National Curriculum and Credit Framework (NCCF)

Syllabus

for

Major Courses in Physiology

w.e.f. Academic Session 2023-24

Kazi Nazrul University

Asansol, Paschim
Bardhaman West Bengal
713340

Basic Structural Framework of the Syllabus:

SEMESTER I:

SEMESTER	COURSE TYPE	PAPER CODE	PAPER NAME	CREDIT	MARKS
1	MAJOR- (MJC-1)	BSCPHYMJ101	CELL BIOLOGY AND BIOCHEMISTRY	05	100
1	MINOR- (MNC-1)	BSCPHYMN101	CELL BIOLOGY AND BIOCHEMISTRY	05	100
1	MD (MDC-1)	See Pool	See Pool	3	50
1	SKILL ENHANCEMENT COURSES (SEC-1)	BSCPHYSE101	HUMAN EXPERIMENT	03	50
1	Ability Enhancement (AE)	AEC-1	English/MIL Communication	04	50

MAJOR COURSE (MJC)

SEMESTER I

Course Name: CELL BIOLOGY AND BIOCHEMISTRY

Course Code: **BSCPHYMJ101**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: MJC-1</td><td colspan="2">L-T-P: 3-0-4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Learning outcomes:

- *Students will understand the structures and purposes of basic components prokaryotic and eukaryotic cells will especially macromolecules membrane and organelle student will understand how these cellular components are used to generate and utilized energy in cells.*
- *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.*
- *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.*
- *Understand the principles of various fields of biochemistry and genetics.*
- *Develop transferable quantities skill apply modern instrumentation theory and practice to biochemical problem.*
- *The student will be able to correlate the various metabolites of carbohydrate, protein and fat.*
- *The learning outcomes are designed to help learners understands the objectives of studying B.Sc Honours physiology.*

THEORY (MJC-1)

Paper Name (Theory): Cell Biology and Biochemistry

Unit I: Brief Overview of Physiological Systems [5 Marks]

- Brief Overview of Physiological Systems: Basics of anatomy, functional organization and physiological functions of Cardiovascular system, Respiratory system, Digestive system, Endocrine system, Nervous system, Reproductive system, Excretory system and Blood and Immune system.

Unit II: Cellular Basis of Physiology [10 Marks]

- General concept of structure and functions of animal tissues and cells: Anatomy, electron microscopic structure and functions of animal tissues, eukaryotic cells and cell organelles (Nucleus, endoplasmic reticulum, ribosomes, Golgi bodies, mitochondria) lysosomes, peroxisomes, cytoskeletal elements, centrosomes and plasma membrane.
- Cellular transport: Passive and active transport. Ion channels, ionophores. Intercellular communication: Basic idea of tight junctions, gap junctions, adherens junctions, desmosomes and cell adhesion molecules, Extracellular matrix components.

Unit III: Chemistry of Biomolecules [20 Marks]

- **Carbohydrates:** Definition and classification. Monosaccharides – Classification, structure, stereoisomerism, optical isomerism, optical activity, epimerism. Cyclic structures- Pyranose and furanose forms, anomerism, 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, deoxy sugars, sugar alcohols, sugar acids, sugar esters, their biochemical and physiological importance. Disaccharides – Maltose, Lactose and Sucrose: Structure, Occurrence and Physiological importance. Polysaccharides – Starch, Glycogen, dextrin, Cellulose, Glycosaminoglycans, Glycoproteins, Sialic acids.
- **Lipids:** Definition and classification. Fatty acids - Classification, systemic nomenclature and structure. Mono-, Di- and Triglycerides. Properties of Fat and Fatty acids Hydrolysis, saponification number, Iodine number, Acetyl number, Acid number, Reichert-Meissl number. Cis-trans isomerism. Eicosanoids, Phospholipids, Glycolipids, Sphingolipids, Steroids and sterols, Cholesterol & its ester -their structure

and physiological importance. Lipoproteins - Structure and classification. Micelle, bilayer, Liposome.

- **Proteins:** Amino acids: Classification, Structure, Nomenclature and Optical properties. Protonic equilibria of amino acids – Zwitterions, Isoelectric point, titration curve of amino acids. Reactions with ninhydrin and formaldehyde. 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 Quaternary. Forces stabilizing the structures. Denaturation and Renaturation.
- **Nucleic Acids**: Purine and Pyrimidine bases: Structure, nomenclature and tautomerism. Nucleic acids: Nucleosides and Nucleotides-structure. Polynucleotides. DNA double helix, Primary, Secondary and Tertiary structure. A-DNA, B-DNA and Z-DNA. RNA - Structure, types, features. Denaturation and annealing of DNA. Hyperchromicity, melting temperature and half Cot value.

PRACTICAL (MJC-1)

Paper Name (Practical): Cell Biology and Biochemistry

1. Qualitative analysis for the identification of physiologically important substances: Starch, Dextrin, Glucose, Fructose, Lactose, Maltose, Sucrose, Albumin, Gelatine, Peptone, Hydrochloric acid, Lactic Acid, Uric Acid, Urea, Acetone, Glycerol and Bile salts.

Recommended readings:

1. *Best and Taylor's Physiological basis of Medical Practices, by B.K. Brobecks. The William and Wilkins Co.*
2. *Review of Medical Physiology, by W.F. Ganong, Lange Medical Book. Pretices- Hall International. Mc Graw Hill.*
3. *Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.*
4. *Molecular Biology of the Gene, by J.D.Watson; H.H.Nancy& others; BenjaminCummings.*
5. *Molecular Biology of the Cell, by B. Alberts and others,Garland*
6. *Molecular Cell Biology, by H. Lodish; D. Baltimore & Others. Scientific American Book.*

7. *Harper's Illustrated Biochemistry, by R. K. Murray & others. Lange Medical Book, International Edition, McGraw Hill.*
8. *Lehninger's Principles of Biochemistry. By D. L. Nelson and M.M. Cox, Worth Publishers Inc.*
9. *Text Book of Biochemistry, by E.S. West; W. R. Todd.; H. S. Mason; J. T. VanBruggen. The Macmillan Company.*
10. *Biochemistry. By D. Das. Academic Publishers.*
11. *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.*
12. *Practical Biochemistry in Medicine by SrinivasRao., Academic Publishers.*
13. *Note Books on Practical Biochemistry. (Published by the Physiological Society of India, Kolkata.)*

SKILL ENHANCEMENT COURSES (SEC)

SEMESTER I

Course Name: **HUMAN EXPERIMENT**

Course Code: **BSCPHYSE101**

Course Type: Core (Practical)	Course Details: SEC-1			L-T-P: 0–0-3	
Credit: 3	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	…	20	…

Learning outcomes:

- *At the end of this course, students will be provided with useful information about the health and well-being*
- *This course will help them to evaluate the impact and effectiveness of public health interventions, policies, and programs on human populations and communities.*
- *Knowing the exact principles and procedures of measurement of physical fitness, BMI, BSA, body fat, etc. will help them in the understanding of injury management and disease prevention.*

PRACTICAL (SEC-1)

Paper Name (Practical): Human Experiment

Unit I: Determination of BMI, BSA, PI, CI, waist-hip ratio, MUAC, body fat percentage. Determination of physical fitness by Harvard and modified Harvard Step Tests, Measurement of systolic and diastolic arterial blood pressure by sphygmomanometer and determination of pulse and mean pressure. Determination of heart rate by palpation.

Recommended readings:

1. *Physiology, by R.M. Berne and M.N. Levy, C.V Mosby Co.*
2. *The Physiological Basis of Physical Education and Athletics, by W.D. McArdle, F. Katch and V.L Katch. Williams and Wilkins.*

3. *The Text Book of Work Physiology by P.O. Astrand and K. Rodhal. McGraw-Hill Books Co.*
4. *Human factors in Engineering and Design, by E.O. McCormick and M. Sanders. Tata McGraw Hill.*
5. *Sports Physiology, by E.L. Fox, Saunders College Publishing Holt-Saunders.*
6. *Ross and Wilson Anatomy and Physiology in Health and Illness, by A. Waugh and A. Grant. International Edition, Churchill Livigstone Elesvier.*
7. *Ergonomics in Sport and Physical Activity, Enhancing performance and improving safety by Thomas Reilly, Publisher:- Human Kinetics.*
8. *Exercise Physiology and Ergonomics by Asis Goswami, Academic Publishers.*

MINOR COURSE (MNC)

SEMESTER I

Course Name: CELL BIOLOGY AND BIOCHEMISTRY

Course Code: **BSCPHYMN101**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: MJC-1</td><td colspan="2">L-T-P: 3-0-4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
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- *Understand the principles of various fields of biochemistry and genetics.*
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- *The student will be able to correlate the various metabolites of carbohydrate, protein and fat.*
- *The learning outcomes are designed to help learners understands the objectives of studying B.Sc Honours physiology.*

THEORY (MNC-1)

Paper Name (Theory): Cell Biology and Biochemistry

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- Brief Overview of Physiological Systems: Basics of anatomy, functional organization and physiological functions of Cardiovascular system, Respiratory system, Digestive system, Endocrine system, Nervous system, Reproductive system, Excretory system and Blood and Immune system.

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- General concept of structure and functions of animal tissues and cells: Anatomy, electron microscopic structure and functions of animal tissues, eukaryotic cells and cell organelles (Nucleus, endoplasmic reticulum, ribosomes, Golgi bodies, mitochondria) lysosomes, peroxisomes, cytoskeletal elements, centrosomes and plasma membrane.
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Unit III: Chemistry of Biomolecules [20 Marks]

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and physiological importance. Lipoproteins - Structure and classification. Micelle, bilayer, Liposome.

- **Proteins:** Amino acids: Classification, Structure, Nomenclature and Optical properties. Protonic equilibria of amino acids – Zwitterions, Isoelectric point, titration curve of amino acids. Reactions with ninhydrin and formaldehyde. 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 Quaternary. Forces stabilizing the structures. Denaturation and Renaturation.
- **Nucleic Acids**: Purine and Pyrimidine bases: Structure, nomenclature and tautomerism. Nucleic acids: Nucleosides and Nucleotides-structure. Polynucleotides. DNA double helix, Primary, Secondary and Tertiary structure. A-DNA, B-DNA and Z-DNA. RNA - Structure, types, features. Denaturation and annealing of DNA. Hyperchromicity, melting temperature and half Cot value.

PRACTICAL (MNC-1)

Paper Name (Practical): Cell Biology and Biochemistry

1. Qualitative analysis for the identification of physiologically important substances: Starch, Dextrin, Glucose, Fructose, Lactose, Maltose, Sucrose, Albumin, Gelatine, Peptone, Hydrochloric acid, Lactic Acid, Uric Acid, Urea, Acetone, Glycerol and Bile salts.

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12. *Practical Biochemistry in Medicine by SrinivasRao., Academic Publishers.*
13. *Note Books on Practical Biochemistry. (Published by the Physiological Society of India, Kolkata.)*

Basic Structural Framework of the Syllabus:

SEMESTER II:

SEMESTER	COURSE TYPE	PAPER CODE	PAPER NAME	CREDIT	MARKS
2	MAJOR-(MJC-2)	BSCPHYMJ201	CELL SIGNALLING, ENZYMES AND BIOPHYSICS	05	100
2	MINOR-(MNC-2)	BSCPHYMN201	CELL SIGNALLING, ENZYMES AND BIOPHYSICS	05	100
2	MD (MDC-2)	See Pool	See Pool	03	50
2	VA	(VAC-1)	Environmental Studies	04	50
2	SKILL ENHANCEMENT COURSES (SEC-2)	BSCPHYSE201	APPLIED WORK AND EXERCISE PHYSIOLOGY	02	50

MAJOR COUSES (MJC-2)

SEMESTER II

Course Name: **CELL SIGNALLING, ENZYMES AND BIOPHYSICS**

Course Code: **BSCPHYMJ201**

<table>
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(Theory + Practical)</td><td colspan="2">Course Details: CC-2</td><td colspan="2">L-T-P: 3-0-4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
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<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Learning outcomes:

- *Students will be able to understand the basic principles of signal transduction mechanisms, in particular the concepts of response specificity, signal amplitude and duration, signal integration and intracellular location, give examples of different types of extracellular signals and receptors, and explain their functional significance, describe the mechanisms by which different receptors may be activated by their respective ligands, describe and give examples of the structure and properties of the major components of signal transduction pathways.*
- *Enzymes are bio-catalyst which are highly specific and help to accelerate reactions taking place in organisms. 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.*
- *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 (MJC-2)

Paper Name (Theory): Cell Signalling, Enzymes and Biophysics

Unit I: Cell signalling [10 Marks]

- **Cell signalling:** Definition, Types (Autocrine, Endocrine, Paracrine and signalling by direct contact), Stages of cell signalling (Reception, Transduction and Response), Cell surface receptor proteins – ion channel coupled, G-protein coupled and enzyme-coupled. Intracellular messengers – cAMP, cGMP, IP3, DAG, Protein kinases, Ca2+, CO, NO.
- **Signal transduction pathways:** Phosphatidyl inositides, MAP kinase, JAK-STAT, Raf-Ras, SMAD.

Unit II: Enzyme [15 Marks]

- Definition, Chemical nature of enzymes, comparison between enzymes and inorganic catalyst, Classification, EC. Nomenclature, Concept of apoenzyme, holoenzyme, coenzyme, cofactors, and prosthetic group. Metals in enzyme activity, Enzyme - Substrate complex, Active site, Binding site.
- Models for Enzyme – Substrate interactions (Fischer's template of Lock and Key model and Koshland's induced fit model), Enzyme specificity, Concept of initial rate, maximum velocity and steady-state kinetics. Michaelis-Menten constant (Km), Derivation of Michaelis-Menten equation, Graphical representation of hyperbolic kinetics, Linear transformation of Michaelis-Menten equation: Lineweaver-Burk double reciprocal plot, *Eadie- Hofstee plot, Wolf-Hanes plot,* Significance of Km and Vmax.
- Factors influencing enzyme-catalyzed reactions: substrate concentration, enzyme concentration, pH, temperature. Competitive, noncompetitive, and uncompetitive inhibitions. Regulation of enzyme activities — Irreversible covalent activation, Reversible covalent modifications, Allosteric modulation, Sigmoid Kinetics and Hill equation, K and M series of enzymes. Feedback inhibition. Rate-limiting enzymes and its features, multi-enzymes, Isozymes, Ribozymes and Abzymes.

Unit III: Biophysics and Biophysical Principle [10 Marks]

- Diffusion: Its characteristics, factors influencing and physiological applications. Osmosis: Osmotic pressure – laws, determination – freezing point depression method and physiological applications.
- Surface tension & viscosity: Physiological applications. pH & Buffer, Henderson Hasselbach – equation (quantitative problems). Determination of pH.
- Colloids: Classification, properties (optical, electrical, electrokinetic), Physiological importance of colloids. Definition and physiological importance of Dialysis, adsorption, Gibbs-Donnan membrane equilibrium, endocytosis.
- 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.

