Learning Outcome based Curriculum Framework (LOCF)

For

Choice Based Credit System (CBCS)

Syllabus

B.Sc. (Honours and GE) in Physiology

w.e.f. Academic Session 2020-21

KaziNazrul University

Asansol, Paschim Bardhaman

West Bengal 713340

PREAMBLE ACCORDING TO UGC LOCF

SEMESTER-I
Course Name: Cell Biology and Biophysics
Course Code: BSCHPHYC101

Course Type: **Core (Theory)**	Course Details: **CC-1**			L-T-P: **5-1-0**	
Credit: 6	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		…	**10**	**…**	**40**

Learning outcomes

1. *Students will understand the structures and purposes of basic components prokaryotic and eukaryotic cells will especially macromolecules membrane and organelle student will understands how this cellular components are used to generate and utilized energy in cells.*
2. *Students will understand the cellular components underline mitotic cell division. Students will apply their knowledge of cell biology to selected example of changes or loses in cell function.*
3. *This can include responses to environment or physiological changes or alteration of cell function brought about by mutation and also can acquire knowledge through cell apoptosis.*
4. *Enzymes are bio-catalyst which are highly specific and help to accelerate reactions taking place in organisms.*
5. *After interacting with this the students will be able to:*
   a. *Describe enzymes and their components*
   b. *Recall energetic enzymatic reactions*
   c. *List out models for enzyme substrate binding*
   d. *The students will acquire knowledge of kinetics of enzymatic reaction and enzyme inhibition.*
6. *The student will be able to demonstrate a through comprehension of core concept of bio physics including osmosis, diffusion, plasmolysis, Donnan membrane equilibrium. Therefore the behaviors of biological systems can be predicted from physical principle.*

Theory

Cell Biology and Genetics:

1. Electron microscopic structure and functions of eukaryotic nucleus, endoplasmic reticulum, ribosome, Golgi bodies, mitochondria, lysosomes, peroxisomes, cytoskeletal elements, centrosomes and plasma membrane.
2. Ion pores, ion pumps, ion channels, ionophores, passive transport – facilitated diffusion, uniport, symport, antiport. Active transport, artificial membrane –liposome and erythrocyte ghost.
3. Basic idea of tight junctions, gap junctions and cell adhesion molecules

4. Chromosome structure – morphology. Chromosomal DNA packaging – nucleosomes and higher levels of organization of chromatin. Euchromatin and heterochromatin. Human genome and its characteristics.
5. Nuclear and mitochondrial DNA.
6. Cell cycle – events and regulatory role of cyclin.
7. Elementary idea of apoptosis

Biophysical principles:

1. Diffusion, surface tension and viscosity -- characteristics, factors influencing and biological applications.
2. Osmosis: osmotic pressure – laws, determination – freezing point depression method and biological applications.
3. Protolysis of water, pH, acid-base neutralization curves, Buffer action: Henderson-Hasselbalch equation. Regulation of pH by blood buffers. Determination of pH –indicators, principle of pH meter- hydrogen electrode and glass electrode.
4. Colloids: Classification, properties – optical, electrical, electrokinetic. Biological importance of colloids. Dialysis and ultrafiltration.
5. Gibbs-Donnan membrane equilibrium , Nernst equation.
6. Thermodynamics: Type of surroundings and systems. First Law– internal energy, enthalpy. Second Law – Entropy, Free energy change, Endergonic and Exergonic reactions, Reversible and Irreversible processes, Equilibrium constant. Physiological steady-state, Living body as a thermodynamic system

Enzymes:

1. Classification- EC nomenclature, apoenzyme, holoenzyme, coenzyme, cofactors and prosthetic group.
2. Mechanism of enzyme action: Activation energy, Enzyme-substrate complex, Transition state and Products. Models of enzyme-substrate interactions.
3. Specificity of enzymes. Concept of initial rate, maximum velocity and steady-state kinetics. Michaelis constant, Michaelis-Menten equation, Graphical representation of hyperbolic kinetics-- Lineweaver-Burk plot. Significance of Km and Vmax.
4. Factors influencing enzyme-catalyzed reactions: substrate concentration, enzyme concentration, pH, temperature.
5. Competitive, non- competitive and uncompetitive inhibitions. Regulation of enzyme activities -- covalent modifications, allosteric modifications – Sigmoid kinetics and Hill equation: K- and M-series, Feedbackinhibition.
6. Rate-limiting enzymes. Isozymes, Ribozymes and Abzymes

Recommended readings

1. Harper's Illustrated Biochemistry, by R.K.Murray&others.Lange Medical Book, International Edition, McGraw Hill.

2. Lehninger's Principles of Biochemistry. By D.L.Nelson and M.M. Cox, Worth Publishers Inc.

3. Text Book of Biochemistry, by E.S. West ;W.R.Todd.; H.S.Mason; J.T.VanBruggen. The Macmillan Company.

4. Biochemistry. byD.Das. Academic Publishers. 8. Biophysics and Biophysical Chemistry, by D.Das. Academic Publishers.

5. Biomedical Instrumentation & Measurements, by L. Cromwell, F.J.Weibell&E.A.Pfeiffer; Prentice-Hall of India Pvt Ltd.

6. Biochemistry, by L. Stryer, W.H. Freeman and Co. 23. Text Book of Physiology by G.H.Bell: J.N.Davidson and H.Scarborougl. ELBS.

7. Biophysics and Biophysical Chemistry, by D.Das. Academic Publishers

8. Molecular Biology of the Gene, by J.D.Watson; H.H.Nancy& others; Benjamin-Cummings.

9. Molecular Biology of the Cell, by B. Alberts and others,Garland.

10. Neurobiology, by G.M. Shepherd. Oxford University Press

11. Molecular Cell Biology, by H. Lodish; D. Baltimore & Others. Scientific American Book.

12. Genetics: Analysis of Genes and Genomes, by D.L. Harlt and E.W. Jones &Burtlett Publishers.

SEMESTER-I
Course Name: Biochemistry
Course Code: BSCHPHYC102

Course Type: **Core (Theory+Practical)**	Course Details: **CC-2**			L-T-P: **4-0-2**	
Credit: **4+2**	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Learning outcome

After the completion of course, the students will have ability to:

1. *Understand the principles of various fields of biochemistry and genetics.*
2. *Develop transferable quantities skill apply modern instrumentation theory and practice to biochemical problem.*
3. *The student will be able to correlate the various metabolites of carbohydrate, protein and fat.*
4. *The learning outcomes are designed to help learners understands the objectives of studying B.Sc Honours physiology.*
5. *That is to analyze appreciate and understand the basic concepts of chemical reaction that occurs in living systems which enable then to understand the various perspectives of applied sciences that benefit the mankind.*

Course content*:*

Theory

Biochemistry of Carbohydrates and lipids

1. *Monosaccharides*– classification, structure, stereoisomerism, epimerism. Cyclic structures- pyranose and furanose forms, anomerism, optical activity, mutarotation and its mechanism. Chemical reactions of monosaccharides (glucose & fructose) - Reactions with concentrated mineral acids, alkali, phenylhydrazine and their biochemical importance. Derivatives of monosaccharides - amino sugars, deoxysugars, sugar alcohols, sugar acids, sugar esters, their biochemical and physiological importance.
2. *Disaccharides* –Maltose, Lactose and Sucrose: Structure, Occurrence and Physiological importance.
3. *Polysaccharides* – structure occurrence, and physiological importance of Starch, Glycogen, Dextrin, Cellulose, Glycosaminoglycans, Glycoproteins, Sialic acids, Lectins, Blood group polysaccharides.
4. Lipids: classification. Fatty acids - classification, systemic nomenclature andstructure. Mono- , Di- and
5. Triglycerides. Properties of Fat and Fatty acids Hydrolysis, Saponification, Saponification number, Iodine number, Acetylation - Acetyl number. Hydrogenation, Rancidity-Acid number, Reichert-Meissl number. *Cis-trans* isomerism. Eicosanoids, Phospholipids, Glycolipids, Sphingolipids, Cholesterol and its ester - their structure and physiological importance. Lipoproteins - Structure and classification.

Biochemistry of Amino acids, proteins and nucleic acids:

1. Classification, Structure, Nomenclature and
2. Optical properties. Protonic equilibria of amino acids – Zwitterions, Isoelectric point, titration curve of amino acids. Reactions with ninhydrin and formaldehyde. Peptides and Proteins: Structure and properties of peptide bonds--Phi and Psi angles. Reactions with Sanger's and Edman's reagent. Biuret reaction. Different levels of protein structure -- Primary, Secondary (α-helix and β-pleated sheet), Tertiary and Quarternary. Forces stabilizing the structures. Denaturation and Renaturation. Purine and Pyrimidine: Structure, nomenclature and tautomerism.

Nucleic acids:

1. Nucleosides and Nucleotides-structure. Polynucleotides. DNA double helix-Primary,
2. Secondary and Tertiary structure. A-DNA, B-DNA and Z-DNA. RNA - Structure and types. Denaturation and annealing of DNA. Hyperchromicity, melting temperature and half Cot value.

Practical

Biochemistry Practical

a. Qualitative analysis of biochemical molecules: Carbohydrates- Glucose, fructose, maltose/ lactose, sucrose, starch, dextrin. Protein -Albumin, gelatin, peptone; others - glycerol, bile salts, acetone, HCI, lactic acid, urea

b. Quantitative analysis of biochemical molecules (percentage and total quantity): Carbohydrates- Glucose, lactose. Protein – Amino Nitrogen.

Recommended readings

1. Harper's Illustrated Biochemistry, by R. K. Murray & others. Lange Medical Book, International Edition, McGraw Hill.

2. Lehninger's Principles of Biochemistry. By D.L.Nelson and M.M. Cox, Worth Publishers Inc.

3. Text Book of Biochemistry, by E.S. West ;W.R.Todd.; H.S.Mason; J.T.VanBruggen. The Macmillan Company.

4. Biochemistry. By D.Das. Academic Publishers.

5. Biomedical Instrumentation & Measurements, by L. Cromwell, F.J.Weibell&E.A.Pfeiffer; Prentice-Hall of India Pvt Ltd.

6. Biochemistry, by L. Stryer, W.H. Freeman and Co. 23. Text Book of Physiology by G.H.Bell: J.N.Davidson and H.Scarborougl. ELBS.

7. Practical Biochemistry in Medicine by SrinivasRao., Academic Publishers.

8. Note Books on Practical Biochemistry. (Published by the Physiological Society of India, Kolkata.)

9. Text Book of Biochemistry, by E.S. West ;W.R.Todd.; H.S.Mason; J.T.VanBruggen. The Macmillan Company.

10. Biophysics and Biophysical Chemistry, by D.Das. Academic Publishers.

Semester- I

Course Name: Blood and Immunology

Course Code: BSCHPHYGE101

Course Type: **GE (Theoretical &Practical)**	Course Details: **GEC-1**			L-T-P: 4 **- 0 – 2**	
Credit: 4+2	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Describe the various constituents of blood, hematopoiesis, function and maturation of red cells, white cells and platelets, blood types,transfusion, tissue and organ transplantation.*
2. *Describe endothelial function, blood coagulation and discuss the most common abnormalities and complications relating to endothelial dysfunction and failure of hemostasis*
3. *Discuss the general characteristics of leukocytes (neutrophils and macrophages) and their roles in defending the host against infection, including the monocyte-macrophage system and inflammation*

Course Content:

Theory

Blood and Immune system in health and diseases

1. Blood – Composition and functions, blood cell formation and related disorders, Blood groups , Blood transfusionand its hazards, Blood clotting and its disorders, Normal and abnormal hemoglobins.
2. Immunity- innate and acquired, Antigens , antibody –structure, classification and functions , Cytokines, phagocytosis, ,Cytotoxicity, Allergy, Inflammation , Autoimmune diseases – Arthritis , Graves disease, Myasthenia Graves, Hashimoto's disease. Vaccines, toxoids, HIV

Practical

Biochemistry

1. Qualitative Experiments: Qualitative tests for identification of starch, dextrin, lactose, sucrose, glucose, fructose, albumin, gelatin, peptone, lactic acid, hydrochloric acid, acetone, glycerol, bile salts, urea.
2. Quantitative Experiments: Quantitative estimation of glucose by Benedict's method. Quantitative estimation of amino-nitrogen by Sorensen's formol titration method. (Percentage and total quantity to be done).

References/ Suggested Readings

1. *Essential Food and Nutrition, by M. Swaminathan. The Bangalore Printing & Publishing Co. Ltd.*
2. *Park's Text Book of Preventive and Social Medicine by K.Park, M/s. Banarsidas Bhanot Publishers.*
3. *Concise Medical Physiology by S.K.Chaudhury; New Central Book Agency.*
4. *Medical Physiology by A.B. Mahapatra, Current Books International.*

Semester- II

Course Name: Blood and Cardiovascular System

Course Code: BSCHPHYC201

<table>
<tr><td rowspan="2">Course Type:
Core (Theory+Practical)</td><td colspan="2" rowspan="2">Course Details: CC- 3</td><td colspan="2" rowspan="2">L-T-P: 4–0 -2</td></tr>
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<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>10</td><td>20</td><td>40</td></tr>
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Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Identify and describe the interior and exterior parts of the human heart*
2. *Describe the path of blood through the cardiac circuits*
3. *Describe the size, shape, and location of the heart*
4. *Compare cardiac muscle to skeletal and smooth muscle*
5. *Explain the cardiac conduction system*
6. *Describe the process and purpose of an electrocardiogram*
7. *Explain the cardiac cycle*
8. *Calculate cardiac output*
9. *Describe the effects of exercise on cardiac output and heart rate*
10. *Name the centers of the brain that control heart rate and describe their function*
11. *Identify other factors affecting heart rate*
12. *Describe the various constituents of blood, hematopoiesis, function and maturation of red cells, white cells and platelets, blood types, transfusion, tissue and organ transplantation.*
13. *Describe endothelial function, blood coagulation and discuss the most common abnormalities and complications relating to endothelial dysfunction and failure of hemostasis*
14. *Discuss the general characteristics of leukocytes (neutrophils and macrophages) and their roles in defending the host against infection, including the monocyte-macrophage system and inflammation*
15. *Explain the relationship between the structure and function of the arteries, veins and capillaries.*
16. *Explain and classify common cardiovascular conditions.*
17. *Analyze factors leading to hypertension, as well as approaches useful in preventing and treating the condition*

Course Content*:*

Theory

Blood :

1. Formed elements of blood–origin, formation, functions and fate. Plasma proteins–origin and functions.
2. Haemoglobin – Structure, compounds and derivatives, biosynthesis and catabolism. Foetal hemoglobin.

