

**Syllabus of Choices Offered by Physiology Discipline
for B.Sc. Program under
Choice Based Credit System (CBCS)**



West Bengal State University

Course Curriculum for Physiology General under Choice Based Credit System

- All general courses will have 3 subjects/disciplines of interest. Student will select 4 core courses each from discipline of choice including Physiology as one of the disciplines.
- Student will select 2 elective courses each from discipline of choice including Physiology as one of the disciplines.
- Student may also choose skill enhancement courses in Physiology.

Summary of the Syllabus

Semester I

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses (+2 from allied disciplines)	PHYGCOR01T Nutrition, Metabolism & Gastrointestinal Functions	4	PHYGCOR01P Nutrition, Metabolism & Gastrointestinal Functions	2	6 X 3 = 18 (Including allied disciplines)
Ability Enhancement Courses	ENVSAEC01T Environmental Science	2			2
					20

Semester II

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses (+2 from allied disciplines)	PHYGCOR02T Circulation, Respiration & Excretion	4	PHYGCOR02P Circulation, Respiration & Excretion	2	6 X 3 = 18
Ability Enhancement Courses	ENGLAEC02M English/MIL Communication	2			2
					20

Semester III

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses (+2 from allied disciplines)	PHYGCOR03T Nervous System & Special Senses	4	PHYGCOR03P Nervous System & Special Senses	2	6 X 3 =18
Skill Enhancement Courses	PHYSSEC01M Haematological techniques (OR FROM OTHER DISCIPLINES)	2	PHYSSEC01M Haematological techniques (OR FROM OTHER DISCIPLINES)		2
					20

Semester IV

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Core Courses (+2 from allied disciplines)	PHYGCOR04T Endocrinology & Reproduction	4	PHYGCOR04P Endocrinology & Reproduction	2	6 X 3 =18
Skill Enhancement Courses	PHYSSEC02M Diet Survey (OR FROM OTHER DISCIPLINES)	2	PHYSSEC02M Diet Survey (OR FROM OTHER DISCIPLINES)		2
					20

Semester V

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits
Skill Enhancement Courses	PHYSSEC01M Hematological Techniques (OR FROM OTHER DISCIPLINES)		PHYSSEC01M Hematological Techniques (OR FROM OTHER DISCIPLINES)		2
Discipline Specific Elective Course (ANY ONE) (+2 from allied disciplines)	PHYGDSE01T Biological Statistics	4	PHYGDSE01P Biological Statistics	2	6 X 3 =18
	PHYGDSE02T Sports and Exercise Physiology	4	PHYGDSE02P Sports and Exercise Physiology	2	
					20

Semester VI

Courses	Theoretical (T)	Credits	Practical (P)	Credits	Total Credits

Skill Enhancement Courses	PHYSSEC02M Diet Survey(OR FROM OTHER DISCIPLINES)		PHYSSEC02M Diet Survey(OR FROM OTHER DISCIPLINES)		2
Discipline Specific Elective Course (ANY ONE) (+2 from allied disciplines)	PHYGDSE03T Community Nutrition andPublicHealth	4	PHYGDSE01P Community Nutrition andPublicHealth	2	6
	PHYGDSE04T Environmental Pollution and HumanHealth	4	PHYGDSE04P Environmental Pollution and HumanHealth	2	
					20

Courses of B.Sc. General Physiology under CBCS

Core Courses

1. Nutrition, Metabolism & Gastrointestinal Functions
 2. Circulation, Respiration & Excretion
 3. Nervous System & Special Senses
 4. Endocrinology & Reproduction
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Ability Enhancement Course (AEC) (Compulsory)

1. Environmental Science
 2. English/MIL Communication/Bengali
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Elective Course (EC) (any two)

Discipline Specific Electives (GDSE)	<ol style="list-style-type: none">1. Biological Statistics2. Community Nutrition & Public Health3. Sports and Exercise Physiology4. Environmental Pollution and Human Health
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Skill Enhancement Course (SEC)

1. Hematological Techniques
 2. Diet Survey and formulation of Diet Chart
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Summary of the Syllabus

1. Each semester will consist of 15-18 weeks of academic work equivalent to 90 actual teaching days.
2. One credit is equivalent to one (1) hour of teaching (lecture) or two hours of Practical work per week.

