Curriculum Framework for
UNDERGRADUATE PROGRAMME
IN
PHYSIOLOGY

3 Year B.Sc. (Programme)
&
4 Year B.Sc. (Honours) or B.Sc. (Honours with Research)

Based on guideline of National Heigher Education Qualifications Framework (NHEQF)

Undergraduate Board of Studies in Physiology

Council for Undergraduate Studies
Kalyani University
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PREAMBLE

The syllabus for Physiology for 3/4-year UG Programme in Physiology (Honours/Honours with Research) has been framed as per Curriculum and Credit Framework for Undergraduates Programmes developed by UGC and adhering the model syllabus in Physiology framed by UGBOS. The purpose of the course is to upgrade and internationalize physiology teaching and research at undergraduate level as a multidisciplinary and integrative science subject. The syllabus will equip all undergraduate students with knowledge on basic physiological mechanisms for the set point control of different physiological variables in healthy human beings with special references to their implications in pathogenesis of disease and the physiological basis of their management. The syllabus has been framed in view with multiple entry and exit points and re-entry options. A student can get a UG Certificate after completing 1 year (2 semesters) with basic knowledge in Physiology and a UG Diploma after 2 year (4 semesters) with a broad understanding about Physiology. A student shall get a Bachelor degree in Physiology Major after completing 3 year (6 semesters) programme of study with wide general knowledge in Physiology. After completing 4 year (8 semesters) a student shall get a Bachelor's Honours Degree. If the students complete an extensive research programme in Physiology in the final year of Bachelor's Degree, then he/she will be given Honours with Research Degree.

The ultimate objective of the syllabus is to fit students to get this jobs through acquisition of skills. The objective of framing this new syllabus is to give the students a holistic understanding of the subject giving substantial weightage to both the core content and laboratory skills and techniques used in Physiology. The course content also lists new practical exercises, so that the students get a hands-on experience of the latest techniques that are in current usage both in the advanced research laboratories and in industry.

KALYANI UNIVERSITY

COURSE STRUCTURE OF THE 3/4 YEAR UNDERGRADUATE PROGRAMME IN PHYSIOLOGY

Semester-I									
Course Code	Course Title	Core Topics	Nature of Course	Credit of Course	Class hour/week	Evaluation			Total
						Internal	Semester End		
							T	P	
PHY – M-1	**Foundations of Physiology- 1**	Homeostasis, Body Fluid, Cellular Physiology, Biophysics, Circulating Body Fluid, Functional Anatomy of Heart & Physiology of Breathing	Major	6	6	15	40	20	75
PHY -MI-T-1	**Basics of Physiology-1**	Homeostasis, Body Fluid, Cellular Physiology, Biophysics, Structure and Function of Different Biomolecules, Circulating Body Fluid	Minor	4	4	10	40	-	50
PHY- MU- 1	**Physiology of Nutrition and Dietetics**		Multidisciplinary Course	3	3	10	35		45
PHY – SEC- P-1	**1.Hematological Techniques** **2. Forensic Studies** (any one)		Skill Enhancement Course	3	3	10	-	35	45
VA-T-1	Environmental Education		Value added Course	4	4	10	40	-	50
05				20	20	55			265

Semester-II									
Course Code	Course Title	Core Topics	Nature of Course	Credit of Course	Class hour/week	Evaluation			Total
						Internal	Semester End		
							T	P	
PHY – M- 2	**Foundations of Physiology 2**	Functional Anatomy of G.I. system, Digestion & Absorption, Central, Peripheral and Autonomic Nervous system, Sensory Physiology, Endocrine gland and its Function, Functional Anatomy of Kidney, Structure & Function of different Biomolecule, Enzymology	Major	6	6	15	40	20	75
PHY -MI-T-1	**SAME AS SEM I as it will be taken by other group of students**		Minor	4	4	10	40	-	50
PHY- MU- 2	**Physical and Cultural Physiology**	Physical Exercise, Fitness, Yoga, Asanas, Pranayama	Multidisciplinary Course	3	3	10	35		45
AECC-1	Communicative English		Ability Enhancement Course	4	4	10	40		50
PHY – SEC-P- 2	**1.Clinical and Diagnostic Physiology** **2.Food Safety** (any one)		Skill Enhancement Course	3	3	10	-	35	45
PHY –SI-T-1	Summer Internship (Additional for Certificate/Diploma)		Summer Internship	4	4				50
05				20	20	55			265

