss Publications.
- 2 Delves PJ, Martin SJ, Burton DR, Roitt IM; Roitt's Essential Immunology 11th edition. BlackwellPublishing/Oxford Univ. Press; 2006.
- 3 Kindt TJ, Goldsby RA, Osborne BA, Kuby J: Kuby Immunology 6th edition. New York. WH Freeman; 2006.
- 4 JanewayCA, TraversP, Walport M, Shlomchik MJ: Immunobiology: The immune system in health and disease 6th edition. New York. Garland Science Publishing; 2005.

- 5 Levinson W, Jawetz E: Medical Microbiology and Immunology. Lange publication; 2001.
- 6 Helen Chapel, Mansel Haeney, Siraj Misbah, Neil Snowden. Essentials of Clinical Immunology, 5th Edition. Wiley-Blackwell. 2006.
- 7 William E. Paul. Fundamental immunology. Seventh Edition 2012.
- 8 C.K. Jayaram Paniker, R. Ananthanarayan. Ananthanarayan and Paniker's Textbook of Microbiology Universities Press (India) Pvt. Ltd., Orient Longman Limited. 2009.
- 9 Thomas Jones Mackie, J. G. Collee, James Elvins McCartney. Medical Microbiology. Churchill Livingstone, 1989.
- 10 Betty A. Forbes, Daniel F. Sahm, Alice S. Weissfeld. Bailey & Scott's Diagnostic Microbiology, 12e 2007.
- 11 Stephen D. Allen, William M. Janda, Paul C. Schreckenberger, Washington C. Winn Elmer W. Koneman. Diagnostic Microbiology 5th Edn.. Lippincott Williams and Wilkins. 1998.
- 12 Ellen JO Baron and Patrick R Murray. Manual of clinical microbiology-9th Edition. Volume -1. ASM Press. 2007.
- 13 Stephen Gillespie & Peter M. Hawkey. Principles and Practice of Clinical Bacteriology. Wiley. 2005.
- 14 Eugene W. Nester, Denise G. Anderson, C. Evans Roberts, Jr., Martha T. Nester. Microbiology: A Human Perspective - McGraw-Hill Higher Education, 6<sup>th</sup> Edition.

## **PSG1C03 General biochemistry and metabolism**

Course objectives and out comes will be:

- To learn about the structure, classification, occurrence and reactions of biomolecules and macromolecules, role of vitamins, minerals and trace elements and identify vitamin deficiency disorders, enzyme classification, kinetics, inhibition and regulation of enzymes, the metabolic pathways of carbohydrates, proteins, fatty acids and nucleic acids.
- To understand the fundamental energetics of biochemical processes, chemical logic of metabolic pathways. Knowing in detail about concepts to illustrate how enzymes and redox carriers and the oxidative phosphorylation machinery occur, utilization of proton gradient to drive the formation of high energy bonds and high energy compounds.
- Understanding the metabolic pathways of nitric oxide and eicosanoid synthesis and haem synthesis, role of pentose phosphate pathway in maintaining red cell integrity and metabolism of lipoproteins.
- Understanding the regulation of blood glucose concentration in liver, detoxification reactions of waste compounds and synthesis of nonessential amino acids and urea synthesis.
- Understand the muscle glycogenolysis and glycogen synthesis, beta-oxidation of fatty acids, transamination and deamination of amino acids, Cori cycle and glucose-alanine cycle, biosynthesis and degradation of glycosamino glycans, collagen, mineralization and demineralization of bone.
- Understand fatty acid synthesis and triglyceride storage promoted by insulin and triglyceride hydrolysis and fatty acid release stimulated by glucagon and adrenaline.

- 1 Biomolecules and macro molecules: Biomolecules of carbohydrates, lipids and proteins, their classification, biological functions and occurrences. Structure of biomolecules, basic reactions and properties. Oligosaccharides and polysaccharides, classification, function and occurrences, structural outlines of Starch and cellulose, Classification of hetero polysaccharides, complex lipids and their functions, levels of protein structure (out line study only), structural features of nucleic acids (RNA & DNA).
- 2 Vitamins, minerals, Flavanoids, trace elements - daily requirements, sources, physiological functions deficiency disorders.
- 3 Enzymes, metabolic concepts and Bioenergetics: Basics of enzyme catalysis, Enzymes classifications, outlines of kinetics, inhibition and regulation. Definition, anabolic and catabolic pathways, central pathways, anaplerotic and secondary pathways, Standard free energy, reaction equilibrium, coupling reactions. Bioenergetics: free energy (symbol G); entropy (symbol S); standard and physiological conditions; equilibrium constant for a reaction under physiological conditions and redox data; endergonic and exergonic reactions. Substrate level phosphorylation and oxidative phosphorylation, high energy compounds. Fundamentals of metabolic control - at enzyme level and genetic level.
- 4 Organ based metabolism (out lines only): Blood- Key pathways. Nitric oxide and eicosanoid synthesis; haem synthesis. The importance of the pentose phosphate pathway reduced

glutathione in maintaining red cell integrity. The respiratory burst in phagocytes. Metabolism of lipoproteins.

- 5 Liver: Pentose phosphate pathway; regulation of blood glucose concentration *via* glycogen turnover and gluconeogenesis; interconversion of monosaccharides; lipid syntheses, lipoprotein formation; ketogenesis; bile acid and bile salt formation; phase I and phase II reactions for detoxification of waste compounds; haem synthesis and degradation; synthesis of nonessential amino acids and urea synthesis.
- 6 Muscle: Glycogenolysis and glycogen synthesis; beta-oxidation of fatty acids; transamination and deamination of amino acids; Cori cycle and glucose–alanine cycle, which recycles substrates between muscle and liver.
- 7 Kidney: Gluconeogenesis; glutamine and glutamate metabolism. Part synthesis of vitamin D.
- 8 Connective tissue: Biosynthesis and degradation of glycosamino glycans; biosynthesis of collagen, mineralization and demineralization of bone.
- 9 Fatty acid synthesis and triglyceride storage in adipocytes promoted by insulin and triglyceride hydrolysis and fatty acid release stimulated by glucagon and adrenaline (epinephrine).

#### References:

- 1 Garrett Reginald H and Grisham Charles M, Biochemistry, Saunders College Publishing, Philadelphia.
- 2 Harold Harper, Review of Physiological chemistry, Marusan Co.
- 3 Lehninger Albert, Biochemistry, Kalyani publications, N. Delhi.
- 4 Plummer David T, An introduction to practical Biochemistry, Tata Mac Graw Hill.
- 5 Stryer Lubert & Hall John E, Biochemistry, Freemann.
- 6 Voet Donald & Voet Judith, Biochemistry, John Wiley sons, US.
- 7 Text book of Biochemistry, 6<sup>th</sup> Edition, DMVasudevan and Sreekumari S, Jaypee brothers medical publishers.
- 8 Biochemistry U Sathyanarayana, Books and allied private Ltd.

**PSG1C04 Practical I (Paper PSG1C02)**

The students will able to:

- Develop a deep knowledge in working with microbiological tools and techniques.
- Develop moderately advanced skills in working with microbes such as culturing, staining, preserving, biochemical identification and immunological tests.
- Develop skills in the preparation of microbiological culture medias used for the cultivation of microbes.
- Explain the dangers and safety precautions associated with the handling of various pathogenic microorganisms.
- Understand the working principles of various sterilizing equipments and chemical sterilizing agents used in microbiology lab.
- Develop a skill to set a basic microbiology lab.
- Analyze water quality parameter for the detection of coliforms using MPN test.
- Develop a deep knowledge in various immunological tests commonly performing in clinical laboratories.