PRACTICAL (MJC-2)

Paper Name (Practical): Cell Signalling, Enzymes and Biophysics

1. **Study and identification of stained section of different mammalian tissues** and organs: Parotid gland, Submaxillary gland, Sublingual gland, Tongue, Oesophagus, Stomach, Duodenum, Jejunum, Ileum, Large intestine, Liver, Kidney, Ureter, Pancreas, Spleen, Lymph gland, Lung, Trachea, Thyroid gland, Adrenal gland, Ureter, Kidney, Skin, Ovary, Testis, Uterus, Spinal Cord, Cerebellum, Cerebrum, Cardiac muscle, Skeletal Muscle, Smooth muscle, Artery, Vein, Bone, Cartilage.
2. **Permanent Slide Preparation and Staining**
3. **Study of charts on Cell signalling**
4. **Demonstration: Preparation of Buffer and pH measurement.**

Recommended readings:

1. *Biomedical Instrumentation & Measurements, by L. Cromwell, F. J. Weibell & E. A. Pfeiffer; Prentice-Hall of India Pvt Ltd.*
2. *Biophysics and Biophysical Chemistry, by D. Das. Academic Publishers*
3. *Molecular Biology of the Gene, by J. D. Watson; H. H. Nancy& others; Benjamin-Cummings.*
4. *Molecular Biology of the Cell, by B. Alberts and others, Garland.*
5. *Neurobiology, by G.M. Shepherd. Oxford University Press*

6. *Molecular Cell Biology, by H. Lodish; D. Baltimore & Others. Scientific American Book.*
7. *Mescher A.L. (2013). Junqueira's Basic Histology Text and Atlas. Thirteen Edition. The Tata McGraw Hill Companies.*
8. *Ross M.H and Reith, E.J. (2011). Histology - A Text and Atlas. Sixth Edition. The Williams and Wilkins Company.*
9. *Bailey's Text Book of Histology, revised by W.M. Copenhaver; The Williams and Wilkins Company.*
10. *Eroschenko V.P. (2012). Difiore's Atlas of Histology: With Functional Correlations. Twelfth Edition. Lippincott Williams Wilkins Company.*

MINOR COURSE (MNC-2)

SEMESTER II

Course Name: **CELL SIGNALLING, ENZYMES AND BIOPHYSICS**

Course Code: **BSCPHYMN201**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: CC-2</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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Learning outcomes:

- *Students will be able to understand the basic principles of signal transduction mechanisms, in particular the concepts of response specificity, signal amplitude and duration, signal integration and intracellular location, give examples of different types of extracellular signals and receptors, and explain their functional significance, describe the mechanisms by which different receptors may be activated by their respective ligands, describe and give examples of the structure and properties of the major components of signal transduction pathways.*
- *Enzymes are bio-catalyst which are highly specific and help to accelerate reactions taking place in organisms. After interacting with this the students will be able to:*
  - *e. Describe enzymes and their components*
  - *f. Recall energetic enzymatic reactions*
  - *g. List out models for enzyme substrate binding*
  - *h. The students will acquire knowledge of kinetics of enzymatic reaction and enzyme inhibition.*
- *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 (MNC-2)

Paper Name (Theory): Cell Signalling, Enzymes and Biophysics

Unit I: Cell Signalling [10 Marks]

- **Cell signalling:** Definition, Types (Autocrine, Endocrine, Paracrine and signalling by direct contact), Stages of cell signalling (Reception, Transduction and Response), Cell surface receptor proteins – ion channel coupled, G-protein coupled and enzyme-coupled. Intracellular messengers – cAMP, cGMP, IP3, DAG, Protein kinases, Ca2+, CO, NO.
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- Factors influencing enzyme-catalyzed reactions: substrate concentration, enzyme concentration, pH, temperature. Competitive, noncompetitive, and uncompetitive inhibitions. Regulation of enzyme activities — Irreversible covalent activation, Reversible covalent modifications, Allosteric modulation, Sigmoid Kinetics and Hill equation, K and M series of enzymes. Feedback inhibition. Rate-limiting enzymes and its features, multi-enzymes, Isozymes, Ribozymes and Abzymes.

Unit III: Biophysics and Biophysical Principle [10 Marks]

- Diffusion: Its characteristics, factors influencing and physiological applications. Osmosis: Osmotic pressure – laws, determination – freezing point depression method and physiological applications.
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PRACTICAL (MNC-2)

Paper Name (Practical): Cell Signalling, Enzymes and Biophysics

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10. *Eroschenko V.P. (2012). Difiore's Atlas of Histology: With Functional Correlations. Twelfth Edition. Lippincott Williams Wilkins Company.*

SKILL ENHANCEMENT COURSES (SEC)

SEMESTER II

Course Name: **APPLIED WORK AND EXERCISE PHYSIOLOGY**

Course Code: **BSCPHYSE201**

Course Type: Core (Practical)	Course Details: SEC-2			L-T-P: 3-0-0	
Credit: 3	Full Marks: 50	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		---	30	---	20

Learning outcomes:

- *This course will provide a wide knowledge about structural and functional organization of different body systems.*
- *The students will have gain detailed knowledge about the principles of exercise and training.*
- *They acquire a concept about the importance of physical activity, exercise, yoga and meditation on health.*
- *From this course students will gather the knowledge about the muscle physiology and their involvement in different types of exercise.*
- *The course would fortify to the students to acquire the knowledge about injury management.*

THEORY (SEC-2)

Paper Name (Theory): Applied Work and Exercise Physiology

Unit I: Definitions of work and exercise Physiology, Fundamental concepts of work, different categories of work. Physical work—its definition and nature—isotonic, isometric and isokinetic, positive and negative work.

Physiological basis of work: Concept of physiological work. Power and capacity relation. Workload light, moderate (submaximal) and heavy (maximal) depending on intensity and duration of work. Changes in heart rate, oxygen consumption and blood pressure to assess

person's ability to withstand work load. Effect of heat stress on physiological responses to work load, Aerobic and anaerobic capacity, EPOC, OBLA, lactate threshold and lactate tolerance and their usefulness. Athletic performance based on aerobic and anaerobic capacity. Brief general idea about nutritional aspects of sports.

Recommended readings:

1. *Physiology, by R.M. Berne and M.N. Levy, C.V Mosby Co.*
2. *The Physiological Basis of Physical Education and Athletics, by W.D. McArdle, F. Katch and V.L Katch. Williams and Wilkins.*
3. *The Text Book of Work Physiology by P.O. Astrand and K. Rodhal. McGraw-Hill Books Co.*
4. *Human factors in Engineering and Design, by E.O. McCormick and M. Sanders. Tata McGraw Hill.*
5. *Sports Physiology, by E.L. Fox, Saunders College Publishing Holt-Saunders.*
6. *Ross and Wilson Anatomy and Physiology in Health and Illness, by A. Waugh and A. Grant. International Edition, Churchill Livigstone Elesvier.*
7. *Ergonomics in Sport and Physical Activity, Enhancing performance and improving safety by Thomas Reilly, Publisher:- Human Kinetics.*
8. *Exercise Physiology and Ergonomics by Asis Goswami, Academic Publishers.*

Basic Structural Framework of the Syllabus:

SEMESTER III:

SEMESTER	COURSE TYPE	PAPER CODE	PAPER NAME	CREDIT	MARKS
III	MAJOR- MJC-3	BSCPHYMJ301	Haematology and Cardiovascular System	5	100
III	MAJOR- MJC-4	BSCPHYMJ302	Respiration and Circulation	5	100
III	MINOR- MNC-3	BSCPHYMN301	Haematology and Cardiovascular System	5	100
III	MD-MDC-3	BSCPHYMD301	Multidisciplinary Courses offered in 3rd Semester across the faculties	3	50
III	AEC-2	AEC-2	English Communication	4	50

MAJOR COURS (MJC)

SEMESTER III

Course Name: Haematology and Cardiovascular System

Course Code: **BSCPHYMJ301**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: MJC-3</td><td colspan="2">L-T-P: 3-0-4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Learning outcomes:

- *Describe the various constituents of blood, haematopoiesis, function and maturation of red cells, white cells and platelets, blood types, transfusion, tissue, and organ transplantation.*
- *Describe endothelial function, blood coagulation and discuss the most common abnormalities and complications relating to endothelial dysfunction and failure of haemostasis.*
- *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*
- *Explain the relationship between the structure and function of the arteries, veins and capillaries.*
- *Identify and describe the interior and exterior parts of the human heart*
- *Describe the path of blood through the cardiac circuits*
- *Describe the size, shape, and location of the heart*
- *Compare cardiac muscle to skeletal and smooth muscle*
- *Explain the cardiac conduction system*
- *Describe the process and purpose of an electrocardiogram*
- *Explain the cardiac cycle*
- *Calculate cardiac output*
- *Describe the effects of exercise on cardiac output and heart rate*
- *Name the centres of the brain that control heart rate and describe their function*

- *Identify other factors affecting heart rate*
- *Explain and classify common cardiovascular conditions.*
- *Analyse factors leading to hypertension, as well as approaches useful in preventing and treating the condition*

THEORY (MJC-3)

Paper Name (Theory): Haematology and Cardiovascular System

Unit 1: Blood [15 Marks]

1.1. Blood- properties & composition
1.2. Plasma proteins-Classification, Values & Functions, Plasmapheresis
1.3. Bone Marrow-Classification & Functions
1.4. White Blood Cells-types, characters, shape & size, Functions
1.5. Immune activities of blood Platelets
1.6. Red Blood Cells-Biosynthesis & Factors affecting it
1.7. Haemoglobin – Structure, compounds and derivatives, biosynthesis, and catabolism. Foetal haemoglobin, Embryonic haemoglobin.
1.8. Haemoglobinopathies- Thalassemia, Sickle-cell anaemia. Anaemia-different types and their causes
1.9. Blood volume –regulation and determination by dye and radioisotope methods
1.10. Haemostasis–factors, mechanism, anti-clotting mechanism, anticoagulants, procoagulants. Disorders of haemostasis-Haemophilia, Thrombosis and Embolism
1.11. Blood grouping – ABO and Rh systems, H- antigen. Erythroblastosis fetalis and Rh antigens. Bombay type blood group
1.12. Blood transfusion and its hazards. Red cell fragility
1.13. TC, DC, ESR, MCH, MCHC, PCV, Leukaemia, Leucocytosis, Leukopenia, Purpura, Arneth count
1.14. Blood Volume- Values, physiological variations, measurements, and regulations
1.15. Spleen- Structure & function
1.16. Lymph-Lymphatic system, Source, Composition, circulation, and functions. Edema.

Unit 2: Cardiovascular System – I (Anatomy and Electrical Activity of the Heart) [10 Marks]

2.1 Histology of Heart- Nodal tissues, ventricles, and valves.
2.2 Properties of cardiac muscle.
2.3 Origin and propagation of cardiac impulse-action potential in nodal and ventricular muscles.
2.4 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.

2.5 Electrocardiography – the normal electrocardiogram, electrocardiographic leads, vectorial analysis, the vector cardiogram, the mean electrical axis of heart. The His bundle electrogram.

2.6 Principles of Echocardiography. Cardiac Arrhythmias. Myocardial Infarction.

Unit 3: Cardiovascular System – II (Regulation of Cardiovascular functions) [10 Marks]

3.1 Functional morphology of arteries, arterioles, capillaries, venules and veins, sinusoids.

3.2 General pattern of circulation and significance of branching of blood vessels. The pulse – arterial and venous.

3.3 Haemodynamic of blood flow.

3.4 Blood pressure– its measurement and factors affecting.

3.5 Cardiovascular homeostasis – neural and chemical control of cardiac functions and blood vessels.

3.6 Cardiac and vasomotor centres, baroreceptors and chemoreceptors, innervation of the heart and blood vessels, cardiac and vasomotor reflexes.

3.7 Cardiovascular adjustment after haemorrhage.

PRACTICAL (MJC-3)

Paper Name (Practical): Haematology and Cardiovascular System

1.1 Haematological experiments: Preparation and staining of blood film with Leishman's stain.

1.2 Identification of blood corpuscles.

1.3 Differential count of WBC.

1.4 Total count of RBC and WBC.

1.5 Haemoglobin estimation by Shali's hemoglobinometer method.

1.6 Preparation of haemin crystals.

1.7 Preparation and staining of bone marrow smear.

1.8 Measurement of diameter of megakaryocyte.

1.9 Reticulocyte staining.

1.10 Blood group determination.

1.11 Demonstration: Haematocrit, MCV, MCH and MCHC. Bleeding time, Clotting time, ESR.

1.12 Effect of adrenaline, acetyl choline, temperature, load on cardiac muscle contraction of toad heart

1.13 Measurement of electrical activity of heart by ECG

1.14 Measurement of blood pressure.

Recommended readings:

1. *Best and Taylor's Physiological basis of Medical Practices, by B.K. Brobecks. The William and Wilkins Co.*
2. *Review of Medical Physiology, by W.F. Ganong, Lange Medical Book. Prentices- Hall International. Mc Graw Hill.*
3. *Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.*
4. *Molecular Biology of the Gene, by J.D.Watson; H. H. Nancy& others; Benjamin Cummings.*
5. *Molecular Biology of the Cell, by B. Alberts and others, Garland*
6. *Molecular Cell Biology, by H. Lodish; D. Baltimore & Others. Scientific American Book.*
7. *Harper's Illustrated Biochemistry, by R. K. Murray & others. Lange Medical Book, International Edition, McGraw Hill.*
8. *Lehninger's Principles of Biochemistry. By D. L. Nelson and M.M. Cox, Worth Publishers Inc.*
9. *Text Book of Biochemistry, by E.S. West; W. R. Todd.; H. S. Mason; J. T. VanBruggen. The Macmillan Company.*
10. *Biochemistry. By D. Das. Academic Publishers.*
11. *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.*
12. *Practical Biochemistry in Medicine by Srinivas Rao., Academic Publishers.*
13. *Note Books on Practical Biochemistry. (Published by the Physiological Society of India, Kolkata.)*

MAJOR COURS (MJC)

SEMESTER III

Course Name: **Respiration and Circulation**

Course Code: **BSCPHYMJ302**

Course Type: Core (Theory + Practical)	Course Details: MJC-3			L-T-P: 3-0-4	
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Learning Outcomes:

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

- *Describe and illustrate the main anatomical structures of the respiratory system and the mechanics of inspiration and expiration*
- *List the major functions of the respiratory system*
- *Outline the forces that allow for air movement into and out of the lungs*
- *Outline the process of gas exchange*
- *Discuss the factors that affect pulmonary ventilation*
- *Outline the mechanisms of O2 and CO2 transport in the blood*
- *Describe diseases resulting from mutations in haemoglobin*
- *Demonstrate an understanding of the control of the respiration rate.*
- *Create a flowchart illustrating how respiration is controlled*
- *Discuss how the respiratory system responds to exercise*
- *Explain the importance of water in the body*
- *Contrast the composition of the intracellular fluid with that of the extracellular fluid*
- *Explain the importance of protein channels in the movement of solutes*
- *Identify the causes and symptoms of edema*
- *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.*

- *Describe the phasic flow of blood to the ventricular myocardium through an entire cardiac cycle.*
- *Contrast the local and neural control of cerebral blood flow. Discuss the relative importance of O2, CO2, and pH in regulating cerebral blood flow.*
- *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.*
- *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.*
- *Contrast local and neural control of cutaneous blood flow.*
- *Discuss the unique characteristics of skin blood flow that are adaptive for body temperature regulation.*

THEORY (MJC-4)

Paper Name (Theory): Respiration and Circulation

Unit 1: Respiratory System [20 Marks]

1.1 Anatomy and histology of the lung and airways
1.2 Non-respiratory functions of lung
1.3 Pulmonary ventilation- Spirometer, Douglas bag
1.4 The ventilation boundaries of the Lung- TV, IRV, ERV, RV, FRC, IC, TLC, VC, MVV etc.
1.5 Dead Space, Ventilation- perfusion ratio and alveolar ventilation
1.6 Pulmonary Gas Exchange- Oxygen transport, blood-Oxygen dissociation curve of haemoglobin and myoglobin – factors affecting it, Carbon dioxide transport, Carbon dioxide dissociation curve.
1.7 Haldane Effect, Bohr Effect, Chloride shift
1.8 Mechanics of breathing -- Role of respiratory muscles, glottis. Lung volumes and capacities.
1.9 Compliance of lungs and chest wall, pressure-volume relationship, alveolar surface tension and surfactant, work of breathing.
1.10 Regulation of respiration -- neural and chemical, respiratory centres, chemoreceptors, baroreceptors, pulmonary receptors.
1.11 Hypoxia – types, effects. Asphyxia, Voluntary hyperpnoea, Apnoea, Cyanosis, Periodic breathing, Asthma, Emphysema.
1.12 Lung function tests. Artificial respiration. Concept of non-respiratory functions of lung.