Semester-III									
Course Code	Course Title	Core Topics	Nature of Course	Credit of Course	Class hour/week	Evaluation			Total
						Internal	Semester End		
							T	P	
PHY – M - 3	**Body Fluids and Human Immunity**	Blood, Lymph, Immune Mechanisms, Vaccinations and Immunopathology	Major	6	6	15	40	20	75
PHY -MI-T-2	**Basics of Physiology-2**	Functional anatomy of Heart, Physiology of Breathing, Functional Anatomy of GI system, Digestion & Absorption of Food Stuff, Minerals and Water, Nutrition, Metabolism & Enzymes	Minor	4	4	10	40	-	50
PHY- MU-3	**Community Health Awareness**		Multidisciplinary Course	3	3	10	35		45
PHY – SEC- P- 3	**Computational Physiology** **Or,** **Health and Nutrition** (Any one)		Skill Enhancement Course	3	3	10	-	35	45
VA-T-2			Value added Course	4	4	10			50
05				20	20	55			265

Semester-IV									
Course Code	Course Title	Core Topics	Nature of Course	Credit of Course	Class hour/week	Evaluation			Total
						Internal	Semester End		
							T	P	
PHY – M- 4	**Metabolic Physiology**	Energy balance, Metabolism & Enzymology	Major	6	6	15	40	20	75
PHY –M -5	**Hormone and Reproduction**	Endocrine glands, Hormones, Receptors & Reproductive Physiology	Major	6	6	15	40	20	75
PHY- MI- T-2	**SAME AS SEM III as it will be taken by other group of students**		Minor	4	4	10	40	-	50
AECC-2	MIL		Ability Enhancement Course	4	4	10			50
PHY –SI-T-2	Summer Internship (Additional for Certificate/Diploma)		Summer Internship	4	4				
04				20	20	50			250

Semester-V									
Course Code	Course Title	Core Topics	Nature of Course	Credit of Course	Class hour/week	Evaluation			Total
						Internal	Semester End		
							T	P	
PHY – M- 6	**Advanced Cellular Physiology**	Cellular Physiology, Biophysical Properties, Nanotechnology	Major	6	6	15	40	20	75
PHY -M- 7	**Skin and Muscle Function**	Nerve Muscle Physiology, Skin & Integumentary System	Major	6	6	15	40	20	75
PHY- MI- P-3	PHYSIOLOGY PRACTICAL		Minor	4	4	10	-	40	50
MI-T-3	Other/Separate Subject		Minor	4	4	10			50
04				20	20	50			250

Semester-VI									
Course Code	Course Title	Core Topics	Nature of Course	Credit of Course	Class hour/week	Evaluation			Total
						Internal	Semester End		
							T	P	
PHY – M- 8	**Respiration and Cardiovascular Function**	Respiratory Physiology, Cardiovascular Physiology	Major	6	6	15	40	20	75
PHY -M-9	**Brain Function**	Nervous System, Special Senses	Major	6	6	15	40	20	75
PHY- M- 10	**Human Nutrition**	GIT, Digestion, Absorption & Nutrition	Major	6	6	15	40	20	75
PHY-SI-3	Outreach/Internship		Major	2					
03				20	20				