- 1 Microscopic examination of pathogenic microbes using permanent slides.
- 2 Staining – Simple and Differential
- 3 Preparation of permanent slides.
- 4 Preparation of antibiotic discs.
- 5 Culture media preparation
- 6 Isolation and enumeration of bacteria
- 7 Preparation of stock cultures
- 8 Antibiograms of common bacterial pathogens.
- 9 Determination of MIC.
- 10 Demonstration of antifungal activity.
- 11 Insoluble antibacterial sensitivity by ditch plate method.
- 12 Detection of beta lactamase production.
- 13 Biochemical tests for bacterial identification
- 14 Identification of common bacterial pathogens
- 15 Gel diffusion test.
- 16 Widal test.
- 17 VDRL test.
- 18 ELISA
- 19 Isolation of DNA from animal tissues.
- 20 Assay of cellulase activity by agar diffusion method.

**PSG1C05 Practical II (PSG1C03)**

The students will able to:

- Analyse different sugars from a mixture and understand the preparation of different solutions.
- Acquire knowledge about the standardization and optimization of pH meter.
- Develop competence in sampling and laboratory management, develop good laboratory practices and minimize hazards in laboratory.
- Apply the knowledge in the working principle of UV-VIS spectrophotometer to quantify different biomolecules present in test samples.
- Apply the knowledge in clinical biochemistry to diagnose the samples and interpret the results by comparing with normal values.
- Understand the different chromatography and electrophoresis techniques.

- 1 Qualitative analysis of carbohydrates (Monosaccharides, Disaccharides and Polysaccharides).
- 2 Qualitative analysis of proteins and amino acids.
- 3 Quantitative estimation of proteins- Comparative studies using Lowry's Method, Biurette Method and Spectrophotometric method.
- 4 Quantitative estimation of glucose.
- 5 Quantitative estimation of cholesterol.
- 6 Quantitative estimation of serum creatinine.
- 7 Quantitative estimation of serum urea.
- 8 Quantitative estimation of serum uric acid.
- 9 Quantitative estimation of serum bilirubin.
- 10 Preparation of solutions of different normality and molarity.
- 11 Preparation of buffers of different pH.
- 12 Paper chromatography of sugars.
- 13 TLC of amino acids.
- 14 Column chromatography of plant pigments and analysis of the spectra of different fractions.
- 15 Poly acryl amide gel electrophoresis of proteins.
- 16 Determination of specific and total activity of an enzyme.
- 17 Extraction of enzymes from animal tissues and Isoenzyme analysis.



## **PSG2C06 Digestive and excretory system**

The students will be able to:

- Know the parts and functions of the digestive system and renal system, various mechanisms involved in the process of digestion of various biomolecules.
- Know the enzymatic activities and movement mechanisms involved, disorders associated with digestion, mechanism of urine formation and role of kidneys in maintaining the acid-base balance.
- Know the various diagnostic methods to check renal functions and associated structures.
- Know the structure and functions of skin.

- 1 Introduction, functional anatomy of gastro intestinal tract and its innervations. Secretory functions of GIT- Saliva-properties, composition, functions and regulation of secretion and applied aspects. Stomach- functional anatomy. Gastric juice- properties, composition, functions, mechanisms and regulation of secretion, experimental evidences of gastric secretion (Sham feeding and Pavlov's pouch), Applied aspects- Gastritis, Peptic ulcer, Zollinger-Ellison Syndrome. Exocrine Pancreas-Pancreatic juice- properties, composition, functions and regulation of secretion. Pancreatitis. Liver - Functions of liver. Bile- composition, functions and regulation of secretion. Functions of gall bladder, Enterohepatic circulation – Gall stones.
- 2 Small intestine: Functional anatomy- Succus entericus- properties, composition, functions and regulation of secretion. Functions of large intestine. Applied aspects.
- 3 Motor functions of GIT- Mastication, deglutition – stages – Achalasia. Gastric emptying, Movements of stomach, Vomiting, Small intestine- movements. Large intestine -functions and movements, Defecation. Applied aspects- Diarrhea, constipation.
- 4 Jaundice, appendicitis, Steatorrhea, Irritable bowel syndrome (IBS). Inflammatory bowel disease (IBD), Hirschprung's disease, Gastro Esophageal Reflex Disorder (GERD).
- 5 Digestion and absorption of carbohydrates, proteins and lipids. Applied aspects – Malabsorption syndrome. Dietary fibres.
- 6 Excretory system: Functional anatomy of kidneys, functions of kidney. Nephrons-cortical and juxta medullary regions. Juxta glomerular apparatus-functions.
- 7 Mechanism of urine formation: Ultrafiltration, Glomerular filtration rate - factors affecting, selective reabsorption-sodium, urea, water, glucose, tubular maximum for glucose (TmG), renal threshold for glucose, tubular load for glucose. Mechanism of urine concentration, counter current mechanism, acidification of urine. Renal function tests. Concept of clearance-inulin, Para amino hippuric acid (PAH) clearances. Micturition, innervation of bladder cystometrogram, atonic bladder, automatic bladder, diuretics, artificial kidney, renal failure. Acid base balance.
- 8 Skin: Structure and functions of skin. Sweat glands.

### References:

- 1 Text Book of Medical Physiology – A.P.Krishna Scientific Publications, New Delhi.
- 2 The Principles of Physiology – David Jenson.
- 3 Physiological Basis of Medical Practice – Best and Taylor.
- 4 Warwick, R, Gray's anatomy, 1980, Livingstone, Churchill.
- 5 Text book of Medical Physiology – AP Krishna, Scientific publications, New Delhi.

## **PSG2C07 Cardiovascular and respiratory system**

The students will be able to:

- Know the physiological anatomy of human heart and blood vessels, their role in circulation, various mechanisms involved in circulating blood to various parts of the body, techniques that help to study the functioning of heart and their application in diagnosing various disorders.
- Know the importance of blood pressure and its maintenance, circulatory pathways and mode of blood flow through the blood vessels, variations and disorders related to it, effects of exercise on cardiac activities.
- Know the physiological anatomy of human lungs and the bronchial system the various mechanisms involved in respiration, role of respiratory muscles and various pressures in the process of respiration and associated disorders, mechanism of transport of respiratory gases, their mode of transport and associated disorders, techniques used to assess the functionality of lungs like spirometry, role of brain and associated nervous structures in regulating the respiratory mechanisms, effects of exercise on respiratory activities.

