VIDYASAGAR UNIVERSITY

Midnapore, West Bengal

PROPOSED CURRICULUM & SYLLABUS (DRAFT) OF

BACHELOR OF SCIENCE WITH PHYSIOLOGY

(MULTIDISCIPLINARY STUDIES)

3-YEAR UNDERGRADUATE PROGRAMME

(w.e.f. Academic Year 2023-2024)

Based on

Curriculum & Credit Framework for Undergraduate Programmes

(CCFUP), 2023 & NEP, 2020

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VIDYASAGAR UNIVERSITY
BACHELOR OF SCIENCE IN LIFE SCIENCES with PHYSIOLOGY
(*Under CCFUP, 2023*)

Level	YR.	SEM	Course Type	Course Code	Course Title	Credit	L-T-P	Marks		
								CA	ESE	TOTAL
B.Sc. in Life Sc. with Physiology	2nd	III	**SEMESTER-III**							
			Major-A2	PHYPMJ02	**T: Nutritional energy and metabolism; P: Practical** ***(To be studied by students taken* Physiology *as Discipline- A)***	4	3-0-1	15	60	75
			Major-A3	PHYPMJ03	**T: Cardio-respiratory & Excretory Physiology; P: Practical** ***(To be studied by students taken* Physiology *as Discipline- A)***	4	3-0-1	15	60	75
			SEC	SEC03	***To be taken from SEC-03 of Discipline C.***	3	0-0-3	10	40	50
			AEC	AEC03	Communicative English-2 (***common for all programmes***)	2	2-0-0	10	40	50
			MDC	MDC03	Multidisciplinary Course-3 (***to be chosen from the list***)	3	3-0-0	10	40	50
			Minor-3 (Disc.-C3)	PHYMIN03	**T: Cell Biology and Cardiovascular and nerve-muscle physiology, excretory system along with Metabolism; P: Practical** ***(To be studied by students taken Physiology as Discipline- C)***	4	3-0-1	15	60	75
			Semester-III Total			20				375
		IV	**SEMESTER-IV**							
			Major-B2		***To be decided*** ***(Same as MajorA2 for Physiology taken as Discipline-B)***	4	3-0-1	15	60	75
			Major-B3		***To be decided*** ***(Same as Major–A3 for* Physiology *taken as Discipline-B)***	4	3-0-1	15	60	75
			Major (Elective) -1	PHYMJE-01	**T: Neuromuscular Physiology; P: practical** ***(To be studied by students taken Physiology as Discipline- A)***	4	3-0-1	15	60	75
			AEC	AEC04	MIL-2 (***common for all programmes***)	2	2-0-0	10	40	50
			Minor -4 (Disc.-C4)	PHYMIN04	**T: Endocrine system and Reproduction P: Practical** ***(To be studied by students taken Physiology as Discipline- C)***	4	3-0-1	15	60	75
			Summer Intern.	IA	Internship / Apprenticeship- **activities to be decided by the Colleges following the guidelines to be given later**	4	0-0-4	-	-	50
			Semester-IV Total			22				400
			TOTAL of YEAR-2			42	-	-	-	775

MJP = Major Programme (Multidisciplinary), MI = Minor, A/B = Choice of Major Discipline; C= Choice of Minor Discipline; SEC = Skill Enhancement Course, AEC = Ability Enhancement Course, MDC = Multidisciplinary Course, CA= Continuous Assessment, ESE= End Semester Examination, T = Theory, P= Practical, L-T-P = Lecture-Tutorial-Practical, MIL = Modern Indian Language

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Major A2/B2

Credits 04 (FM: 75)

Major A2/B2T: Nutritional energy and metabolism (Theory): Credits 03 [45L]