Semester-VII									
Course Code	Course Title	Core Topics	Nature of Course	Credit of Course	Class hour/week	Evaluation			Total
						Internal	Semester End		
							T	P	
PHY – M-11	**Functions of Kidney**		Major	6	6	15	40	20	75
PHY -M-12	**Microbiology and Genetic Basis of Life**	Microbiology, Molecular Biology & Biotechnology	Major	6	6	15	40	20	75
PHY- M- 13	**Perspectives of Man at Work**	Ergonomics, Sports & Exercise Physiology, Yoga	Major	6	6	15	40	20	75
PHY- MI-T-4	**Basics of Physiology-3**	Nerve-Muscle Physiology, Central, Peripheral & Autonomic Nervous System, Sensory Physiology, Endocrine Glands, Reproductive Physiology, Functional Anatomy of Kidney	Minor	4	4	10	40	-	50
MI-T-8	Other/Separate Subject		Minor	4	4	10			50
05				26	26	65			325

Semester-VIII								
Course Code	Course Title	Core Topic	Nature of Course	Credit of Course	Class hour/week	Evaluation		Total
						Internal	Semester End	

							T	P	
PHY – M-14	**Physical and Biological Environment**	Environmental Physiology & Toxicology	Major	4	4	10	40	-	50
PHY -M-15	**Life in Challenging Environment**	Stress Physiology, High Altitude, Space Physiology, Deep Sea Physiology	Major	4	4	10	40	-	50
PHY- M- 16	**Biological Rhythms, Population and Developmental Phenomena**	Developmental Biology, Population Control & Chronobiology	Major	4	4	10	40	-	50
PHY- M- 17	**Public Health**		Major	6	6	15	40	20	75
PHY- M-18	**Biological Instrumentation and Literature Studies in Physiology**		Major	6	6	15	40	20	75
	M-17 And M-18 For Honours Without Research Students								
PHY-SI-4	**Research Project/Dissertation** **Advanced instrumentation in Physiological Research and Recent Advances in the Topic Proposed** (Hypothesis proposed, Protocol Designing, Methodology, Work Execution, Data Interpretation, Preparation of Report)			**12**	**12**				**150**
	SI-4 for Honours with Research Students								
05				**24**	**24**				**300**
				170					

Details of Courses

Major

Semester I

PHY-M-1: Foundations of Physiology-1 (1 course x 6 credits = 6 credits: Marks 60+15=75)

Course Code: PHY-M-T-1 [No. of Lectures (one hour each): 60]

1. **Homeostasis:** Neural and Endocrine Regulations, Positive & Negative Feedback.
2. **Body Fluids:** Significance, Components, Composition, Concentration of body fluids, Dehydration, Overhydration.
3. **Cellular Physiology:** Basic Structure differences between prokaryotic and eukaryotic cells, Electron microscope structures and functions of the organelles of eukaryotic cell with special emphasis on plasma membrane, mitochondria and cytoskeleton, Properties of membrane: transport across cell membranes, cell junctions-tight junction and gap junction, cell inclusions.
4. **Biophysics:** Diffusion, Surface tension, Viscosity-their characteristics factors influencing and biological applications, Osmosis-laws of osmosis and biological application, Acid, base, salts, Acid base-buffers, Buffers in pH regulation, dipoles, dielectric constant
5. **Concept of Circulating Body Fluid:** Composition & Functions of cellular component of Blood, Plasma, Lymph
6. **Functional Anatomy of Heart:** Anatomy of Heart (right side, left side, layers of the wall, septa, valves etc), Actions of the Heart (Chronotropic, Ionotropic, Dromotropic, Bathmotropic action), Blood vessels (Arterial system, Venous system, complication in blood vessels) Properties of cardiac muscle, capillaries and its importance .
7. **Physiology of Breathing:** Physiological anatomy of respiratory tract, Respiratory movements, Respiratory Pressures & volumes, Compliance, Work of Breathing. surfactant and respiratory distress syndrome

Course Code: PHY-M-P-1 [No. of Classes (two hours each): 30]

1. Study of Compound and Binocular Microscope and it's handling.
2. Study & Identification of Stained Section of different mammalian tissues and organs: Trachea, Lungs, Cardiac Muscle, Skeletal Muscle, Smooth Muscle, Artery, Vein, Spleen, Lymph Gland.
3. Preparation of blood smear and identification of blood cells
4. Determination of Systolic, Diastolic, Pulse & Mean Blood Pressure by non-invasive methods (Auscultatory Method).
5. Measurement of Peak Expiratory Flow Rate.