- 1 Cardiovascular System: Physiological anatomy of heart. Greater and lesser circulation. Structure and properties of cardiac muscle. Junctional tissues of heart - Origin and spread of cardiac impulses, heart block. Cardiac cycle: Definition, mechanical events during different phases of systole and diastole. Pressure volume changes inside heart chambers and aorta, innervation of heart. Heart Rate- Normal value, physiological variation. Regulation of heart rate. Cardiac output - Definition, normal values, physiological variation, factors affecting, cardiac index, cardiac reserve, regulation of cardiac output. Principles of measurement of cardiac output. Electrocardiogram-Principles of electrocardiography, Normal ECG. Characteristics of waves, Einthoven's triangle and law. Significance of ECG. Heart sounds- Causes, characteristics, significance, phonocardiogram, murmurs.
- 2 Blood Pressure: Arterial blood pressure- Definition, normal values, physiological variations, factors affecting. Regulation of BP. Measurement of BP. Hypertension and Hypotension. Arterial pulse, venous pulse, triple response, circulation time, apex beat. Central venous pressure. Haemodynamics – Peripheral resistance, blood viscosity, laminar blood flow, turbulent blood flow, velocity of blood flow. Poiseuille's law. Microcirculation – Capillary circulation, Starling forces. Local and humoral control of blood flow - Autoregulation of blood flow and hyperemia. Regional Circulation – Coronary circulation and coronary artery disease, pulmonary, splanchnic, cutaneous, cerebral and foetal circulation. Circulatory shock and syncope. Cardiac failure, cardiopulmonary resuscitation (CPR). Cardio vascular changes during exercise and effect of gravity on CVS, echocardiography, cardiac arrhythmia. Lymphatic system: Lymph formation, composition, circulation and functions, lymphatic organs, disorders of lymphatic obstruction.
- 3 Respiratory system: Functional anatomy. Functions of respiratory system-Respiratory and non respiratory functions. Respiratory membrane. Mechanism of breathing - Respiratory muscles and their action. Intrapleural and intrapulmonary pressure changes during respiratory cycle. Forces acting on respiratory membrane. Pressure – Volume relationships. Compliance – chest and lungs, values, total compliance. Surfactant, hyaline membrane disease.
- 4 Spirometry - Lung volumes and lung capacities, normal values, significance. Vital capacity and

- timed vital capacity-factors affecting and significance of vital capacity. Minute respiratory volume. Maximum Voluntary Ventilation. Breathing reserve. Respiratory dead space-Anatomical and physiological- Definition and normal value. Principle of measurement. Pulmonary ventilation and alveolar ventilation. Ventilation perfusion ratio, airway resistance.
- 5 Pulmonary gas exchange-Composition of inspired air, expired air, partial pressures. Factors affecting gas exchange across the respiratory membrane. Transportation of oxygen in blood. Oxygen- Hb dissociation curve. Transportation of carbon dioxide in the blood. Chloride shift, Haldane effect. Respiratory quotient.
  - 6 Regulation of respiration- Neural regulation – Respiratory centres. Herring – Bruer 's Inflation and deflation reflexes. Chemical regulation of respiration. Peripheral and central chemo receptors. Effect of pH concentration,  $PCO_2$  and  $PO_2$  on respiration. Hypoxia –Types and effects. Cyanosis, asphyxia, dyspnoea, periodic breathing. Acclimatization to high altitude, mountain sickness, dysbarism. Asthma, emphysema, apnoea. Artificial respiration – Manual methods, Holger-Neilson method and mouth to mouth breathing. Respiratory changes during exercise.

#### References:

- 1 Review of Medical Physiology – Ganong. W.F. McGraw Hill INC. New York.
- 2 Text Book of Anatomy and Physiology – Tortora. Harper Collins College Publications.
- 3 Text book of Medical Physiology – AP Krishna, Scientific publications, New Delhi.
- 4 Text Book of Medical Physiology. Hall and Guyton W.B. Saunders Company, London.

## **PSG2C08 Biostatistics and bioinformatics**

The students will able to:

- Understand the methodology of collecting data for analysis and represent in graphs, basic statistical methods to solve problems.
- Apply the importance of various statistical tools (ANOVA, SPSS, T-test, Chi-square test etc.) in research.
- Understand the structure of molecules, its sequencing and designing of molecules and structure predictions, basic principles and concepts of biology in computer science and mathematics to solve complex biological problems using database through internet, softwares to extract information from large databases and to use this in computer modeling.

- 1 Biostatistics: Methods for collecting data, tabulation and representation of data, sampling and sample design, types of classification, tabulation, diagrammatic representation by line diagram, bar diagram, pie diagram, histogram, frequency polygon, frequency curves and cumulative frequency curves. Measures of central tendency: mean, median, mode, range, mean deviation and standard error. Correlation analysis and regression analysis, probability analysis of variables. Tests of significance: t- test, Chi square test and goodness of fit; Analysis of variance: one way classification and two way classification.
- 2 Introduction to Bioinformatics: Definition and History of Bioinformatics, Internet and Bioinformatics, Introduction to Data Mining, Applications of Data Mining to Bioinformatics Problems.
- 3 Introduction to biological databases, classification of biological databases, Genbank, Protein Data Bank, Swiss-prot etc. Biological data formats, data retrieval - Entrez and SRS. ExpASSY.
- 4 Introduction to Sequence alignment, Local and Global alignment concepts, Multiple sequence alignment –Progressive alignment. Database searches for homologous sequences –Fasta and Blast versions. Bioinformatics Softwares: Clustal, RasMol, EMBOSS, Genetic Analysis Software, Phylip. Evolutionary analysis: distances - clustering methods – rooted and unrooted tree representation.
- 5 Fragment assembly-Genome sequence assembly. Gene finding method, Gene prediction - Analysis and prediction of regulatory regions. Structure prediction and protein modelling.

### References:

- 1 Andreatas D. Baxevanis, B. F. Francis Ouellette. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins John Wiley and Sons, New York (1998).
- 2 Jonathan Pevsner. Bioinformatics and functional genomics. 2<sup>nd</sup> edn, John Wiley & Sons, Inc. 2009.
- 3 Bryan Bergeron. Bioinformatics computing. Prentice Hall PTR. 2002.
- 4 David W. Mount. Bioinformatics - sequence and genome analysis.
- 5 Arthur M Lesk. Introduction to Bioinformatics. Oxford University Press. 2002.
- 6 Jerrold H. Zar. Biostatistical Analysis.5<sup>th</sup> Edn. 2009.

**PSG2C09 Practical III (PSG1C01 & PSG2C06)**

The students will be able to:

- Use different types of microscopes.
- Learn to collect blood samples, determine haemoglobin, count RBC, WBC, stain blood smears, determine blood groups, evaluate bleeding and clotting time, enumerate ESR, PCV and find the osmotic fragility of blood cells.

- 1 Study of microscope and its uses.
- 2 Collection of blood and preparation of blood smear.
- 3 Study of haemocytometer.
- 4 Haemoglobinometry.
- 5 Determination of RBC count.
- 6 Determination of WBC count.
- 7 Determination of blood groups.
- 8 Leishman's staining and differential leukocyte count.
- 9 Calculation of blood indices.
- 10 Determination of bleeding time.
- 11 Determination of clotting time.
- 12 Determination of ESR.
- 13 Determination of PCV.
- 14 Determination of specific gravity of blood.
- 15 Arneth count.
- 16 Absolute eosinophil count.
- 17 Platelet count.
- 18 Reticulocyte count.
- 19 Osmotic fragility determination.

**PSG2C10 Practical IV (PSG2C07)**

The students will be able to:

- Record blood pressure and interpret the values during different conditions like exercise and pathology, examine radial pulse, record ECG, examine the cardio vascular system.
- Use the stethoscope for recording breathing sounds and measure lung volumes and capacities using a spirometry and elicit an artificial respiration.

- 1 Recording of blood pressure.
- 2 Effect of exercise on blood pressure.
- 3 Examination of radial pulse.
- 4 Electro cardiography.
- 5 Clinical examination of cardio vascular system.
- 6 Stethography for recording chest movements.
- 7 Spirometry.
- 8 Artificial respiration – ALBP method demonstration
- 9 Clinical examination of respiratory system
- 10 Normal cardiogram of amphibian heart.
- 11 Effect of temperature on cardiogram.
- 12 CASE HISTORY/spotters/calculations.

