



Government of West Bengal
Government General Degree College at Kharagpur-II
Department of Physiology
Madpur, Paschim Medinipur – 721149, West Bengal

Government General Degree College at Kharagpur II

Department of Physiology
B.Sc. Honours in Physiology [3 tier system]
Programme Outcome (PO)
&
Course Outcome (CO)

Syed Benazir Firdaus
HEAD
Department of Physiology
Govt. General Degree College, KGP-II
Madpur, Paschim Medinipur, 721149



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Government General Degree College at Kharagpur II

Department of Physiology
B.Sc. Honours in Physiology (3 Tier Examination Pattern)
w.e.f. 2014-2015

Programme Outcome (PO)

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B.Sc. Honours in Physiology (3 Tier Examination Pattern)

w.e.f. 2014-2015 Programme outcome

At the end of the course B.Sc. General in Physiology, students are expected to :

- Gain the basic knowledge about various components of the Human Physiology.
- Understand about Cellular Physiology, structural units of human physiology, Biophysical Principles, Biochemistry, blood and body fluids. & Metabolism.
- Develop knowledge about the various physiological systems including Biomolecules, enzymology and the techniques involved in studying Physiology
- To gain knowledge about nerve muscle Physiology, cardiovascular Physiology and circulation.
- To learn about the various systems of the Human body like the digestive system, the respiratory system, the renal physiology etc.
- Gain knowledge about pharmacology, regulation of body temperature, nervous system, sensory physiology, work physiology, sports physiology, ergonomics etc.
- To know about metabolism, nutrition, dietetics, social physiology, community health, microbiology, immunology and environmental Physiology.
Gain knowledge about endocrinology, reproductive Physiology, applied biotechnology, biostatistics and concepts of computer etc.
- To perform various experiments in biochemistry, human experimental, animal experimental, histology, hematology, biophysics etc.
- To learn different basic skills in the field of classical and clinical Physiology so that they may apply those for further learning in allied fields.
- To gain an extensive knowledge in the subject of Human Physiology so that they may be confident enough to seek jobs for which they may be eligible completing the undergraduate certificate course.
- To be competent enough to pursue their future career in paramedical, pharmacology, teaching, industry and other professions in Physiology and allied science, following completion of the course.

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Course Outcome (CO)

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Course Outcomes

Course	Paper code	Unit & Unit name	Outcomes
PART-I	Paper- I (Theory)	Unit-01 i) Cell Biology and Structural Units of Human Systems ii) Tissue Organization and Basic Anatomy of Human Body iii) Biophysical and Biochemical Principles iv) Blood and Body Fluids.	This course helps the students to gain knowledge about the electron microscopic structures of the various cellular and sub cellular structures including the organelles. Students learn about membrane structures, cytoskeleton, cell cycle and the various types of cell junctions. Students also get to know about the tissues in human body, the organs and organ system organization of human body. Students also learn about the biophysical and biochemical principles of Physiological processes, their significance, various laws associated with those principles, thermodynamics, application of thermodynamics in human physiology, significance of thermodynamics and the laws in human physiological processes. Students also gain knowledge about the various compartments of the human body, role and significance of water in human physiology, body fluids including blood and lymph. Students learn in details about the various components of the blood, their functions, their formation processes, their clinical and physiological significances etc.,. Students gain insight about the various diseases, parameters and conditions associated with blood including ESR, TC, DC, PCV, MCH, MCHC, MCV. Anemia: megaloblastic and microcytic, pernicious, aplastic, hypo-chromic etc. Blood group, transfusion of blood, haemoglobin formation, erythropoiesis, mechanism and