❖ **Nutrition and Energy balance:**

Energy in Human Nutrition: Basic concept of energy and units, calorific and physiological fuel value, respiratory quotient (RQ), Total energy expenditure (TEE), Basal metabolic rates (BMR), and Resting energy expenditure (REE), Specific dynamic action (SDA), physical activity ratio (PAR). **BMR:** Determination of BMR by Benedict Roth apparatus and WHO/ICMR prediction equation, Factors affecting BMR. Adult consumption unit (ACU), determination of energy requirements of Indians in different age groups by doubly labeled water (DLW) method and prediction equation method. **Formulation of Diet chart:** Basic principle of diet chart. Formulation of a balanced diet chart for vegetarian and non-vegetarian, infants, growing children, sedentary adults, moderate working adults, college students, pregnant and lactating mothers, and athletes in low and moderate socio-economic status. **Food pyramid:** Food guide pyramid and its nutritional importance. Space Nutrition: change of body composition, energy recommendation for space flights, space food system, types of space foods.

Food and Diet:

Balanced diet. Diet Survey – Principles. Composition and nutritional value of common Indian food stuff - rice, wheat, pulses, egg, meat, fish and milk. Dietary fibers - Role of fibers in human nutrition. Calorie requirement. Vitamins and minerals. Malnutrition and undernutrition.

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. The basic idea on PCM, marasmus, kwashiorkor and their prevention. Iron and iodine deficiency. Recommended dietary allowances, malnutrition and chronic energy, LBW, PEM, xerophthalmia, and micronutrient disorders. Physiology of starvation and obesity. Food toxicity. Effect of processing on nutritive values of foods.

❖ **Metabolism of Bio-molecules:**

Digestion and absorption of carbohydrates, lipids, proteins, and nucleoproteins. **Carbohydrate Metabolism:** Glycolysis, R-L cycle, TCA cycle, Gluconeogenesis, Cori cycle, Glucose-Alanine cycle. Pentose Phosphate Pathway, Glycogenesis and Glycogenolysis. Inborn errors of metabolism of glycogen, galactose. Biological Oxidation: Concept of substrate-level phosphorylation and oxidative phosphorylation, Redox Potential and redox couple. Mitochondrial Electron Transport Chain and its components. Mechanism of electron transport and ATP synthesis. Oxidative Phosphorylation, Inhibitors and uncouplers. **Protein and Amino Acids Metabolism:** Glucogenic and ketogenic amino acids and amino acid pool. Nonprotein nitrogen. Trans-amination, oxidative and non-oxidative deaminations. Ammonotelic, ureotelic and uricotelic organisms. Metabolism of glycine, sulfur-containing amino acids, tryptophan, and tyrosine. **Inborn errors of metabolism (IBM)** of tryptophan, phenylalanine, and tyrosine. One carbon metabolism, labile methyl group, and transmethylation. Synthesis of Urea and Nitric oxide. Reactive Oxygen Species: Formation of Reactive Oxygen Species and the role of Catalase, Superoxide Dismutase, Glutathione Peroxidase and Glutathione Reductase in combating oxidative stress. Role of vitamins as antioxidants. **Purine & Pyrimidine Metabolism:** Purines and Pyrimidines: Biosynthesis - de novo and salvage pathways. Catabolism (Regulation of the above-mentioned biochemical pathways/cycle not required). **Lipid Metabolism:** β-oxidation of saturated fatty acids (Palmitic acids), ω and α oxidation. Biosynthesis of saturated fatty acid (C16). Formation and sphingomyelin. Brief concept of cholesterol biosynthesis and its physiological significance. Metabolism of adipose tissue. Role of lipoproteins in transport and storage of lipids.

Mineral metabolism: Sodium, potassium, chloride, calcium and phosphorus metabolism. Trace elements (iron, iodine, fluorine, selenium) - their functions and deficiencies.

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Major A2/ B2P: Practical

Credits 01

Biochemistry:

- **Qualitative analysis of biochemical molecules:**

Carbohydrates- Glucose, fructose, maltose/ lactose, sucrose, starch, dextrin.
Proteins – Albumin, gelatin, peptone.
Others - glycerol, cholesterol, bile salts and pigments, acetone, HCI, lactic acid, urea, uric acid blood.

