



COOCH BEHAR PANCHANAN BARMA UNIVERSITY

PANCHANAN NAGAR, VIVEKANANDA STREET, COOCH BEHAR – 736101

4 Year Under Graduate Degree (Honours) in PHYSIOLOGY

Programme Objective:

The basic objective of the course is comprehensive understanding of human physiology. The course emphasizes on the detail structure-function relationship of different systems of human body. The biochemical reactions, molecular integrations and responses to internal and external environment are also included in the course. The intervention of new technologies and biomedical instruments in combating the anomalies in physiological processes are also addressed.

Programme Outcome:

- Demonstrate comprehensive understating of the structure and function of the human body.
- Evaluate the impact of the recent information on the current concepts related to various topics of physiology
- Plan and execute physiology-related laboratory experiments or field investigations, analyses and interpret the collected information using appropriate methods
- Demonstrate elementary understanding of the clinical applications of physiology
- Enhance the capability of students to answer and explain the urgings that they face in next level of studies.

DETAILED COURSE STRUCTURE

1ST YR		2ND YR				3RD YR				4TH YR HONS				4TH YR RESEARCH		HONS WITH			
1ST SEM	C	2ND SEM	C	3RD SEM	C	4TH SEM	C	5TH SEM	C	6TH SEM	C	7TH SEM	C	8TH SEM	C	7TH SEM	C	8TH SEM	C
Major-1	6	Major-2	6	Major-3	6	Major-5	6	Major-7	6	Major-10	6	Major-13*	6	Major-17	6	Major-13	6	Major-17	6
Minor-1	6	Minor-2	6	Major-4	6	Major-6	6	Major-8	6	Major-11	6	Major-14	6	Major-18	6	Major-14#	6	Major-18#	6
MDC-1	3	VAC-1	3	Minor-3	6	Minor-4	6	Major-9	6	Major-12	6	Minor-5	6	Minor-6	6	Minor-5	6	Minor-6	6
SEC-1	3	SEC-2	3	SEC-3	3	AEC-2	4	MDC-3	3	VAC-2	3	Major-15**	6	Major-19	6	Major-15**	6	Major-19	6
AEC-1	4	INTRN	4	MDC-2	3							Major-16	6			Major-16	6		
SEM Credits	22	22		24		22		21		21		30		24		30		24	
	44			46			42			54			54						
Total Credit= 132 (3 Year UG):																			
Total Credit= 186 (4 Year Hons)																			
Total Credit= 186 (4 Year Hons with Research)																			



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SEMESTER-WISE MARKS DISTRIBUTION (Upto 3rd year i.e., 6th semester)

YEAR	1ST SEM	Internal Assessment						TOTAL	Credit		
		Theory	Practical	Internship/ Dissertation	Project/ Seminar/ Assignment	CE	Attendance				
1ST	Major-1 Cellular Physiology, Biophysics & Biophysical Chemistry	50	25		10	10	5	100	6	EXIT WITH UG CERTIFICATE	
	Minor-1 (As opted by the student)	50	25		10	10	5	100	6		
	MDC-1 (As opted by the student)	35	0		0	10	5	50	3		
	SEC-1 (As opted by the student)	0	35		0	10	5	50	3		
	AEC-1 (As opted by the student)	35	0		0	10	5	50	4		
		170	85		20	50	25	350	22		
	2ND SEM										
	Major -2 Haematology & Nerve-Muscle Physiology	50	25		10	10	5	100	6		
	Minor-2 (As opted by the student)	50	25		10	10	5	100	6		
	VAC-1 (As opted by the student)	35	0		0	10	5	50	3		
	SEC-2 (As opted by the student)	0	35		0	10	5	50	3		
	INTRN			50 (Internship)					50	4	
		135	85	50	20	40	20	350	22		
	3RD SEM										
2ND	Major-3 Environmental Physiology, Social Physiology and Community Health	50	25		10	10	5	100	6	EXIT WITH UG DIPLOMA	
	Major-4 Structural Biochemistry & Enzymology	50	25		10	10	5	100	6		
	Minor-3 (As opted by the	50	25		10	10	5	100	6		



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	student)								
	SEC-3 (As opted by the student)	0	35	0	10	5	50	3	
	MDC-2 (As opted by the student)	35	0	0	10	5	50	3	
		185	110	30	50	25	400	24	
	4TH SEM								
	Major-5 Gastro-intestinal Physiology and Metabolic biochemistry	50	25	10	10	5	100	6	
	Major-6 Cardiovascular and Respiratory Physiology	50	25	10	10	5	100	6	
	Minor-4 (As opted by the student)	50	25	10	10	5	100	6	
	AEC-2 (As opted by the student)	35	0	0	10	5	50	4	
		185	75	30	40	20	350	22	
	5TH SEM								
3RD	Major-7 Neurophysiology and Nutrition & Dietetics	50	25	10	10	5	100	6	EXIT WITH 3 YEAR UG DEGREE
	Major-8 Microbiology & Immunology	50	25	10	10	5	100	6	
	Major-9 Renal Physiology and sensory physiology	50	25	10	10	5	100	6	
	MDC-3 (As opted by the student)	35	0	0	10	5	50	3	
		185	75	30	40	20	350	21	
	6TH SEM								
	Major-10 Endocrinology	50	25	10	10	5	100	6	
	Major-11 Genetics and Molecular Biology	50	25	10	10	5	100	6	
	Major-12 Reproductive Physiology & Embryology	50	25	10	10	5	100	6	
	VAC-2 (As opted by the student)	35	0	0	10	5	50	3	
		185	75	30	40	20	350	21	



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Course: *Major I*

Paper Name: Cellular Physiology, Biophysics & Biophysical Chemistry

Paper Code: PHY-MAJ1

Course outcome: This course introduces the students to the basics of cell and its components. This gives them a strong foundation on the basic unit of life. The students should be able to apply the principles of physical sciences to understand and solve biological complexities through this course. At the end of the course, the student has a strong foundation on the functions of the cell and biophysical principles.

Theory:

04 Credit

UNIT I:

1. General concept of electron microscopic structure of animal cells and cell organelles and their functions (Special emphasis on Nucleus, Endoplasmic reticulum, ribosomes, Golgi bodies, Mitochondria, Lysosomes, Peroxisomes)
2. Electron microscopic structure of plasma membrane and its functions, Membrane transport (Passive, active and carrier-mediated transport, Ion channels, Ionophores)
3. Cytoskeletal Structure, Extracellular matrix components, Intracellular communications (Tight Junctions, gap junctions, adherens junctions, desmosomes, Intercalated disc, and cell adhesion molecules).

UNIT II:

1. Cell Division (Mitosis and Meiosis)
2. Cell cycle and its regulation, Check points of cell cycle
3. Cell death (Apoptosis, Necrosis, autophagy) and Aging (Physiological and metabolic changes)
4. Histological structure of animal tissues and functions (Special emphasis on epithelial tissue, connective tissue, areolar tissue, adipose tissue, and glandular tissues)
5. Homeostasis- General Concept.