Unit 2: Regional Circulation [15 Marks]

2.1 Microcirculation- Anatomy and regulation of blood flow through micro circulation
2.2 Vasoactive chemicals, Oedema
2.3 Cerebral Circulation- Anatomy, Mechanisms, Peculiarities and Regulation
2.4 Coronary Circulation- Anatomy, Mechanisms, Peculiarities and Regulation
2.5 Cutaneous Circulation and Circulation through Skeletal Muscle
2.6 Placental and Foetal Circulation

PRACTICAL (MJC-4)

Paper Name (Practical): Respiration and Circulation

1.1 Pneumographic recording of effects of talking, drinking, laughing, coughing, exercise, hyperventilation, and breath-holding
1.2 Body Surface Area and Spirometric measurement of VC, TV, IRV, ERV, FEV_1 etc.
1.3 Measurement of changes in respiratory rate during pre- and post-exercise
1.4 Effect of graded exercise on respiratory rate
1.5 Measurement of oxygen saturation by pulse oximeter before and after exercise
1.6 Determination of Physical Fitness Index by Harvard Step Test (Modified).

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.
5. Best and Taylor's Physiological basis of Medical Practices, by B.K. Brobecks. The William and Wilkins Co.
6. Review of Medical Physiology, by W.F. Ganong, Lange Medical Book. Prentices- Hall International. Mc Graw Hill.
7. Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.

MAJOR COURS (MJC)

SEMESTER III

Course Name: **Community Health Care**

Course Code: **BSCPHYMD301**

Course Type: Core (Theory)	Course Details: MDC-3			L-T-P: 2-1-0	
Credit: 3	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
			15		35

Learning Outcomes:

- *After the completion of course, the students will have ability to:*
- *Understand and appreciate the diverse socioeconomic, behavioural, sociocultural, biological, environmental, philosophical, and historical factors that influence health, rehabilitation, and human movement*
- *Comprehend the significant theories, models, themes, and ideas in the biomechanical, physiological, behavioural, pedagogical, biological, socioeconomic, environmental, and sociocultural correlations of Kinesiology and Community Health.*
- *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.*
- *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.*

THEORY (MDC-3)

Paper Name (Theory): Community Health Care

1.1 Community health and Nutrition - Definition & concept of health and diseases, dimension of health, health system, Diseases: causation and prevention of diseases, mode of intervention, epidemic and endemic forms of diseases, physiologists as health-counsellors.

1.2 Nutrition in infancy: Nutritional requirements of nutrients during infancy. Breast feeding – nutritional and other factors, advantages, problems in breast feeding, infant milk substitute (IMS) act 1992. Formula feeding, Vitamin and 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-term babies; Feeding problems – food allergies, cow's milk protein allergy, lactose intolerance, diarrhoea, constipations, vegetarianism

1.3 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- Etiology, symptoms, prevention. Nutritional requirement and problem of adolescents- Anorexia nervosa, Bulbnia nervosa, Binge eating disorder, premenstrual syndrome.

1.4 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, edema and leg-cramps, Heart burn, excessive weight gain. Complication- anaemia, toxaemia, Diabetes mellitus

1.5 Nutrition in lactating women: Nutritional requirements, Factors affecting the volume and concentration of breastmilk

1.6 Protein energy malnutrition: - PEM- symptoms, nutritional requirement in dietary management.

1.7 Nutritional anemia: -Prevalence, Iron metabolism, Iron absorption enhancers and inhibitors, Clinical features &management of Iron deficiency anemia, Megaloblastic anemia.

1.8 Cardiovascular disorders-coronary heart disease (CHD): food and nutrients in CHD. Cardiovascular risk factors, and nutritional management of CHD

1.9 Diabetes mellitus-Dietary management of Diabetes mellitus – nutritional requirements, glycaemia index, Complication of diabetes – hypoglycaemia and insulin shock.

1.10 Nutrition and aging: Process of aging, changes in organ function with aging, nutritional requirement, nutrition related problems in old age- osteoporosis, anaemia, obesity, constipation, malnutrition. Antioxidants in the health of old age

1.11 Overweight and obesity: - prevalence, factors – environmental and life style factor, food intake, Genetic factors. Obesity management.

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.

MINOR COURS (MNC)

SEMESTER III

Course Name: **Haematology and Cardiovascular System**

Course Code: **BSCPHYMN301**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: MNC-3</td><td colspan="2">L-T-P: 3-0-4</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>15</td><td>20</td><td>35</td></tr>
</table>

Learning outcomes:

- *Describe the various constituents of blood, haematopoiesis, function and maturation of red cells, white cells and platelets, blood types, transfusion, tissue and organ transplantation.*
- *Describe endothelial function, blood coagulation and discuss the most common abnormalities and complications relating to endothelial dysfunction and failure of haemostasis*
- *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*
- *Explain the relationship between the structure and function of the arteries, veins and capillaries.*
- *Identify and describe the interior and exterior parts of the human heart*
- *Describe the path of blood through the cardiac circuits*
- *Describe the size, shape, and location of the heart*
- *Compare cardiac muscle to skeletal and smooth muscle*
- *Explain the cardiac conduction system*
- *Describe the process and purpose of an electrocardiogram*
- *Explain the cardiac cycle*
- *Calculate cardiac output*
- *Describe the effects of exercise on cardiac output and heart rate*
- *Name the centers of the brain that control heart rate and describe their function*
- *Identify other factors affecting heart rate*
- *Explain and classify common cardiovascular conditions.*

- *Analyse factors leading to hypertension, as well as approaches useful in preventing and treating the condition*

THEORY (MNC-3)

Paper Name (Theory): Haematology and Cardiovascular System

Unit 1: Blood [15 Marks]

1.1 Blood- properties & composition
1.2 Plasma proteins-Classification, Values & Functions, Plasmapheresis
1.3 Bone Marrow-Classification & Functions
1.4 White Blood Cells-types, characters, shape & size, Functions
1.5 Immune activities of blood Platelets
1.6 Red Blood Cells-Biosynthesis & Factors affecting it
1.7 Haemoglobin – Structure, compounds and derivatives, biosynthesis, and catabolism. Foetal haemoglobin
1.8 Haemoglobinopathies- Thalassemia, Sickle-cell anaemia. Anaemia-different types and their causes
1.9 Blood volume –regulation and determination by dye and radioisotope methods
1.10 Haemostasis–factors, mechanism, anti-clotting mechanism, anticoagulants, procoagulants. Disorders of haemostasis-Haemophilia, Thrombosis and Embolism
1.11 Blood grouping – ABO and Rh systems, H- antigen. Erythroblastosis fetalis and Rh antigens. Bombay type blood group
1.12 TC, DC, ESR, MCH, MCHC, PCV, Leukemia, Leukocytosis, Leukopenia, Purpura, Arneth count
1.13 Blood transfusion and its hazards. Red cell fragility
1.14 Blood Volume- Values, physiological variations, measurements, and regulations
1.15 Spleen- Structure & function
1.16 Lymph-Lymphatic system, Source, Composition, circulation, and functions. Edema

Unit 2: Cardiovascular System – I (Anatomy and Electrical Activity of the Heart) [10 Marks]

2.1 Histology of Heart- Nodal tissues, ventricles, and valves.
2.2 Properties of cardiac muscle.
2.3 Origin and propagation of cardiac impulse-action potential in nodal and ventricular muscles.
2.4 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.
2.5 Electrocardiography – the normal electrocardiogram, electrocardiographic leads, vectorial analysis, the vector cardiogram, the mean electrical axis of heart. The His bundle electrogram.
2.6 Principles of Echocardiography. Cardiac Arrhythmias. Myocardial Infarction.

Unit 3: Cardiovascular System – II (Regulation of Cardiovascular functions) [10 Marks]

3.1 Functional morphology of arteries, arterioles, capillaries, venules and veins, sinusoids.
3.2 General pattern of circulation and significance of branching of blood vessels. The pulse – arterial and venous.
3.3 Haemodynamic of blood flow.
3.4 Blood pressure– its measurement and factors affecting.
3.5 Cardiovascular homeostasis – neural and chemical control of cardiac functions and blood vessels.
3.6 Cardiac and vasomotor centres, baroreceptors and chemoreceptors, innervation of the heart and blood vessels, cardiac and vasomotor reflexes.
3.7 Cardiovascular adjustment after haemorrhage.

PRACTICAL (MNC-3)

Paper Name (Practical): Haematology & Cardiovascular System

1.1 Haematological experiments: Preparation and staining of blood film with Leishman's stain.
1.2 Identification of blood corpuscles.
1.3 Differential count of WBC.
1.4 Total count of RBC and WBC.
1.5 Haemoglobin estimation by Shali's hemoglobinometer method.
1.6 Preparation of haemin crystals.
1.7 Preparation and staining of bone marrow smear.
1.8 Measurement of diameter of megakaryocyte.
1.9 Reticulocyte staining.
1.10 Blood group determination.
1.11 Demonstration: Haematocrit, MCV, MCH and MCHC. Bleeding time, Clotting time, ESR.
1.12 Effect of adrenaline, acetyl choline, temperature, load on cardiac muscle contraction of toad heart
1.13 Measurement of electrical activity of heart by ECG
1.14 Measurement of blood pressure.

Recommended readings:

1. *Best and Taylor's Physiological basis of Medical Practices, by B.K. Brobecks. The William and Wilkins Co.*
2. *Review of Medical Physiology, by W.F. Ganong, Lange Medical Book. Prentices- Hall International. Mc Graw Hill.*
3. *Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.*
4. *Molecular Biology of the Gene, by J.D. Watson; H.H. Nancy& others; Benjamin Cummings.*
5. *Molecular Biology of the Cell, by B. Alberts and others, Garland*
6. *Molecular Cell Biology, by H. Lodish; D. Baltimore & Others. Scientific American Book.*
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10. *Biochemistry. By D. Das. Academic Publishers.*
11. *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.*
12. *Practical Biochemistry in Medicine by Srinivas Rao., Academic Publishers.*
13. *Note Books on Practical Biochemistry. (Published by the Physiological Society of India, Kolkata.)*

Basic Structural Framework of the Syllabus:

SEMESTER IV:

SEMESTER	COURSE TYPE	PAPER CODE	PAPER NAME	CREDIT	MARKS
IV	MAJOR- MJC-5	BSCPHYMJ401	Muscle and Renal Physiology	5	100
IV	MAJOR- MJC-6	BSCPHYMJ402	Metabolism	5	100
IV	MINOR- MNC-4	BSCPHYMN401	Metabolism	5	100
IV	MAJOR-SEC-3	BSCPHYSE401	Statistical Analysis of Physiological Parameters	3	50
IV	VA	VAC-401	Yoga And Health	4	50

MAJOR COURS (MJC)

SEMESTER IV

Course Name: Muscle and Renal Physiology

Course Code: **BSCPHYMJ401**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: MJC-5</td><td colspan="2">L-T-P: 3-0-4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Learning Outcomes:

- After the completion of course, the students will have ability to:
- *Describe the anatomy of structures in posterior abdominal wall in relation to kidneys, ureter, blood supply and venous drainage of kidneys*
- *Describe the structure, functions and regulations of nephrons and tubules*
- *Describe the mechanism of formation and constituents of urine*
- *Describe the acid base balance and its regulation by the kidneys and lungs*
- *Be able to list at least 4 important inorganic ions the concentrations of which the kidneys help regulate.*
- *Be able to name at least 3 important organic wastes that are eliminated by the kidneys.*
- *Be able to name at least 2 hormones normally produced by the kidney*
- *Understand the concept of renal clearance and be able to perform clearance calculations and to interpret the results.*
- *Know how inulin can be used to measure GFR and be able to perform the calculations involved in this measurement.*
- *Know what the filtration fraction is and its typical range of values, be able to calculate the filtered load.*
- *Know what is meant by the terms: tubular transport maximum (Tm), plasma threshold and splay.*
- *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.*
- *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.*
- *Explain the overall transmembrane signalling steps whereby increases in cytosolic calcium initiate crossbridge cycling.*
- *Identify the multiple sources, localization, and roles of calcium in muscle contraction and relaxation.*
- *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.*
- *Diagram the chemical and mechanical steps in the cross-bridge cycle, and explain how the cross-bridge cycle results in shortening of the muscle.*
- *Explain the relationship of preload, afterload and total load in the time course of an isotonic contraction. Distinguish between an isometric and isotonic contraction.*

- *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.*
- *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.*
- *Distinguish between an endplate potential and an action potential in skeletal muscle.*
- *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.*
- *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.*
- *Distinguish between muscle relaxation from the contracted state and the phenomenon of stress relaxation and give examples of each process.*
- *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.*
- *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.*
- *Acquire an advanced knowledge related to the complex skin structure (epidermis, dermis, hypodermis) and skin appendages.*
- *Discover and understand the multiple functions of skin (i.e. sensory organ, immunological barrier, synthesis of vitamin D, etc).*

THEORY (MJC-5)

Paper Name (Theory): Muscle and Renal Physiology

Unit 1: Muscle Physiology [20 Marks]

1.1 Classification of Muscles: Depending upon striation-Striated Muscle, Non-striated Muscle; Depending upon control- Voluntary Muscle, Involuntary Muscle; Depending upon situation- Skeletal, Smooth and Cardiac muscles.

1.2 Microscopic and electron microscopic structure of skeletal, smooth and cardiac muscles.

1.3 Structure of Skeletal Muscle: Muscle mass, Muscle fiber, Myofibrils, Sarcomere, Contractile elements (proteins) of muscle- Actin, Myosin, Troponin, Tropomyosin, Actinin, Nebulin, Titin, Desmin etc. Structure and Function of the sarco-tubular system- T-Tubule, L-Tubule.

1.4 Red and white striated muscle fibers. Single-unit and multi -unit smooth muscle.

1.5 Muscle groups: antagonists and agonists.

1.6 Properties of skeletal muscle: Excitability-Type of stimulus, Quality of stimulus, Excitability Curve or Strength-Duration Curve- Rheobase, Utilization time, Chronaxie; Contractility- Isotonic contraction, Isometric contraction, Contraction time (Red muscle and Pale muscle), Factors affecting force of contraction (Strength of stimulus, Number of stimulus, Temperature, Load), Effects of repeated stimuli, Genesis of tetanus, Onset of fatigue, Summation of stimuli, Summation of contractions, Refractory period, All or None Law; Tonicity; Conductivity; Extensibility; and Elasticity.

1.7 Mechanism of skeletal and smooth muscle contraction and relaxation: Excitation-contraction coupling. Dihydropyridine receptors & Ryanodine receptors.

1.8 Chemical, thermal, and electrical changes in skeletal muscle during contraction and relaxation. Electromyography

Unit 2: Renal Physiology [15 Marks]

2.1 Anatomy of kidney. Histology of nephron.

2.2 Renal circulation – peculiarities and autoregulation.

2.3 Formation of urine– glomerular function and tubular functions.

2.4 Counter-current multiplier and exchanger.

2.5 Renal regulation of osmolarity and volume of blood fluids.

2.6 Diabetes insipidus. Formation of hypertonic urine.

2.7 Renal regulation of acid-base balance, acidification of urine.

2.8 Renal function tests – creatinine, inulin, urea, and PAH clearance tests.

2.9 9. Physiology of urinary bladder and micturition.