## **PSG2C11 Practical V (Paper PSG2C08)**

The students will be able to:

- Learn about computer basics like OS, programming in Visual Basic, Data Access, Internet and Nucleic acid sequence and Protein Data Banks.
- Perform the Data Base Similarity Searches like BLAST, FASTA.
- Understand Multiple sequence alignments, Primer Designing, Homology Modelling, Phylogenetic Analysis and protein structure determination.
- Operate various Molecular Visualizing Tools like Rasmol.
- Apply suitable separation techniques to identify different biomolecules.
- Use of CASTp and ProtParam for surface and structural protein analysis.
- Locate the active sites of a protein molecule, Homology modeling using SPDBV/Modeller.
- Validate model using What Check and Pro Check.
- To do molecular docking using AUTODOCK/ HEX.

- 1 Data retrieval from Swiss-Prot, GenBank and PDB, Pubmed, GEO.
- 2 Pairwise sequence alignment using BLAST and FASTA.
- 3 Multiple sequence alignment with CLUSTAL W.
- 4 Gene structure and function prediction (using GenScan, GeneMark).
- 5 Protein sequence analysis (ExPASy proteomics tools).
- 6 Finding ORF of a given sequence.
- 7 Retrieving motif information of a protein using prosite.
- 8 Retrieving gene information from TAIR database.
- 9 Primer designing.
- 10 Global alignment of two sequences.
- 11 Local alignment of sequences.
- 12 Phylogenetic analysis using PHYLIP.
- 13 Calculating the distance between the ligand and a particular amino acid.
- 14 Finding the active site pockets of a given protein molecule.
- 15 Primary structure analysis of a protein using ProtParam.
- 16 Secondary structure analysis of a protein using SOPMA.
- 17 Surface analysis of a protein using CASTp.
- 18 Retrieving details of a drug molecule.
- 19 Protein/nucleotide sequence analysis using EMBOSS.
- 20 Molecular visualization tools.
- 21 Homology modeling using SPDBV/Modeller.
- 22 Model structure refinement using SPDBV.
- 23 Model validation using What Check and Pro Check.
- 24 Docking using AUTODOCK/ HEX.

## **PSG3C12 Muscle physiology, nervous system and special senses**

The students will be able to:

- Know the physiological anatomy of muscles and types of muscles, their process of contraction and various contractile properties, various benefits of muscular exercise on CVS and respiratory system,
- Know the parts and functions of various structures in the nervous system, fluid system in the nervous system and its importance.
- Know about special senses like eyes, nose, ear and tongue, their associated functions and mechanism of action, their role in executing various responses in the body and align the body posture accordingly, various techniques and diagnostic methods to detect any problems arising in the nerves, muscles and sense organs, functions of different areas of the brain.
- Know the ascending, descending and pain pathways.

- 1 Muscle Physiology and Exercise Physiology: Muscle- types. Comparison between skeletal, cardiac and smooth muscles. Motor unit. Physiological anatomy of skeletal muscle, sarcomere, contractile muscle proteins. Sarcoplasmic reticulum. Properties of skeletal muscle. Neuromuscular junction: Structure, neuromuscular transmission, neuromuscular blockers, myasthenia gravis. Excitation contraction coupling, molecular basis of muscle contraction. Experiments on properties of muscles, chemical changes during contraction, types of contraction – isometric and isotonic. Fast and slow muscles. Muscle dystrophy and rigor mortis.
- 2 Smooth muscle- structure, types and functions. Mechanism of smooth muscle contraction. Exercise Physiology: Isotonic and isometric exercise, gradation of exercise. Changes during exercise, cardiovascular, respiratory, metabolic, endocrine and nervous. Effect of training on muscular performance, health benefits of exercise.
- 3 Nervous System: Organization and overview of functions of nervous system. Neuron- Structure, classification and properties. Resting membrane potential, Action potential, strength-duration curve. Nerve fibre - Classification, conduction of impulses in myelinated & nonmyelinated nerve fibers. Velocity of conduction of nerve impulse. Degeneration and regeneration of nerve fibre, Neurotrophins. Neuroglia- Types and functions. Sensory receptors – Definition, classification and properties. Synapse – Structure, transmission, properties, synaptic inhibition. Neurotransmitters: Definition, types, examples. Organization of spinal cord. Reflex action, reflex arc, classification of reflexes, properties of reflexes.
- 4 Ascending tracts – Sensory pathways – Dorsal column, lateral column (name of important tracts, explanation of lateral spinothalamic tract) anterior column. Pathway for fine touch, crude touch, pressure, pain and temperature.
- 5 Physiology of pain – Definition of pain, pain receptors, classification of pain. Pain pathways- fast and slow. Modulation of pain at spinal cord level. Central pain analgesic mechanisms. Referred pain, phantom pain, projected pain, analgesia. Principles of pain management.
- 6 Descending tracts – Pyramidal and extra pyramidal pathways. Origin, course, termination and functions. Upper motor neuron lesion and lower motor lesion. Lesions of spinal cord- complete



and hemisection of spinal cord.

- 7 Gross structure and functions of Medulla and pons. Cerebellum - structure, connections and functions. Cerebellar disorders. Hypothalamus – structure, connections and functions. Thalamus - structure, connections and functions. Basal ganglia – structure, connections and functions. Cerebral cortex, cytoarchitecture, lobes and functions, hemispheres. Limbic system – organization, connections and functions.
- 8 Cerebrospinal fluid, formation, circulation and functions. Hydrocephalus, lumbar puncture, blood brain barrier.
- 9 Autonomic Nervous System, organization and functions.
- 10 Special Senses: Vision - Functional anatomy. Structure of retina. Rods and cones. Mechanism of formation of image - Basic optics. Phototransduction. Refractive errors with correction, Aqueous humor, Vitreous humor, Intraocular pressure, Pupillary reflexes with pathways - Light reflexes & accommodation reflex. Argyll Robertson pupil. Physiology of color vision & color blindness. Visual-adaptation – light and dark, cataract, Critical Fusion Frequency. Visual pathway with lesions at various levels, Visual acuity and field of vision.
- 11 Audition - Structure and function of external and middle ear. Structure of organ of Corti, Cochlear fluids. Mechanism of hearing, activation of hair cell, auditory pathway, theories of hearing, frequency and intensity discrimination. Auditory pathway. Applied aspects: Hearing tests, deafness, audiometry, vestibular apparatus, functions.
- 12 Olfaction - Olfactory receptors, mechanism of stimulation, olfactory pathway. Gustation – Modalities of taste, taste buds, mechanism of stimulation, taste pathway.

#### References:

- 1 Essential Medical Physiology – Leonard Johnson. Lippin Cott.
- 2 Fundamentals of Neurophysiology – R.F. Schmidt- Springer Verlag New York.
- 3 Raff, Hershel, Vanders human physiology: The mechanism of body function, 2008, Boston, 11th Ed., McGrawHill.
- 4 Text book of Medical Physiology – AP Krishna, Scientific publications, New Delhi.
- 5 Rhoades, Rodney. and Tanner, George A., Medical physiology /1995. Boston : 1st ed. Little, Brown.