3. Haemoglobinopathies- Thalassemia ,Sickle-cell anemia. Anemia-different types and their causes.
4. Blood volume –regulation and determination by dye and radioisotope methods.
5. Hemostasis – factors, mechanism, anti-clotting mechanism, anticoagulants, procoagulants. Disorders of hemostasis-Haemophilia, Thrombosis and Embolism.
6. Blood types – ABO and Rh systems, H- antigen. Erythroblastosis foetalis and Rh antigens. Bombay type blood group,
7. Blood transfusion and its hazards. Red cell fragility

Cardiovascular System – I :

1. Histology of Heart- Nodal tissues, ventricles and valves.
2. Properties of cardiac muscle.
3. Origin and propagation of cardiac impulse-action potential in nodal and ventricular muscles.
4. The cardiac cycle- events, pressure and volume changes. Heart sounds. Murmurs. Cardiac output – measurement by application of Fick's principle and dye dilution method, factors affecting. Starling's law of heart.
5. Electrocardiography – the normal electrocardiogram, electrocardiographic leads, vectorial analysis, the vector cardiogram, the mean electrical axis of heart. The His bundle electrogram.
6. Principles of Echocardiography. Cardiac Arrhythmias. Myocardial Infarction.

Cardiovascular System – II :

1. Functional morphology of arteries, arterioles, capillaries, venules and veins, sinusoids.
2. General pattern of circulation and significance of branching of blood vessels. The pulse – arterial and venous.
3. Hemodynamics of blood flow.
4. Blood pressure– its measurement and factors affecting.
5. Cardiovascular homeostasis – neural and chemical control of cardiac functionsand blood vessels. Cardiac and vasomotor centers, baroreceptors and chemoreceptors, innervation of the heartandblood vessels, cardiac and vasomotor reflexes. Cardiovascular adjustment after haemorrhage.

Practical

Hematology:

Hematological experiments : Preparation and staining of blood film with Leishman's stain. Identification of blood corpuscles. Differential count of WBC. Total count of RBC and WBC. Haemoglobin estimation. Preparation of haemin crystals. Preparation and staining of bone marrow smear. Measurement of diameter of megakaryocyte. Reticulocyte staining. Blood group determination. Demonstration: Haematocrit, MCV, MCH and MCHC. Bleeding time, Clotting time, ESR.

References/ Suggested Readings:

1. *Barman, S (23rd Edition): Ganong's Review of Medical Physiology, McGraw Hill Lange.*
2. *Guyton and Hall (11th Edition): Textbook of Medical Physiology, Elsevier Saunders.*
3. *Akhter, A S (2011) The heart and pericardium, Elsevier.*

Semester- II

Course Name: Respiration and Circulation

Course Code: BSCHPHYC202

Course Type: **Core (Theory+Practical)**	Course Details: **CC-4**			L-T-P: 4**- 0 –2**	
Credit: 4+2	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Describe and illustrate the main anatomical structures of the respiratory system and the mechanics of inspiration and expiration*
2. *List the major functions of the respiratory system*
3. *Outline the forces that allow for air movement into and out of the lungs*
4. *Outline the process of gas exchange*
5. *Discuss the factors that affect pulmonary ventilation*
6. *Outline the mechanisms of O2 and CO2 transport in the blood*
7. *Describe diseases resulting from mutations in haemoglobin*
8. *Demonstrate an understanding of the control of the respiration rate.*
9. *Create a flowchart illustrating how respiration is controlled*
10. *Discuss how the respiratory system responds to exercise*
11. *Explain the importance of water in the body*
12. *Contrast the composition of the intracellular fluid with that of the extracellular fluid*
13. *Explain the importance of protein channels in the movement of solutes*
14. *Identify the causes and symptoms of edema*
15. *Explain how water and solutes traverse the capillary wall. Use Fick's equation for diffusion to identify the factors that will affect the diffusion mediated delivery of nutrients from the capillaries to the tissues. Define and give examples of diffusion-limited and flow-limited exchange.*
16. *Describe the phasic flow of blood to the ventricular myocardium through an entire cardiac cycle.*
17. *Contrast the local and neural control of cerebral blood flow. Discuss the relative importance of O2, CO2, and pH in regulating cerebral blood flow.*
18. *Describe the structural components of the blood brain barrier and how this barrier impedes the movement of gases, proteins, and lipids from the blood to neurons. Identify the differences in cerebrospinal fluid and plasma relative to protein concentration, and describe the function of cerebrospinal fluid.*
19. *Contrast the local and neural control of the splanchnic circulation. Describe the role of the hepatic portal system and the hepatic artery in providing flow and oxygen to the liver. CV 122: Describe the blood pressure in the hepatic portal vein, hepatic sinusoids, and the vena cava.*
20. *Contrast local and neural control of cutaneous blood flow.*
21. *Discuss the unique characteristics of skin blood flow that are adaptive for body temperature regulation.*

CourseContent

Theory

Respiration

1. Anatomy and histology of the lung and airways.
2. Mechanics of breathing -- role of respiratory muscles, glottis. Lungvolumes and capacities.
3. Compliance of lungs and chest wall, pressure-volume relationship, alveolar surface tension andsurfactant, work of breathing.
4. Ventilation- perfusion ratio. Dead space and uneven ventilation. Spirometry.
5. Transport ofgases in body - Partial pressure and composition of normal atmospheric gases in inspired, expired, alveolar air and blood-Oxygen dissociation curve of haemoglobin and myoglobin – factors affecting. Carbon dioxide dissociation curve.
6. Regulation of respiration -- neural and chemical, respiratory centres, chemoreceptors, baroreceptors, pulmonary receptors.
7. Hypoxia – types, effects. Asphyxia, Voluntary hyperpnoea, Apnoea, Cyanosis, Periodic breathing, Asthma, Emphysema.
8. Lung function tests. Artificial respiration. Concept of non-respiratory functions of lung.

Body Fluids and Regional Circulation

1. Lymph and tissue fluids – formation, circulation, functions and fate. Lymphatic organs-Histological structures andfunctions of lymph gland and spleen.
2. Regional circulations – cerebral, coronary, pulmonary and hepatic, skeletal muscle [1.5 Credit] (18 Lectures)

Practical

Human Experiments:

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

b) Spirometric measurement of vital capacity.

c) Measurement of some common anthropometric parameters- stature, weight, eye height, shoulder height, eye height (sitting), elbow height, sitting height, elbow rest height (sitting), knee height (sitting), shoulder elbow length, arm reach from wall, elbow-to-elbow breadth, knee-to-knee breadth (sitting), shoulder breadth, head length, head breadth, head circumference and neck circumference, mid-arm circumference, waist circumference, hip circumference, chest circumference.[2 Credits]

References/ Suggested Readings

1. *Barman, S (23rd Edition): Ganong's Review of Medical Physiology, McGraw Hill Lange.*
2. *Guyton and Hall (11th Edition): Textbook of Medical Physiology, Elsevier Saunders.*
3. *Human Physiology, by R.F.Schmidt& G. Thews, Springer-Verlag.*
4. *Physiology of Respiration by J.H.Comroe. Year Book Medical Publishers.*

Semester- II

Course Name: Community Health

Course Code: BSCHPHYGE201

Course Type: **GE (Theoretical &Practical)**	Course Details: **GEC-2**			L-T-P: 4 **- 0 - 2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Understand and appreciate the diverse socioeconomic, behavioural, sociocultural, biological, environmental, philosophical, and historical factors that influence health, rehabilitation, and human movement*
2. *Comprehend the significant theories, models, themes, and ideas in the biomechanical, physiological, behavioral, pedagogical, biological, socioeconomic, environmental, and sociocultural correlations of Kinesiology and Community Health.*
3. *Comprehend and demonstrate ethical practices and the application of scientific findings and/or critical analysis in order to interpret new ideas related to health, rehabilitation, and/or human movement.*
4. *Apply best practices in developing, implementing, assessing, and evaluating programs and interventions related to health promotion, physical activity adoption and adherence, and the prevention and treatment of diseases.*

Course Content:

Theory

1. **Community health and Nutrition -** Definition & concept of health and diseases, dimension of health, health system, Diseases: causation andprevention of diseases, mode of intervention, epidemic and endemic forms of diseases, physiologists as health-counselors.
2. **Nutrition in infancy:** Nutritional requirements of nutrients during infancy. Breast feeding – nutritional and othersfactors, advantages, problems in breast feeding, infant milk substitute (IMS) act 1992. Formula feeding, Vitaminand mineral supplementation – vit –D, Iron, Fluoride, Supplementary foods of milk, cow's milk, goat's milk,vegetarian beverages, fruit juice. Nursing caves; solid supplements wearing, Nutritional requirement of pre-termbabies; Feeding problems – food allergies, cow's milk protein allergy, lactose intolerance, diarrhea, constipations, vegetarianism
3. **Nutrition in childhood and adolescence:** Nutritional requirement of pre-school and school children, monitoringgrowth and development. Nutrition related problems of children- childhood obesity, dental caries, allergies,deficiency of Vitamin A- Etiology, symptoms, prevention. Nutritional requirement and problem of adolescents-Anorexia nervosa, Bulbnia nervosa, Binge eating disorder, premenstrual syndrome.
4. **Nutrition in pregnancy:** maternal factors effecting pregnancy outcome: maternal age, pre-pregnant weight, weightgain during pregnancy, life style factors. Birth weight standards,Low birth weight baby. Nutritional requirementsduring pregnancy. Problems in pregnancy- morning sickness, nausea and vomiting, constipation, edema and leg-cramps, Heart burn, excessive weight gain. Complication- anaemia, toxaemia, Diabetes mellitus

5. **Nutrition in lactating women:** Nutritional requirements, Factors affecting the volume and concentration of breastmilk
6. **Protein energy malnutrition**:- PEM- symptoms, nutritional requirement in dietary management.
7. **Nutritional anemia**:-Prevalence, Iron metabolism, Iron absorption enhancers and inhibitors, Clinical features &management of Iron deficiency anemia, Megaloblastic anemia.
8. **Cardiovascular disorders**-Coronary heart disease (CHD): food and nutrients in CHD. Cardiovascular risk factorsand nutritional management of CHD
9. **Diabetes mellitus**-Dietary management of Diabetes mellitus – nutritionalrequirements, glycaemia index, Complication of diabetes – hypoglycaemia and insulin shock.
10. **Nutrition and aging:** Process of aging, changes in organ function with aging, nutritional requirement, nutritionrelated problems in old age- osteoporosis, anaemia, obesity, constipation, malnutrition. Antioxidants in the health of old age
11. **Overweight and obesity:-**prevalence, factors – environmental and life style factor, food intake, Genetic factors.Obesity management.

Practical

Haematological Experiments:

1. Preparation and staining of blood film with Leishman's stain.
2. Identification of blood corpuscles.
3. Differential count of WBC.
4. Total count of RBC and WBC.
5. Haemoglobin estimation.
6. Preparation of haemin crystals.
7. Blood group determination.