- **Quantitative analysis:**

Preparation of buffer (pH 4 to 10)
Determination of strength of NaOH, HCl, and H_2SO_4 by titration against oxalic acid.
Quantitative estimation of chloride by Mohr's method, amino nitrogen by formol titration method.

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Major A3/B3:

Credits 04 (FM: 75)

Major-A3/B3T: Cardio-respiratory & Excretory Physiology (Theory): Credits 03 [45L]

❖ Cardiovascular and Respiratory Physiology-II:

Cardiovascular Physiology-II: Membrane potentials: Transmembrane potential, pacemaker potential, and cardiac tissue electrophysiology. Understanding of cardiac muscle as a mechanical, electrical, and functional syncytium. **Electrical and Contractile Activity of the Heart: Electrocardiography (ECG)-** Origin and significance of different components of normal ECG; Different types of ECG lead; Einthoven triangle. Principle of Echocardiography. Electrical behaviour of the myocardium .Blood flow through the heart: Coronary circulation and its importance. Coronary Flow in relation to the Cardiac Cycle**.** Anatomical organization, peculiarities, and significance of pulmonary, cerebral, cutaneous, hepatic, and renal circulation. Cardiac diseases: Myocardial Infarction and Angina Pectoris, Congestive Heart Failure, Coronary Atherosclerosis.

❖ Respiratory System:

Respiratory system-II: Comparison of respiration in different species, anatomical considerations. Lung volume and capacities: Tidal volume, inspiratory and expiratory reserve volumes, residual volume, vital capacity, functional residual capacity, and maximum breathing capacity. Measurement of respiration: Spirometer; Clinical significance. Partial pressures and percentage of respiratory gases in expired, expired, alveolar airs and in blood. Reasons, precautions and treatment of Infectious and inflammatory Disorders: Sinusitis, Tonsillitis, Diphtheria, Asbestosis, Bronchial carcinoma**,** Hay fever (allergic rhinitis), Pharyngitis, Laryngitis and tracheitis. Some disorders of the respiratory system: Adult Respiratory Distress Syndrome (AIDS), Chronic obstructive pulmonary disease (COPD), Smoking and Lung Cancer, Pneumonia, Sleep apnea, Tuberculosis (TB), Chronic bronchitis, Asthma, and Pleurisy. Diving physiology and decompression sickness.

❖ Excretory system:

Gross structure & functions of kidney: Microanatomical structure (including electron microscopy) and functions of a nephron and structural differences between cortical and Juxtamedullary nephrons. Juxtaglomerular apparatus. Non-excretory functions of the kidney.

Urine formation: Mechanism of urine formation, concept of ultrafiltration, glomerular filtration rate, reabsorption by passive and active tubular transport. Concept of the counter-current system, counter-current multiplier, exchanger, and mechanism of concentrated urine formation. Non-excretory functions of the kidney. Normal and abnormal constituents of urine and their clinical significance. Concept of renal threshold. Renal function tests (inulin, urea clearance tests). **Renal disease:** Renal stone formation, Polycystic Kidney Disease (PKD), Simple Kidney Cysts., Kidney Infection (Pyelonephritis), Kidney Stones. **Dialysis and artificial kidney**. Innervations of the urinary bladder and micturition, micturition reflexes, and its regulation by higher centers.

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Major-A3/B3P: Practical

Credits 01

- **Experimental Physiology:**

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

- **Biochemical Urine analysis:** Identification of normal and abnormal constituents of urine.