## **PSG3C13 Endocrine system and reproductive system**

The students will be able to:

- Know the physiological anatomy of endocrine and reproductive organs.
- Know the actions of various hormones released by the endocrine glands, their mechanism of action and the disorders associated with variations in their normal level.
- Know the processes taking place in the male and female reproductive system, idea about the process of pregnancy and associated features, various family planning techniques.

- 1 Introduction - Types of chemical messengers. General properties of hormones. Classification of hormones and mechanism of action. Major endocrine glands. Anterior Pituitary – Hypothalamic control of pituitary secretion. Physiological functions of growth hormone (GH), role of somatomedins on growth, regulation of GH secretion. Abnormalities of GH secretion - Dwarfism, gigantism, acromegaly. Functions and regulation of secretion of prolactin, TSH, ACTH, FSH and LH. Posterior pituitary, antidiuretic hormone -Functions and regulation of secretion, Diabetes insipidus and Syndrome of Inappropriate Anti Diuretic Hormone (SIADH). Oxytocin - Functions and regulation of secretion.
- 2 Thyroid gland - Synthesis, secretion, functions and regulation of secretion of thyroid hormones. Disorders of thyroid – goitre, cretinism, myxoedema, Grave's disease, thyroid function tests, antithyroid substances. Adrenal Cortex – Synthesis and secretion of adrenocortical hormones, Functions of the mineralocorticoids- aldosterone, regulation of secretion of aldosterone. Conn's syndrome. Functions and regulation of secretion of glucocorticoids- cortisol, disorders- Addison's disease, Cushing's syndrome, adrenal androgens, adrenogenital syndrome.
- 3 Adrenal medulla - Biosynthesis of catecholamines. Functions of adrenal medullary hormones. Alarm reaction. Pheochromocytoma. Endocrine Pancreas - Physiological functions of insulin, mechanism of action-Insulin receptors, regulation of insulin secretion, diabetes mellitus- types and pathophysiology Glucagon – Functions and regulation of secretion. Somatostatin – Pancreatic polypeptide Hormonal regulation of blood glucose. Hypoglycemia.
- 4 Parathyroid gland – functions and regulation of secretion of PTH. Actions of PTH on regulation of plasma calcium and phosphate concentration. Tetany. Calcitonin: Functions and regulation of secretion. Calcium metabolism- Hormonal regulation of plasma calcium level. Other endocrine glands - Pineal gland, thymus. Local hormones - Histamine, serotonin, prostaglandins, acetylcholine, bradykinin. GIT hormones. Growth, development and aging.
- 5 Puberty – Pubertal changes in male and female. Male reproductive system - Functional anatomy. Spermatogenesis- steps and factors influencing spermatogenesis. Abnormal spermatogenesis, semen. Sertoli cells. Functions and regulation of secretion of testosterone. Cryptorchidism, hypogonadism, infertility.
- 6 Female reproductive system - Functional anatomy, oogenesis- steps and factors influencing. Menstrual cycle- ovarian and uterine changes. Tests for ovulation. Hormonal control of menstrual cycle. Female sex hormones, oestrogen, progesterone, relaxin.

- 7 Physiology of pregnancy - Fertilization, implantation. Placenta, hormones of placenta and functions. Pregnancy diagnostic tests. Maternal changes during pregnancy. Parturition: initiation and onset of labor. Lactation - Role of estrogen and progesterone in the development of breasts. Role of prolactin and oxytocin in milk ejection process. Menopause.
- 8 Family planning, Physiology of contraception – Physiological basis of different methods of contraception in males and females. Sex determination, Sex differentiation Chromosomal aberrations of sexual development.

#### References:

- 1 Text Book of Medical Physiology. Hall and Guyton W.B. Saunders Company, London.
- 2 Review of Medical Physiology – Ganong. W.F. McGraw Hill INC. New York.
- 3 Text Book of Anatomy and Physiology – Tortora. Harper Collins College Publications.
- 4 Text Book of Anatomy & Physiology – Patton & Thibodiau – Mosby.

**PSG3C14 Practical VI (Paper PSG3C12)**

The students will be able to:

- Know to perfuse an animal and isolate organs for histological study.
- Know to study the sensory and motor systems of a man, examine the cranial nerves, elicit deep and superficial reflexes, check visual acuity, colour vision, pupillary reflexes.
- Know to do tests of hearing, muscle contraction studies and the use of stereotaxy.

- 1 Perfusion of mammalian heart.
- 2 Histological preparation of brain.
- 3 Examination of sensory system.
- 4 Examination of motor system.
- 5 Examination of cranial nerves – I & II
- 6 Examination of cranial nerves III, IV,VI,
- 7 Examination of cranial nerves V & VII
- 8 Examination of cranial nerves VIII, IX & XII
- 9 Perimetry (Lister's).
- 10 Eliciting deep reflexes.
- 11 Eliciting superficial reflexes.
- 12 Acuity of vision.
- 13 Colour vision.
- 14 Pupillary reflexes.
- 15 Testing for hearing/deafness.
- 16 Mosso's ergography.
- 17 Instruments used in experimental physiology.
- 18 Preparation of gastrocnemius sciatic nerve.
- 19 Simple muscle curve.
- 20 Effect of temperature on muscle contraction.
- 21 Effect of two successive stimuli.
- 22 Fatigue curve.
- 23 Genesis of tetanus.
- 24 Velocity of impulse transmission.
- 25 Use of stereotaxy.

## **PSG3E01 Molecular Biology**

The students will be able to:

- Know the various stages of cell cycle and their regulation, different stages of development and their regulation, mechanism of gene regulation, different types of chromosomal aberrations, DNA damage and repair, basics of replication, transcription and translation.
- Analyse the various enzymes involved in central dogma of life, DNA finger printing, different blotting techniques, applications of PCR.
- Understand gene cloning, use of vectors, plasmids and cosmids, concept of operon, gene regulations and various factors involved in gene expression, gene therapy, gene transfer and isolation and purification of DNA from various sources.

- 1 Cell division and its regulation; DNA super coiling; structure and organization of chromatin. Central dogma of molecular genetics; DNA replication in prokaryotes and eukaryotes and its regulation; DNA polymerases and ligases. Transcription in prokaryotes and eukaryotes and its regulation; Introns and Exons; mRNA splicing and split genes; RNA polymerases. Translation in prokaryotes and eukaryotes; Post translational modifications. One gene one enzyme hypothesis; overlapping genes; Regulation of gene expression in prokaryotes and eukaryotes; Operon concept and functioning of lac operon. Transposition; Environmental regulation of gene expression; DNA methylation.
- 2 Genetic recombination; linkage, crossing over and gene mapping; extra chromosomal inheritance; plasmids and cosmids; attenuation and anti -termination. DNA damage and repair; Mutations; Chromosomal aberrations- deletion, duplication; transposons and transposable elements. Cell differentiation and differential gene activity; Law of DNA constancy and C value paradox.
- 3 Principles and applications of molecular biology techniques- DNA finger printing; PCR techniques; Southern blotting; Northern blotting; cDNA and genomic libraries. Principles and applications of PCR based techniques; RAPD, RFLP and AFLP techniques. Molecular biology of cancer; oncogenes and its regulation of expression. Lysogenic and lytic cycle of viruses. Genetic engineering- transformation, conjugation and transduction. Gene cloning; cloning vectors-bacterial DNA, bacteriophage vectors, plasmids and cosmids.
- 4 Techniques in genetic engineering; Principles and methods of gene targeting; Incorporation of foreign DNA into eukaryotic cells; gene gun; protoplast fusion and somatic hybridization; gene transfer methods in plants and animals. Gene therapy and its applications; recombinant proteins. Protocols for isolation, purification and characterization of DNA from different sources. Signal transduction pathways; receptors; ligands; mechanism of hormonal action; membrane and cytoplasmic receptors. Protein targeting.