2.10 Composition of urine. Abnormal constituents of urine, their detection and significance.

2.11 Renal dialysis. Non-excretory functions of kidney.

PRACTICAL (MJC-5)

Paper Name (Theory): Muscle and Renal Physiology

1.1 Normal and abnormal constituents of urine

1.2 Preparation, staining and Permanent slide identification of Excretory system and Muscle physiology

1.3 Hand-grip dynamometer

1.4 Staining of Muscle Fibre

MAJOR COURS (MJC)

SEMESTER IV

Course Name: Metabolism

Course Code: **BSCPHYMJ402**

Course Type: Core (Theory + Practical)	Course Details: MJC-6			L-T-P: 3-0-4	
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Learning Outcomes:

- *Gain knowledge of key metabolic pathways involved in carbohydrate, protein, lipid, and nucleic acid metabolism, including their roles in energy production and biosynthesis.*
- *Understand the enzymatic processes that drive the metabolism of carbohydrates, proteins, lipids, and nucleic acids, and how these enzymes are regulated.*
- *Learn how carbohydrate metabolism (e.g., glycolysis, gluconeogenesis) is interconnected with lipid and protein metabolism, allowing cells to adapt to different energy demands.*
- *Comprehend the processes of protein synthesis, degradation, and amino acid metabolism, including their role in maintaining nitrogen balance and producing energy.*
- *Understand lipid metabolism, including fatty acid oxidation, synthesis, and cholesterol metabolism, and their roles in energy storage, membrane structure, and signalling.*
- *Recognize how nucleic acid metabolism, including DNA replication, RNA transcription, and nucleotide synthesis, is crucial for genetic information flow and cellular function.*
- *Explore the regulation of these metabolic pathways by hormones (e.g., insulin, glucagon) and other regulatory mechanisms, ensuring metabolic homeostasis.*
- *Identify how disruptions in carbohydrate, protein, lipid, and nucleic acid metabolism contribute to metabolic disorders such as diabetes, obesity, cardiovascular diseases, and genetic disorders.*
- *Develop the ability to apply knowledge of these metabolic pathways in practical scenarios, such as clinical diagnostics, metabolic engineering, and therapeutic interventions.*

- *Enhance critical thinking and problem-solving skills in analysing metabolic processes, interpreting experimental data, and understanding the integration of metabolism in health and disease contexts.*

THEORY (MJC-6)

Paper Name (Theory): Metabolism

Unit I: Metabolism of Carbohydrate [15 marks]

1.1 Introduction to Carbohydrate Metabolism

- Overview of carbohydrates: Structure and classification
- Importance of carbohydrates in metabolism
- Anabolism vs. catabolism in carbohydrate metabolism

1.2 Glycolysis

- Overview of glycolysis: Pathway and key steps
- Enzymes involved in glycolysis
- Regulation of glycolysis
- Energetics of glycolysis
- Clinical relevance: Glycolysis in cancer (Warburg effect)

1.3 Glycogen Metabolism

- Glycogenesis: Synthesis of glycogen
- Glycogenolysis: Breakdown of glycogen
- Regulation of glycogen metabolism
- Hormonal control (Insulin, Glucagon, Epinephrine)
- Glycogen storage diseases

1.4 Gluconeogenesis

- Overview of gluconeogenesis: Pathway and key steps
- Comparison with glycolysis
- Regulation of gluconeogenesis
- Role in maintaining blood glucose levels
- Clinical implications: Fasting and diabetes

1.5 Pentose Phosphate Pathway (PPP)

- Overview of the pentose phosphate pathway
- Oxidative and non-oxidative phases of PPP
- Role of PPP in NADPH production and ribose synthesis
- Regulation of PPP

- Clinical relevance: Role in oxidative stress and G6PD deficiency

1.6 Citric Acid Cycle (Krebs Cycle)

- Link between glycolysis and the citric acid cycle: Pyruvate dehydrogenase complex
- Overview of the citric acid cycle: Pathway and key steps, R-L cycle, Glucose-Alanine cycle
- Energetics and regulation of the citric acid cycle
- Anaplerotic reactions
- Integration with other metabolic pathways

1.7 Oxidative Phosphorylation and Electron Transport Chain

- Overview of the electron transport chain (ETC)
- Role of oxidative phosphorylation in ATP production
- Coupling of the ETC and ATP synthesis
- Regulation of oxidative phosphorylation, Inhibitors and uncouplers.
- Mitochondrial disorders and reactive oxygen species (ROS)

1.8 Carbohydrate Metabolism in Different Physiological States

- Fed state vs. fasting state: Metabolic shifts
- Carbohydrate metabolism during exercise
- Adaptations during prolonged fasting and starvation
- Metabolic syndrome and insulin resistance
- Carbohydrate metabolism in diabetes mellitus
- Hormonal regulation: Insulin, glucagon, and epinephrine

1.9 Disorders of Carbohydrate Metabolism

- Inborn errors of carbohydrate metabolism (e.g., galactosemia, fructose intolerance)
- Glycogen storage diseases
- Diabetes mellitus: Type 1 and Type 2
- Hypoglycemia: Causes and management
- Metabolic adaptations in obesity

Unit 2: Metabolism of Lipid [10 marks]

2.1 Introduction to Lipids

- Overview of lipids: Structure, classification, and biological importance
- Role of lipids in cell membranes, energy storage, and signaling

2.2 Fatty Acid Oxidation

- Overview of fatty acid oxidation: Beta-oxidation pathway, Alpha-oxidation, Omega-oxidation
- Steps of beta-oxidation: Activation, transport, and breakdown of fatty acids

- Energetics of beta-oxidation: ATP yield
- Regulation of fatty acid oxidation

2.3 Ketogenesis and Ketone Bodies

- Formation of ketone bodies: Ketogenesis in the liver
- Types of ketone bodies: Acetoacetate, β-hydroxybutyrate, and acetone
- Ketone body metabolism: Utilization and excretion
- Physiological role of ketone bodies during fasting and starvation
- Clinical implications: Diabetic ketoacidosis and ketogenic diets

2.4 Fatty Acid Synthesis (Lipogenesis)

- Overview of fatty acid synthesis: De novo lipogenesis
- Enzymes involved: Acetyl-CoA carboxylase, fatty acid synthase
- Regulation of fatty acid synthesis: Hormonal and nutritional control
- Role of the liver and adipose tissue in lipogenesis
- Clinical relevance: Obesity, non-alcoholic fatty liver disease (NAFLD)

2.5 Synthesis and Metabolism of Triglycerides and Phospholipids

- Triglyceride synthesis: Glycerol-3-phosphate pathway
- Storage and mobilization of triglycerides
- Phospholipid synthesis: Role in membrane structure and signaling
- Disorders of triglyceride and phospholipid metabolism

2.6 Cholesterol Metabolism

- Overview of cholesterol synthesis: Mevalonate pathway
- Regulation of cholesterol synthesis: HMG-CoA reductase
- Cholesterol transport: Role of lipoproteins (LDL, HDL, VLDL)
- Clinical relevance: Hypercholesterolemia, atherosclerosis, and statins
- Cholesterol homeostasis: Dietary regulation and bile acid synthesis

2.7 Lipoprotein Metabolism and Transport

- Structure and function of lipoproteins: Chylomicrons, VLDL, LDL, HDL
- Lipoprotein metabolism: Exogenous and endogenous pathways
- Role of apolipoproteins in lipoprotein function
- Disorders of lipoprotein metabolism: Hyperlipidaemia, dyslipidaemia
- Clinical relevance: Cardiovascular diseases

2.8 Lipid Metabolism in Different Physiological States

- Lipid metabolism in the fed state vs. fasting state
- Lipid metabolism during exercise
- Lipid metabolism during pregnancy and lactation
- Metabolic adaptations during prolonged fasting and starvation
- Lipid metabolism in obesity and metabolic syndrome

2.9 Integration of Lipid Metabolism with Other Pathways

- Interaction with carbohydrate metabolism: Cross-talk between glycolysis, gluconeogenesis, and lipogenesis
- Interaction with protein metabolism: Amino acid catabolism and lipid synthesis
- Role of the liver, adipose tissue, and muscle in metabolic homeostasis
- Hormonal regulation: Insulin, glucagon, epinephrine, and cortisol
- Impact of diet and lifestyle on lipid metabolism

2.10 Disorders of Lipid Metabolism

- Inherited disorders of lipid metabolism (e.g., Gaucher's disease, Tay-Sachs disease)
- Lipid storage diseases: Sphingolipidoses, Niemann-Pick disease
- Obesity: Pathophysiology and metabolic complications
- Fatty liver disease: Alcoholic and non-alcoholic fatty liver disease (NAFLD)

Unit 3: Metabolism of Protein and Nucleic acids [10 marks]

3.1 Amino Acid Metabolism

- Amino acid catabolism: Transamination and deamination
- Urea cycle: Conversion of ammonia to urea
- Essential vs. non-essential amino acids
- Amino acid biosynthesis: Pathways and regulation
- Basic idea of glucogenic and ketogenic amino acids. Metabolism of glycine, sulfur-containing amino acids, tryptophan and phenylalanine
- Disorders of amino acid metabolism (e.g., phenylketonuria, alkaptonuria, tyrosinemia etc.)
- Non-protein Amino acids

3.2 Protein Degradation

- Protein turnover: The balance between synthesis and degradation
- Ubiquitin-proteasome system: Marking proteins for degradation
- Role of protein degradation in cellular homeostasis

3.3 Nucleotide Metabolism

- De novo synthesis of purine and pyrimidine nucleotides
- Salvage pathways for nucleotide synthesis
- Regulation of nucleotide biosynthesis
- Catabolism of nucleotides: Uric acid production and excretion
- Clinical relevance: Disorders of nucleotide metabolism (e.g., gout, Lesch-Nyhan syndrome)

PRACTICAL (MJC-6)

Paper Name (Practical): Metabolism

1. Estimation of percentage and total quantity of glucose (Benedict's Method)
2. Estimation of percentage and total quantity of lactose of milk (Benedict's Method)
3. Estimation of percentage and total quantity of sucrose (Benedict's Method)
4. Estimation of percentage and total quantity of amino nitrogen (Formol Titration Method)
5. Estimation of percentage and total quantity of chloride (Mohr's method)

Recommended readings:

1. *Best and Taylor's Physiological basis of Medical Practices, by B.K. Brobecks. The William and Wilkins Co.*
2. *Review of Medical Physiology, by W.F. Ganong, Lange Medical Book. Pretices- Hall International. Mc Graw Hill.*
3. *Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.*
4. *Molecular Biology of the Gene, by J.D.Watson; H.H.Nancy& others; BenjaminCummings.*
5. *Molecular Biology of the Cell, by B. Alberts and others,Garland*
6. *Molecular Cell Biology, by H. Lodish; D. Baltimore & Others. Scientific American Book.*
7. *Harper's Illustrated Biochemistry, by R. K. Murray & others. Lange Medical Book, International Edition, McGraw Hill.*
8. *Lehninger's Principles of Biochemistry. By D. L. Nelson and M.M. Cox, Worth Publishers Inc.*
9. *Text Book of Biochemistry, by E.S. West; W. R. Todd.; H. S. Mason; J. T. VanBruggen. The Macmillan Company.*
10. *Biochemistry. By D. Das. Academic Publishers.*
11. *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.*
12. *Practical Biochemistry in Medicine by SrinivasRao., Academic Publishers.*
13. *Note Books on Practical Biochemistry. (Published by the Physiological Society of India, Kolkata.)*

MAJOR COURS (MJC)

SEMESTER IV

Course Name: **Statistical Analysis of Physiological Parameters**

Course Code: **BSCPHYSE401**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: SEC-3</td><td colspan="2">L-T-P: 0-0-3</td></tr>
<tr><td rowspan="3">Credit: 3</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td></td><td>20</td><td></td></tr>
</table>

Course Learning Outcomes:

- *After the completion of course, the students will have ability to:*
- *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.*
- *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.*
- *Demonstrate mastery of data analysis and statistical concepts by communicating critically reasoned analysis through written and oral presentations.*
- *Acquire up-to-date skills and/or applications of computer and statistical programming related to future career choices.*
- *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.*
- *Read, interpret, and critically analyze journal articles directed at undergraduate*

PRACTICAL (SEC-3)

Paper Name (Practical): Statistical Analysis of Physiological Parameters

UNIT-1: Biostatistics

1.1 Scope of statistics – utility and misuse.
1.2 Principles of statistical analysis of biological data.
1.3 Basic concepts – variable, parameter, statistics.
1.4 Sampling. Presentation of data-frequency distribution, frequency polygon, histogram, bar diagram and pie diagram. Parameters.
1.5 Different classes of statistics- mean, median, mode, mean deviation, variance, standard deviation, standard error of the mean. Standard score.
1.6 Degrees of freedom.
1.7 Probability. Normal distribution. Student's t-distribution.
1.8 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, ANOVA test.
1.9 Linear correlation and linear regression.

UNIT-2: Data Analysis using Computer software

2.1 Elementary ideas about probability,
2.2 Discussion of sampling techniques,
2.3 Data summarization,
2.4 Common sampling distributions,
2.5 Statistical inference and hypothesis testing,
2.6 Regression and
2.7 Nonparametric inference
2.8 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.

MINOR COURS (MNC)

SEMESTER IV

Course Name: Metabolism

Course Code: **BSCPHYMN401**

Course Type: Core (Theory + Practical)	Course Details: MNC-4			L-T-P: 3-0-4	
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Learning Outcomes:

- *Gain knowledge of key metabolic pathways involved in carbohydrate, protein, lipid, and nucleic acid metabolism, including their roles in energy production and biosynthesis.*
- *Understand the enzymatic processes that drive the metabolism of carbohydrates, proteins, lipids, and nucleic acids, and how these enzymes are regulated.*
- *Learn how carbohydrate metabolism (e.g., glycolysis, gluconeogenesis) is interconnected with lipid and protein metabolism, allowing cells to adapt to different energy demands.*
- *Comprehend the processes of protein synthesis, degradation, and amino acid metabolism, including their role in maintaining nitrogen balance and producing energy.*
- *Understand lipid metabolism, including fatty acid oxidation, synthesis, and cholesterol metabolism, and their roles in energy storage, membrane structure, and signaling.*
- *Recognize how nucleic acid metabolism, including DNA replication, RNA transcription, and nucleotide synthesis, is crucial for genetic information flow and cellular function.*
- *Explore the regulation of these metabolic pathways by hormones (e.g., insulin, glucagon) and other regulatory mechanisms, ensuring metabolic homeostasis.*
- *Identify how disruptions in carbohydrate, protein, lipid, and nucleic acid metabolism contribute to metabolic disorders such as diabetes, obesity, cardiovascular diseases, and genetic disorders.*
- *Develop the ability to apply knowledge of these metabolic pathways in practical scenarios, such as clinical diagnostics, metabolic engineering, and therapeutic interventions.*

- *Enhance critical thinking and problem-solving skills in analyzing metabolic processes, interpreting experimental data, and understanding the integration of metabolism in health and disease contexts.*

THEORY (MNC-4)

Paper Name (Theory): Metabolism

Unit I: Metabolism of Carbohydrate [15 marks]

1.1 Introduction to Carbohydrate Metabolism

- Overview of carbohydrates: Structure and classification
- Importance of carbohydrates in metabolism
- Anabolism vs. catabolism in carbohydrate metabolism

1.2 Glycolysis

- Overview of glycolysis: Pathway and key steps
- Enzymes involved in glycolysis
- Regulation of glycolysis
- Energetics of glycolysis
- Clinical relevance: Glycolysis in cancer (Warburg effect)

1.3 Glycogen Metabolism

- Glycogenesis: Synthesis of glycogen
- Glycogenolysis: Breakdown of glycogen
- Regulation of glycogen metabolism
- Hormonal control (Insulin, Glucagon, Epinephrine)
- Glycogen storage diseases

1.4 Gluconeogenesis

- Overview of gluconeogenesis: Pathway and key steps
- Comparison with glycolysis
- Regulation of gluconeogenesis
- Role in maintaining blood glucose levels
- Clinical implications: Fasting and diabetes

1.5 Pentose Phosphate Pathway (PPP)

- Overview of the pentose phosphate pathway
- Oxidative and non-oxidative phases of PPP
- Role of PPP in NADPH production and ribose synthesis
- Regulation of PPP