[COURSE LEARNING OUTCOMES: Graduates will learn about some part of the fundamental Human Physiology like Homeostasis, Body Fluid, Cellular Physiology, Biophysics, Circulating Body Fluid, Functional Anatomy of Heart & Physiology of Breathing. They will gain their practical knowledge related to the theory part.]

Semester II

PHY-M-2: Foundations of Physiology -2 **(1 course x 6 credits = 6 credits: Marks 60+15=75)**

Course Code: PHY-M-T-2 [No. of Lectures (one hour each): 60]

1. **Functional Anatomy of GI System:** Anatomy & Histology of alimentary canal and digestive glands, movement of alimentary canal and their regulations, mastication and deglutition.
2. **Digestion & Absorption of Food Stuff, Minerals & Water:** Digestion and Absorption of Carbohydrates, Lipids, Proteins & Nucleic Acids.
3. **Central, Peripheral & Autonomic Nervous System (Overview):** A brief outline of the Organization and Basic functions (Sensory & Motor) of the nervous system (central, peripheral & Autonomic).
4. **Sensory Physiology (Overview):** Classification of general & special senses and their receptors, Physiology of Taste & Smell, Structure and Functional significance of Auditory apparatus (External, Middle & Inner Ears), Anatomy and structure of the eye ball.
5. **Endocrine Glands & their Functions:** Definition of endocrine glands and hormones, Classification & Function of Hormones.
6. **Functional Anatomy of Kidney:** Anatomy & Function of Kidney, Histology of nephron and structural difference between cortical and juxta medullary nephrons, JGA.
7. **Chemistry of Biomolecules:** Classification, Structure, Properties and Functions of Carbohydrates, Proteins and lipids. Structure, types and Function of DNA and RNA. **Enzymes:** Chemical Nature and Classification of Enzymes, Coenzymes, Prosthetic groups, Isoenzymes, Pro-enzymes, Allosteric enzymes, Ribozymes, Abzymes.

Course Code PHY-M-P-2 [No. of Classes (two hours each): 30]

1. Study & Identification of Stained Section of different mammalian tissues and organs: Esophagus, Stomach, Duodenum, Ileum, Jejunum, Large Intestine, Liver, Kidney, Ureter, Salivary Gland, Pancreas, Adrenal Gland, Thyroid Gland, Testis, Ovary, Spinal Cord, Cerebral Cortex, Cerebellum, Skin.
2. Kymographic recording of normal movement of rat's intestine in Dale's Apparatus (Demonstration)
3. Determination of Visual Acuity by Snellen's Chart/ Landolt's C Chart. Determination of Colour Blindness by Ishihara Chart.
4. Qualitative tests for the identification of physiologically important substances: Glucose, Fructose, Sucrose, Lactose, Albumin, Gelatin, Peptone, Starch, Dextrin, glycerol, acetone, bile salts, urea, uric acid, HCl, lactic acid.
5. Identification of normal & abnormal constituents of urine.

[COURSE LEARNING OUTCOMES: Graduates will learn about some part of the fundamental Human Physiology like Functional Anatomy of G.I. system, Digestion & Absorption, Central, Peripheral and Autonomic Nervous system, Sensory Physiology, Endocrine gland and its Function, Functional Anatomy of Kidney, Structure & Function of different Biomolecule, Enzymology. They will gain their practical knowledge related to the theory part also.]