References/ Suggested Readings

1. *Essential Food and Nutrition, by M. Swaminathan. The Bangalore Printing & Publishing Co. Ltd.*
2. *Park's Text Book of Preventive and Social Medicine by K.Park, M/s. Banarsidas Bhanot Publishers.*
3. *Concise Medical Physiology by S.K.Chaudhury; New Central Book Agency.*
4. *Medical Physiology by A.B. Mahapatra, Current Books International.*

Semester- III

Course Name: Muscle, Renal Physiology and Skin

Course Code: BSCHPHYC301

Course Type: **Core (Theoretical+ Practical)**	Course Details: **CC- 5**			L-T-P: 4**–0 - 2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Describe the anatomy of structures in posterior abdominal wall in relation to kidneys, ureter, blood supply and venous drainage of kidneys*
2. *Describe the structure, functions and regulations of nephrons and tubules*
3. *Describe the mechanism of formation and constituents of urine*
4. *Describe the acid base balance and its regulation by the kidneys and lungs*
5. *Be able to list at least 4 important inorganic ions the concentrations of which the kidneys help regulate.*
6. *Be able to name at least 3 important organic wastes that are eliminated by the kidneys.*
7. *Be able to name at least 2 hormones normally produced by the kidney*
8. *Understand the concept of renal clearance and be able to perform clearance calculations and to interpret the results.*
9. *Know how inulin can be used to measure GFR and be able to perform the calculations involved in this measurement.*
10. *Know what the filtration fraction is and its typical range of values, be able to calculate the filtered load.*
11. *Know what is meant by the terms: tubular transport maximum (Tm), plasma threshold and splay.*
12. *Be able to explain the mechanisms by which the kidneys regulated the volume and composition of the extracellular fluid, the causes of ADH (vasopressin), aldosterone, renin-angiotensin and atrial natriuretic hormone release.*
13. *Be able to describe the systemic effects of ADH (vasopressin), aldosterone, renin-angiotensin and atrial natriuretic hormone release, the specific sites of ADH (vasopressin), aldosterone, renin-angiotensin and atrial natriuretic hormone release. Effects of sympathetic activity on renal function.*
14. *Explain the overall transmembrane signaling steps whereby increases in cytosolic calcium initiate crossbridge cycling.*
15. *Identify the multiple sources, localization, and roles of calcium in muscle contraction and relaxation.*

16. *Draw a myosin molecule and label the subunits (heavy chains, light chains) and describe the function of the subunits. Diagram the structure of the thick and thin myofilaments and label the constituent proteins.*
17. *Diagram the chemical and mechanical steps in the cross-bridge cycle, and explain how the cross-bridge cycle results in shortening of the muscle.*
18. *Explain the relationship of preload, afterload and total load in the time course of an isotonic contraction. Distinguish between an isometric and isotonic contraction.*
19. *List the steps in excitation-contraction coupling in skeletal muscle, and describe the roles of the sarcolemma, transverse tubules, sarcoplasmic reticulum, thin filaments, and calcium ions.*
20. *List in sequence the steps involved in neuromuscular transmission in skeletal muscle and point out the location of each step on a diagram of the neuromuscular junction.*
21. *Distinguish between an endplate potential and an action potential in skeletal muscle.*
22. *List the possible sites for blocking neuromuscular transmission in skeletal muscle and provide an example of an agent that could cause blockage at each site.*
23. *Describe the differences in actomyosin regulation of, respectively, smooth and skeletal muscle and indicate the structural similarities in their respective contractile units. Explain why smooth muscles can develop and maintain force with a much lower rate of ATP hydrolysis than skeletal muscle.*
24. *Distinguish between muscle relaxation from the contracted state and the phenomenon of stress relaxation and give examples of each process.*
25. *Diagram the relationship between the timing of the action potential and a twitch in cardiac muscle and explain why this prevents tetanic contraction. Diagram the steps in the excitation-contraction coupling mechanism in cardiac muscle and compare with skeletal muscle including different mechanisms for sarcoplasmic reticulum calcium release.*
26. *On the length versus force diagram show how an increase in contractility changes the relationship between afterload and amount of shortening. Describe the mechanisms through which inotropic interventions change cardiac contractility. Describe the physiological consequences of the low-resistance, gap junction pathways between cardiac muscle cells.*
27. *Acquire an advanced knowledge related to the complex skin structure (epidermis, dermis, hypodermis) and skin appendages.*
28. *Discover and understand the multiple functions of skin (i.e. sensory organ, immunological barrier, synthesis of vitamin D, etc).*

Course Content*:*

Theory

Muscle Physiology:

1. Microscopic and electron microscopic structure of skeletal, smooth and cardiac muscles. The sarcotubular system.
2. Red and white striated muscle fibers. Single-unit and multi -unit smooth muscle.
3. Muscle groups: antagonists and agonists.

4. Properties of skeletal muscle: excitability, contractility, all or none law, summation of stimuli, summation of contractions, effects of repeated stimuli, genesis of tetanus, onset offatigue, refractory period, tonicity, conductivity, extensibility and elasticity. Optimal load, optimal length of fibers.
5. Muscle proteins. Mechanism of skeletal and smooth muscle contraction andrelaxation:Excitation-contractioncoupling. Dihydropyridine receptors & Ryanodine receptors. Mechanical components of muscle. Isometric and isotonic contractions – muscle length, tension and velocity relationships.
6. Chemical, thermal andelectrical changes in skeletal muscle during contraction and relaxation. Electromyography

Renal Physiology:

1. Anatomy of kidney. Histology of nephron.
2. Renal circulation – peculiarities and autoregulation.
3. Formation of urine– glomerular function and tubular functions.
4. Counter-current multiplier and exchanger.
5. Renal regulation of osmolarity and volume of blood fluids.
6. Diabetes insipidus. Formation of hypertonic urine.
7. Renal regulation of acid-base balance, acidification of urine.
8. Renal function tests – creatinine, inulin, urea, and PAH clearance tests.
9. Physiology of urinary bladder and micturition.
10. Composition of urine. Abnormal constituents of urine, theirdetection and significance.
11. Renal dialysis. Non-excretory functions of kidney.

Skin and Body Temperature Regulation:

1. Structure and functions of skin. Cutaneous circulation.
2. Sweat glands –structure and composition of sweat.
3. Sweat formation, secretion and its regulation. Insensible perspiration.
4. Regulation of body temperature in homeotherms – its physical and physiological processes, roles of neural and hormonal processes. Pyrexia, hyperthermia and hypothermia.

Practical

Permanent Slides Identification

a) Study and identification of stained section of different mammalian tissues and organs : Bone, Hyaline cartilage, Trachea, Lung, Spleen, Lymph gland, Parotid gland, Submaxillary gland, Sublingual gland, Tongue, Oesophagus, Stomach, Duodenum, Jejunum, Ileum, Large intestine, Liver, Kidney, Ureter, Pancreas, Adrenal gland, Thyroid gland, Testis, Ovary, Spinal cord, Cerebral cortex, Cerebellum, Skin, Cardiac muscle, Skeletal muscle, Smooth muscle, Artery, Vein, Uterus**.**

b) Paper chromatography, TLC

References/ Suggested Readings:

1. *Barman, S (23rd Edition): Ganong's Review of Medical Physiology, McGraw Hill Lange.*
2. *Guyton and Hall (11th Edition): Textbook of Medical Physiology, Elsevier Saunders.*
3. *The Kidney : An outline of Normal and Abnormal Functions, by H.E. Dewardener, ELBS.*

Semester- III

Course Name: Gastrointestinal Physiology

Course Code: BSCHPHYC302

Course Type: **Core (Theory+Practical)**	Course Details: **CC-6**			L-T-P: **4- 0 –2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Identify the sources and typical amounts of fluid and nutrients entering and leaving the gastrointestinal tract daily.*
2. *For major classes of nutrients (carbohydrates, proteins, fats), differentiate the processes ofingestion, digestion, absorption, secretion, and excretion; include the location in the GI tract where each process occurs.*
3. *Understand the integrated regulation (neural, endocrine, luminal) that drives digestion and absorption of nutrients after a meal and the temporal sequence of regulatory events during digestion.*
4. *Understand how the physical and chemical compositions of luminal contents are sensed and the cellular and systemic responses to luminal stimuli.*
5. *Describe the major anatomical characteristics of the enteric nervous system and the major cellular divisions of enteric ganglia (sensory nerves, interneurons, and motor neurons).*
6. *Know how afferent and efferent extrinsic nerves (sympathetic and parasympathetic) interact with the enteric nervous system and regulate the functions of the GI tract. GI*
7. *Know the major excitatory and inhibitory motor neurotransmitters and major digestive hormones in the GI tract and how these biomediators affect function in GI tissues and cells.Understand the neural circuitry driving major GI reflexes and the neural pathways and neurotransmitters that accomplish reflex control of GI functions.*
8. *Identify the cell type and anatomical location of the endocrine cells secreting major GI hormones, such as gastrin, secretin, cholecystokinin (CCK), GLP-1, GLP-2, leptin, and motilin.*
9. *List the water, ionic, bile salt, and bilirubin components of bile as secreted by the*
10. *Describe the mechanisms liver and after modification by the gallbladder.*
11. *Describe whereby the gall bladder concentrates bile, and the endocrine mechanism stimulating gall bladder contraction and the secretion of bile through the sphincter of Oddi into the small intestine.*
12. *Describe the enterohepatic circulation, including any different handling among primary and secondary bile salts, and bile acids.*
13. *Describe the sequential digestion of ingested starch by enzymes of the salivary glands, pancreas, and the intestinal apical membrane. Describe the sequential digestion of ingested proteins by gastric pepsin, pancreatic enzymes, and enzymes at the intestinal apical membrane. Make sure to include the role of duodenal enteropeptidase.*

14. *Compare the membrane transport mechanisms responsible for uptake of sugars, amino acids and di-peptides by intestinal epithelial cells.*
15. *Describe the mechanisms and molecules mediating the solubilization and digestion of lipids in the small intestine.*
16. *Describe the mechanisms for the uptake, processing and release of lipids by the small intestinal epithelium and consequences of their malabsorption. Describe the composition and formation of chylomicrons, their movement across the enterocyte basolateral membrane, and the route of entry into the cardiovascular system.*
17. *Describe common causes of steatorrhea, and predict effects of steatorrhea on absorption of fat-soluble vitamins. Compare the absorption of fat soluble and water soluble vitamins and give examples of diseases resulting from their malabsorption.*
18. *List the diseases of enzyme and transport deficiencies leading to osmotic diarrhea.*

CourseContent:

Theory

Digestive system

1. Anatomy and histology of alimentary canal.
2. Digestive glands – histological structures of salivary glands, pancreas, liver.
3. Deglutition. Movements of alimentary canal and their regulations.
4. Composition, functions and regulation of the secretion of salivary, gastric, pancreatic and intestinal juices and bile. Synthesis of Bile acids.
5. Entero-hepatic circulation.
6. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids.
7. Defecation. Faeces. GALT.
8. Basic concepts of Peptic Ulcer, Jaundice and Gall-stones.

Vitamin and minerals

1. Vitamins: Thiamine, Riboflavin, Niacin, Pyridoxine, Pantothenic Acid, Biotin, Cyanocobalamin, Folic Acid, Ascorbic Acid, Inositol. Vitamins A, D, E and K. Chemistry, dietary sources, daily requirements, biochemical roles and functions, deficiency symptoms, hyper-vitaminosis, anti-vitamins.
2. Minerals: Sources, biological functions, metabolism and regulation of sodium, potassium, calcium, phosphorus, iron, zinc, iodine and fluoride.

Practical

Dales Experiment

1. Dales Experiments – studies on smooth muscle. Kymographic recording of normal movements of rat's intestine in Dale's apparatus.
2. Effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements.

References/ Suggested Readings

1. *Barman, S (23rd Edition): Ganong's Review of Medical Physiology, McGraw Hill Lange.*
2. *Guyton and Hall (11th Edition): Textbook of Medical Physiology, Elsevier Saunders.*
3. *Best & Taylor's Physiological Basis of Medical Practices, edited by B.K.Brobeck.The William and Wilkins Co.*
4. *Harper's Illustrated Biochemistry, by R.K.Murray&others.Lange Medical Book, International Edition, McGraw Hill.*
5. *Biochemistry. By D.Das. Academic Publishers.*

Semester- III

Course Name: Nervous System

Course Code: BSCHPHYC303

Course Type: **Core (Theory+Practical)**	Course Details: **CC-7**			L-T-P: 4**- 0 –2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Define, and identify on a diagram of a motor neuron, the following regions: dendrites, axon, axon hillock, soma, and an axodendritic synapse.*
2. *Define, and identify on a diagram of a primary sensory neuron, the following regions: receptor membrane, peripheral axon process, central axon process, soma, sensory ganglia.*
3. *Describe the normal distribution of Na+ , K+ , and Cl- across the cell membrane, and using the chord conductance (Goldman) equation, explain how the relative permeabilities of these ions create a resting membrane potential. Describe ionic basis of an action potential.*
4. *Describe the ionic basis of each of the following local graded potentials: excitatory post synaptic potential (EPSP), inhibitory post synaptic potential (IPSP), end plate potential (EPP) and a receptor (generator) potential.*
5. *Contrast the generation and conduction of graded potentials (EPSP and IPSP) with those of action potentials.*
6. *Describe the functional role of myelin in promoting saltatory conduction, contrasting the differences between the CNS and PNS.*
7. *Compare conduction velocities in a compound nerve, identifying how the diameter and myelination lead to differences in conduction velocity. Use these differences to classify sensory nerve fibers as group Ia, Ib, II, III, and IV fibers or as A-alpha, A-beta, A-delta, B, and C fibers.*
8. *Compare electrical and chemical synapses based on velocity of transmission, fidelity, and the possibility for neuromodulation (facilitation or inhibition).*
9. *Describe chemical neurotransmission, listing in correct temporal sequence events beginning with the arrival of a wave of depolarization at the pre-synaptic membrane and ending with a graded potential generated at the post-synaptic membrane.*
10. *Define the characteristics of a classical neurotransmitter.*
11. *Learn the synthetic pathways, inactivation mechanisms and neurochemical anatomy and mechanisms of receptor transduction for the following classical and non-classical neurotransmitters: • Catecholamines: dopamine, norepinephrine, epinephrine • Acetylcholine • Serotonin (5-hydroxytryptaine) • Histamine • GABA (γ-aminobutyric acid) • Glutamate • Endorphins • Enkephalins • Dynorphins • Substance P • Nitric Oxide • Carbon Monoxide • Endocannabinoid*
12. *Describe formation and reabsorption of cerebral spinal fluid (CSF), including the anatomy and function of the choroid plexus.*