Total credits in Semester I: 6 (for Physiology) + 2 (Compulsory) = 8 = (8 - 2) = 6 for Physiology only

3. Numbers in parentheses indicate value of credit.

Details of Courses:

Components of Core Courses

PHYGCOR01T: Nutrition, Metabolism & Gastrointestinal Functions	4 Credits
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Enzymes : (6 hours)

Classification, coenzymes, cofactor, Prosthetic Groups. Mechanism of enzyme action: activation energy, enzyme-substrate complex, transition state. Michaelis constant, Michaelis-Menten equation, Hyperbolic kinetics, Significance of K_m and V_{max} . Enzyme Inhibition: Competitive, noncompetitive, uncompetitive. Factors regulating enzyme activities: substrate concentration, enzyme concentration, pH and temperature. Isoenzymes, Allosteric enzymes, Ribozymes, Abzymes, Concept of Rate limiting enzymes.

Chemistry of Biomolecules: (14 hours)

Classification, structure, Properties and Functions of Carbohydrates, Proteins and lipids. Structure, types and Function of DNAs and RNAs.

Nutrition & Metabolism: (20 hours)

Carbohydrate metabolism. Protein metabolism. Fat metabolism. Nutrition – BMR, RQ, RDA, SDA, NPU, Biological value of proteins. Vitamins: A, C, D, E, K, B12. Minerals: Sodium, Potassium, Calcium, Iron, Iodine, Fluorine.

Gastrointestinal Functions: (20 hours)

1. **Digestion & absorption** Introduction, carbohydrates, Proteins & Nucleic Acids, Lipids.
2. **Regulation of Gastrointestinal Function**
General Considerations, Gastrointestinal hormones, Mouth & Esophagus, Stomach, Digestive Function of the Stomach. Exocrine Portion of the Pancreas, Liver & Biliary System, Small Intestine, Colon.

PHYGCOR01P: Nutrition, Metabolism & Gastrointestinal Functions Lab	2 Credits
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Biological Chemistry:

Qualitative tests for the identification of physiologically important substances: Hydrochloric acid, lactic Acid, Uric Acid, Glucose, Galactose, Fructose, Sucrose, Lactose, Albumin, Gelatin, Peptone, Starch, Dextrin, Urea, Glycerol, Bile salts.

Biochemical Estimation:

Quantitative estimation of glucose and sucrose by Benedict's method. Quantitative estimation of amino nitrogen [Sorensen's formol titration method (percentage as well as total quantity to be done)]. Estimation of percentage quantity of lactose in milk by Benedict's method.

Demonstration:Dale's Experiments : Kymographic recording of normal movements of rat's intestine in Dale's apparatus. Effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements.

Ability Enhancement Course (AEC) (Compulsory)

1. Environmental science
2. English/MIL communication

SEMESTER-II

PHYGCOR02T	
Circulation, Respiration & Excretion	4 Credits

Circulation (25 hours)

1. **Origin of the Heartbeat & the Electrical Activity of the heart** Introduction, Origin & Spread of Cardiac Excitation, The Electrocardiogram, Cardiac Arrhythmias, Hypertrophy and cardiac myopathy.
2. **The Heart as a Pump** Introduction, Mechanical Events of the Cardiac Cycle, Cardiac Output.
3. **Dynamics of Blood & Lymph Flow** Introduction, Introduction, Blood, Bone Marrow, White Blood Cells, Platelets, Red Blood Cells, Hemostasis: factors, mechanism. Hemoglobin. Anatomic Considerations: artery, vein, capillaries. Lymphatic Circulation & Interstitial Fluid Volume.
4. **Cardiovascular regulatory Mechanisms** Introduction, Local Regulatory Mechanisms, Regulation by Hormones, Systemic Regulation by the Nervous System.
5. **Circulation Through Special Regions** Introduction, Coronary Circulation, Circulation of the skin, Placental & Fetal Circulation.

Respiration (20 Hours)

1. **Pulmonary Function**
Anatomy of the Lungs, Mechanics of breathing, Gas Exchange in the lungs, Pulmonary Circulation, Other Functions of the Respiratory System.
2. **Gas Transport Between the Lungs & the Tissues**
Introduction, Oxygen Transport, Carbon Dioxide Transport, Respiratory acidosis and alkalosis.
3. **Regulation of Respiration**

Neural control of Breathing, Chemical Control of Breathing.

4. Respiratory Adjustments in Health & Disease

Forms of Hypoxia, Hypercapnia & Hypocapnia, Artificial Respiration.

Excretion (15 hours)

Renal Function & Micturition Introduction,

Juxta Glomerular Apparatus, Function of Malpighian corpuscles and renal tubule, counter-current mechanism, Water Excretion, Acidification of the Urine & Bicarbonate Excretion, Regulation of Na⁺ & Cl⁻ Excretion, Renal Circulation, Disorders of Renal Functions, Filling of the Bladder, Emptying of the Bladder, Non-excretory function of kidney.