### References:

- 1 Text book of Medical Physiology, AP Krishna, Scientific publication, New Delhi.
- 2 Molecular Biology of the Gene by James D. Watson; Michael Levine; Tania A. Baker; Alexander Gann; Stephen P. Bell.
- 3 Molecular Cell Biology, by Harvey Lodish, Arnold Berk, S Lawrence Zipursky, Paul Matsudaira, David Baltimore and James Darnell.
- 4 Cell and Molecular Biology by E.D.P . De Robertis and E.M.F. De Robertis Jr.
- 5 Molecular biology of cells by B. Alberts, D. Bray, J. Lewis.
- 6 Molecular Cloning: A laboratory manual by Sambrook & Russel.
- 7 Genetics: Principles and analysis by Daniel L Hartl.

8 Cell Biology by C.B. Pawar.

## **PSG3E02 Biotechnology**

The students will be able to:

- Know to culture different types of cells, produce mass culture of cells.
- Know the use of animal cells for production of vaccines, enzymes and hormones, use of recombinant DNA technique in industries and use of genetically modified organisms.
- Know the patenting rules.

- 1 Culture of special types – epithelial, mesenchymal, neuroexodermal, haemopoietic and gonadal tissues. Lymphocyte culture and culture of tumour tissues. Organ culture – methods, maintenance and utility. Organ transplants. Mass culture - production, harvesting and purification. Culture and maintenance of embryonic stem cells. Hybridoma technology. Production of maps and its applications. Application of animal tissue culture. Use of animal cells in the production of vaccines, enzymes and hormones. Uses in toxicity studies and mutagenicity studies. Applications of recombinant DNA techniques in medicine and industries.
- 2 Genetically modified organisms. Uses of genetically modified organisms in the environment. Genetic engineering and approach to detoxification. Animal cloning, regulation of genetic engineering, patenting of living organisms. Economic, ethical and social implications in biotechnology. Apoptosis- definition, mechanism and significance. Cellular aging.

### References:

- 1 Advances In Agricultural Biotechnology by Mude, V.
- 2 Basic Microbiology: Illustrated Laboratory Manual by D. K. Khuntia.
- 3 Principles Of Biotechnology And Genetic Engineering by Dr. A.J. Nair.
- 4 Biotechnology Procedures And Experiments Handbook by S. Harisha.
- 5 Molecular Biology by Dr. Priyanka Siwach, Dr. Namita Singh.
- 6 Process Biotechnology Fundamentals by S. N. Mukhopadhyay.
- 7 Environmental biology and Toxicology by P. D. Sharma.
- 8 Genetics: principles & Analysis of Genes & Genomes by Hartl & Jone.

### **PSG3E03 Instrumentation and enzymology**

The students will be able to:

- Know to the principles of centrifugation, chromatography types, spectrophotometry, spectroscopy techniques and types of solvents.
- Know the principle of lyophilization, use of Radioactive isotopes in biological research, general properties of enzymes, enzyme structure and naming, enzyme substrate specificity, regulation of metabolism.
- Know about enzyme inhibition, Techniques for enzyme purification, characterization and application.

- 1 Solutions – Properties; Osmosis, Diffusion; Dialysis. Solvents – Different types- Polar and Non polar solvents. Colloids- Properties. Principles and applications of Centrifugation, Electrophoretic techniques, different types of chromatographic techniques, HPLC, GC. Principles and applications of colorimetry, spectrophotometry, fluorimetry and flame photometry, pH meter, rotary evaporator.
- 2 Principles and applications of spectroscopy, mass spectroscopy, NMR, atomic absorption and emission spectroscopy, ORD and CD, electron spray. Principles and applications of Lyophilization techniques; Biphasic separation. Principles and applications of Tracer techniques in Biology. Applications of Radioactive isotopes in Biological Research, effect of radiations on biological systems. Autoradiography and its applications, Geiger – Muller counter. General properties of Enzymes, Enzyme structure- apoenzyme, holoenzyme, coenzyme & cofactors. Four levels of organization – primary, secondary, tertiary and quaternary. Enzymes – Classification, naming and EC numbering of enzymes. Structure of enzyme active site; lock and key and induced fit hypotheses of enzyme substrate specificity. Enzyme substrate complex, Mechanisms of enzyme catalysis, Coenzymes- chemical structure and specific functions.
- 3 Enzyme kinetics: Michaelis Menton equation; Factors affecting enzyme activity. Regulation of enzyme activity- covalent modification, allosteric regulation, feed back regulation. Enzyme inhibition – competitive, noncompetitive and uncompetitive inhibition. Multimeric enzymes; multienzyme complexes; structure of pyruvate dehydrogenase complex and the mechanism of catalysis. Isoenzymes- properties and significance; lactate dehydrogenase. Intracellular and extracellular enzymes; soluble and membrane bound enzymes. Ribozymes- structure, properties and functions; Abzymes- structure, properties and functions. Techniques for enzyme purification and characterization. General applications of enzymes- Industrial and clinical.

#### References:

- 1 Principles and techniques in practical biochemistry, Keith Wilson & John Walker, Cambridge University Press.
- 2 Biochemistry, 4<sup>th</sup> Edition, Lubert Stryer, WH Freeman and publishers, Newyork.
- 3 Biochemistry (with principles of biophysics), 9<sup>th</sup> Edition, Debjyothidas, Academic publishers, Calcutta.
- 4 Text book of Biochemistry, 6<sup>th</sup> Edition, DM Vasudevan and Sreekumari S, Jaypee brothers medical publishers.

## **PSG3E04 Behavioral physiology**

The students will be able to:

- Know on the evolution of psychology, biological basis of behaviour, sensation and perception and principles of learning, memory and its applications, physiology and psychology of thinking motivation and emotion.
- Overcome stress through cognitive methods and meditation, brain dexterity, different perceptions, thinking and language processing, theories of emotion, body language, lie detection.
- Know psychological assessment tests of intelligence and personality assessment, nature and assessment of intelligence, personality assessment.
- Know of stress, nature and types, effect of stress on physical health, psycho-physiological disorders, stress and cardio-vascular disorders, stress and immune functioning. Modifiers of Stress, health impairing lifestyles, coping with and reducing stress.