13. *Contrast the barrier mechanisms between the blood brain barrier and the blood CSF barrier and the consequences of barrier break down.*
14. *Describe the impact of the blood brain barrier for the CNS distribution of intravenously administered hydrophilic and hydrophobic drugs.*
15. *Locate and describe the function of circumventricular organs.*
16. *Describe the cutaneous and proprioceptive mechanoreceptors and their function: Pacinian corpuscles, Meissner's corpuscles, Ruffini endings, Merkel cell, A-delta and C free nerve endings, Golgi tendon organ, muscle spindle.*
17. *Define rapidly and slowly adapting sensory reception and correlate these with the types of sensory receptors serving the Dorsal Column-Medial Lemniscus system and the spinothalamic system, respectively.*
18. *Describe the steps in sensory transduction and action potential generation at a mechanoreceptor and at a nociceptor.*
19. *Use the Weber-Fechner Law to determine the relationship between afferent neuronal firing frequency and perception of a stimulus.*
20. *Discuss what is meant by the Pain/Temperature/Coarse Touch System and be able to trace its connections to the cerebral cortex.*
21. *List the neural components of the Dorsal Column-Medial Lemniscus system and its Trigeminal analogs.*
22. *Describe the functional properties of the Dorsal Column-Medial Lemniscus system,*
23. *List the neural components of the spino-thalamic system and its trigeminal analogues.*
24. *List functional properties of the spino-thalamic system.*
25. *Explain how motor units are normally recruited to increase muscular force and what the functional advantages are of this recruitment order.*
26. *Discuss the underlying physiological mechanisms in which muscular force can be increased by increasing the rate at which action potentials are transmitted to the muscle from the CNS.*
27. *Describe the concept of central pattern generator and list the motor activities that are supported by these circuits.*
28. *Describe the three states of human brain activity based on EEG, EOG and EMG records.*
29. *Distinguish characteristics of non-rapid eye movement sleep (NREM).*
30. *Distinguish characteristics of rapid eye movement sleep (REM).*
31. *Outline the current understanding of regulatory mechanisms in the brainstem and diencephalon regulating the appearance of NREM, REM and wake states. Include the neurotransmitters and the mechanism of the ultradian rhythm underlying the sleep-wake cycle.*
32. *Describe the symptoms of narcolepsy, sleep apnea, disorders of initiating and maintaining sleep, and REM sleep behavior disorder.*
33. *Describe how respiration, cardiovascular, renal, gastrointestinal, eye movement, muscle, and endocrine function change from wake to NREM and REM states.*

Course Content:

Theory

Nerve Physiology:

1. Structure, classification and functions of neurons and neuroglia. Cytoskeletal elements and axoplasmic flow. Myelinogenesis.
2. The resting membrane potential. The action potential. Electrotonic potentials.
3. Current of injury.
4. Propagation of nerve impulse in different types of nerve fibers.
5. Compound action potentials.

6. Properties of nerve fibers: excitability, conductivity, all or none law, accommodation, adaptation, summation, refractory period, indefatigability. Chronaxie, rheobase and utilization time.
7. Synapses: types, structure, synaptic transmission of the impulse, synaptic potentials, neurotransmitters, co-transmitters, neuromodulators.
8. The neuromuscular junction: structure, transmission, end-plate potential, MEPP, post-tetanic potentiation. Motor unit. Motor point.
9. Injury to peripheral nerves – degeneration and regeneration in nerve fibre, changes in the nerve cell body, trans-neuronal degeneration, changes in receptors and motor end-plates, denervation hypersensitivity.
10. Thermal changes of nerve during activity. Nerve growth factors.

Nervous System

1. A brief outline of organization and basic functions (sensory, motor and association) of the nervous system (central and peripheral). Structural organization of different parts of brain and spinal cord.
2. Reflex action – definition, reflex arc, classificationand properties. Autonomic nervous system : organization, outflow, ganglia, centres and functions. Chemical transmission in autonomic nervous systems. Central control of autonomic nervous system.
3. CSF: formation, circulation and functions. Blood-CSF and Blood-Brain barrier. Ascending and descending tracts: origin, courses, termination and functions.Lower per motor neurones.
4. Functions of the spinal cord with special referenceto functional changes following hemi-section and complete section of spinal cord –Brown-Sequard syndrome. Spinal animal.
5. Pain production, perception and regulation. Referred pain. Decerebrate rigidity, decorticate rigidity.
6. Postural reflexes. Muscle spindle andGolgi tendon organ: their structure, innervations and functions, regulation of muscle tone.
7. Structure, connections and functions of cerebellum.
8. Structure and functions of vestibularapparatus. Nuclei, connections and functions of thalamus and hypothalamus.
9. Basal nuclei:structure, connections and functions.
10. Cerebral cortex: histological structure, localization offunctions.
11. Limbic system: structure, connections and functions. Physiology of emotion.
12. Electrophysiology of brain: spontaneouselectrical activity of brain, EEG and EOG, evokedpotential, DC potential.
13. Isolated cortex.
14. Higher functions of nervous system: conditioning, learning and short-term and long-term memory. Speech. Aphasia. Asymmetrical organization of certain cognitive functions-split brain.
15. Reticular formation: organization, connection and functions of ascending and descending reticular formation.
16. Physiological basis of sleep and wakefulness.

Practical

Preparation of Permanent Slides

1. Histology – Sectioning and staining
2. Staining of sections by haematoxylin-eosin and iron-haematoxylin.
3. Demonstration: Preparation of permanent slides – fixation, dehydration, paraffin embedding, block preparation,
4. Cutting and staining.

References/ Suggested Readings

1. *Barman, S (23rd Edition): Ganong's Review of Medical Physiology, McGraw Hill Lange.*
2. *Guyton and Hall (11th Edition): Textbook of Medical Physiology, Elsevier Saunders.*
3. *Best & Taylor's Physiological Basis of Medical Practices, edited by B.K.Brobeck.The William and Wilkins Co.*
4. *The Human Nervous System, by Charles nobach, McGraw Hill Book Co.*
5. *The Human Nervous System, by M.L. Barr &J.A.Keirman,Harper& Row.*

Semester- III

Course Name: Alimentary Physiology

Course Code: BSCHPHYGE301

Course Type: **GE (Theoretical &Practical)**	Course Details: **GEC-3**			L-T-P: 4 **- 0 - 2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Understand the integrated regulation (neural, endocrine, luminal) that drives digestion and absorption of nutrients after a meal and the temporal sequence of regulatory events during digestion.*
2. *Understand how the physical and chemical compositions of luminal contents are sensed and the cellular and systemic responses to luminal stimuli.*
3. *Describe the major anatomical characteristics of the enteric nervous system and the major cellular divisions of enteric ganglia (sensory nerves, interneurons, and motor neurons).*
4. *Know how afferent and efferent extrinsic nerves (sympathetic and parasympathetic) interact with the enteric nervous system and regulate the functions of the GI tract. GI*
5. *Know the major excitatory and inhibitory motor neurotransmitters and major digestive hormones in the GI tract and how these biomediators affect function in GI tissues and cells. Understand the neural circuitry driving major GI reflexes and the neural pathways and neurotransmitters that accomplish reflex control of GI functions.*
6. *Identify the cell type and anatomical location of the endocrine cells secreting major GI hormones, such as gastrin, secretin, cholecystokinin (CCK), GLP-1, GLP-2, leptin, and motilin.*
7. *List the water, ionic, bile salt, and bilirubin components of bile as secreted by the liver and after modification by the gallbladder.*
8. *Describe the cellular mechanisms for the hepatic uptake, conjugation, and secretion of bile salts and bilirubin.*
9. *Describe the mechanisms whereby the gall bladder concentrates bile, and the endocrine mechanism stimulating gall bladder contraction and the secretion of bile through the sphincter of Oddi into the small intestine.*
10. *Describe the enterohepatic circulation, including any different handling among primary and secondary bile salts, and bile acids.*
11. *Describe the sequential digestion of ingested starch by enzymes of the salivary glands, pancreas, and the intestinal apical membrane. Describe the sequential digestion of ingested proteins by gastric pepsin, pancreatic enzymes, and enzymes at the intestinal apical membrane. Make sure to include the role of duodenal enteropeptidase.*
12. *Compare the membrane transport mechanisms responsible for uptake of sugars, amino acids and di-peptides by intestinal epithelial cells.*
13. *Describe the mechanisms and molecules mediating the solubilization and digestion of lipids in the small intestine.*

14. *Describe the mechanisms for the uptake, processing and release of lipids by the small intestinal epithelium and consequences of their malabsorption. Describe the composition and formation of chylomicrons, their movement across the enterocyte basolateral membrane, and the route of entry into the cardiovascular system.*
15. *Describe common causes of Xerostomia, Chorda Tympani Syndrome, Sjogren syndrome, Gastritis, Gastric Atrophy, Zollinger – Ellison Syndrome, Pancreatitis, Steatorrhea, Jaundice, Hepatitis, Chirrosis of Liver, Malabsorption syndrome, Crohn's disease or Enteritis, Diarrhea, Constipation, Appendicitis, Ulcerative Colitis, Belching.*

Course Content:

Theory

Alimentary Physiology

1. Anatomy and histology of alimentary canal. Digestive glands – histological structures of salivary glands, pancreas, liver.
2. Deglutition. Movements of alimentary canal and their regulations.
3. Composition, functions and regulation of the secretion of salivary, gastric, pancreatic and intestinal juices and bile. Synthesis of Bile acids.
4. Enterohepatic circulation.
5. Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids.
6. Defecation. Feces.
7. GALT.
8. Basic concepts of Peptic Ulcer, Jaundice and Gall-stones. Brief idea about Xerostomia, Chorda Tympani Syndrome, Sjogren syndrome, Gastritis, Gastric Atrophy, Zollinger – Ellison Syndrome, Pancreatitis, Steatorrhea, Jaundice, Hepatitis, Chirrosis of Liver, Malabsorption syndrome, Crohn's disease or Enteritis, Diarrhea, Constipation, Appendicitis, Ulcerative Colitis, Belching.

Practical

Fresh tissue experiments and Permanent Slide Identification

1. Fresh tissue experiments:
a) Examination & staining of fresh tissue: squamous, ciliated & columnar epithelium, skeletal muscle fibre (Rat/Goat) by Methylene blue stain.
b) Transitional epithelium, mesentery (Rat/ Goat) (counter stain by Methylene blue)
c) Staining of adipose tissue by Sudan III or IV

2. Identification of permanent slides:
Bone, cartilage, lung, trachea, spleen, lymph gland, liver, salivary glands, pancreas, esophagus, stomach, small intestine, large intestine, ovary, adrenal, testis, thyroid, spinal cord, cerebellum, cerebral cortex, kidney, skin, tongue.

References/ Suggested Readings

1. *Concise Medical Physiology by S.K.Chaudhury; New Central Book Agency.*
2. *Medical Physiology by A.B. Mahapatra, Current Books International.*
3. *Harper's Illustrated Biochemistry, by R.K.Murray&others. Lange Medical Book, International Edition, McGraw Hill.*
4. *Biochemistry. By D.Das. Academic Publishers.*

Semester- III

Course Name: Diet chart and ECG

Course Code: BSCHPHYSEC301

Course Type: **Core (Practical)**	Course Details: **SEC-1**			L-T-P: 0**–2-10**	
Credit: **6**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**…**	**20**	**…**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Interpret and apply nutrition concepts to evaluate and improve the nutritional health of communities.*
    a) *Determine and translate nutrient needs into menus for individuals and groups across the lifespan, in diverse cultures and religions, and for different income levels.*
    b) *Plan a community intervention based upon a needs assessment*
    c) *Advocate for a public policy related to nutrition programs or health care*
2. *Interpret and apply nutrition concepts to evaluate and improve the nutritional health of individuals with medical conditions*
    a) *Apply biological, biochemical and physiologic scientific principles to nutrition practice*
    b) *Interpret of medical terminology and laboratory parameters relating to nutrition*
    c) *Interpret scientific research, apply it to nutrition practices, and document interventions*
    d) *Calculate and/or define of diets for health conditions addressed by health promotion/disease prevention activities or uncomplicated instances of chronic disease of the general population*
    e) *Collect pertinent information for comprehensive nutrition assessments*
    f) *Determine medical nutrition therapy for a variety of advanced medical conditions. (CPD, DPD only)*
3. *Identify and apply food principles to food and nutrition systems*
    a) *Calculate and interpret nutrient composition of foods*
    b) *Apply scientific research, including microbiology, food science and food safety to functions of ingredients in food and process controls*
    c) *Demonstrate basic food preparation, quantity food production, and food presentation skills*
    d) *Modify recipes and recipe proportions for individual, group dietary and volume production*

e) *Summarize health promotion and disease prevention theories and guidelines and explain the role of food in promotion of a healthy lifestyle*
f) *Analyze foodservice operations using the foodservice systems approach*

4. *Apply management principles to evaluate human, physical and fiscal resources in organizations.*
    a) *Apply principles and theories of management to the administration of human, physical and financial resource in food and nutrition services*
    b) *Apply management concepts to personnel selection, training, evaluation. organizational behavior, governmental influences, labor management relations, marketing and budgeting through case studies and the development of a business plan.*
5. *Integrate knowledge and skills in food and nutrition with professional issues affecting the nutrition and/or dietetics fields.*
    a) *Develop a position on a public policy affecting nutrition and food issues and/or programs*
    b) *Utilize outcomes based research and statistics to interpret a nutrition issue*
    c) *Explain health care policy and systems as related to food and nutrition health*
    d) *Describe issues related to third party reimbursement for nutrition care*
6. *Describe the electrical pathway of the heart*
7. *Identify the three planes of electrocardiography: standard limb leads, augmented leads, precordial leads*
8. *Describe the components of a normal 12 Lead ECG*
9. *Describe the six step systemic approach to interpretation of 12 Lead ECG*
10. *Relate coronary artery anatomy to myocardial perfusion*
11. *Recognize common ECG patterns associated with various locations of injury/infarction.*
12. *Interpret various 12 lead ECG examples*