Skill Enhancement Course (SEC)

Semester-I

PHY-SEC-P-1: Hematological Techniques **(1 course x 3 credits = 3 credits: Marks 35+10=45)**

Practical including Basic Theory: **[No. of Classes (two hours each): 45]**

1. Preparation of blood smear and identification of blood cells
2. Determination of haematocrit, MCV, MCH, MCHC.
3. Determination of bleeding time & clotting time.
4. Measurement of haemoglobin in blood.
5. CBC profile
   i. Differential count of WBC/Microscopic analysis of different blood cells
   ii. Total count of RBC & WBC
6. Preparation of hemin crystal
7. Preparation & staining of bone marrow
8. Measurement of diameter of megakaryocyte
9. Blood group determination

[COURSE LEARNING OUTCOMES: By the end of this course, the students should be able to understand the principles of hematology, both blood physiology, functions, and disorders and explain the pathophysiology of common haematological disorders, discuss the anatomy, functional organization and characteristics of the hematopoietic system. The students would also be able to interpret diagnostic test results and erroneous test results and able to fix them.]

OR

PHY-SEC-P-1: Forensic Studies **(1 course x 3 credits = 3 credits: Marks 35+10=45)**

Practical including Basic Theory: **[No. of Classes (two hours each): 45]**

1. Introduction to Forensic Science
2. Advanced Forensic Biology
3. Forensic Toxicology
4. Preparation of hemin crystal
5. Southern Blotting-Result Analysis
6. Qualitative Test for Detection of Blood

7. Fingerprints in Forensic science
8. H & E staining of tissue section.
9. Preparation & staining of Bone Marrow smear.
10. Measurement of diameter of megakaryocyte.
11. Reticulocyte staining.
12. Suitable staining and examination of fresh tissues - epithelial, areolar, adipose (Sudan III or IV)

[COURSE LEARNING OUTCOMES: By the end of this course, the students should be able to know about the Forensic Science, preparation of hemin crystal, theoretical knowledge about Southern Blotting, Fingerprints in Forensic Science and to identify and describe in detail the microscopic structure of the major organs, tissues and cells of the body and can explain the theoretical background to surgical cutup, tissue fixation, tissue processing, microtomy and staining using routine and specialized techniques. The students would be able to demonstrate proficiency in the preparation of routine formalin-fixed, paraffin-embedded tissue sections, to demonstrate proficiency in haematoxylin and eosin staining and few selected special staining methods.]

Semester-II

PHY-SEC-P-2: Clinical and Diagnostic Physiology **(1 course x 3 credits = 3 credits: Marks 35+10=45)**

Practical including Basic Theory: **[No. of Classes (two hours each): 45]**

1. Recording of ECG (Demonstration)
2. Gram Staining of bacteria and identification of Gram-positive & Gram-negative bacteria.
3. Staining and identification of bacterial spores.
4. Estimation of blood chloride (silver nitrate method), Colorimetric estimation of blood constituents: Inorganic Phosphate (Fiske-Subbarow as given in Hawk's Physiological Chemistry, 14^{th} edition) and Sugar (Folin-Wu method) / GOD-POD Method (kit method), Estimation of serum protein (Biuret Method, by plotting standard Curve), SGPT & SGOT / (AST/ALT Kit method).

[COURSE LEARNING OUTCOMES: By the end of this course, the students should be able to discuss the fundamental biochemistry and microbiology knowledge related to health and can explain the clinical significance of the laboratory tests. The students can also determine various substances present in blood during pathological situation and their use in diagnosis and monitoring of disease and evaluate the abnormalities which commonly occur in the clinical field.]

OR

PHY-SEC-P-2: Food Safety **(1 course x 3 credits = 3 credits: Marks 35+10=45)**

Practical including Basic Theory: **[No. of Classes (two hours each): 45]**

Qualitative tests of identifying food adulterants in some food samples: Metanil Yellow, Rhodamin-B, Saccharin, Monosodium Glutamate, Aluminum Foil, Chicory, Bisphenol-A and

Bisphenol-S, Chocolate brown HT, Margarine, Pb, Hg, As, PCB, Dioxin, etc., in turmeric powder, besan, laddoo, noodles, chocolate and amriti.

[COURSE LEARNING OUTCOMES : By the end of this course, the students should be able to handle issues related to health hazards of chemicals in food as well as of environmental pollutants that pose a threat to life. The students would also be to handle the adulteration of common foods and their adverse impact on health and can comprehend certain basic skills of detecting adulteration in common foods.]