UNIT III:

1. Measurement of concentration of solutes (Normality, Molarity, Molality, Formality, Moles Equivalent)
2. Principles of dilution, pH and Buffer- General concept
3. Osmosis and Diffusion- General concept and physiological importance
4. Surface tension and Specific Gravity- General concept and physiological importance
5. Colloids- Definition, Types, Properties, and Importance
6. Biophysical aspect and physiological aspect of flow and pressure (Special emphasis on Laminar and streamline flow, Poiseuille- Hagen Formula, Laplace's Law, Bernouli's Principle)
7. Viscosity and Resistance- General Concept and physiological importance.



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Practical:

02 Credit

1. Introduction on principle and function of different components of microscope
2. Identification of stained sections of different mammalian tissues and organs (Bone, trachea, lungs, spleen, lymph gland, esophagus, stomach, duodenum, ileum, jejunum, large intestine, liver, kidney, ureters, salivary gland, pancreas, thyroid gland, adrenal gland, testis, ovary, uterus, spinal cord, cerebral cortex, cerebellum, skin, cardiac muscle, skeletal muscle, smooth muscle, artery, vein, tongue.)
3. Preparation and measurement of the strength of buffer solutions
4. Measurement of pH of the given buffer solutions
5. Determination of systolic, diastolic, pulse and mean blood pressure by Auscultatory method.

References:

1. Rastogy, S. C. (2005). Cell and molecular biology. New Age International Publishers.
2. Hardin, J., Becker, G., Kliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education, Inc. U.S.A. 8th edition.
3. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Alberts, B. Johnson, A. Lewis, J. Raff. M. (2008). Molecular Biology of the Cell.
5. Das, D. (2004). Biophysics and Biophysical Chemistry. Fifth Edition. Academic Publishers.
6. Roy, R.N. A. (2015). Text Book of Biophysics. New Central Book Agency (P) Ltd.
7. Das, D. (2008). Biochemistry. Academic Publishers.
8. Mescher, A.L. (2013). Junqueira's Basic Histology Text and Atlas. Thirteenth Edition. The Tata McGraw Hill Companies.
9. Ross, M.H, and Reith, E.J. (2011). Histology - A Text and Atlas. Sixth Edition. The Williams and Wilkins Company.
10. Eroschenko, V.P. (2012). Difiore's Atlas of Histology: With Functional Correlations. Twelfth Edition. Lippincott Williams Wilkins Company.
11. Chatterjee, C.C. (2016). Human Physiology Volume 1. Eleventh Coloured Edition. CBS. Publishers and Distributors Pvt. Ltd.
12. Mahapatra, A.B.S.M. (2014). Essentials of Medical Physiology. Fourth Edition. Current Books International.
13. Note Books on Practical Histology. Published by The Physiological Society of India. Kolkata.
14. Keele, C.A., Neil, E., Toels N. (1982). Samson Wright's Applied Physiology. Thirteenth Edition. Oxford University Press.
15. Pal, G.K. Pal, P. (2013). Textbook of Practical Physiology. Third Edition. Universities Press.



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Course: *Major 2*

Paper Name: Haematology & Nerve-Muscle Physiology

Paper Code: PHY-MAJ2

Course outcome: The course includes complete understanding of human blood and nerve-muscle and its disorders based on an up-to-date knowledge. By the end of this course, the students should be able to understand the principles of haematology and nerve-muscle physiology, functions, and disorders.

Theory:

04 Credit

UNIT I:

1. Composition and functions of blood, Plasma Protein, Plasmapheresis, Bone marrow
2. RBC- Erythropoiesis, Characteristics, and fate
3. Haemoglobin- Chemistry, biosynthesis, fate, types & derivatives, functions, haemoglobinopathies
4. Platelets: Blood coagulation- Mechanisms, factors, anticoagulants, coagulation-hastening factors, prothrombin time, coagulation disorders
5. WBC- types, leukopoiesis, fate
6. Blood Group: ABO, Rh-typing, Blood transfusion: General concept, hazards, and precautions,
7. Different diagnostic techniques and parameters and their physiological significances (Special emphasis on ESR, Haematocrit, PCV, MCV, MCH, MCHC)
8. Clinical implication of different components of blood (Special emphasis on anaemia, polycythemia, leucocytosis, leucopenia, leucoma, purpura and erythroblastosis foetalis)
9. Lymph: formation, circulation, and function; Edema.

UNIT II:

1. Microscopic structure of nerve cells and glial cells, Myelinated and unmyelinated nerve fibres, Myelinogenesis
2. Excitation and conduction of nerve impulse, Resting membrane Potential, Action Potential, Electrotonic potentials, Ionic basis of excitation and conduction,
3. Types of nerve fibres and functions, Properties of nerve fibres: excitability, contractility, all or none law, accommodation, adaptation, summation, refractive period, concept of chronaxie and rheobase
4. Neurotrophins- Definition, Chemical nature, and functions
5. Degeneration and regeneration of nerve fibre
6. Sensory receptors as biological transducers, types, and properties, Receptor Potential.

UNIT III:

1. Microscopic structure of striated, smooth & cardiac muscles, Sarcotubular system
2. Electrical phenomena and ionic fluxes in different types of muscles
3. Muscle proteins, Mechanism of muscle contraction and relaxation, Excitation-contraction coupling, isotonic and isometric contraction, Chemical, thermal, and electrical changes in muscle during contraction and relaxation



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4. Properties of muscle: excitability, contractility, all or none law, summation of stimuli, summation of contractions, effects of repeated stimuli, genesis of tetanus, onset of fatigue, refractory period, tonicity, conductivity, extensibility & elasticity
5. Muscle fibre, Red and White striated muscle fibre, Single and multi-unit smooth muscle
6. Spasticity and flaccidity of muscle, myasthenia gravis, rigor mortis, muscular dystrophy, hypotonia and hypertonia of muscle.

UNIT IV:

1. Synapse: types, functional anatomy
2. Synaptic transmission: Electrical events, chemical transmission; inhibition and facilitation at synapse
3. Principal neurotransmitter systems, neuromodulators
4. Neuromuscular junctions: functional anatomy, transmission mechanism, endplate potential
5. Motor unit, Motor point.

Practical:

02 Credit

1. Preparation and staining of blood film
2. Identification of blood corpuscles
3. Differential Count of WBC
4. Total Count of RBC and WBC
5. Bleeding and Clotting time
6. Blood group determination
7. Haemoglobin estimation
8. Preparation and staining of bone marrow
9. Isolation and staining of nerve fibres with node of Ranvier and muscle fibres,
10. Demonstration of kymographic recording of skeletal muscle contraction and calculation of latent period, contraction period, relaxation period, maximum height of contraction from supplied muscle curve
11. Phenomenon of human fatigue by Mosso's Ergograph
12. Examination of motor system: bulk (Inspection and palpation), tone (Hypotonia, hypertonia), strength (grading) of muscle.