PHYGCOR02P	
Circulation, Respiration & Excretion Lab	2 Credits

Circulation: Sphygmomanometric measurement of arterial blood pressure at rest and after exercise. Modified Harvard step test and determination of physical fitness. Recording of recovery heart-rate after standard exercise and graphical plotting.

Respiration: Pneumographic recording of effects of talking, drinking, laughing, coughing, exercise, hyperventilation and breath - holding.

Demonstration: Measurement of oxygen saturation by pulse oxymeter before and after exercise. Measurement of peak expiratory flow rate. Measurement of forced expiratory volume (FEV) in first second. **Cardiovascular Experiments:** Preparation of Amphibian Ringer solution. Kymographic recording of the movements of perfused heart of toad. Study of the effects of changes in perfusion fluid pressure, changes in temperature, excess calcium and potassium ion concentration, acetylcholine, adrenaline on the movement of heart. **Renal biochemistry:** Identification of normal and abnormal constituents of urine. **Hematological Experiments:** Differential count of WBC. Total count of RBC and WBC. Preparation and staining of bone marrow. Measurement of diameter of megakaryocyte. Reticulocyte staining.

Ability Enhancement Course (AEC) (Compulsory)

1. Environmental science
2. English/MIL communication

SEMESTER-III

PHYGCOR03T: Nervous system & Special senses	4 Credits
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Nerve & Muscle (20 hours)

1. **Excitable Tissue: Nerve** Introduction, Nerve Cells, Excitation & Conduction, Measurement of Electrical Events, Ionic Basis of Excitation & Conduction, Properties of Mixed Nerves, Nerve Fiber Types
2. **Excitable Tissue: Muscle** Introduction, Skeletal Muscle: Morphology, Electrical Phenomena & Ionic Fluxes, Contractile Responses, Properties. Cardiac Muscle: Morphology, Electrical Properties, Mechanical Properties Pacemaker Tissue, Smooth Muscle: Morphology.
3. **Synaptic & Junctional Transmission** Introduction, Synaptic Transmission: Functional Anatomy, Electrical Events at Synapses, Inhibition & Facilitation at Synapses, Chemical Transmission of Synaptic Activity.
4. **Initiation of Impulses in Sense Organs** Introduction, Sense Organs & Receptors, The Senses, Electrical & Ionic Events in Receptors, "Coding" of Sensory Information.

Nervous system (25 hours)

1. **Reflexes** Introduction, Monosynaptic Reflexes: The Stretch Reflex, Polysynaptic Reflexes: The Withdrawal Reflex, General Properties of Reflexes.
2. **Cutaneous, Deep & Visceral Sensation** Introduction, Pathways Touch, Proprioception, Temperature, Pain.
3. **Arousal Mechanisms, Sleep, & the Electrical Activity of the Brain** The Reticular Formation & the Reticular Activating System, The Thalamus & the Cerebral Cortex: structure & functions. The Electroencephalogram, Physiological Basis of the EEG & Sleep, Interpretation of abnormal EEG pattern.
4. **Control of Posture & Movement** Introduction, General Principles, Basal Ganglia & Cerebellum: Structure & functions. Movement disorders.
5. **The Autonomic Nervous System** Introduction, Anatomic Organization of Autonomic Outflow, Chemical Transmission at autonomic Junctions.
6. **Central Regulation of Visceral Function** Introduction, Hypothalamus: Anatomic Considerations, Hypothalamic Function, Relation to Autonomic Function, Relation to Sleep, Hunger, Thirst, Control of Posterior Pituitary Secretion, Control of Anterior pituitary Secretion, Temperature Regulation, fever.
7. **Neural Basis of Instinctual Behavior & Emotions** Introduction, Limbic system: Anatomic Considerations, Functions - Sexual Behavior, Fear & Rage, Motivation,

Special sense (15 hours)

Vision: Anatomic Considerations, The Image-Forming Mechanism (accommodation and visual acuity), The Photoreceptor Mechanism: Genesis of Electrical Responses, Visual Pathways and effects of lesions of these pathways, Color Vision, Errors in visual process.

Hearing & Equilibrium: Introduction, Anatomic considerations, Hair cells, Mechanism of hearing, Vestibular function.

Smell & Taste: Introduction, Smell: Receptors & Pathways. Taste: Receptor Organs & Pathways.

PHYGCOR03P Nervous system & Special Senses Lab	2 Credits
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Histological Study, Experiment of Nerve and Muscle:

Isolation and Staining of nerve fibres with node(s) of Ranvier (AgNO3) and muscle fibres (H and E).