Course Content*:*

Practical

1. **Diet chart preparation**
    a. Introduction to Nutrition Care Process: Definition of Nutrition Care Process.
    b. Steps of Nutrition Care Process
    c. Nutrition Assessment:-Definition , Nutrition assessment component, Critical thinking
    d. Nutrition Diagnosis: nutrition diagnosis domain:- intake, clinical, behavioral – environmental
    e. Nutrition diagnosis component• nutrition vs. medical diagnosis
    f. Nutrition Interventions: Definition and objectives
    g. Nutrition Monitoring & Evaluation: Definition, Nutrition monitoring & evaluation components, nutrition goals & objectives.
    h. Evaluation of nutrition care
    i. Diet chart preparation
2. **ECG Recording**
    a. Introduction to ECG
    b. ECG grids

c. ECG Complexes and intervals
d. Heart rate, Cardiac axis
e. Approach to ECG Interpretation: Rate, Rhythm, Axis, Intervals, P wave, QRS complex, ST segment, T wave, overall interpretation
f. Rhythm analysis: Locate the P wave, relationship between P wave and QRS Complex, analyze QRS morphology, interpretation and calculation of rhythm

References/ Suggested Readings:

1. *Barman, S (23rd Edition): Ganong's Review of Medical Physiology, McGraw Hill Lange.*
2. *Guyton and Hall (11th Edition): Textbook of Medical Physiology, Elsevier Saunders.*
3. *Akhter, A S (2011) The heart and pericardium, Elsevier.*

Semester- IV

Course Name: Sensory Physiology

Course Code: BSCHPHYC401

Course Type: **Core (Theory+Practical)**	Course Details: **CC-8**			L-T-P: 4- **0 –2**	
Credit: 4+2	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Understand the general properties of sensory systems and the range of complexity*
2. *Understand the types of receptors and their function*
3. *Understand receptive fields and basics of stimulus coding and processing*
4. *Identify the order of signal propagation from the stimulus to the CNS*

Course Content:

Theory

Sensory receptor and Olfaction

1. Classification of general and special senses. Receptors as biological transducers.
2. Muller's law ofspecific nerve energies. Weber-Fechner law, Steven's power law. Sensory transduction in Pacinian corpuscle.
3. Adaptation of receptors – phasic and tonic adaptations.
4. Olfaction and Gustation: Structure and functions of the receptor organs, nerve pathways, centers. Properties of olfactory and gustatory sensation and their transduction & coding. Electro-olfactogram. Abnormalities of olfactory and taste sensation.[1 credit] (12 Lectures)
5. Vision: Structure of the eyeball. Structure of lens. Cataract .Formation, circulation and functions of aqueous humour, glaucoma. Mechanism of accommodation. Pupillary reflexes light reflex, near response. Argyll- Robertson pupil. Errors of refraction and their corrections. Histological details of retina, peripheral retina, fovea and blind spot. Retinal detachment. Visual pathway and centers. Effects of lesion in visual pathway. Photopic and scotopic vision. Chemical and electrical changes in retina on exposure to light. Visual processing in the retina. Electroretinogram. Positive and negative after- images. Contrast phenomenon. Light and dark adaptation. Colour vision and its modern concept. Colour blindness. Visual field-- perimetry. Visual acuity – measurement, mechanism and factors affecting. Critical fusion frequency.
6. Audition: Sound waves, decibel. Structure and functional significance of auditory apparatus – external, middle and internalears. Organ of Corti. Auditory transduction. Auditory pathways and centers. Mechanism of hearing and its moderntheories. Different electrical potentials of internal ear. Discrimination of sound frequency andloudness.Localization of sound source. Audiometry. Deafness.

Practical

Histology and Human Experiment

Fresh tissue preparation

1. Suitable staining and examination of fresh tissues – epithelial, areolar, adipose(Sudan III or IV) and muscle tissues.
2. Silvernitrate preparation of cornea and urinary bladder for cell spaces and sciatic nerve for nodes of Ranvier

References/ Suggested Readings

1. *Barman, S (23rd Edition): Ganong's Review of Medical Physiology, McGraw Hill Lange.*
2. *Guyton and Hall (11th Edition): Textbook of Medical Physiology, Elsevier Saunders.*
3. *Best & Taylor's Physiological Basis of Medical Practices, edited by B.K.Brobeck.The William and Wilkins Co.*
4. *The Human Nervous System, by Charles nobach, McGraw Hill Book Co.*

Semester- IV

Course Name: Instrumentation, Biostatistics and Environment

Course Code: BSCHPHYC402

Course Type: **Core (Theory+Practical)**	Course Details: **CC-9**			L-T-P: 4**- 0 –2**	
Credit: 4+2	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Define the principal concepts about biostatistics.*
2. *Recognize the definition of statistics, its subject and its relation with the other sciences.*
3. *Restate the principal concepts about biostatistics.*
4. *Collect data relating to variable/variables which will be examined and calculate descriptive statistics from these data.*
5. *Identify data relating to variable/variables.*
6. *Identify convenient sample by using sampling theory.*
7. *Identify distribution form relating to the variable/variables.*
8. *Recognize normal distribution.*
9. *Interpret data via normal distribution.*
10. *Define the principal concepts of probability.*
11. *Recognize the binomial distribution.*
12. *Interpret data via binomial distribution.*
13. *Apply hypothesis testing via some of the statistical distributions.*
14. *Define some concepts about hypothesis testing.*
15. *Apply hypothesis testing to the data through these concepts.*
16. *Arrange the results of the hypothesis testing and make a statistical decision.*
17. *Discuss the applications of biophysics and principle involved in bioinstruments*
18. *Describe the methodology involved in biotechniques*
19. *Describe the applications of bioinstruments*
20. *Demonstrate knowledge and practical skills of using instruments in biology and medical field*
21. *Perform techniques involved in molecular biology and diagnosis of diseases*
22. *Update current knowledge regarding biomedical engineering involving new methods and the instrumentation*
23. *The student knows the principles of living species environmental physiology (how the living organism obtains and maintains the homeostasis at molecular, cellular and tissue levels, in the context of changes in the surrounding environment; expenditure and energy needs, thephysiological and neurobiological foundations of the behavior and cognitive interaction between the subject and the environment).*

Course Content:

Theory

Instrumentation and computer

1. Principles of construction and uses of compound microscope, phase contrast microscope, fluorescence microscope, polarizing microscope, confocal microscopy, transmission and scanning electron microscope,
2. Photoelectric colorimeter.
3. Brief idea of CRO, CT scan, fMRI and PET.
4. Computer: Basic concepts of software, hardware and types of computer. Computer packages: concept of MS Word, Excel, power point. Concepts of networking and web site, computer virus

Biostatistics

1. Scope of statistics – utility and misuse.
2. Principles of statistical analysis of biological data.
3. Basic concepts – variable, parameter, statistics.
4. Sampling. Presentation of data-frequency distribution, frequency polygon, histogram, bar diagram and pie diagram. Parameters.
5. Different classes of statistics- mean, median, mode, mean deviation, variance, standard deviation, standard error of the mean. Standard score.
6. Degrees of freedom.
7. Probability. Normal distribution. Student's t-distribution.
8. Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, t-test and z score for significance of difference. Distribution-free test - Chi-square test.
9. Linear correlation and linear regression.

Human and environment

1. Environment – Physical and biological aspects.
2. Effects of exposure to hot and cold environment.
3. Acclimatization to hot and cold environment.
4. Heat disorders and its preventive measures.
5. Effects of hypobaric and hyperbaric environment. Caisson disease. Preventive measure for hypobaric and hyperbaric effects.
6. Acclimatization to high-altitudes.
7. G force, ionizing and non-ionizing radiations - physiological effects and preventive measures.
8. Air, noise and water pollutions – causes, effects, prevention measures and control.
9. Brief idea of the hazards of pesticides, carcinogens, mutagens, neurotoxins and war gases.
10. Impact of Greenhouse effects on life

Practical

Problems on Biostatistics and Environmental Physiology

1. Experiments on Biostatistics
2. Computation of mean, median, mode, standard deviation and standard error of the mean withphysiological data like body temperature, pulse rate, respiratory rate, height and weight ofhuman subjects.
3. Graphical representation of data in frequency polygon and histogram.
4. Student's t test for significance of difference between means.
5. Demonstration: Statistical analysis and graphical representation of biological data with computerapplication program (Microsoft Excel).

Environmental Physiology

1. Measurement of noise by Sound level meter.
2. Measurement of illumination level by lux meter

References/ Suggested Readings

1. *Biophysics and Biophysical Chemistry, by D.Das. Academic Publishers.*
2. *Biomedical Instrumentation & Measurements, by L. Cromwell, F.J.Weibell&E.A.Pfeiffer; Prentice-Hall of India Pvt Ltd.*
3. *Statistics in Biology and Psychology by D.Das. Academic Publishers.*
4. *An Introduction to Biostatistics (2nd ed.) by N.Gurumani, M.J.P.Publishers, Chennai.*
5. *Medical Statistics by B.K.Mahajan. Jaypee Brothers, Medical PublishersPvt. Ltd.*

Semester- IV

Course Name: Metabolism

Course Code: BSCHPHYC403

Course Type: **Core (Theory+Practical)**	Course Details: **CC-10**			L-T-P: 4**- 0 –2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *How homeostasis is controlled in the body*
2. *The function of specific anabolic and catabolic pathways and how these pathways are controlled and interrelated*
3. *Understand of the molecular basis of the control of metabolism*

Course Content:

Theory

Metabolism

Biological oxidation and carbohydrate metabolism

1. Biological oxidation – Redox Potential,
2. Mitochondrial Electron Transport Chain, Oxidative Phosphorylation – Inhibitors and uncouplers.
3. Carbohydrate - Glycolysis, R-L cycle, TCA cycle,
4. Gluconeogenesis - Cori cycle, Glucose-Alanine cycle.
5. Anaplerotic reactions and Amphibolic nature of TCA cycle.
6. Pentose Phosphate Pathway.
7. Glycogenesis and Glycogenolysis. (*Hormonal regulation of the above mentioned biochemical pathways/cycle not required.)*

Metabolism of amino acid and purine and pyrimidine

1. Amino acids - Amino acid pool. Deamination, transamination, amination and decarboxylation. Synthesis of Urea and Nitric oxide. Basic idea of glucogenic and ketogenic amino acids. Metabolism of glycine, sulfur-containing amino acids, tryptophan and phenylalanine.
2. *Purines and Pyrimidines*– Biosynthesis :*de novo* and salvage pathways. Catabolism. *(Regulation of the above mentioned biochemical pathways/cycle not required.)*

Lipid metabolism and reactive oxygen species

1. Lipid -- β-oxidation and biosynthesis of saturated and monounsaturated fatty acids.
2. Metabolism of Triglycerides.
3. Biosynthesis of Lecithin, Cephalin and Cholesterol.
4. Metabolism of Adipose Tissue.
5. Role of lipoproteins in transport and storage of lipids.
6. Formation of Reactive Oxygen Species and the role of Catalase, Superoxide Dismutase, Glutathione Peroxidase and Glutathione Reductase in combating oxidative stress – role of vitamins. (*Hormonal regulation of the above mentioned biochemical pathways/cycle not required.)*

Methodologies:

1. Chromatography: Principles and uses of: TLC, Gel filtration, Affinity chromatography ion-exchange chromatography.
2. Electrophoresis: Principles and method, uses of Agarose gel electrophoresis, SDS – PAGE.
3. Ultracentrifugation: moving boundary and density gradient ultracentrifugation.
4. Radioactivity – Classification and properties. Their use – radiolabelling of biomolecules and its detection by autoradiography. Principles of radioimmunoassay (RIA), ELISA. Immunoblotting.

Practical

Nutritional status and growth

1. Growth monitoring and nutritional assessment: assessment of nutritional status of boys and girls of differentages of a community (2 to 20 years) from standard stature for age, and weight for age curves.
2. Assessment of nutritional status from height – vs – weight of adult male and female.
3. Assessment of nutritional status from measurement of food intake by 24 – hour recall method and foodfrequency questionnaire method.
4. Assessment of nutritional status from anthropometric measures from MUAC, head circumference andanthropometric indices such as BMI, Waist – Hip ratio.