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			significance of the coagulation of blood is also taught to the students.
		Unit-02 i) Chemistry of Bio-molecules ii) Enzymology iii) Techniques in Studying Physiology	Students learn about the various biochemical details, structure, functions and the metabolic processes associated with the various components of food including carbohydrates, lipids, amino acids, proteins, peptides, purine, pyrimidine, nucleic acids etc. Students learn about enzymology, the mechanism of action and the kinetics of enzyme substrate reaction, allosteric inhibition, clinical significance of enzymes, rate limiting enzymes, immobilized enzymes, isozymes, ribozymes, abzymes, antizymes, synzymes etc. Students learn about the basic principles and functions of the techniques like light, phase contrast, electron microscopy, atomic force microscopy and fluorescence microscopy. Spectrophotometer. Principle of chromatography, ion exchange, gel filtration, GLC, TLC and immune-affinity chromatography. Electrophoresis: SDS-PAGE and agarose gel. Cell fractionation: Homogenization and ultrasonication, Ultracentrifugation, Differential and density gradient centrifugation etc. Students also learn about radioactive wastes, their management and effects on human health. The course also helps the students to know about the biomedical instruments, their uses, principles etc., and these include USG, Endoscopy, X-ray, MRI, CT-scan, Hemodialysis, Artificial pacemaker etc.
Paper II (Theory)	Unit-03 i) Nerve-Muscle Physiology ii) Cardio-Vascular Physiology and Circulation		Students learn about the nerve muscle physiology, neuromuscular junctions, transmission of nerve impulse, the various components of the nervous system. Students also learn about the muscles and mechanism of contraction of smooth muscle contraction etc. Students learn about the resting membrane

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			potentials, action potentials, neurotransmitters, Concept of chronaxie and rheobase, EPSP, IPSP, nerve regeneration and various aspects of the nervous system. Students learn about the cardiovascular system and circulation. They get an insight into the various components of the heart and the mechanisms involved in circulation, the pace maker, ECG, mechanisms of regulation of circulation, details of cardiac muscle, cardiac impulses, details of blood pressure and about regional circulations etc.
		Unit-04 i) Respiratory System ii) Digestive System iii) Renal Physiology	This part of the course helps the students to learn about the structural and functional details of the respiratory Physiology. They learn about the various lung volumes, lung compliance, transport of the respiratory gases. Students learn about the digestive system, its components, their functions. They also learn about the mechanism, functions and regulation of mastication, deglutition, movement of the alimentary canal etc. They also learn about gall stones, achlorhydria, hyperchlorhydria, peptic ulcer, Pavlov's pouch, defecation reflex, vomiting reflex etc. This part also helps students to learn about the renal physiology, the structural details of the nephrons, functions and mechanism behind the formation of urine, non-excretory functions of the kidneys, dialysis, mechanism of micturition etc.
PART-II	PAPER-III	UNIT-05 i) The Nervous System ii) Skin and Body Temperature Regulation iii) Pharmacological Physiology	i) The students learn about the organization and basic functions of the nervous system – central and peripheral. They know about the receptors, reflex action, neural tracts, postural reflexes, decorticate and decerebrate rigidity. They learn about the signs and symptoms of Brown Sequard syndrome. They understand the structures and functions of cerebellum, cerebral cortex, basal ganglia, thalamus and hypothalamus. Basal ganglia: structure, connections and functions. They acquire knowledge about the physiological basis of

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			<p>memory, conditioning, learning, speech, pain and emotion. They learn about the CSF and organization and control of the autonomic nervous system.</p> <p>ii) They learn about the histological structure of skin and triple response. The students know about sweat, sebum and perspiration. They acquire knowledge about the body temperature regulation and physiological basis of fever.</p> <p>iii) The students develop concepts about the importance of pharmacology in the study of physiological processes. They know about drugs-their agonists and antagonists. They acquire knowledge in pharmacokinetics, pharmacodynamics and assessment of drug toxicity. This helps in gaining elaborate knowledge about the mechanisms of actions of the drugs affecting synaptic and neuro-effector functional sites. drugs affecting catecholamine and cholinergic neuro-transmission, neuromuscular blocking agents, sedatives, narcotic analgesics, antihistamines and diuretics.</p>
		<p>UNIT-06 i) Sensory Physiology ii) Work Physiology, Sports Physiology and Ergonomics</p>	<p>i) The students learn about the classification of general and special senses and their receptors. They know about Muller's law of specific nerve energies and Weber-Fechner law. They develop clear concepts on the mechanism of transduction of stimuli from sensory receptors, adaptation of receptors-phasic and tonic adaptations. They learn about the anatomy of the sensory organs, functions and detection of anomalies in sensory perception.</p> <p>ii) This provides the students a concept of physical work, physiological work, difference between work and sports and the energetics of work. They learn about the cardiovascular and respiratory responses during graded work. They study the methods of measurement of excess post-exercise oxygen consumption, tests for physical work with bicycle ergometer, tread mill and Harvard step test. They develop basic concepts of Sports Psychology, role of sports in emotion, social factors and ergogenic aids. Physical training - general principles and different methods. They study Sports Nutrition, Anthropometry, application of anthropometry in nutrition and ergonomics.</p>