References:

1. Chatterjee, C.C. (2016). Human Physiology Volume 1. Eleventh Coloured Edition. CBS.
2. Hall J.E. (2016). Guyton & Hall Textbook of Medical Physiology. Second South Asia Edition.
3. Mahapatra, A.B.S.M. (2014). Essentials of Medical Physiology. Fourth Edition. Current Books International.
4. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.Khurana, I. (2015).Medical Physiology. 2nd Edition. Elsevier India.
5. Berne, R.M. and Levy M.N. Physiology. C.V.Mosby Co.



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6. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.
 7. Core Text Book Of Neuro-Anatomy, by M.B.Carpenter: the Williams and Wilkins Company.
 8. Khurana, I. (2015).Medical Physiology. 2nd Edition. Elsevier India.
 9. Barrett, K. E. Barman, S.M., Boitano, S. Brooks, H.L. (2012).Ganong's Review of Medical Physiology. 24th Edition. Lange Medical Book. Prentice-Hall International.
 10. Pal, G.K. Pal, P. (2013).Textbook of Practical Physiology. Third Edition. Universities.
 11. Shepherd.G.M. Neurobiology. Oxford University Press.
 12. Chadha, P.V. Handbook of Experimental Physiology and Biochemistry. Jaypee Brothers Medical Publishers.
 13. Babaharik Sharir Bigyan: Jogen Debnath, Shreedhar Prokashani, Kolkata.
 14. Mukherjee, K.L. (2004). Medical Laboratory Technology. Vol. I, Vol. II and Vol. III. Tata McGraw-Hill.
 15. Ghai, C.L. A Text Book of Practical Physiology. 8th Edition. Jaypee.

Course: Major-3

Paper Title: Environmental Physiology, Social Physiology and Community Health

Paper Code: PHY-MAJ3

Course outcome: The course will mainly emphasize the organismal, ecological, and evolutionary significance of physiological functions and basics of various community health issues. Students will be able to describe how the body senses and responds to environmental variation. Student will also be able to know the etiology, symptoms and prevention of different public health conditions and many other communicable and non-communicable diseases. The student will be able to perform community survey and epidemiological survey on field and will be able to draw inferences from their observations.

Theory:

04 Credit

UNIT I: Environmental Physiology

1. Basic concepts and definitions of ecology: ecology, ecosystems, phenotypic plasticity, ecotypes, ecoclines, major terrestrial biomes.
2. Ecology of populations: Concept of population and meta-population; r- and K-selection; characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential, logistic, density-dependent; limits to population growth; deterministic and stochastic models of population dynamics.
3. Strategies of adaptation in humans: Physiological responses to high altitude, high atmospheric pressure, hot and cold environment.
4. Environmental Pollutions: Air Pollution: Definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.



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Water Pollution: Definition, types, health hazards, water pollutants, biochemical oxygen demand (BOD), thermal pollution, concept of safe drinking water standards. Soil Pollution: Causes, health hazards, solid waste managements- bioremediation, phytoremediation. Sound Pollution: Definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards). Radionuclide Pollution: Ionizing radiations, effects of ionizing radiation on human health, permissible doses. Arsenic Pollution: Sources, sources of arsenic in ground water, drinking water standard for arsenic (WHO, USEPA), health effects of chronic arsenic poisoning.

UNIT II: Social Physiology and Community Health

1. Basic idea about community structure, definition and concept of health and diseases, health system.
2. Population problem – principles and methods of family planning.
3. Vulnerable sections in the society and their health care: health and diseases in infant /children /old persons, women in the reproductive age, rural/tribal population, health problems of old ages.
4. Health situation in India; diseases: causation and prevention of diseases, mode of intervention, epidemic and endemic forms of diseases, epidemiological triad, web of causation and social determinants of diseases.
5. Principles and social importance of immunization against diseases. National vaccination schedule for infants, children, and pregnant women.
6. Malnutrition and over-nutrition in a community and their possible remedial measures.
7. Social implications of PCM -- Marasmus, Kwashiorkor, Endemic goitre, Nutritional anaemias, Rickets, Osteomalacia, Xerophthalmia, Beriberi.
8. Etiology, epidemiology and prevention -- Communicable diseases: Cholera, Malaria, Swine flu, Japanese Encephalitis, Rabies, Dengue, Hepatitis and AIDS, Kala-azar, Tuberculosis, Diarrhoeal disorders.
9. Non-communicable and life style diseases – Hypertension, Obesity, Diabetes, Cardiovascular Diseases, Arthritis, Cancer.

Practical:

02 Credit

1. Measurement of dissolve oxygen
2. Determination of particulate matter in air sample
3. Measurement of noise by sound level meter
4. Measurement of pH of soil
5. Effect of temperature on cardiac rhythm, degree of contraction - analysis on model graphical record.
6. Field study in environmental/social physiology using both qualitative and quantitative studies from any one of the following bio-geographical area (coastal/ forest/ Hills) with report submission.

References:



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1. Understanding Medical Physiology by R.L. Bijlani
2. Review of Medical Physiology by W.F. Ganong
3. Textbook of Medical Physiology by A.C. Guyton
4. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders.:
5. Groom. B. & Jenkins. M. 2000. Global Biodiversity: Earth's Living Resources in the 21st Century. World Conservation Press, Cambridge, UK.
6. Loreau, M. & Inchausti, P. 2002. Biodiversity and Ecosystem functioning: Synthesis and Perspectives. Oxford University Press, Oxford, UK.
7. Pandit, M.K., White, S.M. & Pocock, M.J.O. 2014. The contrasting effects of genome size, chromosome number and ploidy level on plant invasiveness: a global analysis. *New Phytologist* 203: 697-703. 12
8. Pimentel, D. (Ed.). 2011. Biological invasions: Economic and environmental costs of alien plant, animal, and microbe species. CRC Press.
9. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications.
10. Wilson, E. O. 1985. The Biological Diversity Crisis. *BioScience* 35: 700-706.
11. Gaston, K.J. & Spicer, J.I. 1998. Biodiversity: An Introduction. Blackwell Science, London, UK.
12. Primack, R.B. 2002. Essentials of Conservation Biology (3rd edition). Sinauer Associates, Sunderland, USA.
13. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
14. Pandit, M.K. & Grumbine R.E. 2012. Ongoing and proposed hydropower development in the Himalaya and its impact on terrestrial biodiversity. *Conservation Biology* 26:1061- 1071.
15. Singh, J. S., Singh, S.P. & Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
16. Sodhi, N.S. & Ehrlich, P.R. (Eds). 2010. Conservation Biology for All. Oxford University Press.
17. Park's Textbook of Preventive and Social Medicine, K.Park, M/s. Banarasidas Bhanot, 2015.
18. Communicable Disease Control Handbook, Jeremy Hawker et.al, Blackwell Publishing.
19. Cheung, S.S. (2010) Advanced Environmental Physiology. Human Kinetics, Champaign Illinois.

Course: Major-4

Paper Title: Structural Biochemistry & Enzymology

Paper Code: PHY-MAJ4

Course outcome: This course will develop knowledge and understandings regarding concepts of biocatalysts; cellular biochemical energetics; structural features and nature of interactions of several



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biomolecules in physiological processes. The students will be able to identify an unknown solution of physiological importance through sequential biochemical tests.