Measurement of grip strength. Determination of visual acuity by Snellen’s chart / Landolt’s C chart. Determination of colour blindness by Ishihara chart.

Demonstration: Study of Kymograph, Induction coil, Key and other instruments used to study mechanical responses of skeletal muscle. Kymographic recording of mechanical responses of gastrocnemius muscle to a single stimulus and two successive stimuli. Kymographic recording of the effects of variations of temperature and load (after-load) on single muscle twitch. Calculation of work done by the muscle. Determination of nerve conduction velocity. **Neurological experiments:** Experiments on superficial (plantar) and deep (knee jerk) reflex. Reaction time by stick drop test. Short term memory test (shape, picture word). Two point discrimination test. Principles of fixation and staining, Staining and identification of fixed endocrine glands and nervous tissue.

Skill Enhancement Course (SEC)

PHYSSEC01M Hematological Techniques	2 Credits
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Preparation of blood smear and identification of blood cells. Preparation of haemin crystal. Bleeding time, clotting time. Measurement of haemoglobin in blood. Preparation of serum, Blood group determination.

SEMESTER-IV

PHYGCOR04T: Endocrinology & Reproduction	4 Credits
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Endocrinology:(30 hours)

- 1. The Thyroid Gland** Introduction, Anatomic Considerations, Formation & Secretion of Thyroid Hormones, Transport of Thyroid Hormones, Effects of Thyroid Hormones, Clinical Correlates.
- 2. Endocrine Functions of the Pancreas & the Regulation of Carbohydrate Metabolism** Introduction, Islet Cell Structure, Structure, Biosynthesis, & Secretion of Insulin, Effects of Insulin, Insulin Excess, Glucagon, Hypoglycemia & Diabetes Mellitus in Humans.
- 3. The Adrenal Medulla & Adrenal Cortex** Introduction, Adrenal Morphology, Adrenal Medulla, Structure & Function of Medullary Hormones, Adrenal Cortex, Structure & Biosynthesis of Adrenocortical Hormones, Effects of

Adrenal Androgens & Estrogens, Physiologic Effects of Glucocorticoids, Effects of Mineralocorticoids, Summary of the effects of Adrenocortical Hyper & Hypofunction in Humans.

4. **Hormonal Control of Calcium Metabolism & the Physiology of Bone** Introduction, The Parathyroid Glands: Structure, hormone, functions. Calcitonin. Role on Calcium & Phosphate Metabolism,
5. **The Pituitary Gland** Introduction, Morphology, Posterior pituitary hormones, Growth Hormone, Pituitary Hyper- and hypo-function.
6. **Endocrine Functions of the Kidneys, Heart, & Pineal Gland** Introduction, The Renin-Angiotensin System, Erythropoietin, The Endocrine Function of the Heart: Atrial Natriuretic Peptide.

Reproduction: (30 hours)

The male reproductive System: Structure, Gametogenesis, Endocrine Function of the Testes, Control of Testicular Function, Abnormalities of Testicular Function, The Female Reproductive system: The Menstrual Cycle, Ovarian Hormones, Control of Ovarian Function, Abnormalities of Ovarian Function, Pregnancy: Physiological changes during pregnancy. Placenta: Structure & functions. Puberty, Precocious & Delayed Puberty, Menopause, Pituitary Gonadotropins & Prolactin,

PHYGCOR04P:	
Endocrinology & Reproduction Lab	2 Credits

Histology

Study and Identification of Stained Sections of Different Mammalian Tissues and Organs:

Trachea, Lungs, Spleen, Lymph gland, Esophagus, Stomach, Duodenum, Ileum, Jejunum, large Intestine, Liver, Kidney, Salivary glands, Pancreas, Adrenal gland, Thyroid gland, Testes, Ovary, Spinal Cord, Cerebral cortex, Cerebellum, Skin, Cardiac muscle, Skeletal muscle, Smooth muscle, Artery, Vein, Tongue.

Demonstration: Study of the effects of oxytocin on uterine contraction. Study of the effects of adrenaline on intestinal / uterine movements. Study of estrous cycle. Staining and identification of kidney and ureters. Estimation of estrogen by spectrophotometric method. Pregnancy test from human urine by kit method.

Skill Enhancement Course (SEC)

PHYSSEC02M: Diet survey and Formulation of diet chart	2 Credits
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Survey of dietary status of people in the nearby area by the students, analysis of survey results, and, formulation of diet chart.