- Clinical relevance: Role in oxidative stress and G6PD deficiency

1.6 Citric Acid Cycle (Krebs Cycle)

- Link between glycolysis and the citric acid cycle: Pyruvate dehydrogenase complex
- Overview of the citric acid cycle: Pathway and key steps, R-L cycle, Glucose-Alanine cycle
- Energetics and regulation of the citric acid cycle
- Anaplerotic reactions
- Integration with other metabolic pathways

1.7 Oxidative Phosphorylation and Electron Transport Chain

- Overview of the electron transport chain (ETC)
- Role of oxidative phosphorylation in ATP production
- Coupling of the ETC and ATP synthesis
- Regulation of oxidative phosphorylation, Inhibitors and uncouplers.
- Mitochondrial disorders and reactive oxygen species (ROS)

1.8 Carbohydrate Metabolism in Different Physiological States

- Fed state vs. fasting state: Metabolic shifts
- Carbohydrate metabolism during exercise
- Adaptations during prolonged fasting and starvation
- Metabolic syndrome and insulin resistance
- Carbohydrate metabolism in diabetes mellitus
- Hormonal regulation: Insulin, glucagon, and epinephrine

1.9 Disorders of Carbohydrate Metabolism

- Inborn errors of carbohydrate metabolism (e.g., galactosemia, fructose intolerance)
- Glycogen storage diseases
- Diabetes mellitus: Type 1 and Type 2
- Hypoglycemia: Causes and management
- Metabolic adaptations in obesity

Unit 2: Metabolism of Lipid [10 marks]

2.1 Introduction to Lipids

- Overview of lipids: Structure, classification, and biological importance
- Role of lipids in cell membranes, energy storage, and signaling

2.2 Fatty Acid Oxidation

- Overview of fatty acid oxidation: Beta-oxidation pathway, Alpha-oxidation, Omega-oxidation
- Steps of beta-oxidation: Activation, transport, and breakdown of fatty acids

- Energetics of beta-oxidation: ATP yield
- Regulation of fatty acid oxidation

2.3 Ketogenesis and Ketone Bodies

- Formation of ketone bodies: Ketogenesis in the liver
- Types of ketone bodies: Acetoacetate, β-hydroxybutyrate, and acetone
- Ketone body metabolism: Utilization and excretion
- Physiological role of ketone bodies during fasting and starvation
- Clinical implications: Diabetic ketoacidosis and ketogenic diets

2.4 Fatty Acid Synthesis (Lipogenesis)

- Overview of fatty acid synthesis: De novo lipogenesis
- Enzymes involved: Acetyl-CoA carboxylase, fatty acid synthase
- Regulation of fatty acid synthesis: Hormonal and nutritional control
- Role of the liver and adipose tissue in lipogenesis
- Clinical relevance: Obesity, non-alcoholic fatty liver disease (NAFLD)

2.5 Synthesis and Metabolism of Triglycerides and Phospholipids

- Triglyceride synthesis: Glycerol-3-phosphate pathway
- Storage and mobilization of triglycerides
- Phospholipid synthesis: Role in membrane structure and signaling
- Disorders of triglyceride and phospholipid metabolism

2.6 Cholesterol Metabolism

- Overview of cholesterol synthesis: Mevalonate pathway
- Regulation of cholesterol synthesis: HMG-CoA reductase
- Cholesterol transport: Role of lipoproteins (LDL, HDL, VLDL)
- Clinical relevance: Hypercholesterolemia, atherosclerosis, and statins
- Cholesterol homeostasis: Dietary regulation and bile acid synthesis

2.7 Lipoprotein Metabolism and Transport

- Structure and function of lipoproteins: Chylomicrons, VLDL, LDL, HDL
- Lipoprotein metabolism: Exogenous and endogenous pathways
- Role of apolipoproteins in lipoprotein function
- Disorders of lipoprotein metabolism: Hyperlipidemia, dyslipidemia
- Clinical relevance: Cardiovascular diseases

2.8 Lipid Metabolism in Different Physiological States

- Lipid metabolism in the fed state vs. fasting state
- Lipid metabolism during exercise
- Lipid metabolism during pregnancy and lactation
- Metabolic adaptations during prolonged fasting and starvation
- Lipid metabolism in obesity and metabolic syndrome

2.9 Integration of Lipid Metabolism with Other Pathways

- Interaction with carbohydrate metabolism: Cross-talk between glycolysis, gluconeogenesis, and lipogenesis
- Interaction with protein metabolism: Amino acid catabolism and lipid synthesis
- Role of the liver, adipose tissue, and muscle in metabolic homeostasis
- Hormonal regulation: Insulin, glucagon, epinephrine, and cortisol
- Impact of diet and lifestyle on lipid metabolism

2.10 Disorders of Lipid Metabolism

- Inherited disorders of lipid metabolism (e.g., Gaucher's disease, Tay-Sachs disease)
- Lipid storage diseases: Sphingolipidoses, Niemann-Pick disease
- Obesity: Pathophysiology and metabolic complications
- Fatty liver disease: Alcoholic and non-alcoholic fatty liver disease (NAFLD)

Unit 3: Metabolism of Protein and Nucleic acids [10 marks]

3.1 Amino Acid Metabolism

- Amino acid catabolism: Transamination and deamination
- Urea cycle: Conversion of ammonia to urea
- Essential vs. non-essential amino acids
- Amino acid biosynthesis: Pathways and regulation
- Basic idea of glucogenic and ketogenic amino acids. Metabolism of glycine, sulfur-containing amino acids, tryptophan and phenylalanine
- Disorders of amino acid metabolism (e.g., phenylketonuria, alkaptonuria, tyrosinemia etc.)
- Non-protein Amino acids

3.2 Protein Degradation

- Protein turnover: The balance between synthesis and degradation
- Ubiquitin-proteasome system: Marking proteins for degradation
- Role of protein degradation in cellular homeostasis

3.3 Nucleotide Metabolism

- De novo synthesis of purine and pyrimidine nucleotides
- Salvage pathways for nucleotide synthesis
- Regulation of nucleotide biosynthesis
- Catabolism of nucleotides: Uric acid production and excretion
- Clinical relevance: Disorders of nucleotide metabolism (e.g., gout, Lesch-Nyhan syndrome)

PRACTICAL (MNC-4)

Course Name (Practical): Metabolism

1. Estimation of percentage and total quantity of glucose (Benedict's Method)
2. Estimation of percentage and total quantity of lactose of milk (Benedict's Method)
3. Estimation of percentage and total quantity of sucrose (Benedict's Method)
4. Estimation of percentage and total quantity of amino nitrogen (Formol Titration Method)
5. Estimation of percentage and total quantity of chloride (Mohr's method)

Recommended readings:

1. *Best and Taylor's Physiological basis of Medical Practices, by B.K. Brobecks. The William and Wilkins Co.*
2. *Review of Medical Physiology, by W.F. Ganong, Lange Medical Book. Pretices- Hall International. Mc Graw Hill.*
3. *Text book of Medical Physiology, by A.C. Guyton. W.B. Saunders Co.*
4. *Molecular Biology of the Gene, by J.D.Watson; H.H.Nancy& others; BenjaminCummings.*
5. *Molecular Biology of the Cell, by B. Alberts and others,Garland*
6. *Molecular Cell Biology, by H. Lodish; D. Baltimore & Others. Scientific American Book.*
7. *Harper's Illustrated Biochemistry, by R. K. Murray & others. Lange Medical Book, International Edition, McGraw Hill.*
8. *Lehninger's Principles of Biochemistry. By D. L. Nelson and M.M. Cox, Worth Publishers Inc.*
9. *Text Book of Biochemistry, by E.S. West; W. R. Todd.; H. S. Mason; J. T. VanBruggen. The Macmillan Company.*
10. *Biochemistry. By D. Das. Academic Publishers.*
11. *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.*
12. *Practical Biochemistry in Medicine by SrinivasRao., Academic Publishers.*
13. *Note Books on Practical Biochemistry. (Published by the Physiological Society of India, Kolkata.)*

Value Added Courses

SEMESTER IV

Course Name: **Yoga and Health**

Course Code: **VAC401**

L - T – P: 4 - 0 - 0

Learning Outcomes:

1. *Understand the principles and philosophy of yoga*
2. *Learn various yoga techniques for physical, mental, and emotional well-being*
3. *Apply yoga practices for stress management and overall health*
4. *Analyse the scientific basis of yoga and its applications in modern life*

THEORY (VAC-2)

Paper Name (Theory): Yoga and Health

Unit 1: Introduction to Yoga (10 marks)

1.1 Definition and history of yoga
1.2 Principles and philosophy of yoga
1.3 Types of yoga (Hatha, Vinyasa, Ashtanga, etc.)
1.4 Physiological effects of yoga on body systems
1.5 Neurological and psychological benefits of yoga
1.6 Research studies on yoga and health

Unit 2: Yoga Techniques (8 marks)

2.1 Asanas (postures) for physical health
2.2 Pranayama (breathing techniques) for mental well-being
2.3 Mudras (hand gestures) and Bandhas (energy locks)
2.4 Relaxation techniques (Savasana, Yoga Nidra)

Unit 3: Yoga for Stress Management (10 marks)

3.1 Understanding stress and its effects
3.2 Yoga practices for stress relief (asanas, pranayama, meditation)
3.3 Mindfulness and self-awareness techniques

Unit 4: Applications of Yoga in Modern Life (7 marks)

4.1 Yoga in daily life (workplace, relationships, etc.)
4.2 Yoga for specific health conditions (back pain, hypertension, etc.)
4.3 Yoga and mental health (anxiety, depression, etc.)

Recommended readings:

1. Dr R Nagarathna and Dr H R Nagendra: Yoga for Promotion of Positive Health Published by SVYP, Bangalore 4.
2. Gharote, M.M. & others: Therapeutic references in Traditional Yoga Texts, the Lonavla Institute, Lonavla, 2010.
3. Gharote ML: Hatharatnavali, The Lonavala Yoha Institute, Lonavala, Pune, IInd Edition, 2009 4. Swami Kuvalyananda & Shukla, S.A.: Gorakshasatkam, Kaivalyadhama, Lonavla, 2006
4. Dr Nagendra H R : The Secret of Action - Karma Yoga, Published by SVYP, Bangalore, 2003
5. Yoga and Mental Health by Prof. R. S. Bhogal
6. I. K. Taimini : The Science of Yoga, (The Theosophical, Publishing House, Adyar Chennai 2005)
7. Swami Satyananda Saraswati : Hatha Yoga, Pub: BSY Mungher
8. Woods, J.H. : The Yoga System of Patanjali, M.L.B.D., Delhi, 1988
9. Swami Vivekananda: Rajayoga, Advaita Ashram, Calcutta, 2000
10. Iyengar B.K.S. : Light on Patanjali Yoga (New York, Schocken Books, 1994)
11. Burley, Mikel: Hatha Yoga, Its' Context Theory and Practice (M.L.B.D. Delhi, 2000)
12. Ghosh, Shyam: The Original Yoga, Munshiram Manoharlal, New Delhi, 1999
13. Burnier, Radha: Hathayoga Pradipika of Svatmarama, The Adyar Library publications, Chennai. 2000
14. Woodroffe, Sir John: The Serpent power (Ganesh & Company, Madras, 2000)

National Curriculum and Credit Framework (NCCF)

Syllabus

for

Major Courses in Physiology

w.e.f. Academic Session 2023-24

Kazi Nazrul University

Asansol, Paschim
Bardhaman West Bengal
713340

Basic Structural Framework of the Syllabus:

SEMESTER V:

SEMESTER	COURSE TYPE	PAPER CODE	PAPER NAME	CREDIT	MARKS
V	MAJOR- MJC-7	BSCPHYMJ501	GASTROINTESTINAL PHYSIOLOGY	5	100
V	MAJOR- MJC-8	BSCPHYMJ502	REPRODUCTIVE PHYSIOLOGY AND EMBRYOLOGY	5	100
V	MAJOR- MJC-9	BSCPHYMJ503	ENDOCRINOLOGY AND CHRONOBIOLOGY	5	100
V	MINOR- MNC-5	BSCPHYMN501	ENDOCRINOLOGY AND REPRODUCTIVE PHYSIOLOGY	5	100

MAJOR COURS (MJC)

SEMESTER V

Course Name: **Gastrointestinal Physiology**

Course Code: **BSCPHYMJ501**

Course Type: Core (Theory + Practical)	Course Details: MJC-7			L-T-P: 3-0-4	
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Course Learning Outcomes:

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

- *Identify the sources and typical amounts of fluid and nutrients entering and leaving the gastrointestinal tract daily.*
- *For major classes of nutrients (carbohydrates, proteins, fats), differentiate the processes of ingestion, digestion, absorption, secretion, and excretion; include the location in the GI tract where each process occurs.*
- *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.*
- *Understand how the physical and chemical compositions of luminal contents are sensed and the cellular and systemic responses to luminal stimuli.*
- *Describe the major anatomical characteristics of the enteric nervous system and the major cellular divisions of enteric ganglia (sensory nerves, interneurons, and motor neurons).*
- *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*
- *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.*
- *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.*
- *List the water, ionic, bile salt, and bilirubin components of bile as secreted by the*
- *Describe the mechanisms liver and after modification by the gallbladder.*

- *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.*
- *Describe the enterohepatic circulation, including any different handling among primary and secondary bile salts, and bile acids.*
- *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.*
- *Compare the membrane transport mechanisms responsible for uptake of sugars, amino acids and di-peptides by intestinal epithelial cells.*
- *Describe the mechanisms and molecules mediating the solubilization and digestion of lipids in the small intestine.*
- *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.*
- *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.*
- *List the diseases of enzyme and transport deficiencies leading to osmotic diarrhoea.*

THEORY (MJC-7)

Course Content: Gastrointestinal Physiology

Unit 1: Anatomy and Physiology of Alimentary Canal

1.1 Overview of the Gastrointestinal System: Functions of the GI system, Organs involved in digestion, General structure of the alimentary canal- Tongue, Oral mucosa, Salivary glands, Oesophagus, Stomach, Small intestine, Large intestine.

1.2 Salivary Glands: Histological Structure and function of salivary glands (parotid gland, submandibular gland, sublingual gland). Composition and functions of salivary juice. Mechanism of salivary secretion, and factors affecting salivary secretion. Hyposalivation and Hypersalivation and disorders.

1.3 Gastric Secretion: Glands of stomach. The composition and character of gastric juice. Phases of gastric secretion, Mechanism of gastric secretion, regulation of gastric secretion, experiments on gastric secretion, sham feeding, Pavlov's pouch, function of gastric Juice, gastric-mucosal barrier, ulcer, gastritis, Zollinger-Ellison syndrome.

1.4 Pancreas: Functional anatomy of pancreas (acini and islets of Langerhans). Exocrine and endocrine functions of pancreas. Regulation of pancreatic secretion. Steatorrhea and pancreatitis.

1.5 Hepato-Biliary system: Structure of the liver, Gall bladder, and bile ducts. Composition and functions of bile, types of bile, mechanism of bile secretion, regulation of bile secretion and flow, enterohepatic circulation, liver function tests, jaundice, hepatitis and gall stone.

1.6 Secretion and Movement of GI Tract: Secretion from the small intestine, composition and character of intestinal juice, mechanism of secretion, regulation of secretion. The basis of movement- basal electrical rhythm, migrating motor complex, pacemaker. Process of mastication and deglutition. Movement of stomach- empty stomach, receptive relaxation, peristalsis, gastric emptying, vomiting, gastro-oesophageal reflex. Movement in intestine- segmentation contraction, pendular movement, peristalsis, gastro-ileal reflex, gastrocolic reflex, defaecation. Regulation of motility- nervous regulation (enteric nervous system and autonomic nervous system), hormonal regulation (gastrointestinal hormones), factors influencing motility (diet, stress, and disease).

1.7 GI Hormones: Ghrelin, Leptin, Secretin, CCK-PZ, Somatostatin, Motilin, Peptide YY, GIP, VIP, Substance P.

1.8 Digestion and Absorption: Physiology of digestion and absorption of carbohydrates, proteins, and lipids. Absorption of water and electrolytes. Absorption of vitamins. malabsorption syndrome, Crohn's disease.