Theory:

04 Credit

UNIT I: Structural Biochemistry & Biomolecular Chemistry

1. Carbohydrates: Definition and classification.

Monosaccharides – Classification, structure. Different types of Isomerisms : stereoisomerism, optical activity & optical isomerism, epimerism, Fischer & Haworth projections and Formation of cyclic structures - Pyranose and furanose forms and its isomerism, anomerism. Mutarotation and its mechanism. Properties and Chemical reactions of monosaccharides (Glucose & Fructose). Derivatives of monosaccharides - Structure, biochemical and physiological importance of Amino sugars, deoxy sugars, sugar alcohols, sugar acids, amino sugar acids (sialic acids), sugar esters.

Disaccharides – Maltose, Lactose and Sucrose: Structure, Occurrence and Physiological importance. *Polysaccharides* – Starch, Glycogen, Dextrin, Cellulose, Glycosaminoglycans (GAGs), Acid mucopolysaccharides, Proteoglycans, Glycoproteins.

2. Lipids: Definition and classification.

Fatty acids - Classification, systematic (IUPAC) nomenclature and structure. Mono-, Di- and Triglycerides. Isomerisms of saturated and unsaturated fatty acids: stereoisomerism, optical isomerism, positional isomerism, geometric isomerism. Properties and chemical reactions of fatty acids and fats.

Chemical characterization of fats : Saponification number, Iodine number, Acetyl number, Acid number, Reichert-Meissl number, Polenske number.

Eicosanoids : Leukotrienes, Lipoxins, Prostaglandins, Thromboxanes.

Structure and physiological importance - Phospholipids and Plasmalogens (Ether-linked & Vinyl-ether-linked), Glycolipids, Sphingolipids/Sphingomyelins, Cholesterol. Lipoproteins - Structure and classification. Micelle, Bilayer, Liposomes.

3. Proteins

Amino Acids: Classification and structure of amino acids. Isomerism, properties and chemical reactions of amino acids. Isoelectric point, pI, Protonic equilibria & acid-base behaviour of amino acids, Titration Curve of glycine.

Peptides and Proteins:

Structural features and bio-physical properties of peptide bonds, Torsion Angles (Phi & Psi). Ramachandran Plot.

Different levels of protein structure (Three-dimensional structure of proteins) -- Primary, Secondary (α -helix, β -pleated sheet, reverse turns, triple helix supercoil), Tertiary (supersecondary motifs & domains) and Quaternary. Chemical bonding forces stabilizing protein structures.



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Properties and chemical reactions of proteins (with focus on amphoteric nature and colour reactions).
Role of Primary Structure in the maintenance of Higher Order Structures: Anfinsen's Experiment.

4. *Nucleic Acids*

Purines and Pyrimidines: Classification, Structure, nomenclature and tautomerism.

Nucleosides and Nucleotides – Classification and structure. Polynucleotides.

Nucleic acids: DNA double helix - Primary, Secondary and Tertiary structure. A-DNA, B-DNA and Z-DNA. Denaturation and annealing of DNA, Hyperchromicity and melting temperature, RNA - Structure and types.

UNIT II: Enzymology

1. Structure, Chemical nature, Classification. Apoenzyme, Holoenzyme, Coenzymes, Prosthetic Groups & Cofactors.
2. Mechanism of enzyme action: ES complex, Transition State, Models for ES interaction, Substrate Specificities.
3. Concept of substrate concentration, initial rate, & maximum velocity on enzyme kinetics. Michaelis constant, Significance of K_m and V_{max} .
4. Derivation of the rate-equation of a single-substrate enzyme-catalysed reaction (Michaelis-Menten equation), Graphical representation of hyperbolic substrate saturation kinetics.
5. Lineweaver-Burk double-reciprocal plot & linear transformation of enzyme Kinetics.
6. Different types of Reversible & Irreversible Enzyme Inhibitions: Competitive, Noncompetitive, Uncompetitive, & Mixed Inhibitions.
7. Factors influencing enzyme-catalysed reactions: substrate concentration, enzyme concentration, pH, temperature.
8. Modulation of enzyme activities: Allosteric Enzymes, Feedback Regulation, Covalent Modifications.
9. Regulation of enzyme activity: Induction & Repression. Rate limiting enzymes, Isozymes, Proenzymes, Ribozymes, Abzymes, Antizymes, Synzymes.
10. Enzymes in clinical diagnosis.

Practical:

02 Credit

1. Introduction of qualitative assessment of physiologically important biomolecules. Qualitative tests (Systematic analysis and Confirmatory test) for the identification of physiologically important substances:
Hydrochloric acid, lactic Acid, Uric Acid, Glucose/Galactose, Fructose, Sucrose, Lactose/Maltose, Albumin, Gelatin, Peptone, Starch, Dextrin/glycogen, Urea, Glycerol, Bile salts, Acetone.
2. Problems (Theoretical/Graphical & Numerical) on LB double reciprocal plot / straight line kinetics of enzymes and enzyme inhibitions.
3. Numerical problems related to measurement of buffer concentration.



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4. Numerical problems on enzyme activities.

References:

1. Das, D. (2010). Biochemistry. 14th Edition, Academic Publishers.
2. Nelson & Cox (2017). Lehninger Principles of Biochemistry. 7th Edition. WH Freeman & Co Ltd.
3. Berg, Gatto, Hines, Tymoczko, Stryer (2023). Biochemistry. 10th Edition. WH Freeman & Co Ltd.
4. Voet & Voet (2002). Biochemistry. 4th Edition. John Wiley & Sons.
5. Kennelly, Rodwel, Weil. Harper's Illustrated Biochemistry (2023). 32nd Edition. McGraw Hill.
6. Rastogi & Aneja (2020). Zubay's Principles of Biochemistry. 5th Indian Edition. Medtech.
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8. Grisham & Garrett (2016). Biochemistry. 6th Edition. Brooks/Cole.
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Course: Major-5

Paper Title: Gastro-intestinal Physiology and Metabolic biochemistry

Paper Code: PHY-MAJ5

Course outcome: This course will provide a foundation understanding of the basic functions of the gastrointestinal systems and metabolism. It also features the regulatory aspects of metabolism for better understanding of physiology and therapeutic applications. Upon completion of this course, students will be able to comprehend how the failure of normal gastrointestinal physiology and their integrations are associated with some diseases.

Theory

04 Credit

UNIT I: Gastro-intestinal Physiology

1. Anatomy and histology of alimentary canal.
2. Digestive glands – histological structures and functions of salivary glands, pancreas, liver.
3. Deglutition, Movements of alimentary canal and their regulation
4. Composition, functions, and regulation of the secretion of salivary, gastric, pancreatic and intestinal juices and bile.
5. Gastrointestinal hormones and their functions and regulation of secretions



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6. Splanchnic circulation
 7. Digestion and absorption of carbohydrates, proteins, lipid and Nucleic Acids, Absorption of Water, Electrolytes and Vitamins
 8. Defecation. GALT. Basic concepts of Peptic Ulcer, Jaundice and Gallstones.