References/ Suggested Readings

1. *Biophysics and Biophysical Chemistry, by D.Das. Academic Publishers.*
2. *Biomedical Instrumentation & Measurements, by L. Cromwell, F.J.Weibell&E.A.Pfeiffer; Prentice-Hall of India Pvt Ltd.*
3. *Lehninger's Principles of Biochemistry. By D.L.Nelson and M.M. Cox, Worth Publishers Inc.*
4. *Text Book of Biochemistry, by E.S. West ;W.R.Todd.; H.S.Mason; J.T.VanBruggen. The Macmillan Company.*
5. *Biochemistry. byD.Das. Academic Publishers.*

Semester- IV

Course Name: Cardio- Respiratory System

Course Code: BSCHPHYGE401

Course Type: **Core (Theory+Practical)**	Course Details: **GEC-4**			L-T-P: 4**- 0 –2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Identify and describe the interior and exterior parts of the human heart*
2. *Describe the path of blood through the cardiac circuits and describe the size, shape, and location of the heart*
3. *Compare cardiac muscle to skeletal and smooth muscle*
4. *Explain the cardiac conduction system*
5. *Describe the process and purpose of an electrocardiogram*
6. *Explain the cardiac cycle and calculate cardiac output*
7. *Name the centers of the brain that control heart rate and describe their function*
8. *Identify other factors affecting heart rate*
9. *Describe and illustrate the main anatomical structures of the respiratory system and the mechanics of inspiration and expiration*
10. *List the major functions of the respiratory system*
11. *Outline the forces that allow for air movement into and out of the lungs*
12. *Outline the process of gas exchange*
13. *Discuss the factors that affect pulmonary ventilation*
14. *Outline the mechanisms of O2 and CO2 transport in the blood*
15. *Describe diseases resulting from mutations in haemoglobin*
16. *Demonstrate an understanding of the control of the respiration rate.*
17. *Create a flowchart illustrating how respiration is controlled*

Course Content:

Theory

Cardiovascular system I

1. Cardiovascular system-Anatomy and histology of the heart.
2. Properties of cardiac muscle.
3. Origin andpropagation of cardiac impulse.
4. Cardiac cycle:events.
5. Heart sounds. Heart rate.Cardiac output: methodsof determination (dye dilution and Fick principle), factors affecting, regulation.

Cardiovascular system II

1. Structure of arteries, arterioles, capillaries. venules and veins. Pulse - arterial and venous.
2. Blood pressureand its regulation andfactors controlling.
3. Baro- and chemoreceptors.
4. Vasomotor reflexes.

5. Methods ofmeasurement of blood pressure.
6. Peculiarities ofregional circulations: coronary, pulmonary, renal, hepaticand cerebral.

Respiratory System

1. Anatomy and histology of the respiratory passage and organs.
2. Role of respiratory muscles in breathing.
3. Artificialrespiration.
4. Significance of physiological and anatomical dead space. Lung volumes andcapacities.
5. Exchange of respiratory gases betweenlung and blood and between blood and tissues.Transport of oxygen and carbon dioxide in blood. Regulation of respiration -neural and chemical.
6. Hypoxia.

Practical

Human experiments

1. Sphygmomanometric measurement of arterial blood pressure at rest and after exercise.
2. Modified Harvard step test and determination of physical fitness. Recording of recovery heart-rate after standard exercise and graphical plotting.
3. Pneumographic recording of effects of talking, drinking, laughing, coughing, exercise, hyperventilation and breath- holding.

References/ Suggested Readings

1. *Concise Medical Physiology by S.K.Chaudhury; New Central Book Agency.*
2. *Medical Physiology by A.B. Mahapatra, Current Books International.*

Semester- IV

Course Name: Statistical Analysis of Data

Course Code: BSCHPHYSEC401

Course Type: **Core (Practical)**	Course Details: **SEC-2**			L-T-P: 0**–2-10**	
Credit: **6**	Full Marks: **50**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**…**	**20**	**…**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Have a solid foundation of mathematical and statistical processes at a level comparable to that of students graduating with a BA/BS in Statistics at other universities. Processes should include (but are not limited to) a proficiency in collection, organization, design, and drawing inferences from data using appropriate statistical methodology and problem solving skills.*
2. *Demonstrate their ability to apply statistics in other fields at an appropriate level and demonstrate their ability to apply knowledge acquired from their major to real world models.*
3. *Demonstrate mastery of data analysis and statistical concepts by communicating critically reasoned analysis through written and oral presentations.*
4. *Acquire up-to-date skills and/or applications of computer and statistical programming related to future career choices.*
5. *Apply their knowledge of statistics through an in-depth senior project/research experience. Results will be presented in both written (paper, publication, portfolio, etc.) and visual (PowerPoint, poster, portfolio, etc.) formats.*
6. *Read, interpret, and critically analyze journal articles directed at undergraduate students.*

Course Content:

Practical

Statistical Analysis of Data

1. Elementary ideas about probability,
2. Discussion of sampling techniques,
3. Data summarization,
4. Common sampling distributions,
5. Statistical inference and hypothesis testing,
6. Regression and
7. Nonparametric inference

Basic Application of Computer in Physiological data Analysis

M.S. Word and M.S. Excel.

References/ Suggested Readings:

1. *Statistics in Biology and Psychology by D.Das. Academic Publishers.*
2. *An Introduction to Biostatistics (2nd ed.) by N.Gurumani, M.J.P.Publishers, Chennai.*
3. *Medical Statistics by B.K.Mahajan. Jaypee Brothers, Medical PublishersPvt. Ltd.*

Semester- V

Course Name: Endocrinology and Chronobiology

Course Code: BSCHPHYC501

Course Type: **Core (Theory+Practical)**	Course Details: **CC-11**			L-T-P: **4- 0 –2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Classify hormones.*
2. *Know the properties of polypeptide structure hormones.*
3. *Know the properties of steroid structure hormones.*
4. *Classify receptors.*
5. *Relate the membrane receptor and the hormones.*
6. *Relate the receptor and the hormones.*
7. *Apprehend where the hormones are synthesized.*
8. *Illustrate what kind of hormone is synthesized in what kind of endocrine gland.*
9. *Explain what kind of hormone is released from what kind of endocrine gland.*
10. *Compare the hormones released from hypophysis.*
11. *List the interior hypopyhsial lobe hormones.*
12. *List the posterior hypopyhsial lobe hormones.*
13. *Understand the basic principles of biological and environmental rhythms*
14. *Understand the underlying mechanism of circadian rhythms in the human body*
15. *Gain knowledge of which human body functions and behaviors are controlled by rhythms*
16. *Learn how rhythms influence eating and metabolism*
17. *Experience a hands-on recording of own body rhythms in a basic class experiment*

Course Content:

Theory

Endocrinology:

1. Classification of endocrine glands and hormones. Methods of study of endocrine functions.
2. Hypothalamus as a neuroendocrine organ. Anterior and posterior pituitary -- histological structure of the gland. Chemical nature, mode of action, functions and regulation of secretion of their hormones. Hypo- and hyperactive states of the gland.Pineal gland – histological structure. Chemical nature, biosynthesis, mode of actions, functions and regulation of secretion of melatonin.
3. Thyroid and parathyroid -- histological structure of the glands. Chemical nature, mode of action, functions and regulation of secretion of the hormones. Hypo- and hyperactive states of the glands.
4. Thymus -- histological structure of the gland. Chemical nature, mode of action and functions of thymic hormones.
5. Adrenal cortex and medulla -- histological structure of the gland. Chemical nature, mode of action,functions and regulation of secretion of the hormones. Biosynthesis and catabolism ofcatecholamines. Hypo- and hyperactive states of the gland. Heart as an endocrine organ. Prostaglandins and Kinins.

6. Pancreatic islets -- histological structure. Chemical nature, mode of action, functions and regulation of secretion of the hormones. Hormonal control of blood sugar. Hyperinsulinism and diabetes mellitus.
7. Growth factors –EGF, TGF, PDGF, IGF and FGF. Chemical nature, mode of action, functions.
8. Gastro -intestinal hormones -- Chemical nature, mode of action, functions and regulation of secretion of the hormones.

Chronobiology:

1. Different types of physiological rhythms – ultradian, circadian, infradian. Different zeitgebers and their relation with circadian clock. Hormonal biorhythms and their significance: adrenocortical, pineal and prolactin. Body temperature rhythm. Neural basis of biological clock and role of suprachiasmatic nuclei. Sleep-wakefulness cycle. Time keeping genes. Jet-lag and shift work.

Practical

Review of Scientific Literature

Students are required to submit a review of scientific literature on any topic given by the teachers .

References/ Suggested Readings

1. *Endocrinology. Vols- I II and III by L.O.DeGroot. W.B.Saunders Co.*
2. *William's Text Book of Endocrinology by J.D.Wilson and D.W.Saunders of Co.*
3. *The Circadian System of Man by R.A.Wever, Spinger-Verlag.*
4. *The Clock That Time Us, by M.C.Moore-Ede and others, Harvard University Press.*
5. *Circadian Rhythms and the Human, by D.S.Minors and J.M.Waterhouse. Wright. PSG.*
6. *The Physiological Clock: Circadian Rhythms and Biological Chronometry by E.Bunning Springer-Verlag.*

Semester- V

Course Name: Reproductive Physiology and Embryology

Course Code: BSCHPHYC502

Course Type: **Core (Theory+Practical)**	Course Details: **CC-12**			L-T-P: **4- 0 –2**	
Credit: 4+2	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Describe the key gross and microscopic components of the reproductive systemsin several mammalian species.*
2. *Describe gametogenesis and the anatomical; structures of gametes and relate it toits functions.*
3. *Demonstrate knowledge of key principles of reproductive endocrinology including: a) biosynthesis and chemistry of the different classes of hormones, b)mechanisms of action of hormones.*
4. *Demonstrate a detailed and comparative knowledge of the control of mammalianreproduction.*
5. *Demonstrate a detailed and comparative knowledge of the physiology ofpregnancy, parturition and lactation in the mammalian species.*
6. *Evaluate the principles, merits and limitations of various forms of reproductivetechnology in use.*
7. *Demonstrate interpretation of experimental data, identify controls, state hypotheses.*
8. *Describe the processes of gametogenesis and fertilization leading to blastocyst formation*
9. *Describe the process of implantation*
10. *Describe the embryological processes of gastrulation, how the different germ layers form and what these germ layers will eventually give rise to*
11. *Describe how placenta and foetal membranes are formed as well as the purposes of these structures*
12. *Describe neural tube formation and how the neural tube differentiates into specific components of the nervous system*
13. *Explain the development and function of the placenta, the amnion and the umbilical cord*
14. *Describe the development and function of the umbilical cord.*
15. *Describe the development of alimentary canal, heart, urinary system and genitalsystem.*
16. *Explain the foetal circulation and ossification of bones*

Course Content:

Theory

Reproductive Physiology:

1. Primary and accessory sex organs and secondary sex characters.

2. Histology of testis. Endocrine functions of testis. Spermatogenesis. Hypothalamic control of testicular functions.
3. Histology of ovary. Ovarian hormones and theirfunctions. Oogenesis and ovulation. Formation and functions of corpus luteum. Hypothalamic control of ovarianfunctions. Physiology of puberty.Estrous cycle. Menstrual cycle and its regulation. Abnormalities in menstrual cycle.
4. Onset of menopause and post-menopausal changes. Structure and functions of placenta. Maintenance of pregnancy and the bodily changes during pregnancy. Parturition. Pregnancy tests. Development of mammary glands, lactation and their hormonal control.

Embryology

1. Basic concepts of stem cells:Totipotency,
2. Differentiation - Committed stem cell.
3. Fertilization, Blastulation,Implantation,Gastrulation, Placentation.
4. Development of alimentary canal, heart, urinary system and genitalsystem. Foetal circulation. Ossification of bone.

Practical

Human Experiment

1. Tests for color blindness.
2. Determination of body fat and lean body mass.
3. Determination of respiratory rate in different posture at rest.
4. Determination of static and dynamic lung function test
5. Pneumographic recording of normal respiratory movements and the effects of talking , drinking , laughing, coughing , exercise, breath holding and hyperventilation

References/ Suggested Readings

1. *Best & Taylor's Physiological Basis of Medical Practices, edited by B.K.Brobeck.The William and Wilkins Co.*
2. *Review of Medical Physiology. By W.F.Ganong, lange Medical Book. Prentice-Hall International.*
3. Human Physiology, by R.F.Schmidt& G. Thews, Springer-Verlag.
4. *Endocrinology. Vols- I II and III by L.O.DeGroot. W.B.Saunders Co.*
5. *William's Text Book of Endocrinology by J.D.Wilson and D.W.Saunders of Co.*
6. *Medical Embryology by J.Langman, Williams & Wilkins.*
7. *Essentials of Human Embryology by A.K. Datta. Current Books International.*
8. *Human Embryology by I.B.Singh, McMillan India Ltd.*

Semester- V

Course Name: Pharmacology

Course Code: BSCHPHYDSE501

Course Type: **Core (Theory+Practical)**	Course Details: **DSEC-1**			L-T-P: 4**- 0 –2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Describe the basic scientific concepts and principles that serve as the foundational underpinnings of the pharmacological sciences including pharmacokinetics; pharmacodynamics; drug metabolism; and drug-drug interactions; and explain how these fundamental pharmacological properties can influence route of administration, drug action; drug efficacy and potency; drug levels in the body; potential for drug interactions; drug toxicity; and the appropriate choice of drug for pharmacotherapy in a given patient.*
2. *Describe the specific pharmacology of the major drugs and drug classes currently used in medical practice including their indications, contraindications, clinical use, mechanisms of action, physiological effects, pharmacokinetic properties, major adverse effects and clinically significant drug interactions;*
    a. *Anaesthetics, sedatives and hypnotics*
    b. *Diuretics*
    c. *Neuromuscular blockers*
    d. *Different Adrenoceptor agonists and antagonists*
    e. *Antianginal drugs*

Course Content:

Theory

Pharmacology

1. The importance of pharmacology in the study of physiological processes.
2. Definition of drug, agonist andantagonist.
3. Drug delivery. Pharmacokinetics : Absorption, Distribution, Permeation, Elimination, Clearance, Halflife.
4. Pharmacodynamics:dose-response curves. Drug biotransformation. Bioavailability. Drug accumulation. Drugtoxicity – LD50, ED50, therapeutic index.
5. Anaesthetics: types and mechanism of action of general anaesthetics. Sedatives - hypnotics: benzodiazepine,zolpidem.
6. Diuretics - Carbonic anhydrase inhibitor, loop diuretic, potassium sparing and osmotic diuretics
7. Neuromuscular blockers: Tubocurarine and succinylcholine.
8. Organ system effects and mechanism of action of adrenoceptor agonists and antagonists:
    a. Adrenergic stimulants: Amphetamine and ephedrine.α- adrenergic stimulants – Methaxomine and clonidine.
    b. β- adrenergic stimulants –Metaproterenol and salbutamol. Adrenergic antagonists: Labetelol.
    c. α- adrenergic blockers – Phenoxybenzamine and phentolamine.

d. β- adrenergic blockers – Propranolol and atenolol.