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			They learn about work-rest cycle, industrial safety, occupational hazards, occupational diseases - Silicosis, Asbestosis, Farmer's lung.
	PAPER-IV	UNIT-07 i) Metabolism of Bio-molecules ii) Nutrition & Dietetics iii) Social Physiology and Community Health	<p>i) Students learn about metabolism of bio-molecules, inborn errors of metabolism of glycogen & galactose, biological oxidation and mitochondrial electron transport chain and its components. They know about synthesis of specialized products from amino acids (viz., catecholamines, creatine phosphate, nicotinamide, histamine, serotonin and melatonin, melanin, gamma-aminobutyrate, taurine and glutathione); inborn errors of metabolism of tryptophan, phenylalanine and tyrosine. They acquire knowledge about one carbon metabolism, labile methyl group, transmethylation and synthesis of Urea and Nitric oxide.</p> <p>They gain knowledge about Reactive Oxygen Species and the role of antioxidant enzymes in combating oxidative stress. They study the role of vitamins as antioxidants. Students learn about purine & pyrimidine metabolism and mineral metabolism.</p> <p>ii) This section helps them develop basic concepts in nutrition, nutrients, nutraceutical, cosmoceutical, nutrigenomics. They gain knowledge about Glycemic Index (GI), dietary resistant starch as prebiotics, nutritive value of carbohydrates, proteins, fats and vitamins. They learn about Protein Efficiency ratio (PER), nitrogen balance, Net protein utilization (NPU), Biological value of protein, protein spares, etc.</p> <p>Students know about respiratory quotient (RQ), total energy expenditure (TEE), basal metabolic rates (BMR) and Resting energy expenditure (REE), specific dynamic action (SDA), physical activity ratio (PAR), determination of BMR by Benedict Roth apparatus and WHO/ICMR prediction equation, adult consumption unit (ACU), determination of energy requirements of Indians in different age groups by doubly labeled water (DLW) method and prediction equation method.</p>

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			<p>They can formulate diet chart for infant, growing child, sedentary adults, moderate working adults, college students, pregnant and lactating mothers and athletes in low and moderate socio-economic status.</p> <p>They learn about Space Nutrition that includes change of body composition, energy recommendation for space flights, space food system, types of space foods. They develop concepts in Social Physiology and Community Health. This includes demography, factors affecting Community Health, direct and indirect Nutritional Assessment of Human Individual and Community (Steps- Diet History, Nutritional Anthropometry, Dietary Survey, Clinical Examinations, Biochemical and Radiological assessment, Mortality rates, and Morbidity rates). They also learn about nutritional problem in community like malnutrition, undernutrition, etc.; nutritional deficiencies in pregnancy and remedial measures; dietary management for diseases like cancer, diabetes, etc.</p> <p>They know about causes, pathogenesis and preventions of communicable diseases like cholera, measles, etc.; composition, functions and uses of ORS; National Nutrition Related Health Programmes such as Vit. A Prophylaxis Programme, Anemia Prophylaxis Programme, ICDS, Mid Day Meal Programme; requirement of breast feeding and benefits.</p>
		<p>UNIT-08 i) Microbiology ii) Immunology iii) Environmental Physiology</p>	<p>i) This section helps the students to learn about organization of prokaryotic cell, classification of bacteria on the basis of morphology, staining characteristics, biochemical tests and 16S rRNA test for identification; nutritional requirements of bacteria, nutritional types, culture media; sterilization and pasteurization along with their applications. They learn about different methods of pure culture technique, bacterial growth curve and physical conditions for growth, bacterial metabolism, bacterial genetics and control of bacterial growth using antiseptics, etc. They know about Food microbiology, Industrial Microbiology; and Environmental Microbiology.</p>