UNIT II: Metabolic Biochemistry

1. Carbohydrate Metabolism – Glycolysis, Krebs Cycle, Glycogenesis, Glycogenolysis, Neoglucogenesis, HMP shunt, R-L cycle, Cori cycle, glucose-alanine cycle.
2. Protein Metabolism – Deamination, Transamination, Urea-Ornithine cycle, Biosynthesis of specialized products from amino acids, Metabolism of glycine-serine-alanine, phenylalanine and tyrosine, sulphur containing amino acids, and tryptophan.
3. Fat Metabolism – Mitochondrial Beta-oxidation of Saturated & Unsaturated Fatty Acids, Peroxisomal Beta-oxidation, alpha- and omega-oxidations, ketone body formation and fate, cholesterol biosynthesis, Cytosolic fatty acid biosynthesis, Biosynthesis of phospholipids and their metabolism, Metabolism of triglycerides, Lipoproteins.
4. Purine & Pyrimidine Metabolism – Biosynthesis of purine & pyrimidine nucleotides (*de novo* & Salvage pathways), Catabolism of free bases-nucleosides-nucleotides, Purine Salvage Cycle.
5. One Carbon Metabolism- Sources, Biosynthesis & Fates of C₁ units & compounds, One Carbon Pool.
6. Two carbon & Three Carbon Metabolisms- Integrations of Carbohydrate, Fat and Protein Metabolism.
7. Biological Oxidation & Electron Transport Chain- Redox Potential & Redox Couples, Electron transferring respiratory chain Complexes, Mechanism & pathway of electron transfer, The Q Cycle, Cytochrome oxidase & Terminal respiration, Free energy changes during electron flow.
8. Oxidative Phosphorylation- Sites, Structure of ATP Synthase Complex, Chemiosmotic Theory, Mechanism of ATP Synthesis, Proton-Motive Force & Mechanism of Proton Translocation, P:O Ratio, Uncouplers, High Energy Compounds.

Practical

02 Credit

1. Study of Dale's Apparatus and preparation of Ringer Lock solution.
2. Demonstration of Kymographic recording of normal movements of rat's intestine in Dale's Apparatus. Effects of hypoxia, acetylcholine, and adrenaline on normal intestinal movements.
3. Histological study: slide preparation and staining of the fixed sections of the different parts of mammal's gastrointestinal system (parts of alimentary canal, digestive glands, liver, pancreas)
4. Colorimetric study: Estimation of glucose and sucrose by Benedict's method - Percentage and total quantity.
5. Estimation of amino nitrogen (Sorensen's Formol titration method) Percentage and total quantity.
6. Estimation of percentage quantity of lactose in milk by Benedict's method.



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Course: Major-6

Paper Title: Cardiovascular and Respiratory Physiology

Paper Code: PHY-MAJ6

Course outcome: This course will provide an understanding of the basic functions of the cardiovascular and respiratory systems. Upon completion of this course, students will be able to comprehend how the failure of normal cardiovascular and respiratory physiology and their integrations are associated with some diseases.

Theory

04 Credit



UNIT I: Cardiovascular Physiology

1. Anatomy of heart and systemic circulation, Properties of cardiac muscle
2. Origin and Spread of Cardiac Excitation
3. Electrocardiography – Principle, Vectorcardiogram and Mean Electrical Axis of heart, Einthoven Law and Triangle, Leads and different waves, Normal electrocardiogram
4. Electrocardiographic Findings in Cardiac & Systemic Diseases, Cardiac arrhythmias, hypertrophy and cardiac myopathy, Heart block
5. Mechanical Events of the Cardiac Cycle, Pressure and volume changes, Heart sounds and murmurs
6. Cardiac Output - Definition, factors affecting it and measurement, Fick's principle, Starling's Law of Heart
7. Cardiovascular regulatory Mechanisms- Local Regulatory Mechanisms, Substances Secreted by the Endothelium, Systemic Regulation by Hormones and Nervous system
8. Blood pressure-Types, Measurement & Regulation
9. Anatomic and Biophysical Considerations of: 1) Arterial and Arteriolar Circulation ,2) Capillary Circulation, 3) Lymphatic Circulation and Interstitial Fluid Volume, 4) Venous Circulation
10. Circulation Through special Regions:
 - 1) Cerebral Circulation: Anatomic Considerations, Cerebrospinal Fluid, The Blood-Brain Barrier, Cerebral Blood Flow, Regulation of Cerebral Circulation, Brain Metabolism and Oxygen Requirements
 - 2) Coronary Circulation: Anatomy, Regulation and Peculiarities
11. Cardiovascular Homeostasis in Health & Disease: Compensation for Gravitational Effects, Exercise, Shock (in brief), Hypertension (in brief), Heart Failure, stroke (in brief).

UNIT II: Respiratory Physiology

1. Anatomy of the Lungs, Properties of Gases, Spirometry: Lung volumes and capacities. Dead space.
2. Mechanics of breathing – Mechanism, Resistances of breathing, surfactant, compliance.
3. Gas Exchange in the lungs
4. Pulmonary Circulation, Ventilation – perfusion ratio.
5. Oxygen Transport – Mechanism, dissociation curve and factors regulating it.
6. Carbon Dioxide Transport –Mechanism, dissociation curve and factors regulating it,
7. Regulation of Respiration- Neural control of Breathing, Respiratory centre, respiratory reflexes.
8. Chemical regulation of respiration
9. Respiratory Adjustments in Health and Disease: Effects of Exercise, Hypoxia: Types & effects
10. Oxygen Therapy, Hypercapnia and Hypocapnia,
11. Other Respiratory Abnormalities (Mountain sickness, apnoea, dyspnoea, dysbarism, Chyne Stroke Breathing and HAPO). Respiratory acidosis, and alkalosis
12. Artificial Respiration
13. Other Functions of the Respiratory System –Excretory, body defence function of lungs.



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1. Determination of blood pressure at different body postures. Measurement of blood pressure before and after exercise with graphical presentation.
2. Recording of 12-lead electrocardiogram. Computation of HR, PQ interval, QRS complex, PR interval, mean electrical axis from supplied ECG recording graph.
3. Demonstration and interpretation of kymogram regarding the effects of excess calcium and potassium ion concentration, acetylcholine, adrenaline (through perfusion fluid) on the movement of heart.
4. Hospital visits and demonstration of Echocardiogram
5. Measurement of peak expiratory flow rate
6. Measurement of oxygen saturation by pulse oximeter before and after exercise.
7. Measurement of Vital capacity using bell's spirometer
8. Pneumographic recording of effects of hyperventilation, breath-holding and talking on respiratory movements.
9. Demonstration on digital spirometer for lung function test (PFT).

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Course: Major-7

Paper Title: Neurophysiology and Nutrition & Dietetics

Paper Code: PHY-MAJ7

Course outcome: At the successful completion of this course the student should be able to demonstrate knowledge of the scope of neurophysiology, and detailed knowledge in some areas including somatosensory system. The student should be able to apply basic physical and physiological principles to address questions related to brain and behaviour. In the nutrition and dietetics part, the student should



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be able to understand the nutritional requirement through different stages of life and gain the practical knowledge of displaying raw and cooked food and learn their nutritive value.