PRACTICAL (MJC-7)

Course Content: Gastrointestinal Physiology

1.1 Dales Experiments –Introduction on Dale's apparatus and preparation of Dale's fluid.

1.2 Studies on smooth muscle. Kymographic recording of normal movements of rat's intestine in Dale's apparatus.

1.3 Effects of hypoxia, acetylcholine and adrenaline-Atropine 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

MAJOR COURS (MJC)

SEMESTER V

Course Name: **Reproductive Physiology and Embryology**

Course Code: **BSCPHYMJ502**

<table>
<tr><td>Course Type:

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(Theory + Practical)</td><td colspan="2">Course Details: MJC-8</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- *Describe the key gross and microscopic components of the reproductive systems in several mammalian species.*
- *Describe gametogenesis and the anatomical; structures of gametes and relate it toits functions.*
- *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.*
- *Demonstrate a detailed and comparative knowledge of the control of mammalian reproduction.*
- *Demonstrate a detailed and comparative knowledge of the physiology of pregnancy, parturition and lactation in the mammalian species.*
- *Evaluate the principles, merits and limitations of various forms of reproductive technology in use.*
- *Demonstrate interpretation of experimental data, identify controls, state hypotheses.*
- *Describe the processes of gametogenesis and fertilization leading to blastocyst formation*
- *Describe the process of implantation*
- *Describe the embryological processes of gastrulation, how the different germ layers form and what these germ layers will eventually give rise to*
- *Describe how placenta and foetal membranes are formed as well as the purposes of these structures*
- *Describe neural tube formation and how the neural tube differentiates into specific components of the nervous system*

- *Explain the development and function of the placenta, the amnion and the umbilical cord*
- *Describe the development and function of the umbilical cord.*
- *Describe the development of alimentary canal, heart, urinary system and genital system.*
- *Explain the foetal circulation and ossification of bones*

THEORY (MJC-8)

Course Content: Reproductive Physiology and Embryology

Unit I: Primary and Accessory Sex Organs

1.1 Male reproductive system: testes, epididymis, vas deferens, seminal vesicles, prostate gland, Bulbo-urethral gland, and urethra

1.2 Female reproductive system: ovaries, fallopian tubes, uterus, cervix, vagina, Bartholin's gland, mammary gland

Unit 2: Male Reproductive Physiology

2.1 Histology of testis: seminiferous tubules, Leydig cells, and Sertoli cells

2.2 Endocrine functions of testis: testosterone production, mechanism of action and regulation

2.3 Spermatogenesis: stages and factors regulating spermatogenesis, Spermiogenesis

2.4 Hypothalamic control of testicular functions, Andropause

2.5 Abnormalities in male reproductive health: cryptorchidism, hydrocele, varicocele, prostate enlargement

Unit 3: Female Reproductive Physiology

3.1 Histology of ovary.

3.2 Follicular development and maturation

3.3 Ovarian hormones: estrogen, progesterone, and their functions and mechanism of action

3.4 Regulation of secretion of female sex hormones

3.5 Oogenesis and ovulation

3.6 Formation and functions of corpus luteum, corpus albicans

3.7 Hypothalamic control of ovarian functions

Unit 4: Physiology of Puberty, Menstrual Cycle, and Pregnancy

4.1 Physiology of puberty: onset and changes

4.2 Estrous cycle and menstrual cycle: phases and regulation

4.3 Abnormalities in menstrual cycle

4.4 Onset of menopause and post-menopausal syndrome

4.5 Structure and functions of placenta

4.6 Maintenance of pregnancy and bodily changes during pregnancy, Ectopic pregnancy

4.7 Parturition and pregnancy tests

4.8 Mammary glands and Lactation

4.9 Male and Female infertility

4.10 Contraception

Unit 5: Embryology

5.1 Basic Concepts of Embryology

5.2 Totipotency and differentiation

5.3 Committed stem cells

5.4 Fertilization and blastulation

5.5 Implantation and gastrulation

5.6 Placentation and embryoblast formation

5.7 Development of alimentary canal, heart, urinary system, and genital system

5.8 Foetal circulation and ossification of bone

5.9 Developmental abnormalities

PRACTICAL (MJC-8)

Course Content: Reproductive Physiology and Embryology

1. Identification of vaginal cytology and understanding the phases of the estrous cycle of female rat.
2. Power Point Presentation preparation on topics of Reproductive physiology and embryology

Recommended 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.*

MAJOR COURS (MJC)

SEMESTER V

Course Name: **Endocrinology and Chronobiology**

Course Code: **BSCPHYMJ503**

<table>
<tr><td>Course Type:

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(Theory + Practical)</td><td colspan="2">Course Details: MJC-9</td><td colspan="2">L-T-P: 3-0-4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

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

THEORY (MJC-9)

Course Content: Endocrinology and Chronobiology

Unit I: Introduction to Endocrinology and Hypothalamic-Pituitary Axis

1.1 Classification of Endocrine Glands and Hormones

- Exocrine and endocrine glands
- Classification of hormones (steroid, peptide, amine)

1.2 Hypothalamus as a Neuroendocrine Organ

- Histological structure, Neurotransmitters and Neurohormones- Chemical nature and structure
- Neural functions (Regulation of body temperature, hunger, thirst, and sleep) and mode of action
- Preliminary concepts of magnocellular and parvocellular neurons

1.3 Anterior Pituitary

- Histological structure, - Chemical nature and structure of anterior pituitary hormones
- Neural functions and Regulation of secretion (hypothalamic-pituitary axis)
- Hypo- and hyperactive states (dwarfism, acromegaly, Cushing's disease)

1.4 Posterior Pituitary

- Histological structure, Chemical nature and structure of posterior pituitary hormones
- Physiological functions (osmoregulation, parturition) and Regulation of secretion

Unit II: Adrenal Gland-Cortex and Medulla

2.1 Adrenal Cortex

- Histological structure, Hormones of different cortical layers (glucocorticoids, mineralocorticoids, and sex steroids)- Chemical nature, structure, and functions
- Regulation of secretion (hypothalamic-pituitary-adrenal axis)
- Hypo- and hyperactive states

2.2 Adrenal Medulla

- Histological structure, Hormones (epinephrine, norepinephrine, and dopamine) - Chemical nature, structure, and functions
- Regulation of secretion (sympathetic nervous system)
- Biosynthesis and catabolism of catecholamines

Unit III: Thyroid and Parathyroid Glands

3.1 Thyroid- Parathyroid

- Histological structure of Thyroid and Parathyroid Gland, Hormones (T3, T4, calcitonin, PTH) - Chemical nature, structure and functions
- Regulation of secretion (hypothalamic-pituitary-thyroid axis, calcium homeostasis)
- Hypo- and hyperactive states

Unit IV: Pancreatic Islets and Gastrointestinal Hormones

4.1 Pancreatic Islets

- Histological structure of Pancreas, Hormones (insulin, glucagon, somatostatin) - Chemical nature, structure, and functions
- Regulation of secretion (glucose homeostasis)
- Hypo- and hyperactive states

4.2 Gastrointestinal Hormones

- Hormones of GI tract – Chemical, structure, and functions
- Regulation of secretion (digestion and absorption)
  Hypo- and hyperactive states

Unit V: Growth Factors

5.1 Chemical nature, mode of action, functions of the followings

- Transforming growth factor (TGF)
- Epidermal growth factor (EGF)
- Platelet-derived growth factor (PDGF)
- Insulin-like growth factor (IGF)
- Fibroblast growth factor (FGF)

Unit VI: Other endocrine factors

6.1 Chemical nature, mode of action, functions

- Atrial natriuretic peptide, brain natriuretic peptide, endorphin, prostaglandins, kinins, thymosin, thymopoietin.

Unit VII: Chronobiology

- Different types of physiological rhythms – ultradian, circadian, infradian, circa mural
- 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 (MJC-9)

Course Content: Endocrinology and Chronobiology

1. Review of Scientific Literature: Submission of 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.

MINOR COURS (MNC)

SEMESTER V

Course Name: **Reproductive Physiology and Embryology**

Course Code: **BSCPHYMN501**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: MNC-5</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
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</table>

Course Learning Outcomes:

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

- *Describe the key gross and microscopic components of the reproductive systems in several mammalian species.*
- *Describe gametogenesis and the anatomical; structures of gametes and relate it toits functions.*
- *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.*
- *Demonstrate a detailed and comparative knowledge of the control of mammalian reproduction.*
- *Demonstrate a detailed and comparative knowledge of the physiology of pregnancy, parturition and lactation in the mammalian species.*
- *Evaluate the principles, merits and limitations of various forms of reproductive technology in use.*
- *Demonstrate interpretation of experimental data, identify controls, state hypotheses.*
- *Describe the processes of gametogenesis and fertilization leading to blastocyst formation*
- *Describe the process of implantation*
- *Describe the embryological processes of gastrulation, how the different germ layers form and what these germ layers will eventually give rise to*
- *Describe how placenta and foetal membranes are formed as well as the purposes of these structures*
- *Describe neural tube formation and how the neural tube differentiates into specific components of the nervous system*

- *Explain the development and function of the placenta, the amnion and the umbilical cord*
- *Describe the development and function of the umbilical cord.*
- *Describe the development of alimentary canal, heart, urinary system and genital system.*
- *Explain the foetal circulation and ossification of bones*

THEORY (MNC-5)

Course Content: Reproductive Physiology and Embryology

Unit I: Primary and Accessory Sex Organs

1.3 Male reproductive system: testes, epididymis, vas deferens, seminal vesicles, prostate gland, Bulbo-urethral gland, and urethra

1.4 Female reproductive system: ovaries, fallopian tubes, uterus, cervix, vagina, Bartholin's gland, mammary gland

Unit 2: Male Reproductive Physiology

2.1 Histology of testis: seminiferous tubules, Leydig cells, and Sertoli cells

2.2 Endocrine functions of testis: testosterone production, mechanism of action and regulation

2.3 Spermatogenesis: stages and factors regulating spermatogenesis, Spermiogenesis

2.4 Hypothalamic control of testicular functions, Andropause

2.5 Abnormalities in male reproductive health: cryptorchidism, hydrocele, varicocele, prostate enlargement

Unit 3: Female Reproductive Physiology

3.1 Histology of ovary.

3.2 Follicular development and maturation

3.3 Ovarian hormones: estrogen, progesterone, and their functions and mechanism of action

3.4 Regulation of secretion of female sex hormones

3.5 Oogenesis and ovulation

3.6 Formation and functions of corpus luteum, corpus albicans

3.7 Hypothalamic control of ovarian functions

Unit 4: Physiology of Puberty, Menstrual Cycle, and Pregnancy

4.1 Physiology of puberty: onset and changes

4.2 Estrous cycle and menstrual cycle: phases and regulation

4.3 Abnormalities in menstrual cycle

4.4 Onset of menopause and post-menopausal syndrome

4.5 Structure and functions of placenta

4.6 Maintenance of pregnancy and bodily changes during pregnancy, Ectopic pregnancy

4.7 Parturition and pregnancy tests

4.8 Mammary glands and Lactation

4.9 Male and Female infertility

4.10 Contraception

Unit 5: Embryology

5.1 Basic Concepts of Embryology

5.2 Totipotency and differentiation

5.3 Committed stem cells

5.4 Fertilization and blastulation

5.5 Implantation and gastrulation

5.6 Placentation and embryoblast formation

5.7 Development of alimentary canal, heart, urinary system, and genital system

5.8 Foetal circulation and ossification of bone

5.9 Developmental abnormalities

PRACTICAL (MNC-8)

Course Content: Reproductive Physiology and Embryology

1. Identification of vaginal cytology and understanding the phases of the estrous cycle of female rat.
2. Power Point Presentation preparation on topics of Reproductive physiology and embryology

Recommended 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.*

Basic Structural Framework of the Syllabus:

SEMESTER VI:

SEMESTER	COURSE TYPE	PAPER CODE	PAPER NAME	CREDIT	MARKS
VI	MAJOR- MJC-10	BSCPHYMJ601	MOLECULAR BIOLOGY	5	100
VI	MAJOR- MJC-11	BSCPHYMJ602	NERVOUS SYSTEM	5	100
VI	MAJOR- MJC-12	BSCPHYMJ603	SENSORY PHYSIOLOGY	5	100
VI	MAJOR- MJC-13	BSCPHYMJ604	IMMUNOLOGY AND MICROBIOLOGY	5	100
VI	SI- SIMC-1	SI601	SUMMER INTERNSHIP	2	50

MAJOR COURS (MJC)

SEMESTER VI

Course Name: **Molecular Biology**

Course Code: **BSCPHYMJ601**

<table>
<tr><td>Course Type:

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(Theory + Practical)</td><td colspan="3">Course Details: MJC-10</td><td colspan="2">L-T-P: 3-0-4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- *Understand and appreciate the diversity of life as it evolved over time by processes of mutation, selection and genetic change.*
- *Illustrate that fundamental structural units define the function of all living things.*
- *Explain that the growth, development, and behavior of organisms are activated through the expression of genetic information in context.*
- *Summarize that biological systems grow and change by processes based upon chemical transformation pathways and are governed by the laws of physics.*
- *Illustrate that living systems are interconnected and interacting across scales of space and time.*
- *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.*
- *Execute quantitative analysis to interpret biological data.*
- *Construct and utilize predictive models to study and describe complex biological systems.*
- *Apply concepts from other sciences in order to interpret biological phenomena.*
- *Communicate biological concepts and understanding to members of a diverse scientific community as well as to the general public.*
- *Identify social and historical dimensions of biological investigation.*

THEORY (MJC-10)

Course content: Molecular Biology

Unit 1: Genome Organization and Structure

1.1 Genome and its organization

1.2 Idea about gene, coding sequence, regulatory sequence

1.3 Intron, exon, nucleosome structure, Concept of Lariat

1.4 Packaging of DNA into higher-order structures

1.5 Brief idea of chloroplast DNA and Mitochondrial DNA

Unit 2: DNA Replication (Prokaryote)

2.1 DNA Replication-Basic idea of DNA and Chromosome

2.2 Messelson and Stahl Experiment

2.3 Hershey Chase Experiment

2.4 Features of DNA Replication

2.5 Semiconservative Nature of DNA Replication-Proof of semiconservative nature

2.6 Bidirectional DNA Replication-Features of bidirectional DNA replication, Mechanism of bidirectional DNA replication

Unit 3: Prokaryotic DNA Polymerases and Regulatory Proteins

3.1 DNA Polymerases-Types of DNA polymerases

3.2 Functions of DNA polymerases

3.3 DNA Ligases and Other Regulatory Proteins

3.4 Functions of DNA ligases

3.5 Other regulatory proteins involved in DNA replication

Unit 4: Transcription

4.1 Transcription in Prokaryotes

4.2 E. coli as model system

4.3 Prokaryotic RNA polymerase

4.4 Role of sigma factor

4.5 Promoter, initiation, elongation, and termination of RNA chains

4.6 Basic idea of Eukaryotic Transcription

Unit 5: Genetic Code and Translation

5.1 Genetic Code-Properties of genetic code

5.2 Wobble hypothesis

5.3 Translation

5.4 Codon-anticodon interaction, Shine-Dalgarno sequence

5.5 Mechanism of translation (initiation, elongation, and termination) in prokaryotes

Unit 6: Gene Regulation

6.1 Principles of Gene Regulation

6.2 Negative and positive regulation

6.3 Concept of operons (Inducible and Repressible Operon)

6.4 Lac operon concept

Unit 7: Gene Mutation and DNA Repair

7.1 Gene Mutation

7.2 Different types of mutagens, and types of mutation (Silent, Lethal, Missense, Nonsense, Frameshift, Point mutation etc.)