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			<p>ii) The students gain knowledge about the immune system, types of immunity, immuno-competent cells, primary and secondary lymphoid organs and antigen-antibody interaction. They also learn about Major Histocompatibility Complex, antigen processing and presentation, biology of B-lymphocyte and T-lymphocyte. They study the mechanisms of humoral immunity, antibody diversity, cytokines, complements, cell mediated immunity, hypersensitivity reactions, autoimmunity, immunization and immunological techniques like ELISA, etc.</p> <p>iii) The students learn about environment, acclimatization to hot and cold environment, heat disorders and their preventive measures. They gain knowledge about the physiological effects and preventive measures against G force, noise, vibration and radiation. They also learn about the types of pollutants, sources, mechanism of action and effects of metabolic pollutants, neurotoxin, mutagen, carcinogen, teratogens. They know about heavy metal toxicity (Pb, Hg, Cd, As), Air pollution, water pollution, biotransformation, bioaccumulation, biomagnification and health hazards of pesticides. They develop concepts of population overgrowth and their effects on health, xenobiotics and their effects.</p>
		<p>PRACTICAL PAPER – V A. Histology B. Biochemistry</p>	<p>A. They can stain fresh tissues obtained from goats and rats. They are trained to carry tissue preparation, section cutting and staining for histological examination. They acquire skills to identify normal histological sections of different organs with the help of their characteristic features. They also learn preparation of hemin crystal (usually applied in criminal investigation); determination of coagulation time by capillary method, bleeding time (Duke method), blood grouping and Rh typing; preparation and staining of human blood film (Leishman); identification and measurement of WBC, differential count of WBC, Arneht count, platelet count, total count of RBC and WBC; staining of reticulocyte and estimation</p>



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			<p>of hemoglobin (visual method) and cyanmethaemoglobin.</p> <p>B. This section trains the student to be adept in analytical skills with knowledge in qualitative and quantitative analysis of biochemical molecules. They learn about:</p> <ul style="list-style-type: none">a. Determination of strength of NaOH, HCl and H₂SO₄ by titration against oxalic acid.b. Preparation of buffer (pH 4 to 10)c. Quantitative estimation of chloride by Mohr's method, amino nitrogen by formol titration method.d. Estimation of free and total acidity in supplied gastric juice.e. Assay of enzymes: Determination of optimum pH, temperature, V_{max} and K_m value of enzyme (amylase through 3, 5 dinitrosalicylate reagent).f. Estimation of DNA, RNA and total protein by DPA, Orcinol and Lowry method. <p>They can perform chromatography to identify amino acid and sugar. They are also trained in food stuff analysis. This includes estimation of lactose and calcium from milk, determination of total carbohydrate by phenol-sulphuric acid method from cereals, estimation of free amino acids by ninhydrin method and total protein by quantitative biurette reagent method from pulses; determination of acid value and iodine number of fat; estimation of Vit-C from lemon juice; identification of food adulterants: starch from milk, dalda from butter, saw dust and colouring agents from spices, saccharine in sugar.</p>
PART-III	PAPER- VI (Theory)	UNIT -09: i) The Endocrine System and Chronobiology ii) Reproductive Physiology iii) Embryology	<p>i) The students gather knowledge about endocrine system and chronobiology. This includes concept and definition of endocrine systems, glands and hormones, experimental and clinical methods of study of endocrine glands, general classification of hormones on chemical basis, concepts of hormone receptors and cell signalling, mechanisms and modern concept of hormone actions. They learn about the role of hypothalamus as a neuro-endocrine organ. They know about the physiological</p>