9. Antianginal drugs: Nitroglycerine and calcium channel blocker – Nifedipine and verapamil. Nonsteroid anti-inflamatory drugs

Practical

Experimental Physiology

1. Dose response curve of oxytocin on uterine muscle tone
2. Dose response curve of adrenaline on intestinal smooth muscle movement
3. Effect of different electrolytes (K^+, Na^+, Ca^{+2}, etc) on the contractility of intestinal smooth muscle
4. Pentobarbital sleeping time in rat /mice – assessment of amphetamine and benzodiazepine action
5. Effect of sedative and stimulant drug (amphetamine and benzodiazepine etc) on locomotor activity on open field
6. Effect of antidepressant drug on Forced swim test in rats

References/ Suggested Readings

1. *Pharmacology by M.Das. Books and Allied (Pvt. Ltd.)*
2. *Basic and Clinical Pharmacology by E.G.Katzung. Appleton and Lange.*
3. *Quintessence of Medical Pharmacology, S.K.Chaudhuri, New Central Book Agency*
4. *Pharmacology in Medicine by S.N.Pradhan; R.P.Maickel and S.N.Dutta. S.P.Press International Inc.*

Semester- V

Course Name: Community Health Care

Course Code: BSCHPHYDSE502

Course Type: **Core (Theory+Practical)**	Course Details: **DSEC-2**			L-T-P: 4**- 0 –2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Understand and appreciate the diverse socioeconomic, behavioural, sociocultural, biological, environmental, philosophical, and historical factors that influence health, rehabilitation, and human movement*
2. *Comprehend the significant theories, models, themes, and ideas in the biomechanical, physiological, behavioral, pedagogical, biological, socioeconomic, environmental, and sociocultural correlations of Kinesiology and Community Health.*
3. *Comprehend and demonstrate ethical practices and the application of scientific findings and/or critical analysis in order to interpret new ideas related to health, rehabilitation, and/or human movement.*
4. *Apply best practices in developing, implementing, assessing, and evaluating programs and interventions related to health promotion, physical activity adoption and adherence, and the prevention and treatment of diseases.*

Course Content:

Theory

Community Health Care

1. Definition & concept of health and diseases, dimension of health, health system, Diseases: causation andprevention of diseases, mode of intervention, epidemic and endemic forms of diseases, physiologists as health counsellors Epidemiological triad, web of causation, high - risk group, prevention of communicable diseases, prevention of non -communicable diseases, drug abuse and addiction, drug metabolism and detoxification
2. **Nutrition in infancy:** Nutritional requirements of nutrients during infancy. Breast feeding – nutritional and others factors, advantages, problems in breast feeding, infant milk substitute (IMn S) act 1992. Formula feeding, Vitamin and mineral supplementation – vitamin –D, Iron, Fluoride, Supplementary foods of milk, cow's milk, goat's milk, vegetarian beverages, fruit juice. Nursing caves; solid supplements wearing, Nutritional requirement of pre- term babies; Feeding problems – food allergies, cow's milk protein allergy, lactose intolerance, diarrhoea, constipations vegetarianism
3. **Nutrition in childhood and adolescence:** Nutritional requirement of pre-school and school children, monitoring growth and development. Nutrition related problems of children- childhood obesity, dental caries, allergies, deficiency of Vitamin-A- aetiology, symptoms, prevention. Nutritional requirement and problem of adolescents-Anorexia, Bulbnia nervosa, Binge eating disorder, premenstrual syndrome.
4. **Nutrition in pregnancy:** maternal factors effecting pregnancy outcome: maternal age, pre-pregnant weight, weight gain during pregnancy, life style factors. Birth weight standards,Low birth weight baby. Nutritional requirements during pregnancy. Problems in pregnancy- morning

sickness, nausea and vomiting, constipation, oedema and leg cramps, Heart burn, excessive weight gain. Complication- anemia, toxemia, Diabetes mellitus

5. **Nutrition in lactating women:** Nutritional requirements, Factors affecting the volume and concentration of breast milk
6. **Protein energy malnutrition**:- PEM- symptoms, nutritional requirement in dietary management.
7. **Nutritional anemia**:-Prevalence, Iron metabolism, Iron absorption enhancers and inhibitors, Clinical features & management of Iron deficiency anemia, Megaloblasticanemia.
8. **Cardiovascular disorders**-Coronary heart disease (CHD): food and nutrients in CHD. Cardiovascular risk factors and nutritional management of CHD, Hypertension: Diet and blood pressure.
9. **Diabetes mellitus**-Dietary management of Diabetes mellitus – nutritional requirements, glycaemic index, Complication of diabetes – hypoglycaemia and insulin shock, ketoacidosis.
10. **Nutrition promotion in community**: causes and consequences of malnutrition in India.Community based
11. Intervention programmes – Mid – day – meal for school children. Specialnutrition programme (SNP) Integrated child development services (ICDS), National Nutritional Anaemia control programmes, Vitamin – A prophylaxis programme, National Iodine deficiency disorder control programme public distribution system. Targeted public distribution
12. **Nutrition and aging:** Process of aging, changes in organ function with aging, nutritional requirement, nutrition related problems in old age- osteoporosis, anemia, obesity, constipation, malnutrition. Antioxidants in the health of old age
13. **Overweight and obesity:-**prevalence, factors – environmental and life style factor, food intake, Genetic factors. Obesity management. Underweight – Aetiology and management.

Practical

Diet Chart Preparation

Preparation of diet chart for the following:

i. adolescents,
ii. pregnant and lactating women,
iii. elderly humans,
iv. athletes

References/ Suggested Readings

1. *Essential Food and Nutrition, by M.Swaminathan. The Bangalore Printing & Publishing Co. Ltd.*
2. *Park's Text Book of Preventive and Social Medicine by K.Park, M/s. BanarsidasBhanot Publishers.*
3. *Concise Medical Physiology by S.K.Chaudhury; New Central Book Agency.*
4. *Medical Physiology by A.B. Mahapatra, Current Books International.*

Semester- V

Course Name: Social Physiology and Nutrition

Course Code: BSCHPHYDSE503

Course Type: **Core (Theory+Practical)**	Course Details: **DSEC-3**			L-T-P: 4- **0 –2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Understand and appreciate the diverse socioeconomic, behavioural, sociocultural, biological, environmental, philosophical, and historical factors that influence health, rehabilitation, and human movement*
2. *Comprehend the significant theories, models, themes, and ideas in the biomechanical, physiological, behavioral, pedagogical, biological, socioeconomic, environmental, and sociocultural correlations of Kinesiology and Community Health.*
3. *Comprehend and demonstrate ethical practices and the application of scientific findings and/or critical analysis in order to interpret new ideas related to health, rehabilitation, and/or human movement.*
4. *Apply best practices in developing, implementing, assessing, and evaluating programs and interventions related to health promotion, physical activity adoption and adherence, and the prevention and treatment of diseases.*
5. *Understand what an adequate and well-balanced diet is.*
6. *Examine the several concepts of nutrition.*
7. *Explain elements of nutrition.*
8. *List rules of adequate and balanced diet.*
9. *Learn the physical and social changes taking place during the elderly period of life.*
10. *Learn the changes in a body taking place during the ageing period of life*
11. *Learn the energy and food demands of the elderly people.*
12. *Learn how to make nutritive plans according to those demands*
13. *Have knowledge about the diseases caught by the elderly people and their nutritive demands.*
14. *Examine the chronic diseases caught by the elderly people.*
15. *Learn the nutritive ways peculiar to those diseases.*
16. *Make samples of menu planning suitable for the elderly people, growing child, adult man and woman, pregnant woman and lactating woman.*

Course Content:

Theory

Social Physiology

1. Population problem – principles and methods of family planning,
2. Problem of infertility and AssistedReproductive Technologies.
3. Malnutrition – PCM, marasmus, kwashiorkor, marasmic kwashiorkor, endemic goitre, nutritional anaemias, rickets, osteo-malatia, xeropthalmia, beriberi and their social implications.

4. Principles and social importance of immunization against diseases.
5. Epidemiology and prevention of cholera, malaria, hepatitis and AIDS

Nutrition

1. Constituents of food and their significance.
2. Basal metabolic rate - factors, determination by Benedict-Roth Apparatus. Respiratory quotient. Specific dynamic action.
3. Calorific value of foods. Body calorie requirements – adult consumption unit.
4. Dietary requirements of carbohydrate, protein, lipid and other nutrients.
5. Food groups, Food exchange tables..
6. Balanced diet and principles of formulation of balanced diets for growing child, adult man and woman, pregnant woman and lactating woman.
7. Nitrogen balance, essential amino acids, biological value of proteins – measurement and factors affecting. Proteins sparers. Supplementary value of protein. Protein efficiency ratio and net proteinutilization of dietary proteins.
8. Dietary fibres. Principle of diet survey.
9. Composition and nutritional value of common food stuffs. Physiology of starvation and obesity

Practical

Diet Survey

1. Diet survey report of a family (as per ICMR specification): Each student has to submit a report on his/her own family or in a community.
2. Identification of food adulterants: starch from milk, dalda from butter, saw dust and colouring agents from spices, saccharine in sugar, argemone in oil

References/ Suggested Readings

1. *Essential Food and Nutrition, by M.Swaminathan. The Bangalore Printing & Publishing Co. Ltd.*
2. *Park's Text Book of Preventive and Social Medicine by K.Park, M/s. BanarsidasBhanot Publishers.*
3. *Concise Medical Physiology by S.K.Chaudhury; New Central Book Agency.*
4. *Medical Physiology by A.B. Mahapatra, Current Books International.*
5. *Park's Text Book of Preventive and Social Medicine by K.Park, M/s. BanarsidasBhanot Publishers.*

Semester- VI

Course Name: Molecular Biology

Course Code: BSCHPHYC601

Course Type: **Core (Theory)**	Course Details: **CC-13**			L-T-P: 4- **0–2**	
Credit: 4+2=**6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Understand and appreciate the diversity of life as it evolved over time by processes of mutation, selection and genetic change.*
2. *Illustrate that fundamental structural units define the function of all living things.*
3. *Explain that the growth, development, and behavior of organisms are activated through the expression of genetic information in context.*
4. *Summarize that biological systems grow and change by processes based upon chemical transformation pathways and are governed by the laws of physics.*
5. *Illustrate that living systems are interconnected and interacting across scales of space and time.*
6. *Design a scientific process and employ the scientific method, demonstrating that biology is evidence based and grounded in the formal practices of observation, experimentation, and hypothesis testing.*
7. *Execute quantitative analysis to interpret biological data.*
8. *Construct and utilize predictive models to study and describe complex biological systems.*
9. *Apply concepts from other sciences in order to interpret biological phenomena.*
10. *Communicate biological concepts and understanding to members of a diverse scientific community as well as to the general public.*
11. *Identify social and historical dimensions of biological investigation.*

Course Content:

Theory

1. Genome and its organization: (idea about gene, coding sequence, regulatory sequence,
2. intron, exon, Nucleosome structure and packaging of DNA into higher order structures, brief
3. idea of chloroplast DNA and Mitochondrial DNA)
4. DNA Replication—Messelson and Stahl Experiment, Hershey Chase Experiment, Features of DNA Replication, Proof of semiconservative nature of DNA replication, Featuresof bidirectional DNA replication. Mechanism of bidirectional DNA replication
5. DNA Polymerases, Ligases and other regulatory proteins.
6. Transcription – Transcription in prokaryotes with E. Coli as model system: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation andtermination of RNA chains
7. Genetic code – properties and wobble hypothesis.
8. Translation – codon-anticodon interaction and mechanism (Initiation, elongation andtermination) in prokaryotes.
9. Principles of gene regulation, negative and positive regulation, concept of operons

10. Regulation of gene expression in bacteria: lac operon concept, trp operon concept..
11. Gene mutation – agents and types. DNA repairing processes.
12. Concept of oncogenes and properties of cancer cells.
13. Causes (spontaneous, chemical agent, radiation) and types of DNA damage
14. Mechanism of DNA repair: Direct repair, base excision repair, nucleotide excision repair, mismatch repair, recombination repair.
15. Molecular basis of mutation, types of mutation (missense mutation, nonsense mutation, silent mutation, point mutation, frameshift mutation).
16. Elementary idea of recombinant DNA technology and its applications – Cloning: Cloning vectors (pBR322, pUC18/19, YACs), Bacteriophage lambda and M13 based vectors. Cosmids, Ti plasmid as transformation vector. Use of linkers and adaptors, Homopolymeric tailing, c-DNA synthesis and cloning. Genomic DNA and c-DNA libraries.
17. Restriction and Modification systems in bacteria: Types I, II and III. Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering, RestrictionMapping, Restriction Fragment Length Polymorphism (RFLP).
18. Enzymes used in Recombinant DNA techniques: DNA ligase, Polynucleotide Kinase, DNA Polymerase, Reverse Transcriptase, Terminal deoxynucleotidyl transferase, Phosphatases.
19. Polymerase Chain Reaction & qPCR
20. Gene therapy, transgenic animal.
21. Northern and Southern blotting.