Semester-III

PHY-SEC-P-3: Computational Physiology **(1 course x 3 credits = 3 credits: Marks 35+10=45)**

Practical including Basic Theory: **[No. of Classes (two hours each): 45]**

1. Characteristic, evolution, types of computer, anatomy of computer, brain versus computer, binary operations, logic GATES, elementary idea about computer languages.
2. Operating system and command. File management in MS-Word, Excel, Power Point, representation of Physiological result in graph, Statistical Calculation in Excel. Presentation of electrocardiogram, lungs volumes, nerve discharge etc by computer.
3. Computation of mean, median, mode, standard deviation and standard error of the mean with physiological data like temperature, pulse rate, respiratory rate, height and weight of human subjects. Geographical representation of data in frequency polygon and histogram. Student's t-test for significance of difference between means.

[COURSE LEARNING OUTCOMES: By the end of this course, the students should be able to understand basic computer concepts, definition and information technology. The students would also be able to interpret commonly reported statistical measures published in healthcare research and can analyze the different type of data using appropriate statistical software.]

OR

PHY-SEC-P-3: Health and Nutrition **(1 course x 3 credits = 3 credits: Marks 35+10=45)**

Practical including Basic Theory: **[No. of Classes (two hours each): 45]**

1. Survey of dietary status of people in the nearby area by the students.
2. Analysis of survey results.
3. Formulation of diet chart.
4. Epidemiological studies on human.

[COURSE LEARNING OUTCOMES: By the end of this course, the students should be able to define social, economic, cultural, and environmental influences on food access and dietary choices and can evaluate and predict ways in which complex interactions of

components of the food system influence human health and nutrition. The students would also be able to demonstrate an understanding of public health.]

Multidisciplinary Course

(Evaluation shall be carried out by the college)

Semester-I

PHY-MU-1: Physiology of Nutrition and Dietetics (1 course x 3 credits = 3 credits: Marks 35+10=45) [No. of Total Classes: 45]

Theory:

1. Constituents of food and their significance.
2. BMR, SDA, Basic concept of energy and units, Calorific values of food, ACU, Dietary requirement of carbohydrate, protein, lipid and other nutrients.
3. Balanced Diet and principles of formulation of balanced diets for growing child, adult man and woman, pregnant woman and lactating mother, elder people
4. Dietary fibres, Vitamins, Minerals,
5. Starvation, Obesity, Space nutrition.

Practical:

Nutrition and Dietetics- Diet Survey (Field Study Record)

1. Diet survey report (hand-written) of a family (as per ICMR specification): Each student has to submit a report.
2. A report (hand-written) on the basis of field survey from ONE of the following:
   a) Physiological parameters of Human (at least three parameters).
   b) Anthropometric measurements of Human (at least three parameters)
   c) Epidemiological studies on Human.

[COURSE LEARNING OUTCOMES: Graduates will learn about their nutritional demand in their daily life and how they will fulfil their demand in low cost budget.]

Semester-II

PHY-MU-2: Physical and Cultural Physiology (1 course x 3 credits = 3 credits: Marks 35+10=45) [No. of Total Classes: 45]

Theory:

1. Importance of regular exercise in health and wellbeing.
2. Methods for assessing Body Composition, BMI.
3. Types of exercises.

4. Degrees of exercise.
5. Factors affecting muscle work.
6. Energy sources in exercise.
7. Physiological changes (especially Cardio-Respiratory) in exercise.
8. Nutrition and Physical Fitness.
9. Effects of training on physical performance.
10. Concept of Yoga, Schools of Yoga, Asanas, Pranayama.
11. Prevention of Aging by Yoga.

Practical:

1. Measurement of blood pressure before and after different grades of exercise.
2. Recording of recovery heart rate after standard exercise.
3. Determination of Physical Fitness Index by Harvard Step Test (Modified).
4. Performing Yoga & Pranayama.