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			<p>roles of the different endocrine organs, physiological disorders associated with their improper functioning and the gastro-intestinal hormones which are categorized as local hormones. They study about the functions of pineal gland and atrial natriuretic factor (ANF) too.</p> <p>The chronobiology section gives the students an idea about the different types of physiological rhythms- ultradian, circadian, infradian, different zeitgebers and their relation with circadian rhythm. They know about the biorhythms of hormonal secretions and jet lag.</p> <p>iii) The part of the course in reproductive physiology includes the concepts of primary and secondary sex organs, puberty and its control, the functions of male and female reproductive organs. The students learn about the menstrual cycles, ovulation, basic concepts of estrous cycle., pregnancy, fertilization, parturition, ectopic pregnancy, lactation and mammary gland.</p> <p>iii) This section helps the student gain knowledge in embryology. They learn about cleavage, embryogenesis, morula, blastula, gastrula and blastocyst, formation of trilaminar germ disc, development of alimentary system, heart and urogenital system, fetal circulation and its changes after birth. They develop concepts in stem cell biology.</p>
		<p>UNIT -10 i) Genetics and Molecular Biology ii) Applied Biotechnology iii) Bio-Statistics and Concept of Computer</p>	<p>i) In this section the students gather knowledge about genetics and molecular biology including concepts of chromosome structure, nucleosome, molecular organization, chromosomal proteins, the different levels of chromatin organization, double helical structure and Watson Crick model of DNA and its replication. They learn about the Meselson and Stahl Experiment, DNA Polymerases, ligases and other regulatory</p>



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		<p>proteins, brief idea of DNA damage and repair, structure of different RNA molecules and mechanism of transcription of RNA (prokaryotic), elementary idea of gene, genetic code, Wobble hypothesis and mechanism of translation (prokaryotic). They develop elementary idea about regulation of gene expression - operon concept, lac operon, lytic and lysogenic cycle of phage. They also learn about the human genome project, concept of oncogenes, tumour suppressor genes and properties of cancer cells.</p> <p>ii) By studying Applied Biotechnology, they gain elementary idea of genetic engineering including the concept of cloning and its significance, isolation of DNA fragment to be cloned, restriction enzymes, vectors, ligation of DNA to the vector, introduction of recombinant DNA into host cell, screening for recombinant cell, applications of recombinant DNA technology and gene therapy, Basic concepts of Southern, Northern, Western blot techniques and DNA micro-array.</p> <p>The section on fermentation technology includes fermentation, bioreactors and its operation, types of microbes, raw materials and downstream processing, production of human insulin, interferons, vaccines (hepatitis), production, application and utility of monoclonal, antibodies, concept of single cell proteins, biofuels, bioremediation, biofilters, biopesticides (BT cotton, alkaloids of <i>Azadirachta indica</i> (neem), Pheromone, Baculovirus), bioplastic, biosensors and biochips. The students learn extensively about the topics listed above. They know about genetically modified organisms, transgenic goats, cattle and chickens, bio-safety and intellectual property rights, elementary idea about bio-informatics, genomics and proteomics.</p> <p>iii) The biostatistics and computer portion of the course helps the students to become well conversant in application of statistics and computer skills in prediction or presentation of</p>
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			<p>a disease or a drug-effect in a population. They learn about population, parameter and sample, sampling methods, frequency distribution and frequency polygon, histogram, bar-diagram, pie diagram, mean, median, mode and the methods of their computation, merits, demerits and applications, variance, standard deviation, standard error of mean and their computation, normal probability distribution, Students t-distribution, skewness, kurtosis, null-hypothesis, errors of inference, level of significance, two tail and one tail 't' test for significance of difference between sample means, Chi-square test and linear correlation. They gain knowledge about the software, hardware, types of computers, MS Word, Excel, power point. They develop concepts of networking, website and computer virus.</p>
	<p>PAPER- VII (Practical)</p>	<p>A. Experimental Physiology B. Human Experiment and Anthropometric Measurements C. Computer Application D. Project Work / Field Survey)</p>	<p>A. In Experimental Physiology, the students gather knowledge of Experimental Physiology through the study and use of kymograph, induction coils, key and tuning fork in gastrocnemius sciatic preparation, kymographic recording of isotonic muscle twitch. They are trained to study the effects of temperature, summation and load (after-load) on muscle contraction. They also learn how to study the heartbeat of toad and how to study the effects of acetylcholine and excess calcium ion on perfused heart using a kymograph. The students learn to interpret a prepared supplied curve with recording of movements of the heart. They gather knowledge about the kymographic recording of normal movements of rat's intestine in Dale's apparatus, effects of anoxia, acetylcholine and adrenaline on normal intestinal movements.</p> <p>B. The students are trained measure arterial blood pressure at rest, after exercise and at different postural conditions by sphygmomanometer, determination of physical fitness by Harvard step test and measurement</p>