7.3 Philadelphia Chromosome, Down syndrome, Klinefelter's syndrome, Turner's syndrome

7.4 Somatic and Germline mutation

7.5 Chromosomal mutation-Insertion, Deletion, Inversion, Translocation, Substitution etc.

7.6 DNA Repairing Processes

Unit 8: Recombinant DNA Technology

8.1 Elementary Idea of Recombinant DNA Technology

8.2 Applications of recombinant DNA technology

8.3 Cloning Vectors-Plasmid, Phagemid, pBR322, pUC18/19, YACs, BACs.

8.4 Bacteriophage lambda and M13 based vectors

8.5 Cosmids, Ti plasmid as transformation vector

8.6 Restriction Endonuclease- Types I, II, and III-Mode of action, nomenclature, applications of Type II restriction enzymes

8.7 Enzymes Used in Recombinant DNA TechniquesDNA ligase, polynucleotide kinase, DNA polymerase, reverse transcriptase, terminal deoxynucleotidyltransferase, phosphatases

Unit 9: Molecular Biology Techniques

9.1 Polymerase Chain Reaction (PCR)-Principles, Types and Applications of PCR

9.2 Gene Therapy- Concept of adenosine deaminase (ADA)

9.3 Principles and Applications of gene therapy

9.4 DNA fingerprinting

9.5 Significance for the Development of Transgenic Animals

9.6 Applications of transgenic animals

9.7 Gel Electrophoresis-Types, Principle, and Application

9.8 Western, Northern and Southern Blotting-Principle and Applications

PRACTICAL (MJC-10)

Course Content: Molecular Biology

Unit 1: Blood Biochemistry

1.1 Blood Sugar by Folin-Wu Method

1.2 Serum Protein by Biuret Method

1.3 Serum Albumin using Bromocresol Green

1.4 Estimation of RNA by orcinol method

1.5 Blood Uric Acid by cyanide - free method

1.6 Serum urea by DAM method

Unit 2: Visit to a reputed research institute and demonstration of different techniques of Molecular Biology:

2.1 Demonstration of Gel Electrophoreses (Agarose and SDS page)

2.2 Demonstration of Paper Chromatography and TLC

2.3 Demonstration of Western blotting

References/ Suggested Readings

1. Cellular & Molecular Biology, by E.D.P. De Robertis& 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.

MAJOR COURS (MJC)

SEMESTER VI

Course Name: **Nervous System**

Course Code: **BSCPHYMJ602**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="3">Course Details: MJC-11</td><td colspan="2">L-T-P: 3-0-4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- *Define, and identify on a diagram of a motor neuron, the following regions: dendrites, axon, axon hillock, soma, and an axodendritic synapse.*
- *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.*
- *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.*
- *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.*
- *Contrast the generation and conduction of graded potentials (EPSP and IPSP) with those of action potentials.*
- *Describe the functional role of myelin in promoting saltatory conduction, contrasting the differences between the CNS and PNS.*
- *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.*
- *Compare electrical and chemical synapses based on velocity of transmission, fidelity, and the possibility for neuromodulation (facilitation or inhibition).*
- *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.*

- *Define the characteristics of a classical neurotransmitter.*
- *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*
- *Describe formation and reabsorption of cerebral spinal fluid (CSF), including the anatomy and function of the choroid plexus.*
- *Contrast the barrier mechanisms between the blood brain barrier and the blood CSF barrier and the consequences of barrier break down.*
- *Describe the impact of the blood brain barrier for the CNS distribution of intravenously administered hydrophilic and hydrophobic drugs.*
- *Locate and describe the function of circumventricular organs.*
- *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.*
- *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.*
- *Describe the steps in sensory transduction and action potential generation at a mechanoreceptor and at a nociceptor.*
- *Use the Weber-Fechner Law to determine the relationship between afferent neuronal firing frequency and perception of a stimulus.*
- *Discuss what is meant by the Pain/Temperature/Coarse Touch System and be able to trace its connections to the cerebral cortex.*
- *List the neural components of the Dorsal Column-Medial Lemniscus system and its Trigeminal analogs.*
- *Describe the functional properties of the Dorsal Column-Medial Lemniscus system,*
- *List the neural components of the spino-thalamic system and its trigeminal analogues.*
- *List functional properties of the spino-thalamic system.*
- *Explain how motor units are normally recruited to increase muscular force and what the functional advantages are of this recruitment order.*
- *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.*
- *Describe the concept of central pattern generator and list the motor activities that are supported by these circuits.*
- *Describe the three states of human brain activity based on EEG, EOG and EMG records.*
- *Distinguish characteristics of non-rapid eye movement sleep (NREM).*
- *Distinguish characteristics of rapid eye movement sleep (REM).*
- *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.*
- *Describe the symptoms of narcolepsy, sleep apnea, disorders of initiating and maintaining sleep, and REM sleep behavior disorder.*

- *Describe how respiration, cardiovascular, renal, gastrointestinal, eye movement, muscle, and endocrine function change from wake to NREM and REM states.*

THEORY (MJC-11)

Course content: Nervous System

Unit 1: Neuron Structure and Function

1.1 Classification and types of neurons

1.2 Neuron structure: dendrites, cell body, axon, and synapses

1.3 Neuroglia: types, functions, and interactions with neurons

1.4 Myelinogenesis and nerve fiber types

Unit 2: Neuronal Excitability and Conduction

2.1 Resting membrane potential and action potential

2.2 Electrotonic potentials and current of injury

2.3 Propagation of nerve impulse

2.4 Compound action potentials and nerve fiber properties

Unit 3: Synaptic Transmission and Neuromuscular Junction

3.1 Synapse structure and types

3.2 Mechanism of Synaptic transmission and Synaptic Delay

3.3 Neurotransmitters-types, Neuromodulators

3.4 Neuromuscular junction: structure, transmission, and end-plate potential

3.5 Motor unit and motor point

Unit 4: Nerve Injury and Regeneration

4.1 Injury to peripheral nerves: degeneration (Wallerian degeneration); Chromatolysis and regeneration

4.2 Changes in nerve cell body and receptors

4.3 Denervation hypersensitivity and nerve growth factors

Unit 5: Nervous System Organization [3 marks]

5.1 Overview of central and peripheral nervous systems

5.2 Structural organization of brain and spinal cord

Unit 6: Reflexes and Autonomic Nervous System

6.1 Reflex action: definition, reflex arc, classification

6.2 Autonomic nervous system: organization, outflow, ganglia

6.3 Chemical transmission in autonomic nervous system

Unit 7: Central Nervous System Functions

7.1 CSF formation, circulation, and functions

7.2 Blood-CSF and Blood-Brain barrier

7.3 Ascending and descending tracts

7.4 Spinal cord functions and Brown-Sequard syndrome

Unit 8: Sensory and Motor Systems

8.1 Pain production, perception, and regulation

8.2 Postural reflexes and muscle spindle/Golgi tendon organ

8.3 Cerebellar structure, connections, and functions

Unit 9: Higher Brain Functions

9.1 Cerebral cortex: histological structure, localization of functions, Broca's area, Wernicke's area

9.2 Limbic system: structure, connections, and functions

9.3 Physiology of emotion and electrophysiology of brain

Unit 10: Integrative Neuroscience

10.1 Reticular formation: organization, connections, and functions

10.2 Physiological basis of sleep and wakefulness

10.3 Higher functions: Cognition, conditioning, learning, and memory

PRACTICAL (MJC-11)

Course content: Nervous System

Unit 1: Nervous System

1.1 Histological preparations of nervous tissue

1.2 Histopathological staining with Nissl staining, silver staining etc.

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.

MAJOR COURS (MJC)

SEMESTER VI

Course Name: **Sensory Physiology**

Course Code: **BSCPHYMJ603**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="3">Course Details: MJC-12</td><td colspan="2">L-T-P: 3-0-4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
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<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

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

THEORY (MJC-12)

Course content: Sensory Physiology

Unit 1: Classification of Senses and Receptors

1.1 Classification of general and special senses: Definition, examples

1.2 Receptors as biological transducers: Function, types (mechanoreceptors, thermoreceptors, chemoreceptors)

1.3 Muller's law of specific nerve energies: Principle, implications

Unit 2: Sensory Transduction and Laws

2.1 Weber-Fechner law: Principle, applications

2.2 Steven's power law: Principle, applications

2.3 Sensory transduction in Pacinian corpuscle: Mechanism, significance

Unit 3: Olfaction

3.1 Structure and function of olfactory receptors

3.2 Olfactory pathway and transduction

3.3 Abnormalities of olfactory sensation: Causes, effects- Anosmia, Hyposmia, Hyperosmia

Unit 4: Gustation

4.1 Structure and function of gustatory receptors: Taste buds, taste receptors

4.2 Gustatory pathway and transduction

4.3 Abnormalities of gustatory sensation: Causes, effects, taste blindness, ageusia, hypogeusia, dysgeusia.

Unit 5: Vision – Eye Structure and Function

5.1 Structure of the eyeball: Cornea, lens, retina, optic nerve

5.2 Mechanism of accommodation: Ciliary muscles, lens shape

5.3 Pupillary reflexes: Light reflex, near response

5.4 Errors of refraction: Myopia, hypermetropia, astigmatism

Unit 6: Vision - Retina and Visual Pathway

6.1 Histological details of retina: Photoreceptors, bipolar cells, ganglion cells

6.2 Visual pathway: Optic nerve, optic tract, lateral geniculate body

6.3 Effects of lesion in visual pathway: Blindness, visual field defects

6.4 Photopic and scotopic vision: Rods, cones, adaptation

Unit 7: Vision - Visual Processing and Perception

7.1 Visual processing in the retina: Signal transmission, processing

7.2 Colour vision: Modern concept, colour blindness

7.3 Visual field: Visual acuity, Mono-ocular and Binocular Vision

Unit 8: Audition - Sound and Hearing

8.1 Sound waves: Properties, decibel

8.2 Structure and function of auditory apparatus: External, middle, internal ear

8.3 Auditory transduction: Mechanism, significance

8.4 Auditory pathways and centers

Unit 9: Audition - Hearing Mechanisms and Disorders

9.1 Mechanism of hearing: Modern theories, significance

9.2 Discrimination of sound frequency and loudness: Mechanism, significance

9.3 Localization of sound source: Mechanism, significance

9.4 Audiometry: Principles, applications

9.5 Deafness: Causes, effects, types

Unit 10: Electroretinogram and Electro-olfactogram

10.1 Electroretinogram: Principle, applications

10.2 Electro-olfactogram: Principle, applications

PRACTICAL (MJC-12)

Course Content: Sensory Physiology

Unit 1: Fresh tissue preparation

1.1 Suitable staining and examination of fresh tissues – epithelial, areolar, adipose (Sudan III or IV) and muscle tissues.

1.2 . Silver nitrate preparation of cornea for cell spaces

1.3 Audiometry test, Visual acuity test, Colour blindness test

1.4 Experiments on visual field (perimetry)

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.

MAJOR COURS (MJC)

SEMESTER VI

Course Name: **Microbiology and Immunology**

Course Code: **BSCPHYMJ604**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: MJC-13</td><td colspan="2">L-T-P: 3-0-4</td></tr>
<tr><td rowspan="3">Credit: 5</td><td rowspan="3">Full Marks: 100</td><td colspan="2">CA Marks</td><td colspan="2">ESE Marks</td></tr>
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<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- *Define/explain within multiple microbiology disciplines the core theories and practices;*
- *Describe/explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations;*
- *Explain the theoretical basis of the tools, technologies and methods common to microbiology; and*
- *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.*
- *Learn the basic structure of immune system and realizesits importance.*
- *Learn antigen recognition and presenting*
- *Learn structure, of antibody and classes of antibody.*
- *Learn the basic functions of immunity of humoral and cellular types.*
- *Learn the functions of the immune system abnormally, hypersensitivity reactions and the basic mechanisms of autoimmune reactions.*
- *Learn the basic mechanism of antigen antibody reactions.*
- *Learn methods of protection against infectious diseases.*
- *Learn diagnosis of infectious diseases which methods are determined.*

THEORY (MJC-13)

Course content: Microbiology [15 marks]

Unit 1: Bacterial Cell Structure and Classification

- **1.1** Prokaryotic cell: Structure, components, and functions
- **1.2** Classification of bacteria: Morphology, staining characteristics (Gram staining)
- **1.3** Key differences between Gram-positive and Gram-negative bacteria

Unit 2: Bacterial Nutrition and Growth

- **2.1** Bacterial nutritional requirements: Nutritional types (autotrophs, heterotrophs, saprotrophs)
- **2.2** Culture media: Types (solid, liquid, selective, differential); subculture methods
- **2.3** Physical conditions for growth: Temperature, pH, oxygen requirements
- **2.4** Growth curve of bacteria and different phases, Generation time

Unit 3: Bacterial Metabolism

- **3.1** Fermentation: Types (lactic acid, ethanol, butyric acid)
- **3.2** Glyoxylate cycle: Importance in bacterial metabolism
- **3.3** Entner-Doudoroff pathway: Alternative glucose metabolism pathway

Unit 4: Bacterial Genetics

- **4.1** Introduction to bacterial genetics
- **4.2** Transformation: Direct uptake of free DNA
- **4.3** Conjugation: Cell-to-cell transfer of genetic material
- **4.4** Transduction: Phage-mediated gene transfer

Unit 5: Sterilization and Antimicrobial Agents

- **5.1** Sterilization: Methods (heat, radiation, filtration)
- **5.2** Pasteurization: Principles and applications
- **5.3** Bacteriostatic and bactericidal agents
- **5.4** Antibiotics

Unit 6: Virology

- **6.1** Virus morphology: Structure, components (capsid, genome)
- **6.2** Viral genome: Types (DNA, RNA)
- **6.3** Viral classification: Based on genome, host range
- **6.4** Concept about virion and viroid

Course content: Immunology

Unit 7: Innate Immunity

7.1 Immunity: Definition, types (innate, adaptive)

7.2 Mechanical barriers: Skin, mucous membranes

7.3 Antibacterial & antifungal substances: Lysozyme, defensins

7.4 Inflammatory responses: Role in body defenses

7.5 Phagocytosis: Mechanism

7.6 Antigens, Haptens, Epitope, Paratope

Unit 8: Acquired Immunity

8.1 Acquired immunity: Active, passive

8.2 Humoral immunity: B-lymphocytes, plasma cells, immunoglobulins (Types and Structure)

8.3 Cell-mediated immunity: T-lymphocytes, suppressor, helper, Natural killer T cells

8.4 Antigen Presenting Cells

8.5 Antigen processing and presentation

Unit 9: Immune Mechanisms

9.1 Antigen-antibody reactions: Types (precipitation, agglutination)

9.2 Complement system: Classification, activation, function

9.3 Cytokines & lymphokines: Role in immune responses

9.4 Adjuvants

Unit 10: Immunopathology

10.1 Hypersensitivity reactions: Types (anaphylaxis, delayed hypersensitivity)

10.2 Autoimmune diseases: Multiple Sclerosis, Myasthenia Gravis, Guillain-Barré Syndrome, Autoimmune Encephalitis, Hashimoto's Thyroiditis, Graves' Disease, Type 1 Diabetes, Rheumatoid Arthritis, Systemic Lupus Erythematosus.

10.3 Immunopathology of AIDS

10.4 Tumor immunology: Immune responses to cancer

Unit 11: Immunological Techniques

10.1 ELISA test: Principle, applications

10.2 Blood groups: ABO, Rh systems

10.3 Human leucocyte antigens (HLA): Importance in transplantation

PRACTICAL (MJC-13)

Course Content: Microbiology and Immunology

Unit 1: Immunology and Microbiology

1.1 Gram staining of bacteria and identification of Gram-positive and Gram-negative bacteria.

1.2 Demonstration: Spore Staining, Immuno-diffusion, ELISA etc.

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.
3. Owen, J. A., Jones, P. P., Kuby, J., Punt, J., & Stranford, S. A. (2013). Kuby immunology (7th ed.). New York: W.H. Freeman.
4. J. G. Black, "Microbiology: Principles and Explorations,"4th Edition, Prentice Hall, Upper Saddle River, 1999, pp. 386-600.