- **Human experiment:**

1. Study of pulse rate and breathing rate with the change of postures.
2. Determination of diurnal variations of pulse rate, blood pressure, and respiratory rate.
3. Study of blood pressure with the change of postures.
4. Study of pulse rate as an effect of breath-holding.
5. **ECG:** Measurement of different waves of ECG

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Major Elective (MJE)-01:

Credits 04 (FM: 75)

MJE-01T: Neuromuscular Physiology (Theory): Credits 03 [45L]

❖ Nerve-Muscle Physiology:

Muscle Structure and Functions: Histo-anatomical structures of striated, smooth, and cardiac muscles. **Properties of muscles:** Excitability and contractility, all or none law, summation of stimuli and contractions, genesis of tetanus, the onset of fatigue, refractory period, tonicity, conductivity, extensibility, and elasticity. Muscle proteins and Sarcotubular system of Human Skeletal and Cardiac Muscle. **Mechanism of muscle contraction:** Skeletal muscle contraction and relaxation. The modern concept of muscle contraction. Isometric and isotonic contractions. Red and white muscles. Fast and slow twitch muscle fibers. Muscle length, Tension, and Velocity relationships of skeletal muscle. **Muscle groups:** antagonists and agonists. Mechanical, chemical, thermal, and electrical changes in striated muscle during contraction and relaxation. Motor unit and motor point.

Structure, properties, and Function of Neuromuscular junctions: EM structure of Neuromuscular junctions, Neuro-Muscular transmission of impulse, end-plate potential (EPP), miniature end-plate potential (MEPP). Electromyography. Single and multi-unit smooth muscle and mechanism of smooth muscle contraction and relaxation. Factors affecting smooth muscle contraction. The resting membrane potential and its origin. **The Action Potential:** Action potential components and their ionic basis. Compound action potentials. Concept of Chronaxie and Rheobase. Saltatory conduction. Myelinated and Unmyelinated nerve fibers and process of Melanogenesis. **Nerve Impulse & its Conduction:** Propagation of nerve impulse in different nerve fibers. Conduction velocity of nerve impulse concerning myelination and diameter of nerve fibers & its significance. **Properties of nerve fibers:** Excitability, Conductivity, All-or-none law, Accommodation, Adaptation, Summation, Refractory period, Indefatigability. **Synapses:** Types, EM Structure and Functions. Mechanism of Synaptic Transmission, Neurotransmission related Synaptic Potentials (EPSP, IPSP). Structure and distribution of acetylcholine and adrenaline receptors**. Injury to peripheral nerves:** Degeneration and Regeneration of peripheral nerve fibers: Changes in the nerve cell body, degeneration reaction and regeneration mechanism. Effect of different Neurotrophins on nerve growth.

❖ Nervous System-I:

Anatomical and functional Organization: A brief outline of the organization and basic functions of the nervous system – central and peripheral. **Structure and functions of Brain:** Gross neuroanatomy of the brain, structural organization of the different parts of the brain. **Receptors:** Definition, Structure, Classification, Mode of action. Role of blockers and stimulators (Drugs included in pharmacology). **Reflex action**: Definition, classification, properties, reflex arc**. Cerebral cortex:** histological structure, connections, and functions. Organization of the limbic system and its functions.

MJE-01P: Experimental Physiology (Practical): Credits 01

Skeletal Muscle: Study and use of kymograph, induction coils, key and tuning fork in Gastrocnemius sciatic preparation. Kymographic recording of isotonic simple muscle twitch. Effects of temperature, summation, and load (after-load) on muscle contraction.

Heart: Kymographic recording of the heartbeat of the toad. Preparation of amphibian Ringer solution. Kymographic recording of the perfused heartbeat of a toad. Study of the effects of acetylcholine and excess calcium ion on perfused heart (Demonstrations).

Test for supplied CSF: Globulin (Pandy test), total protein, glucose **(Demonstration).**

Reflex analysis: Examination of planter reflex, knee jerk reflex.

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Minor (MI)-03/C3

Credits 04 (FM: 75)

Minor-MI-03/C3T: Cell Biology and Cardiovascular and nerve-muscle physiology, excretory system along with Metabolism (Theory) **Credits 03 [45L]**

- **Cell Biology and Cell Communication:** Cytoskeleton: structure and its role in stabilization of cell shape. Microtubules and their role in cellular movements and secretions. Events of Cell cycle; Cell differentiation; Gap junction, Tight junction (structure and functions); Cell adhesion molecule.