- 1 Introduction: The evolution of Psychology, Definition. The scientific approach to Behavior. Application – The work of Psychologists.
- 2 Biological basis of Behavior: Brain and Behavior – A guide to the nervous system, Neurons and synapses, left and right hemisphere functions. Heredity and Behavior – Basic principles of genetics.
- 3 Sensation and Perception: Sensory pathways of Vision, Audition, Olfaction, Gustation, and Sensation and perception. Other Senses – Kinaesthetic and Vestibular System. Perceptual Processes – Attention, Form Perception, Visual Depth Perception, Plasticity, and Individual Differences.
- 4 Principles of Learning: Classical and Instrumental Conditioning, Punishment and Reinforcement, Schedules of Reinforcement. Skinner's and Bandura's insights on learning.
- 5 Memory: Types, Organization and Processes, Theories of Memory. Application – Eyewitness Testimony. Forgetting and Amnesia.
- 6 Thinking and Language: Cognitive Processes and Creative Thinking. Problem Solving – Types, Barriers to Effective Problem Solving, Approaches to Problem Solving, Cognitive Styles and Problem Solving. Language – Meaning and Structure, Ape Language Controversy, Language Development and Theories of Language Acquisition.
- 7 Motivation and Emotion: Theories and Concepts – Instinct Theory, Drive Theory, Incentive Theory, the Hierarchy of Needs. Expressing and Perceiving Emotions, the Physiology of Emotions, Theories of Emotions. Application – Body Language, Lie Detection.
- 8 Social Motives: Affiliation and Achievement. Components of Emotional Experiences – Cognitive, Physiological, Behavioral. Personality Theories – Nature & Definition. Humanistic Perspective – Rogers Person Centred Theory, Maslow's Theory of Self Actualization. Evaluation of the Psycho-Dynamic Perspective – Freud, Jung, Adler.



- 9 Psychological Assessment and Testing: Psychological Tests, the Nature and assessment of intelligence, Individual differences. Personality assessment.
- 10 Stress, Coping and Health: Stress – Meaning, Nature, and Types – Frustration, Conflict, Changes, Pressure. Responding to Stress- Emotional, Behavioural, and Physiological Response. Effect of Stress on Physical Health – Psycho-Physiological Disorders - Headache, Asthma, Digestive System Diseases. Stress and Cardio-Vascular Disorders. Stress and Immune Functioning. Modifiers of Stress – Social Support, Resilience, Optimism. Health Impairing Lifestyles – Smoking, Poor Nutritional Habits, Lack of Exercise, Alcohol and Drug Use. Coping With and Reducing Stress – Behavioral and Cognitive Methods, Relaxation Minimizing Physiological Vulnerability, Meditation.

#### References:

- 1 Physiology of Behavior 11<sup>th</sup> Edition, Pearson. Carlson, N.R., 2012.
- 2 Psychology: Science of Behavior Ettinger, R.H., 2011 4/e Ed. BVT Publishing.
- 3 Brain & Behavior: An Introduction to Behavioral Psychology Garrett, B.L., (2010) 3<sup>rd</sup> Edn, Ed. SAGE Publications, Inc.
- 4 Introduction to Psychology Morgan, King, Weisz, Schopler (2012), Tata McGraw Hill, Delhi.
- 5 Understanding Psychology Feldman. R (2008), McGraw Hill.
- 6 Health Psychology via Psycho-Social Interactions Edward. P Sarafino, Smith T.W, John Wiley and Sons, Inc., USA.

## **PSG4C15 Advances in neuroscience**

The students will be able to:

- Know the theories of sleep and wakefulness, benefits of sleep for both physical and mental health, sleep disorders, physiology of stress and its causes, physiology of depression and its management, learning and memory, consciousness and epilepsy.
- Know the causes of drug addiction and de-addiction and different types of neurological disorders.

- 1 Sleep and wakefulness, Theories of sleep. Common sleep disorders. Higher functions of nervous system – Learning, memory, forgetting. Neuro-physiological basis. Dementia. Alzheimer's disease, cause, symptoms, mode of treatments. Language and speech. Speech disorders. Emotion, Psycho physiology of consciousness, Split brain - Roger Sperry's experiments. Electroencephalogram pattern and clinical uses. Epilepsy types.
- 2 Neurotrophic factors, Cell death suicide phenomenon, Neurological disorders- Motor neuron disorder, Ischaemic stroke, cerebral thrombosis, multiple sclerosis. Parkinsonism, Experimental therapeutic procedures of tissue transplant. Therapeutic uses of stem cell technology. Spinal cord lesions. Brown Sequard syndrome.
- 3 Physiology of stress, Causes of stress Effect of stress on various organs and systems. Pathophysiology of stress. Stress related diseases and stress relieving mechanisms. Biochemical markers of stress.
- 4 Depression, causes, physiological impact and management.
- 5 Drug addiction: Causes, alcoholism, biogenic amines, psycho active drugs Mood elevators, de-addiction.

References:

- 1 Neuroscience 3<sup>rd</sup> Edition 2004 Purves D Augustine GH. & Fitzpatrick Sinauer Associates.
- 2 From Neuron to Brain: A cellular and Molecular Approach to the Functions of Nervous System. Nicholas JG et al Sinauer Associates.
- 3 Fundamental Neuroscience Squire LR et al Third Edition Academic Press.

## **PSG4C16 Dissertation/ project work and viva - voce**

## **PSG4E05 Diet and Nutrition**

The students will be able to:

- Know the definition, food pattern, health aspects, food habits, superstitions, food selection, food adulterations, classification of micro and macro nutrients.
- Nutritional importance, carbohydrates, requirements and deficiency. Proteins requirements and deficiency, fats, requirements and deficiency. Minerals requirements and deficiency.
- Vitamin, requirements and deficiency, balanced diet, new born diet, infant diet, pre-schooler diet, school age, adolescent diet, adult worker diet, expectant and lactating mothers and old age diets, purpose and methods of cooking.

- 1 Definition, food pattern and its relation to health, factors influencing food habits and selection. Superstitions, culture, religions, income, composition of family, age, occupation. Food selection, storage & preservation, prevention of food adulterations. Elements of nutrition: Classification of micro and macro nutrients.
- 2 Nutritional importance of carbohydrates, proteins, fats. Carbohydrates: types, sources, requirements and deficiency. Proteins: types, sources, requirements and deficiency; protein energy malnutrition. Fats: types, sources, requirements and deficiency. Water: sources, requirements. Minerals: types, sources, requirements and deficiency. Nutritional importance of Calcium, iron, fluoride, copper and cobalt. Vitamins: types, sources, requirements and deficiency, physiological functions. Planning diets: need for planning diets; balanced diet, food group and balanced diet. Influence of age, sex, occupation and physiological state. Steps in planning balanced diet; Planning diet for new born, infant, pre-schooler, school age, adolescent, adult worker, expectant and lactating mothers and old age. Introduction to cookery: purpose and methods of cooking, effects of heat on cooking.

### **References:**

- 1 Biochemistry (with principles of biophysics), 9<sup>th</sup> Edition, Debjyothidas, Academic publishers, Calcutta.
- 2 Text book of Biochemistry, 6<sup>th</sup> Edition, DMVasudevan and Sreekumari S, Jaypee brothers medical publishers.
- 3 Biochemistry Usathyanarayana, Books and allied private Ltd.
- 4 Principles of Biochemistry, Lehninger, WH Freeman and publishers, New York.

## **PSG4E06 Metabolic disorders and management**

The students will be able to:

- Know the metabolic disorders of carbohydrates, glycogen, fructose and galactose, glucose.
- Know the disorders of amino acid metabolism, disorders of urea cycle, nucleic acid metabolism, disorders of purine and pyrimidine metabolism.
- Know the lipid and lipoprotein metabolism, disorders of cholesterol and bile acid, lysosomal storage disorders, inborn errors of metabolism. Nutrition and exercise for management.
- Know of ideal sports drink, high, moderate and low glycaemic index tools.