Practical

Blood Biochemistry and Demonstration of different techniques of Molecular Biology :

i) Blood Sugar by Folin-Wu Method ; ii) Serum Protein by Biuret Method ; iii) Serum Albumin using Bromocresol Green ; iv) Estimation of RNA by orcinol method ; v) Blood Uric Acid bycyanide - free method ; vi) Serum urea by DAM method. [2 Credits]

2. Demonstration of Gel Electrophoreses (Agarose and SDS page)

3. Demonstration of Paper Chromatography and TLC

4. Demonstration of Western blotting

References/ Suggested Readings

1. *Cellular & Molecular Biology, by E.D.P.DeRobertis& E.M.F. De Robertis; Lea &Febiger.*
2. *Molecular Biology of the Gene, by J.D.Watson; H.H.Nancy& others; Benjamin-Cummings.*
3. *Molecular Biology of the Cell, by B. Alberts and others,Garland.*

Semester- VI

Course Name: Ergonomics and Sports Physiology

Course Code: BSCHPHYC602

Course Type: **Core (Theory+Practical)**	Course Details: **CC-14**			L-T-P: 4**- 0 –2**	
Credit: **6**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Demonstrate knowledge of general overall physiological principles associated with metabolic processes; musculoskeletal system; cardiovascular system; aerobic and anaerobic program design.*
2. *Demonstrate knowledge of pathophysiology and risk factors associated with exercise and disease.*
3. *Demonstrate the ability to administer and interpret health appraisals, fitness, and clinical exercise testing.*
4. *Demonstrate the ability to administer and interpret electrocardiography and other diagnostic techniques associated with physiological processes.*
5. *Describe and understand issues involved with patient management and medications.*
6. *Design and monitor exercise prescriptions and fitness programming.*
7. *Assess and evaluate nutritional intake and demonstrate the ability to design weight management programs.*
8. *Demonstrate knowledge of safety, injury prevention, and emergency procedures associated with laboratory activities and general exercise.*
9. *Demonstrate knowledge of cardiovascular physiology, pulmonary physiology, metabolic processes and associated pathology and risk factors for disease.*
10. *Demonstrate knowledge of orthopedic/musculoskeletal issues including pathophysiology and risk factors for injury.*
11. *Demonstrate proficiency in performing laboratory techniques and subsequent analysis of data commonly used in Human Performance Laboratory.*
12. *Demonstrate knowledge of and show ability to carry out the research process in a collaborative environment.*

Course Content:

Theory

Work Physiology and Ergonomics

1. Physical work—its definition and nature—isotonic, isometric and isokinetic, positive and negative work.
2. Concept of physiological work. Power and capacity relation.
3. Work -load – light, moderate(submaximal) and heavy (maximal) depending on intensity and duration of work.
4. Exercise inducing equipment – bicycle ergometer, treadmill and stepping stool.

5. Energetics of work – sources of energy and energy demand for different activities. Assessment of energy cost of various physical work – direct and indirect methods with their limitations.
6. Physiological responses to work – cardiovascular, respiratory, metabolic and muscular – short- term and long-term.
7. Work-rest cycle and importance of rest pause.
8. Basic concept of ergonomics and its application in industry to improve efficiency and industrial safety as well as to restrict occupational health hazards.
9. Anthropometry and its implication in ergonomics in general.

Sports Physiology:

1. Concept of endurance, strength and speed in sports activities.
2. Physical training – principles and their impact onperformance level in sports with reference to cardiovascular, respiratory and muscular changes.
3. Overtraining anddetraining.
4. Warm up and cool down.
5. Brief general idea about nutritional aspects of sports.
6. Aerobic and anaerobicpower—concept, factors affecting, methods of measurement and significance of maximal oxygen consumption andexcess post exercise oxygen consumption.
7. Lactate threshold, lactate tolerance and their usefulness.
8. Concept ofrecovery processes and occurrence of fatigue in physical work.
9. Ergogenic aids. Concept of physical fitness and itsassessment

Practical

Experiments on Exercise Physiology

1. Sphygmomanometric measurement of arterial blood pressure at rest and after exercise.
2. Modified Harvard step test and determination of physical fitness. Recording of recovery heart-rate after standard exercise and graphical plotting.
3. Assessment of Musculoskeletal disorder by questionnaire technique
4. Lung function tests – FEV , FVS, Peak flow rate
5. Assessment of pulmonary disorder by questionnaire method
6. Queens College Step Test
7. McArdle Step test

References/ Suggested Readings

1. *Exercise Physiology – Energy, Nutrition and Human Performance by W.D.McArdle, F.Katch and V.L.Katch. Williams and Wilkins.*
2. *Essentials of Exercise Physiology by L.G.Shaver, Surjeet Publications.*
3. *Energy, Work and Leisure by J.V.G.A.Durin and R.Passmore. Heinemann Educational Books.*
4. *Sports Physiology by E.L.Fox, Saunders College Publishing Holt-Saunders.*

Semester- VI

Course Name: Environment and Stress Physiology

Course Code: BSCHPHYDSE601

Course Type: **Core (Theory+Practical)**	Course Details: **DSEC- 4**			L-T-P: 4**- 0 –2**	
Credit: **4+2**	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Learn basic concepts, Auto Ecology and Population Ecology.*
2. *Learn Dynamics of Population, Ecology of Communities.*
3. *Learn Functional and Structural Features of Communities.*
4. *Learn Ecosystem and Characteristics.*
5. *Learn Functional Characteristics of Ecosystems.*
6. *Learn Ecological Cycles, Biological Accumulation.*
7. *Learn The Great Ecosystems in the World.*
8. *Learn Evolutional Ecology, Natural Selection, Genetic Variability.*
9. *Learn Economics of Environment and Planning, Sustainable Development.*
10. *Evaluate the major interactions between physiological state and the environment*
11. *Identify and develop skills and techniques in monitoring stress responses*
12. *Understand the challenges of journey to Space*
13. *Explain how the senses perceive being 'weightless'*
14. *Understand how key physiological systems respond to microgravity, what mechanisms underlie these changes, and some approaches that may be used to mitigate such effects*
15. *How human space physiology research is performed both in space, and using Earth-based analogues*
16. *How astronauts' physical and mental well-being is important*
17. *Major issues and challenges current human spaceflight and future space exploration must overcome*

Course Content:

Theory

1. Ecosystem – structure and function, different types of ecosystem, food chains, food webs and energy flow andmineral cycling in ecosystems; primary production and decomposition , Biogeochemical cycle.
2. Global environmental problems: global climate change,ozone layer depletion, the greenhouse effect, global warmingand its consequences.Eutrophication, waste water or sewage treatment. Water quality criteria, standards. Safedrinking water act.Wetland and its importance.
3. Space physiology- physiological adjustments in humans due to prolonged exposure in space, nutritionalrequirements of astronaut, special health problems in space, preventive measures of health hazards ofastronauts

4. High altitude physiology-, respiratory problems in high altitude, pulmonary hypertension, adaptation inhighlanddwellers
5. Ionizing and nonionizing radiation- effects on different physiological systemsxenobiotics and their effects
6. Heat stress- physiological and molecular changes in heat stress, prevention of heat stress
7. Stress Physiology – Physiological change in stress, Homeostasis in stress, Oxidative and nitrosative stress –mechanism, management of stress

Practical

Environmental Experiment

1. Measurement of environmental temperature - dry bulb and wet bulb, relative humidity, air velocity.
2. Determination of O2, CO2, BOD and COD. Determination of total alkalinity, Ca, Mg and chlorine in water by titration method

References/ Suggested Readings

1. *General and Comparative Physiology by W.S.Hoar,Prentice-Hall of India Pvt.Ltd.*
2. *Comparative Animal Physiology by C.L.Posser and E.A.Brown. W.B.Saunders.Co.*
3. *Ecology: Principles and Applications by J. L. Chapman and M. J. Reiss, Cambridge University Press*

Semester- VI

Course Name: Occupational Health

Course Code: BSCHPHYDSE602

Course Type: **Core (Theory+Practical)**	Course Details: **DSEC- 5**			L-T-P: 4**- 0 –2**	
Credit: 4+2	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Evaluate workplace to determine the existence of occupational safety and health hazards*
2. *Identify relevant regulatory and national consensus standards along with best practices thatare applicable.*
3. *Select appropriate control methodologies based on the hierarchy of controls*
4. *Analyze injury and illness data for trends.*

Course Content:

Theory

Occupational health

1. Occupational Health – definition, factors affecting occupational health.
2. Occupational health hazards –(i)Occupational hazards in work place – mechanical , chemical, biological, fire, toxic substances, and explosivematerials ,(ii) Environmental hazards – Heat stress, cold stress, noise, vibration, ultra-violet radiation.
3. Occupational safety and health – concept of health and safety; Accidents – theories of accident, effect onindustry; promotion of safety, health and safety training, personal protective devices
4. Occupational diseases – Pneumoconiosis, silicosis, asbestosis, Occupational cancer – skin, lungs, urinarybladder,
5. Occupational health problem of agricultural workers
6. Prevention and health measures of occupational hazards – nutrition, disease control, environmental sanitation,medical measures, ergonomic measures, legislation
7. Occupational stress – causes, evaluation of stress,management of stress

Practical

Project Submission on Field Survey

Students are required to submit a project report on (a) or (b).

(a) On the basis of field survey / laboratory work under the guidance of a teacher. The field survey / laboratorystudiesshouldbe carried out by assessing any one from the followings:

1. Diet survey report of a family (as per ICMR specification)
1. Physiological parameters of humans (at least three parameters).
2. Anthropometric parameters on humans (at least three parameters).
3. Epidemiological studies on humans.
4. Physiological parameters of animals(at least three parameters).

(b) A report may be submitted on the visit to Institute of national importance engaged in physiological, biomedical, biochemical and nutritional research.

References/ Suggested Readings

1. *Energy, Work and Leisure by J.V.G.A.Durin and R.Passmore. Heinemann Educational Books*

Semester- VI

Course Name: Microbiology and Immunology

Course Code: BSCHPHYDSE603

Course Type: **Core (Theory+Practical)**	Course Details: **DSEC- 6**			L-T-P: 4**- 0 –2**	
Credit: 4+2	Full Marks: **100**	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	**10**	**20**	**40**

Course Learning Outcomes:

After the completion of course, the students will have ability to:

1. *Define/explain within multiple microbiology disciplines the core theories and practices;*
2. *Describe/explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations;*
3. *Explain the theoretical basis of the tools, technologies and methods common to microbiology; and*
4. *Demonstrate practical skills in the use of tools, technologies and methods common to microbiology, and apply the scientific method and hypothesis testing in the design and execution of experiments.*
5. *Learn the basic structure of immune system and realizesits importance.*
6. *Learn antigen recognition and presenting*
7. *Learn structure, of antibody and classes of antibody.*
8. *Learn the basic functions of immunity of humoral and cellular types.*
9. *Learn the functions of the immune system abnormally, hypersensitivity reactions and the basic mechanisms of autoimmune reactions.*
10. *Learn the basic mechanism of antigen antibody reactions.*
11. *Learn methods of protection against infectious diseases.*
12. *Learn diagnosis of infectious diseases which methods are determined.*

Course Content:

Theory

Microbiology

1. Bacterial prokaryotic cell. Classification of bacteria on the basis of morphology and staining characteristics – Gram staining, spore staining and acid-fast staining.
2. Bacterial nutritional requirements, nutritional types, culture media, physical conditions for growth.
3. Growth curve of bacteria. Bacterial metabolism- fermentation, glyoxylate cycle, Entner-Doudoroff pathway.
4. Bacterial genetics, transformation, conjugation and transduction.
5. Sterilization and pasteurization. Elementary idea of bacteriostatic and bactericidal agents viz. phenols, alcohol and antibiotics.
6. Elementary knowledge of virus: morphology, viral genome & classification.

Immunology

1. Immunity: Definition, innate immunity, mechanical barrier against pathogenic organism. Antibacterial & antifungal substances in external body secretions, bactericidal actions of HCL, inflammatory responses & its role in body defences, chemotaxis& phagocytosis, lysozyme, role of phagocytes.
2. Acquired immunity, active immunity & passive immunity. Humoral & cell mediated immunity, primary & secondary immune responses.
3. Mechanisms of humoral immunity, antigens, hapten, B- lymphocytes, plasma cells, Classification & molecular structure of immunoglobulins, antigen- antibody reactions & their effects. MAB – complements, classification of complements & their activation, function of complements.
4. Mechanisms of cell mediated immunity. T- lymphocytes, suppressor, helper & killer T cells. Cytotoxic &cytolytic effects of T cells. T- cell B- cell cooperation. Role of macrophages in cell mediated immunity.
5. Cytokines &lymphokines. Antitoxins, interferons, hypersensitivity reaction, anaphylaxis, their effects & examples in the human system.
6. Blood groups, antigens & serum agglutinins. Human leucocyte antigens, autoimmunization. Autoimmune diseases of thyroid & kidney & muscle, AIDS, tumour immunology. ELISA test.

Practical

Experiments on Microbiology

Gram staining of bacteria and identification of Gram positive and Gram negative bacteria. Demonstration: Spore Staining, Immuno-diffusion.

References/ Suggested Readings

1. *Essential Immunology, by I.M. Roitt, Blackwell Scientific Publication*
2. *Microbiology, by M.J.Pelczer& Others; Tata McGraw Hill Publishing Co Ltd.*