- **Cardio-respiratory Physiology: Cardiac anatomy and structure:** Comparative anatomy of heart structure, myogenic heart, specialized tissue. Basic properties of cardiac muscle: rhythmicity, refractory period, all or none law, and staircase phenomenon. **Membrane potentials:** Transmembrane potential, pacemaker potential, and cardiac tissue electrophysiology. Specialized junctional tissue of the heart and origin and propagation of cardiac impulse. **Blood pressure:** Definition, normal values and factors regulating it, systolic, diastolic, mean arterial and pulse pressure. Measurement of blood pressure by sphygmomanometer - principle, method. **Electrocardiography (ECG):** Origin and significance of different components of normal ECG; Different types of ECG lead; Einthoven triangle.
Structure and anatomy of the respiratory system: Basic concepts about the respiratory tract, basic anatomy histology of lungs, respiratory muscles, and their innervations. **Mechanism and Mechanics of Respiration**: Role of different respiratory bones and accessory muscles. Lung compliance, elasticity and elastic recoil of the lung.

- **Nerve-Muscle Physiology & Nervous system: Muscle structure and Functions:** Histo-anatomical structures of striated, smooth, and cardiac muscles. **Properties of muscles:** Excitability and contractility, all or none law, summation of stimuli and contractions, the genesis of tetanus, the onset of fatigue, refractory period, tonicity, conductivity, extensibility, and elasticity. **The Action Potential:** Action potential components and their ionic basis. Compound action potentials. **Nerve Impulse & its Conduction:** Propagation of nerve impulse in different nerve fibers. Conduction velocity of nerve impulse concerning myelination and diameter of nerve fibers. **Properties of nerve fibers:** Excitability, Conductivity, All-or-none law, Accommodation, Adaptation, Summation, Refractory period, Indefatigability. **Synapses:** Types and EM Structure Function. Mechanism of Synaptic Transmission of the Impulse. IPSP & EPSP

- **Renal System: Gross structure & functions of kidney**: Microanatomical structure (including electron microscopy) and functions of a nephron and structural differences between cortical and Juxtamedullary nephrons. Juxtaglomerular apparatus. Non-excretory functions of the kidney. **Urine formation:** Mechanism of urine formation, concept of ultrafiltration, glomerular filtration rate, reabsorption by passive and active tubular transport. Concept of counter-current system, counter-current multiplier, exchanger, and mechanism of concentrated urine formation.

- **Basic concept of the digestive system and metabolism:** Brief idea about the anatomy and histology of the digestive system and organs (Stomach, Pancreas, Liver, Large and Small intestine). Digestion and absorption mechanism of carbohydrates, lipids, proteins, and nucleoproteins.

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Minor (MI)-03/C3P: Practical

Credits 01

Skeletal Muscle: Study and use of kymograph, induction coils, key, and tuning fork in Gastrocnemius sciatic preparation. Kymographic recording of isotonic simple muscle twitch. Effects of load (after-load) on skeletal muscle contraction. Demonstrations of effects of temperature, summation on skeletal muscle contraction **(Optional).**

Smooth Muscle: Preparation of physiological solutions like Dale's fluid, Normal saline etc. Experiments on the isolated intestine of the rat: Normal movement of the isolated intestine, b) Effect of hypoxia, c) Effect of drugs like substances i) Acetylcholine ii) Adrenaline.

Cardiac Muscle: Kymographic recording of the perfused heartbeat of a toad. Preparation of amphibian Ringer solution. Study of the effects of acetylcholine and excess calcium ion on perfused heart (**Demonstrations**).

Urine analysis: Identification of normal and abnormal constituents of urine.