- 1 Introduction: Basic enzymology - Overview of carbohydrate metabolism, glycogen storage disorders, disorders of fructose metabolism, disorders of galactose metabolism, diabetes mellitus and hypoglycemia. Overview of amino acid metabolism, disorders of amino acid metabolism, disorders of urea cycle. Overview of nucleic acid metabolism, disorders of purine metabolism, disorders of pyrimidine metabolism. Haeme metabolism, porphyrias.
- 2 Overview of lipid and lipoprotein metabolism, disorders of lipoprotein metabolism-dyslipidemias, disorders of cholesterol and bile acid synthesis and storage. Organelle functions, glycolipids and complex carbohydrates, lysosomal storage disorders. Inborn errors of metabolism. Optional nutrition for exercise, comparison of nutrient and energy intakes of the physically active and sedentary counter parts. Provide recommendation for carbohydrate, lipid and protein intake for individuals who maintain physically active life styles and who regularly engage in intense physical training. Energy intake of athletes who train for competitive sports. The ideal sports drink and give the rationale for its composition. Describe high – moderate and low glycaemic index tools.

### References:

- 1 Harper's illustrated biochemistry, 29<sup>th</sup> Edition, Robert K Murrall et al., Lange McGraw Hill publishers.
- 2 Biochemistry, 4<sup>th</sup> Edition, Donald Voet and Judith G Voet, John Wiley and sons.
- 3 Medical Biochemistry, John Maynes and Marek H, Mosby, London.

## **PSG4E07 Sports physiology**

The students will be able to:

- Know nutrition, energy intakes of physically active subjects, energy intake of athletes who train for competitive sports, ideal sports drink, glycemic index tools, energy system and energy transfer, body stores of fuels and energy, energy release, blood lactate threshold, oxygen consumption, energy expenditure.
- Know of muscular system structure, functions of skeletal muscle, muscle contraction, fatigue and exhaustion, muscle strength, neuromuscular function and adaptations to exercise, metabolic adaptations to exercise, cardiovascular changes and adaptation to exercise, pulmonary adaptations to exercise, neuroendocrine adaptations to exercise.
- Know the effect of exercise on excretory system, digestive system, body fluids and salts, physiological requirement of specific athletic events like walking, running, bicycling, swimming, speed skating, cross country running, rowing, soccer, golf, tennis, table tennis, badminton, hockey.
- Know the performance of women Vs. men, genetics of physical performances, effect of age, anabolic steroid usage.

- 1 Optional nutrition for exercise, Comparison of nutrient and energy intakes of the physically active and sedentary counter parts. Provide recommendation for carbohydrate, lipid and protein intake for individuals who maintain physically active life styles and who regularly engage in intense physical training. Energy intake of athletes who train for competitive sports. The ideal sports drink and give the rationale for its composition. Describe high moderate and low glycemic index tools.
- 2 Energy system and energy transfer in exercise. Basic energy system and body stores of fuels and energy. Energy release in muscular activity. Outline the relative contribution of three energy system for exercise intensity and duration. Relate the discussion to specific sport activity. The blood lactate threshold, indicating the difference between sedentary and endurance trained individuals. Oxygen consumption during progressive increments in exercise intensity up to max. Measurement of human energy expenditure.
- 3 Muscular system: Structure, functions of skeletal muscle, Physiology of muscle contraction, fatigue and exhaustion, factors influencing. Muscle strength assessment. Discuss the specificity of strength – training response related to sports and occupational tasks. Systemic responses to exercise: Neuromuscular function and adaptations to exercise, metabolic adaptations to exercise, cardiovascular changes and adaptation to exercise, pulmonary adaptations to exercise. Neuroendocrine adaptations to exercise. Effect of exercise on excretory system, digestive system, body fluids and salts. Measurements of fitness and exercise performance, measuring endurance, anaerobic capacity and strength, measuring pulmonary function, body composition and assessment.
- 4 Effect of athletic training on muscle and muscle performance. Clinical exercise testing. Analysis of specific athletic events: Physiological characteristics and physiological requirement of specific athletic events like walking, running, bicycling, swimming, speed skating, cross country running, rowing, soccer, golf, tennis, table tennis, badminton, hockey.
- 5 Performances in sports: Women Vs. Men, genetics of physical performances, effect of age. Effect of performance enhancing drugs. Anabolic steroids.

### References:

- 1 Physiological Aspects of Sport Training and Performance. Human Kinetics I Hoffman J.
- 2 Essential Exercise Physiology Nutrition, Energy and Performance McArdle Wd & Katch FI Lippincot Williams and Wilkins.
- 3 Essential Exercise Physiology McArdle Wd & Katch FI Lippincot Williams and Wilkins.
- 4 Physiology of Sports and Exercise Wilmore JH & Kenney WL Human Kinetics Europe Ltd.

## **PSG4E08 Toxicology**

The students will be able to:

- Know the definition of poison, commonly used poisons, toxic ingredients of domestic poisons, classification of poisons, general treatment in all poisons, importance of viscera and body fluid collection in poisoning case.
- Know of common poisons like lead, phosphorous, sulphuric acid, phenol, organophosphorous poison, barbiturates, alcohol, iron, snake bite, plant poisons.
- Know of poison and law, common causes, signs, symptoms, treatment of the following poisons barbiturates, alcohols, benzodiazepines, phenol, paracetamol, kerosene, snake bite, heavy metals and opium.
- Know of plant poisons like cannabis, tobacco and cocaine.
- Know of first aid in snake bite, gastric lavage, irritants,
- Know of environmental toxins, methyl isocyanate, endosulfan, hydrogen sulfide management, medico-legal importance,
- Know of occupational toxicology Formaldehyde, management, Organo phosphorous poison types, poisoning & management.

- 1 Definition of poison. Commonly used poisons in India: House hold and agriculture based. Toxic ingredients of domestic poisons used. Classification of poisons. Factors modifying action of poisons. General treatment in all poisons. Importance of viscera and body fluid collection in poisoning case.
- 2 Definition of acute, sub acute chronic toxicity.
- 3 Common poisons- lead, phosphorous, sulphuric acid, phenol, organophosphorous poison, barbiturates, alcohol, iron, snake bite, plant poisons.
- 4 Define of - plumbism, vitriolage, golden triangle, golden crescent.
- 5 Poison and Law: Common causes, signs, symptoms, treatment of the following poisons - barbiturates, alcohols, benzodiazepines, phenol, paracetamol, kerosene, snake bite, heavy metals, opium.
- 6 Classification of plant poisons - cannabis, tobacco, cocaine.
- 7 First aid in snake bite.
- 8 Gastric lavage.
- 9 Classify irritants, mechanical irritants, glass powder.
- 10 Abrus, ricin, calotropis.
- 11 Environmental toxicology – Methyl Isocyanate-Bhopal gas tragedy. Endosulfan - source, mechanism of action, complications, management. Hydrogen sulfide – mechanism of action, signs & symptoms, fatal dose, fatal period, management, medico-legal importance. Carbon dioxide and carbon monoxide – Mechanism of action signs & symptoms, fatal dose, fatal period, management, medico legal importance.
- 12 Occupational toxicology: Formaldehyde - signs & symptoms, fatal dose, fatal period, management, medico legal importance. Organo phosphorous poisoning – types mechanism of action, acute poisoning & management.

### References:

1. Forensic Medicine and Toxicology --Anil Aggarwal
2. Modern Medical Toxicology. – V.V.Pillay
3. Goldfrank's Text Book of Toxicology
4. Ellenhorn's Medical Toxicology

5. Forensic Medicine and Toxicology – Narayana Reddy.