Theory

04 Credit

UNIT I: Neurophysiology

1. Structural organization of different parts of brain and spinal cord.
2. Reflex action: definition, reflex arc, classification and properties.
3. Autonomic nervous system: organization, outflow, ganglia, centres and functions. Chemical transmission in autonomic nervous systems.
4. CSF: Formation, circulation and functions. Blood-CSF and Blood-Brain barrier.
5. Ascending and descending tracts: origin, courses, termination and functions.
6. Functions of the spinal cord with special reference to functional changes following hemi-section and complete section of spinal cord.
7. Pain production, perception and regulation. Referred pain.
8. Muscle spindle and Golgi tendon organ: their structure, innervations and functions, postural reflexes.
9. Decorticate, decerebrate rigidity and spinal animal.
10. Brain: Structure, nerve connections and functions of brainstem, cerebellum, reticular formation, hypothalamus, thalamus, basal nuclei and cerebral cortex. Structure and functions of vestibular apparatus.
11. Limbic system: Structure, connections and functions.
12. Physiology of sleep, memory, learning and speech.
13. Neurological Diseases (symptoms, pathophysiology, and treatment): dementia, Alzheimer's disease, Parkinson disease, speech disorder
14. **Molecular neurobiology:** General concept of ionotropic and metabotropic receptors. Structure, sub-types and functions of nicotinic and muscarinic acetylcholine receptors, adrenoceptors, glutamate receptors (NMDA and AMPA receptors), GABA, opiate, receptors.

UNIT II: Nutrition & Dietetics

1. Constituents of food and their significance.
2. Basal metabolic rate -factors, determination by Benedict-Roth apparatus.
3. Respiratory quotient.
4. Specific dynamic action.
5. Basic concept of energy and units.
6. Calorific value of foods.
7. Body calorie requirements – adult consumption unit.
8. Dietary requirements of carbohydrate, protein, lipid and other nutrients.
9. Balanced diet and principles of formulation of balanced diets for growing child, adult man and woman, pregnant woman and lactating woman.
10. Nitrogen balance, essential amino acids, biological value of proteins.
11. Supplementary value of protein.
12. Protein efficiency ratio and net protein utilization of dietary proteins.
13. Dietary fibres and its usefulness.
14. Vitamins and minerals,



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15. Water: dehydration, rehydration, overhydration
 16. Principle of diet survey.
 17. Composition and nutritional value of common food stuffs.
 18. Food quality assessment: Common Foods subjected to Adulteration - Adulteration – Definition – Types; Poisonous substances, foreign matter, Cheap substitutes, Spoiled parts. Adulteration through Food Additives and preservatives – Intentional and incidental. General Impact on Human Health,
 19. Food Safety and Standards Authority of India–Rules and Procedures of Local Authorities. Role of voluntary agencies such as, Agmark, I.S.I. Quality control laboratories of companies.

Practical

02 Credit

1. Experiments on superficial (plantar) and deep (knee jerk) reflex
2. Reaction time by stick drop test
3. Two-point discrimination test
4. Histological study: slide preparation and staining of the fixed sections of the different mammal's nervous tissues
5. Demonstration of Preparation of sciatic nerve innervated gastrocnemius muscle of toad.
6. Demonstration of Kymographic recording of mechanical responses of gastrocnemius muscle to a single stimulus and two successive stimuli.
7. Evaluation of nutritional status- computation of calorie, BMI, BSA
8. Formulation of balance diet as per specification
9. Qualitative tests for identifying Food Adulterants (like Metanil yellow, Saccharin, Monosodium glutamate, Aluminium foil, Bisphenol A and Bisphenol S, Chocolate Brown HT, Margarine, Pb, Hg, As) in food samples (such as turmeric powder, besan, laddoo, noodles, chocolate, and sweets)
10. Diet survey report (hand-written) of a family (as per ICMR specification)

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2. Hall J.E. (2016). Guyton & Hall Textbook of Medical Physiology. Second South Asia Edition.
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21. Swaminathan, M. (2012). Essentials of Food and Nutrition. Vol. I AND Vol. II. Jain Book Agency.

Course: Major-8

Paper Title: Microbiology & Immunology

Paper Code: PHY-MAJ8

Course outcome: Completion of the course should be enabled the students to distinguish, differentiate, identify, and classify various types of microorganisms. Students should be gain an understanding of the molecular pathogenesis of infectious diseases and advances in immunology with the basic mechanisms of immune system. They should be able to use various bioanalytical instrumentations and techniques to study various aspects of microbiology and immunology. The course shall develop capacitance to address environmental problems with microbial solutions.

Theory

04 Credit

UNIT I: Microbiology

1. Classification of bacteria based on morphology and staining techniques.
2. Detailed bacterial cell structure with focus on cell wall and LPS layer.
3. Bacterial staining techniques.
4. Different types of bacterial culture media and culture techniques.
5. Disinfection, Sterilization, pasteurization.
6. Nutritional requirements of bacteria.
7. Bacterial growth curve – different phases and significance, various factors affecting bacterial growth.
8. Bacterial Metabolisms: Fermentation, Glyoxylate cycle and Entner-Doudoroff pathway.
9. Control of microbial growth: Chemotherapeutic agents - Classification and mechanism of actions of antibiotics. Bacteriostatic and bactericidal agents.



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10. Bacterial Genetics: Transformation, Generalized & Specialized (restricted) Transduction, Conjugation (F⁺, F⁻, F['], Hfr strain).
 11. Viruses - Structure and types, Lytic and lysogenic cycle. Rolling Circle Mechanism of viral replication
 12. Food Microbiology: Beneficial and harmful microorganisms in food, causative organisms of food-borne infections - mode of transmission and methods of prevention.
 13. Environmental Microbiology: Microbiology of air, water & soil
 14. Host-Microorganism interactions Host parasite relationship, normal microbial flora of humans, transmission of microorganisms, microbial pathogenicity, and virulence

UNIT II: Immunology

1. Overview of innate and acquired immunity: Elements of acquired immunity: Characteristics of immune response, cells and organs involved in immune response.
2. Immunogens and antigens: Immunogenicity, haptens, super-antigens, adjuvants, cross-reactivity.
3. Antigen-antibody reactions.
4. Immunoglobulins and antibody molecules - classification, Chemical Structure, and functions, isotype-allotype-idiotypic antibodies, polyclonal & monoclonal antibodies.
5. Humoral and cell mediated immunity. Interactions between T and B cell.
6. Antigen processing and presentation.
7. Major Histocompatibility Complex (MHC) – Structure of class I and II molecules, brief idea of peptide binding by MHC molecules.
8. Cytokines and Lymphokines.
9. Complement System: Activation components – classical, alternative and lectin. Biological consequence of complement activation.
10. Hypersensitivity reactions – Types and causes.
11. Vaccination - Principles, types of vaccines and uses, active and passive Immunization, primary and secondary reaction of vaccination, Toxins and Toxoids.
12. Immunodiffusion, immunoprecipitation, immunoagglutination, immunofluorescence, immunohistochemistry, immunocytochemistry, RIA, ELISA.
13. MoAbs and Hybridoma Technology.
14. Immunopathology – Brief idea on autoimmune diseases, AIDS, transplantation immunology.