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Minor (MI)-04/ C4

Credits 04 (FM: 75)

❖ Minor (MI)-04/C4T: Endocrine system and Reproduction (Theory): Credits 03 [45L]

Endocrinology:

Concept & definition of endocrine systems, glands, and hormones. General classification of hormones on a chemical basis. **Hormone actions:** Mechanisms and Modern Concept of hormone actions, G-protein, Cyclic AMP, cyclic GMP, IP3-DAG, Ca2+, **Hypothalamo-hypophysial axis:** Positive and negative Feedback regulation; **Hypothalamus and Pituitary:** Hypothalamus as a neuroendocrine organ, Releasing Factors, Tropic hormones of hypothalamus. **Hormones:** Chemistry, modes of action, and functions of growth hormone (GH), TSH, ACTH, FSH, LH, Prolactin, MSH, Vasopressin, and Oxytocin. Endocrine gland: Pancreas, Adrenal, Thyroid structure, functions, and deficiencies.

Reproductive Physiology:

Primary and secondary sex organs: Physiology and anatomy, secondary sex characters. Puberty and its control. **Testis:** Histological structure of testis, seminiferous tubules, and interstitial cells of Leydig. **Spermatogenesis:** Mechanism of spermatogenesis, Spermiogenesis and hormonal control of testicular function. Prostate and seminal vesicle. **Ovary:** Histological structure of ovary, Graafian follicle, and Corpus luteum, chemical nature and functions of Estrogen and Progesterone. **Menstrual cycles**: Basic concept of menstruation and its hormonal control. **Fertilization:** Hormonal control Fertilization Transport of ovum and sperm in the female reproductive tract. Uterine implantation of fertilized ovum. **Pregnancy:** Physiology of pregnancy, changes during pregnancy and their hormonal control; Pregnancy tests (Immunological); Ectopic pregnancy. **Placenta:** Formation, structure, functions, and fate of the placenta. Placental hormones. **Lactation and Mammary Gland:** Anatomical and histological structure of mammary gland. Phases of mammary development, lactation, and their hormonal control. **Contraceptive:** Definition, types, and use of contraceptives.

Minor (MI)-04/ C4P: Practical Credits 01

Biochemistry:

- **Qualitative analysis of biochemical molecules:**

Carbohydrates- Glucose, fructose, maltose/ lactose, sucrose, starch, dextrin.
Proteins – Albumin, gelatin, peptone.

- **Bio-Chemical Techniques:**
  - Blood calcium and blood lactate estimation.
  - Estimation of triglyceride content of blood.

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Skill Enhancement Course (SEC-3)

Credits 03 (FM: 50)- Practical

- **Occupational Health:**

Occupational health: Basic Concept- The occupational medical history, worker's compensations, disability prevention and management. Occupational health risk. **Occupational Injury:** Musculoskeletal injury, peripheral nervous injury, eye injuries, facial injuries, hearing loss, injury caused by physical hazards, Ergonomics and the prevention of occupational injuries. **Occupational exposures:** Metals, chemicals, solvents, gasses & airborne toxicants, pesticides. **Occupational illness:** Brief idea on: Clinical toxicology & immunology, cardiovascular toxicology, liver, renal & neurotoxicology. Occupational hematology, infection, skin disorders & lung disease. Reproductive toxicology**. Occupational Diseases:** Human diseases associated with occupational exposure. Brief idea on pneumoconiosis, asbestosis, silicosis, farmer's lung and work-related musculoskeletal disorders. **Program management:** Occupational stress, substance abuse & employee assistance programs. Occupational safety, industrial hygiene, biological monitoring. Prevention of accidents. Concept of industrial safety.

Practical:

- Measurement of working heart rate by ten beats methods.
- Determination of cardiac cost of specific work.
- Measurement of blood pressure before and after different grades of exercise.
- Measurement of some common anthropometric parameters. Calculation of BSA and BMI from anthropometric data.
- Measurement of WBGT indices.
- Measurement of noise level by noise level meter.
- Assessment of illumination.
- Determination of strength by hand grip dynamometer.

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