[COURSE LEARNING OUTCOMES: Graduates will learn about their physical fitness status and how they will increase their cardiorespiratory fitness using several simple body exercise, yoga and pranayama.]

Semester-III

PHY-MU-3: Community Health Awareness **(1 course x 3 credits = 3 credits: Marks 35+10=45) [No. of Total Classes: 45]**

Theory:

1. Population problem, malnutrition, PCM, Marasmus, Kwashiorkor, Marasmic Kwashiorkor, Endemic Goiter, Nutritional Anemias, Rickets, Osteomalacia, Xeropthalmia, Beriberi, and their social implications.
2. Principles and their social importance of immunization against infectious diseases.
3. Epidemiology and prevention of AIDS and Hepatitis.
4. Dietary management of obese, diabetic, hypertensive person.
5. Definition: hygiene, health and public health
6. Air, water, food borne diseases: Causes, symptoms and control
7. Sound pollution as a community health issue, definition, concept of noise, source of extraordinary sound, effects of sound pollution on human health, noise index (noise standards)
8. Food additives/adulterants

Practical:

1. Detection of food additives in different food samples
2. Determination of sound levels by sound level meter and noise index

[COURSE LEARNING OUTCOMES: Graduates will learn about social physiology related with several communicable and non-communicable diseases and also problem and management of several public health related issues.]

Minor

Semester I /& II

PHY-MI-T-1: Basics of Physiology-1 (1 course x 4 credits = 4 credits; Marks 40+10=50) [No. of Lectures (one hour each): 60]

1. **Homeostasis:** Neural and Endocrine Regulations, Positive & Negative Feedback.
2. **Body Fluids:** Significance, Components, Composition, Concentration of body fluids, Dehydration, Overhydration.
3. **Cellular Physiology:** Basic Structure differences between prokaryotic and eukaryotic cells, Electron microscopic structures and functions of the organelles of eukaryotic cell with special emphasis on plasma membrane, mitochondria and cytoskeleton, Properties of membrane: transport across cell membranes, cell junctions-tight junction and gap junction.
4. **Biophysics:** Diffusion, Surface tension, Viscosity-their characteristics, factors influencing and biological applications, Osmosis-laws of osmosis and biological application, Acid, Base, salts, Acid base-buffers, Buffers in pH regulation, dipoles, dielectric constant.
5. **Structure & Function of different biomolecules- Carbohydrate, Protein and Lipid:** Classification, Chemistry, Properties & Functions of Carbohydrate, Protein and Lipid.
6. **Concept of Circulating Body Fluid:** Composition & Functions of cellular component of Blood. Hemoglobin, Blood immunity.

[**COURSE LEARNING OUTCOMES:** Graduates will learn about some part of the fundamental Human Physiology like Homeostasis, Body Fluid, Cellular Physiology, Biophysics, structure & function of different biomolecules and Circulating Body Fluid.]

Semester III / & IV

PHY-MI-T-2: Basics of Physiology-2 (1 course x 4 credits = 4 credits; Marks 40+10=50) [No. of Lectures (one hour each): 60]

1. **Functional Anatomy of Heart:** Anatomy of Heart (right side, left side, layers of the wall, septa, valves etc.), Actions of the Heart (Chronotropic, Ionotropic, Dromotropic, Bathmotropic action), Blood vessels (Arterial system, Venous system, complication in blood vessels), Properties of Cardiac muscle, capillaries and its importance.
2. **Physiology of Breathing:** Physiological anatomy of respiratory tract, Respiratory movements, Respiratory Pressures and volumes, Compliance, Work of Breathing, surfactant and respiratory distress syndrome.
3. **Functional Anatomy of GI System:** Anatomy & Histology of alimentary canal and digestive glands, movement of elementary canal and their regulations, mastication and deglutition.