Practical:

02 Credit

1. Gram staining of bacteria and identification of Gram-positive and Gram-negative bacteria.
2. Haemagglutination test with antibodies of A, B, and D antigen.
3. Ouchterlony double diffusion test in agar-gel by kit for determination of antigen-antibody pattern.
4. A Mini-Review writing on Specified Topic related to the course.
5. An educational visit to allied institution or industry.

References:



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10. Abbas AK, Lichtman AH, Pillai S. Basic Immunology. 6 th Edition (2019). Elsevier India.

Course: Major-9

Paper Title: Renal Physiology and sensory physiology

Paper Code: PHY-MAJ9

Course outcome: This course will provide a foundation understanding of the basic functions of the kidney and sensory system of the body. The student should be able to recognise the special senses and tactile sensations along with body temperature regulation and describe their interactions and the mechanisms of perception.

**Theory
Credit**

04

UNIT I: Renal Physiology

1. Anatomy of Kidney, Histology of nephron
2. Formation of urine: Function of Malpighian corpuscles and renal tubule,
3. Counter-current multiplier and exchanger mechanism
4. Water Excretion
5. Renal regulation of acid-base balance, Acidification of the Urine and Bicarbonate Excretion



6. Regulation of Na⁺ and Cl⁻ Excretion
7. Regulation of osmolarity and volume of blood fluids
8. Renal Circulation- Peculiarities and autoregulation
9. Physiology of urinary bladder and micturition
10. Abnormal constituents of urine
11. Disorders of Renal Functions
12. Renal dialysis
13. Diuretics
14. Non-excretory Function of Kidney

UNIT II: Sensory Physiology

1. Characteristics of special senses, Sensory Coding-Weber-Fechner law, Steven's power law
2. **Vision:** Introduction, Anatomic Considerations, Retina Structure, The Image-Forming Mechanism (accommodation and visual acuity), The Photoreceptor Mechanism: Genesis of Electrical Responses, Visual Pathways and effects of lesions of these pathways, Colour Vision, Other Aspects of Visual Function, Eye Movements, Errors in visual process.
3. **Hearing:** Introduction, Structure, and functional significance of auditory apparatus. Organ of Corti. Auditory pathways and centres. Mechanism of hearing – Excitation of Hair Cells, Conversion of Sound Waves into Action Potentials in the Auditory Nerve. Mechanism of discrimination of sound frequencies and intensities. Localization of sound source. Deafness.
4. **Smell & Taste:** Introduction, Smell, Receptors & Pathways, Physiology of Olfaction, Taste, Receptor Organs & Pathways, Physiology of Taste. Abnormalities of olfactory and taste sensation.
5. **Skin:** Structure and functions of skin. Cutaneous circulation. Sweat glands –structure and composition of sweat. Mechanism of sweat formation, secretion, and its regulation. Insensible perspiration. Regulation of body temperature in homeotherms –its physical and physiological processes, roles of neural and hormonal processes. Pyrexia, hyperthermia, and hypothermia.

Practical Credit

02

1. Testing of normal constituents of urine (Biochemical Test)
2. Identification of abnormal constituent of urine (Biochemical Test)
3. Microscopic observation of RBC, Pus Cell and Cast in urine.
4. Histological study: slide preparation and staining of the fixed sections of the kidney and ureter
5. Demonstration of Isolation and Staining of Cornea
6. Determination of visual acuity by Snellen's chart / Landolt's C chart.
7. Determination of colour blindness by Ishihara chart,
8. Perimetry
9. Audiometry

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2. Mahapatra, A.B.S.M. (2014). Essentials of Medical Physiology. Fourth Edition. Current BooksInternational.



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11. Note Books on Practical Biochemistry. Published by The Physiological Society of India. Kolkata.

Course: Major-10

Paper Title: Endocrinology

Paper Code: PHY-MAJ10

Course outcome: The unit will help to develop an understanding of the structure-function relationship as well as mechanism of the endocrine system in maintaining body homeostasis and health. The student will be better able to learn the integrative workings of endocrine signalling system and endocrine pathologies.

Theory

04 Credit

UNIT I: Molecular Endocrinology

1. Basic concept, Chemical nature of hormones
2. Mechanism of action of peptide and steroid hormones
3. Signal transduction mechanism: G-protein coupled receptors and concept of second messenger - cAMP, IP₃, DAG, Ca²⁺, JAK-STAT, MAPK

UNIT II: General Endocrinology

1. Endocrinology Hypothalamus as a neuroendocrine organ. Anterior and posterior pituitary- histological structure of the gland and their secretions. Functions and regulation of Anterior and posterior pituitary hormones, Growth Hormone, Physiology of Growth, Pituitary Insufficiency, Pituitary Hyperfunction in Humans



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2. Hormones of Thyroid gland: Histological structure of the glands. Chemical nature, synthesis and molecular mechanism of action, functions, and regulation of secretion of the hormones. Hypo- and hyperactive states of the glands.
3. Hormones of Adrenal cortex and medulla: Histological structure of the gland. Chemical nature, synthesis and molecular mechanism of action, functions, and regulation of secretion of the hormones. Biosynthesis of catecholamines and steroid hormones. Hypo- and hyperactive states of the gland.
4. Hormones of Pancreatic islets (insulin and glucagon): Histological structure. Chemical nature, molecular mechanism of action, functions, and regulation of secretion of the hormones. Hormonal control of blood sugar. Hyperinsulinism and diabetes mellitus.
5. Hormonal Control of Calcium Metabolism & the Physiology of Bone: Introduction to Bone Physiology, Vitamin D & the Hydroxycholecalciferols, The Parathyroid Glands and its secretions, Calcitonin, Effects of Other Hormones & Humoral Agents on Calcium Metabolism.
6. Endocrine Functions of other organs: Gastro-intestinal hormones, The Renin-Angiotensin System, Erythropoietin, Atrial Natriuretic Peptide.
7. Human chronobiology: Pineal Gland, functions and regulation of secretion of melatonin, biological rhythms; basic concepts and implications. Zeitgebers, Master Clock.

Practical

02 Credit

1. Histological study: slide preparation and staining of the fixed sections of endocrine tissue.
2. Demonstration of Kymographic recording of the effects of oxytocin on uterine contraction in Dale's Apparatus.
3. Study of the effects of adrenaline on uterine movements.
4. Growth chart preparation and interpretation.
5. Interpretation of clinical case study of common endocrinal disorders based on supplied photographs.
6. Review work presentation on clinical endocrinology in student seminar

References:

1. William's Text Book of Endocrinology by J.D.Wilson and D.W.Saunders of Co.
2. Endocrinology. Vols- I, II and III by L.O.DeGroot. W.B.Saunders Co.
3. Chatterjee, C.C. (2016). Human Physiology Volume 1. Eleventh Coloured Edition. CBS.
4. Hall J.E. (2016). Guyton & Hall Textbook of Medical Physiology. Second South Asia Edition.
5. Mahapatra, A.B.S.M. (2014). Essentials of Medical Physiology. Fourth Edition. Current Books International.
6. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee. Khurana, I. (2015). Medical Physiology. 2nd Edition. Elsevier India.
7. Berne, R.M. and Levy M.N. Physiology. C.V.Mosby Co.
8. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.