SEMESTER-V

Skill Enhancement Course (SEC)

PHYSSEC01M Hematological Techniques	2 Credits
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Preparation of blood smear and identification of blood cells. Preparation of haemin crystal. Bleeding time, clotting time. Measurement of haemoglobin in blood. Preparation of serum, Blood group determination.

PHYADSE01T : Biological Statistics	4 Credits
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Scope of statistics – Principles of statistical analysis of biological data. Basic concepts – variable, parameter, statistics. Sampling. Presentation of data-frequency distribution, frequency polygon, histogram, bar diagram and pie diagram. Parameters. Different classes of statistics- mean, median, mode, mean deviation, variance, standard deviation, standard error of mean. Standard score. Degrees of freedom. Probability. Normal distribution. Student's t-distribution. Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, Students' 't' test and z score for significance of difference. Distribution-free test - Chi-square test.

PHYADSE01T : Biological Statistics Lab	2 Credits
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Computation of mean, median, mode, standard deviation and standard error of the mean with physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects. Graphical representation of data in frequency polygon and histogram. Student's 't' test for significance of difference between means. Demonstration: Statistical analysis and graphical representation of biological data with computer using One way ANOVA etc.

PHYADSE02T Sports and Exercise Physiology	4 Credits
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Importance of regular exercise in health and wellbeing. Basic concept of Bioenergetics, Energy sources during exercise (Phosphagen, Anaerobic system and Aerobic system). Cardio-respiratory responses during different grades of exercise. Concept of excess post exercise oxygen consumption (EPOC), physiological fatigue and recovery. Aerobic work Capacity: Measurement, physiological factors and applications. Training: Principles of physical training, Training to improve aerobic and anaerobic power. Effect of overtraining and detraining. Nutritional supplements and ergogenic aids. Sports injury and its' management. Basic idea sports rehabilitation and sports medicine.

PHYADSE02P Sports and Exercise Physiology Lab	2 Credits
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Measurement of blood pressure before and after different grades of exercise. Recording of recovery heart-rate after standard exercise. Determination of VO₂max by queen college step test. Measurement of body fat percentage. Six minute walk test. Determination of endurance time by hand grip dynamometer.

SEMESTER-VI

Skill Enhancement Course (SEC)

PHYSSEC02M: Diet survey and Formulation of diet chart	2 Credits
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Survey of dietary status of people in the nearby area by the students, analysis of survey results, and, formulation of diet chart.

Discipline Specific Electives (DSE) (Any one)

PHYADSE03T Community Nutrition and Public Health	4 Credits
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Principles of human nutrition – relationship between nutrition, health & disease.
Balanced diet, Diet survey, Concept of ACU, Nutritional classification, Digestive absorption, metabolism of carbohydrates, proteins and lipids.
Composition and nutritional value of common Indian foodstuff, rice, wheat, pulses, egg, meat, fish and milk. Dietary fibers. Calorie requirement.
Principles of formulation of balanced diets for growing child, adult man and woman, pregnant and lactating woman.
Diet management of obese, diabetic, hypertensive person and athlete. Basic idea on PCM, marasmus, kwashiorkor and their prevention.

Recommended dietary allowances, malnutrition and chronic energy, LBW, PEM, Xerophthalmia, IDD, Iron and iodine deficiency, micronutrient disorders.
Food toxicity,
Effect of processing on nutritive values of foods
Socioecology of nutrition, Habitual diets in India and their adequacy
Basic idea about community health and public health issues.
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).

PHYADSE03T Community Nutrition and Public Health Lab	2 Credits
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Qualitative assessment of noise, survey on the status of dietary intake in the surrounding area through visits, etc.

PHYADSE06T: Environmental Physiology	4 Credits
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Environmental Pollutions and Health Hazards

Definition: hygiene, health and public health.
Air, Water, Food Borne Diseases: causes, symptoms and control.
Food Additives and Adulterants: definition, examples and human health hazards.
Vector Borne Epidemic Diseases: Malaria and Plague-etiology and control.

Air Pollution: definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.

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 management, 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.

Environmental management

Environmental ethics.

Conservation of topsoil, ground water and wild lives; rain water harvesting; sanctuary, national park, biosphere reserve, wildlife (conservation) Act, 1992.

PHYADSE06P: Environmental Physiology Lab

2 Credits

Determination of sound levels by sound level meter and noise index.

Determination of dissolve oxygen in the supplied water samples-supplied water, ground water extracted by shallow and deep tube wells, stream waters, pond water etc. Detection of food additives in different food samples.

Demonstration of kymographic recording of the effects of food additives on the movement of perfused heart of toad and intestinal movements of rat in Dale's bath.

Biochemical estimation of serum glucose, total proteins, SGPT and SGOT