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			<p>of breathing rate before and after exercise, determining VO₂ max by Queen's College method, studying the effect of graded exercise (by Bicycle ergometer/Treadmill) on heart rate, pneumographic effects of talking, laughing, coughing, exercise, hyperventilation and breath holding, spirometric measurement of vital capacity.</p> <p>They are able measure the anthropometric parameters such as weight, stature, eye height, shoulder height, elbow height, bi-acromian breadth, head breadth, head circumference and neck circumference. mid upper arm circumference, chest circumference, waist circumference, hip circumference, waist hip ratio, BMI, BSA.</p> <p>C. The students study the various aspects of computer application such as operation of MS Word and Excel, preparation of body text and table by using MS word, graphical representation of data in pie, bar and line diagram using Microsoft Excel, presentation of study material by using power point.</p> <p>D. The students learn to carry out field survey using the skills they acquire from human experiment and anthropometry practical classes. They learn to prepare the project / field study report after an educational excursion.</p>
	PAPER- VIII (Practical)	A. Environmental Physiology B. Microbiology C. Clinical Physiology D. Blood Biochemistry E. Biostatistics F. Biotechnology G. Diet Survey	A. In the practical classes of Environmental Physiology the students are trained to measure environmental temperature - dry bulb and wet bulb, relative humidity, air velocity, determination of O ₂ , CO ₂ , BOD, COD level and total alkalinity, Ca, Mg and chlorine in water by titration method, measurement of noise by sound level meter and determination of light intensity by lux meter.


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		<p>B. In the Microbiology part of this course, the students learn sterilization, culture preparation and isolation of bacteria. They also know biochemical characterization of microorganisms are being studied. They are trained to perform Gram staining, Acid-fast staining, Bacterial spore staining.</p> <p>. Clinical Physiology has been studied by doing pregnancy test, pperm count, sperm viability test by using eosine- Y, Routine clinical tests of urine.</p> <p>C. In the Blood biochemistry section, the students learn how to perform Photo-colorimetric estimation of blood constituents such blood cholesterol by FeCl₃ method, estimation of acid and alkaline phosphatase, SGOT and SGPT of supplied blood.</p> <p>D. The Biostatistics section, help them gather extensive knowledge in the field. They learn how to compute mean, median, mode, standard deviation, standard error of the mean with physiological data like body temperature height, weight, heart rate, respiratory rate, blood pressure of human subjects, Student's 't' test and chi-square test for significance of difference between means.</p> <p>F. In the Biotechnology section, they learn to carry out isolation of DNA (from blood and microbial culture), isolation of protein, gel electrophoresis of DNA and protein, quantification of isolated DNA and protein.</p> <p>G. This course helps the students to gain efficiency in conducting diet surveys, preparation of reports of such surveys and offering recommendations when nutritional deficiencies or excess intake by the population are observed.</p>
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