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9. Barrett, K. E. Barman, S.M., Boitano, S. Brooks, H.L. (2012). Ganong's Review of Medical Physiology. 24th Edition. Lange Medical Book. Prentice-Hall International.
10. Pal, G.K. Pal, P. (2013). Textbook of Practical Physiology. Third Edition. Universities.

Course: *Major-11*

Paper Title: Genetics and Molecular Biology

Paper Code: PHY-MAJ11

Course outcome: The objective of this unit is to enable the students to learn regarding molecular nature and way of functioning of key structural elements of cell and genetic materials and thus to develop gross understandings towards molecular explanation of physiological interplays.

Theory

04 Credit

UNIT I: Genetics

1. Basic principles of Mendelian genetics - monohybrid and dihybrid, test and back crosses.
2. Inheritance pattern in human (Sex-linked, autosomal, mitochondrial).
3. Extension of Mendelism - Epistasis and its different types present in animals, Penetrance, expressivity, pleiotropism.
4. Linkage, crossing over and Molecular Recombination – Chromosome theory of linkage, kinds of linkage, types of crossing over, Mechanism of meiotic crossing over and recombination events, significance of crossing over.
5. Allele- multiple allele, gene interaction, gene mapping.
6. Numerical and Structural variations in chromosome- autosomal and sex chromosomal anomalies - basic concepts of aneuploids and polyploids.
7. Non-Mendelian inheritance- extra-chromosomal inheritance, maternal inheritance.
8. Human Cytogenetics - human karyotype and ideogram, banding technique, use of human cytogenetics in medical science.
9. Pedigree analysis- symbols of Pedigree, Pedigrees of sex-linked & autosomal (dominant and recessive) disorders, Inborn errors of metabolism, Blood group genetics.
10. Population genetics- Polymorphism (allelic and SNP), Hardy-Weinberg equilibrium and its testing, Genetic drift.

UNIT II: Molecular Biology



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1. Genes - definition. Chromosome and chromatin structure and molecular organization, DNA- double helix structure.
 2. DNA replication- Meselson and Stahl experiment, DNA polymerase (types, structure, and functions) and other enzymes, replication process in prokaryotes.
 3. Transcription of RNA- process in prokaryotes
 4. Genetic code – properties and wobble hypothesis
 5. Translation- process in prokaryotes
 6. Post-translational modification of proteins, Protein trafficking
 7. Regulation of gene expression – Operon concept: lac operon and trp operon
 8. Chromosomal aberrations and gene mutations (types and agents)
 9. DNA damage and repair mechanisms
 10. Transposons, Repetitive DNA sequences, Interrupted genes, Satellite DNAs, Telomere
 11. Noncoding RNAs (siRNA,miRNA,PiRNA)

Practical:

02 Credit

1. Retrieval of amino acid sequence from mRNA
2. Retrieval of codon in DNA from codon sequence of mRNA
3. Paper chromatography
4. Karyotype analysis
5. Pedigree analysis
6. Demonstration of the estimation of DNA, RNA and Protein
7. Numerical problems on population genetics
8. Group discussion on specified topic related to the course.

References:

1. Berk, A. Kaiser, C.A. Lodish, H, Amon, A. (2016). Molecular Cell Biology
2. Das, D. Handbook of Practical Microbiology, Cell Biology Genetics and Biometry. Academic Publishers.
3. Verma, P.S. and Agarwal, V.K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Pvt. Ltd.
4. David Freifelder. (2008). Molecular Biology. 2nd Edition. Narosa Publishing House.
5. Wilson, K. and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. Seventh Edition.
6. Gardner, E.J. Simmons, M.J, Snustad, D.P. (2006) Principles of Genetics. Eighth Edition. Wiley.



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Course: Major12

Paper Name: Reproductive Physiology & Embryology

Paper Code: PHY-MAJ12

Course outcome: This unit will enlighten the idea about male and female reproductive physiology including adolescent and maternal health and different related disorders.

Theory:

04 Credit

UNIT I: The Male Reproductive System

1. Primary and accessory sex organs
2. Pubertal changes in male and secondary sex characteristics
3. Histological structure of testis
4. Spermatogenesis
5. Ejaculation and constituents of semen
6. Capacitation and acrosomal reaction
7. Testicular hormones: Synthesis, functions, and regulation of secretion
8. Hypothalamic control of testicular function
9. Abnormalities of Testicular Function

UNIT II: The Female Reproductive system

1. Primary and accessory sex organs
2. Pubertal changes in female and secondary sex characteristics
3. Histological structure of ovary and uterus
4. Oogenesis
5. The menstrual cycle and its regulation
6. Ovarian hormones: Synthesis, functions, and regulation of secretion
7. Hypothalamic control of ovarian function
8. Abnormalities of ovarian function and menstrual cycle
9. Onset of menopause and postmenopausal changes
10. Fertilization
11. Implantation
12. Placenta –Structure and Function, Role of placental hormones in maintenance of pregnancy
13. Pregnancy - Hormonal Regulation, Physiological changes during pregnancy and Pregnancy Test
14. Parturition – Process and its regulation
15. Mammary gland development and Lactation with its hormonal control
16. Contraception

UNIT III: Sex Differentiation and Embryology

1. Chromosomal Sex and sex differentiation process



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2. Aberrant Sexual Differentiation
 3. Stem cell: Totipotency, Characteristics and differentiation
 4. Embryology: Blastulation, Gastrulation (concept of induction and differentiation)
 5. Foetal circulation
 6. Organogenesis: Basic concept with special emphasis on development of heart and urinary and genital system

Practical:

02 Credit

1. Histological study: slide preparation and staining of the fixed sections of testis, ovary, and uterus
2. Pregnancy test by immunological method using kit.
3. Report writing on clinical case studies of reproductive physiology and embryology
4. Microteaching on specified topic related to the course.

References:

1. Chatterjee, C.C. (2016). Human Physiology Volume 2. Eleventh Coloured Edition. CBS.Publishers and Distributers Pvt. Ltd.
2. Mahapatra, A.B.S.M. (2014). Essentials of Medical Physiology. Fourth Edition. Current BooksInternational.
3. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.
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5. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. SaundersCo.
6. Ganong, W.F. Review of Medical Physiology. Lange Medical Book. Prentice-Hall International.
7. Schatten, H. Human Reproduction. Willey.
8. Constantinescu, G.M. Animal Model and Human Reproduction. Willey.
9. Chaudhuri, S.K.(2008). Concise Medical Physiology. Sixth Edition. NCBA.
10. Pal, G.K. Pal, P. (2013).Textbook of Practical Physiology. Third Edition. Universities.