4. **Digestion & Absorption of Food Stuff, Minerals & Water:** Digestion and Absorption of Carbohydrates, Lipids, Proteins & Nucleic Acids.
5. **Nutrition:** Constituents of food and their significance, Balanced Diet, Dietary fibres, Vitamins, Minerals. Malnutrition, PCM, Marasmus, Kwashiorkor, Marasmic Kwashiorkor, Endemic Goiter, Nutritional Anemias, Rickets, Osteomalacia, Xeropthalmia, Beriberi, and their social implications. Preparation of Diet Chart.
6. **Metabolism:** Carbohydrate, Protein and Lipid metabolism.
7. **Enzymes:** Chemical Nature and Classification of Enzymes, Coenzymes, Prosthetic groups, Isoenzymes, Pro-enzymes, Allosteric enzymes, Ribozymes, Abzymes

[**COURSE LEARNING OUTCOMES:** Graduates will learn about some part of the fundamental Human Physiology like Functional Anatomy of Heart & G.I. system, Physiology of Breathing, Digestion & Absorption of food stuff, Metabolism and enzymes.]

Semester V

PHY-MI-P-3: Physiology Practical **(1 course x 4 credits = 4 credits; Marks 40+10=50)**

[No. of classes (two hours each): 60]

1. Study of Compound Microscope.
2. Study & Identification of Stained Sections of different mammalian tissues and organs: Cardiac Muscle, Skeletal Muscle, Smooth Muscle, Artery, Vein, Spleen, Lymph Gland, Trachea, Lungs, Esophagus, Stomach, Duodenum, Ileum, Jejunum, Large Intestine, Liver, Salivary Gland, Pancreas, Lungs, Kidney, Ureter, Adrenal Gland, Thyroid Gland, Testis, Ovary, Spinal Cord, Cerebral Cortex, Cerebellum, Skin
3. Qualitative tests for identification of physiological importance substances: Glucose, Galactose, Fructose, Sucrose, Lactose, Albumin, Gelatin, Peptone, Starch, Dextrin.
4. Preparation of Blood smear and Identification of Blood Cells.
5. Measurement of Hemoglobin in Blood.
1. Determination of Systolic, Diastolic, Pulse & Mean Blood Pressure by non-invasive methods (Auscultatory Method).
2. Measurement of Peak Expiratory Flow Rate.
3. Determination of Visual Acuity by Snellen's Chart/ Landolt's C Chart. Determination of Colour Blindness by Ishihara Chart.
4. Identification of normal & abnormal constituents of urine.
5. Staining and identification of Testes, Ovary, Thyroid gland, Cerebellum, Kidney, Ureter, Lung etc

[COURSE LEARNING OUTCOMES: Graduates will handle several sophisticated instruments and they will do their practical on the basis of their theory learnt in last two semesters. Practical skill will be developed after completion of their courses]

Semester VII

PHY-MI-T-4: Basics of Physiology-3 (1 course x 4 credits = 4 credits; Marks 40+10=50) [No. of Lectures (one hour each): 60]

1. **Nerve-Muscle Physiology:** Properties of Nerve and Muscles, Synapse, NM junction.
2. **Central, Peripheral & Autonomic Nervous System (Overview):** A brief outline of the Organization and Basic functions (Sensory & Motor) of the nervous system (central, peripheral & Autonomic).
3. **Sensory Physiology (Overview):** Classification of general & special senses and their receptors, Physiology of Taste & Smell, Structure and Functional significance of Auditory apparatus (External, Middle & Inner Ears), Anatomy and structure of the eye ball.
4. **Endocrine Glands & its Function:** Definition of endocrine glands and hormones, Classification & Function of Hormones.
5. **Reproductive Physiology:** Structure of Male and Female reproductive system, Gametogenesis and Ejaculation, Menstrual cycle.
6. **Functional Anatomy of Kidney:** Anatomy & Function of Kidney, Histology of nephron and its structural difference between cortical and juxta medullary nephrons, JGA.

[COURSE LEARNING OUTCOMES: Graduates will learn about some part of the fundamental Human Physiology like Nerve-Muscle Physiology, Central, Peripheral and Autonomic Nervous system, Sensory Physiology, Endocrine gland and its Function, Functional Anatomy of Kidney. They will gain their practical knowledge related to the theory part also.]