MAJOR COURS (MJC)

SEMESTER VI

Course Name: **Summer Internship**

Course Code: **SI601**

Course Type: Core	Course Details: SIMC-1		L-T-P: 0-0-4
Credit: 2 (60 Hours)	Full Marks: 50	CA Marks	ESE Marks
		30	20

- **Course Overview:**

Internship in Physiology aims to provide students with hands-on exposure to real-life settings in academic, clinical, research, or industrial domains. This course is intended to bridge classroom knowledge with field applications, thereby improving students' skill sets, research aptitude, and overall professional competence. The experience also enhances understanding of emerging health challenges, techniques in physiological assessment, and the practical application of concepts in human and comparative physiology.

- **Course Objectives:**

1. Integrate physiological theory with practical applications.
2. Provide exposure to clinical/research/industrial environments.
3. Cultivate research, technical, and diagnostic skills.
4. Enhance employability through real-world task engagement.
5. Foster communication, teamwork, and problem-solving abilities.
6. Introduce learners to bioinstrumentation and diagnostic tools.
7. Encourage entrepreneurial and health education-related capacities.
8. Promote collaboration with industry, hospitals, research labs, or NGOs.
9. Support capacity-building in ethical and evidence-based research practices.

- ***Learning Outcomes:***

- *Correlate theoretical concepts with practical applications in physiology.*
- *Demonstrate enhanced understanding of biomedical and physiological tools.*
- *Exhibit professional and soft skills such as communication, documentation, and ethics.*
- *Prepare and present scientific reports and engage in knowledge-sharing through presentations.*
- *Develop critical thinking and research methodologies relevant to physiology.*

- **Professional Skill Development:**

- Practical application of physiological concepts in health/research sectors.
- Data recording and analysis using tools like ECG, spirometry, EMG, etc.
- Development of soft skills: time management, adaptability, team spirit, leadership.
- Use of digital and analytical platforms for research documentation.

- **Internship Categories (Choose Any One)**

Duration: 60 hours (can be pursued during vacation or mid-semester break)

I. Conventional Internship:

Students may opt for internships at academic/research institutions (State Govt./ Central Govt. or other universities, hospitals with research units, private diagnostic centers) for lab-based or clinical physiology projects (Online/Offline/Hybrid mode).

II. Field-Based Learning:

Students can engage with public health programs, clinical camps, rehabilitation centers, nutrition counseling units, sports institutes, government health missions, NGOs, or medical startups focusing on physiological well-being.

- **Role of Internship Supervisor (College Faculty Member):**

- Assigned by the Department to monitor attendance, progress, and compliance.
- Ensures communication with external mentor and guides documentation.
- Evaluates student reports and coordinates final assessments.

- **Role of External Mentor:**

- Identified by the Department or the student with approval.
- Provides professional guidance, research insights, and validates performance.
- Issues internship completion certificate/report.

- **Guidelines and Requirements:**

- Title: *Internship Assessment through Project/Field Work* (Group projects allowed).
- Students must maintain an **Attendance Register** and **Work Diary**.
- The final **Internship Report** must include:
    - Objective of the internship
    - Description of tasks/observations
    - Learning outcomes
    - Photos/figures (where applicable)
    - Attendance document
    - Authenticated certificate signed by Supervisor and Mentor

- **Evaluation Scheme:**

A. Continuous Assessment – 30 Marks (Evaluation of Final Report by: - **External Mentor**: 20 Marks - **Internal Supervisor**: 10 Marks)

B. End Semester Examination – 20 Marks (**Presentation Format and Report Quality**: 15 Marks - **Viva Voce (with External Examiner)**: 5 Marks)

Basic Structural Framework of the Syllabus:

SEMESTER VII:

SEMESTER	COURSE TYPE	PAPER CODE	PAPER NAME	CREDIT	MARKS
VII	MAJOR- MJC-14	BSCPHYMJ701	BIOSTATISTICS AND BIOINFORMATICS	5	100
VII	MAJOR- MJC-15	BSCPHYMJ702	ENVIRONMENTAL PHYSIOLOGY	5	100
VII	MAJOR- MJC-16	BSCPHYMJ703	WORK PHYSIOLOGY AND OCCUPATIONAL HEALTH	5	100
VII	MAJOR- MJC-17	BSCPHYMJ704	PHARMACOLOGY	5	100
VII	MINOR- MNC-6	BSCPHYMN701	ENVIRONMENTAL PHYSIOLOGY	5	100

MAJOR COURS (MJC)

SEMESTER VII

Course Name: **Biostatistics and Bioinformatics**

Course Code: **BSCPHYMJ701**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: MJC-14</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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</table>

Course Learning Outcomes:

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

- *Apply descriptive statistics to summarize and present data.*
- *Calculate probabilities using discrete and continuous probability distributions.*
- *Construct and interpret confidence intervals for means and proportions.*
- *Perform hypothesis testing for means and proportions.*
- *Analyze relationships between variables using regression and correlation.*
- *Apply non-parametric tests for hypothesis testing.*
- *Interpret survival analysis results using Kaplan-Meier estimates and log-rank tests.*
- *Design and evaluate research studies using principles of biostatistics.*
- *Apply biostatistical principles to real-world health problems.*
- *Use statistical software to analyze and interpret biostatistical data.*

THEORY (MJC-14)

Course content: Biostatistics and Bioinformatics

Unit 1: Introduction to Biostatistics

1.1 Definition and scope of Biostatistics

1.2 Importance of Biostatistics in medicine and public health

1.3 Types of data and variables

1.4 Summarization and presentation of data

Unit 2: Descriptive Statistics

2.1 Measures of central tendency (mean, median, mode)

2.2 Measures of dispersion (range, variance, standard deviation)

2.3 Skewness and kurtosis

2.4 Data visualization (histograms, box plots, scatter plots)

Unit 3: Probability and Probability Distributions

3.1 Basic concepts of probability

3.2 Rules of probability

Unit 4: Sampling Distributions and Confidence Intervals Sampling distributions (mean, proportion)

4.1 Confidence intervals for mean and proportion

4.2 Interpretation of confidence intervals

Unit 5: Hypothesis Testing

5.1 Basic concepts of hypothesis testing

5.2 Types of errors (Type I, Type II)

5.3 Test statistics and p-values

5.4 Hypothesis testing for means and proportions

Unit 6: Regression and Correlation

6.1 Simple linear regression

6.2 Coefficient of determination (R-squared)

6.3 Correlation coefficient

6.4 Interpretation of regression and correlation results

Unit 7: Non-Parametric Tests

7.1 Introduction to non-parametric tests

Unit 8: Bioinformatics

8.1 Introduction to bioinformatics and computational biology

PRACTICAL (MJC-14)

Course content: Biostatistical Computing

1.1 Introduction to biostatistical computing

1.2 Basic Application of Computer in Physiological data Analysis with M.S. Word and M.S. Excel.

1.3 Data management and analysis using software (R, SPSS, SAS)

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 Publishers Pvt. Ltd.

MAJOR COURS (MJC)

SEMESTER VII

Course Name: **Environmental Physiology**

Course Code: **BSCPHYMJ702**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: MJC-15</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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</table>

Course Learning Outcomes:

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

- *Explain the principles of thermoregulation and its importance in different environments.*
- *Describe the physiological responses to environmental stressors such as temperature, humidity, and altitude.*
- *Discuss the physiological adaptations of animals to different environmental conditions such as desert, Arctic, and aquatic environments.*
- *Explain the principles of respiratory physiology and its adaptation to different environments.*
- *Describe the physiological responses to environmental pollutants such as air, water, and soil pollution.*
- *Analyze the impact of climate change on physiological processes and ecosystems.*
- *Explain the principles of ecological physiology and its importance in understanding ecosystem function.*
- *Discuss the physiological basis of behavioral adaptations to environmental changes.*
- *Apply environmental physiological principles to real-world problems such as conservation, wildlife management, and environmental health.*

THEORY (MJC-15)

Course content: Environmental Physiology

Unit 1: Introduction to Environmental Physiology

1.1 Definition and scope of Environmental Physiology

1.2 Interactions between organisms and their environment

Unit 2: Temperature Regulation

2.1 Thermoregulation: definition and importance

2.2 Heat gain and loss: radiation, conduction, convection, evaporation

2.3 Cold stress

2.4 Thermoregulatory mechanisms: behavioral, physiological, biochemical

2.5 Temperature tolerance: limits, adaptations, acclimatization

Unit 3: Environmental Stress and Adaptation

3.1 Environmental stress: definition, types (physical, chemical, biological)

3.2 Stress response: physiological, biochemical, behavioral

3.3 Adaptation

3.4 Acclimatization: definition, mechanisms, importance

Unit 4: Ecophysiology of Extreme Environments

4.1 Extreme environments: definition, types (high altitude, deep sea)

4.2 Behavioral adaptations: migration, hibernation, aestivation

4.3 Biodiversity

Unit 5: Environmental Toxicology

5.1 Environmental toxicology: definition, importance

5.2 Types of toxins: physical, chemical, biological

5.3 Toxicological responses: physiological, biochemical, behavioral

Unit 6: Environmental Pollution

6.1 Air pollution, water pollution, noise pollution

PRACTICAL (MJC-15)

Course content: Environmental Physiology

1.1 Measurement of noise by Sound level meter.

1.2 Measurement of illumination level by lux meter

1.3 Measurement of environmental temperature - dry bulb and wet bulb, relative humidity, air velocity.

1.4 Determination of, BOD and COD in water by titration method

References/ Suggested Readings:

1. Environmental Physiology of Animals" by Pat Willmer, Graham Stone, and Ian Johnston - A comprehensive textbook covering various aspects of environmental physiology.

2. Environmental Physiology by A. Hemantaranjan

MAJOR COURS (MJC)

SEMESTER VII

Course Name: **Work Physiology and Occupational Health**

Course Code: **BSCPHYMJ703**

Course Type: Core (Theory + Practical)	Course Details: MJC-16			L-T-P: 3-0-4	
Credit: 5	Full Marks: 100	CA Marks		ESE Marks	
		Practical	Theoretical	Practical	Theoretical
		30	15	20	35

Course Learning Outcomes:

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

- *Apply descriptive statistics to summarize and present data.*
- *Calculate probabilities using discrete and continuous probability distributions.*
- *Construct and interpret confidence intervals for means and proportions.*
- *Perform hypothesis testing for means and proportions.*
- *Analyze relationships between variables using regression and correlation.*
- *Apply non-parametric tests for hypothesis testing.*
- *Interpret survival analysis results using Kaplan-Meier estimates and log-rank tests.*
- *Design and evaluate research studies using principles of biostatistics.*
- *Apply biostatistical principles to real-world health problems.*
- *Use statistical software to analyze and interpret biostatistical data.*

THEORY (MJC-16)

Course content: Work Physiology and Occupational Health

Unit 1: Introduction to Work Physiology and Ergonomics

1.1 Definition and nature of physical work: isotonic, isometric, and isokinetic, positive and negative work

1.2 Concept of physiological work

1.3 Importance of work physiology and ergonomics in occupational health

Unit 2: Workload and Energetics of Work

2.1 Classification of workload: light, moderate (submaximal), and heavy (maximal) depending on intensity and duration of work

2.2 Energy demand for different activities

Unit 3: Physiological Responses to Work [5 marks]

3.1 Cardiovascular responses to work

3.2 Respiratory responses to work

3.3 Metabolic and muscular responses to work

Unit 4: Work-Rest Cycle and Occupational Health

4.1 Importance of rest pause and work-rest cycle

4.2 Definition and factors affecting occupational health

4.3 Occupational health hazards: physical, chemical, biological, and psycho-social hazards

Unit 5: Occupational Safety

5.1 Concept of occupational safety and health

5.2 Accidents: theories of accident, analysis of accident, promotion of safety, personal protective devices

Unit 6: Occupational Diseases and Health Problems

6.1 Occupational diseases: pneumoconiosis, silicosis, asbestosis, occupational cancer

6.2 Prevention and health measures of occupational hazards

PRACTICAL (MJC-16)

Course content: Work Physiology and Occupational Health

1.1 Submit a project regarding "Ergonomic evaluation at the Workplace" which includes a systematic assessment of a worker's workstation and job: Identification of potential risks of Musculoskeletal Disorders (MSDs).

References/ Suggested Readings:

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

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.

5. Bridger, R. (2008). Introduction to Ergonomics (3rd ed.). CRC Press. https://doi.org/10.1201/9781439894927

MAJOR COURS (MJC)

SEMESTER VII

Course Name: **Pharmacology**

Course Code: **BSCPHYMJ704**

<table>
<tr><td>Course Type:

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(Theory + Practical)</td><td colspan="2">Course Details: MJC-17</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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<tr><td>Practical</td><td>Theoretical</td><td>Practical</td><td>Theoretical</td></tr>
<tr><td></td><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- *Define the principles of pharmacology and its importance in the study of physiological processes.*
- *Explain the concepts of pharmacokinetics and pharmacodynamics and their applications.*
- *Identify the different types of drugs, including agonists, antagonists, and modulators, and their mechanisms of action.*
- *Describe the pharmacological effects of general anaesthetics, sedatives, and hypnotics.*
- *Explain the mechanisms of action of diuretics, neuromuscular blockers, and adrenoceptor agonists and antagonists.*
- *Discuss the pharmacological management of angina, inflammation, and other diseases.*
- *Analyze the autonomic nervous system and its pharmacological modulation.*
- *Apply the principles of toxicology and pharmacovigilance in drug safety and development.*
- *Evaluate the current topics and future directions in pharmacology, including personalized medicine and gene therapy.*
- *Design and propose a research study on a topic related to pharmacology, incorporating the principles of pharmacokinetics and pharmacodynamics.*

THEORY (MJC-17)

Course content: Pharmacology

Unit 1: Introduction to Pharmacology

1.1 Importance of pharmacology in the study of physiological processes

Unit 2: Pharmacokinetics

2.1 Definition of pharmacokinetics and its importance

2.2 Absorption: mechanisms, factors affecting, and routes of administration

2.3 Distribution: mechanisms, factors affecting, and volume of distribution

2.4 Permeation: mechanisms and factors affecting

2.5 Elimination: mechanisms, factors affecting, and clearance

2.6 Half-life of drug and its importance

Unit 3: Pharmacodynamics

3.1 Definition of pharmacodynamics and its importance

3.2 Dose-response curves: types, interpretation, and significance

3.3 Drug biotransformation: mechanisms, factors affecting, and importance

3.4 Bioavailability: definition, factors affecting, and importance

3.5 Drug accumulation: mechanisms, factors affecting, and importance

3.6 Drug toxicity: definition, types, and importance

Unit 4: General Anaesthetics and Sedatives

4.1 Types of general anaesthetics: inhalational, intravenous, and local

4.2 Mechanism of action of general anaesthetics

4.3 Sedatives and hypnotics

4.4 Mechanism of action of sedatives and hypnotics

Unit 5: Diuretics and Neuromuscular Blockers

5.1 Types of diuretics: carbonic anhydrase inhibitors, loop diuretics, potassium-sparing diuretics, and osmotic diuretics

5.2 Mechanism of action of diuretics

5.3 Neuromuscular blockers: tubocurarine and succinylcholine

Unit 6: Adrenoceptor Agonists and Antagonists

6.1 Adrenergic stimulants: amphetamine and ephedrine

6.2 α-adrenergic stimulants: methoxamine and clonidine

6.3 β-adrenergic stimulants: metaproterenol and salbutamol

6.4 Adrenergic antagonists

Unit 7: Antianginal and Anti-inflammatory Drugs

7.1 Antianginal drugs: nitroglycerine and calcium channel blockers

7.2 Mechanism of action of antianginal drugs

7.3 Nonsteroidal anti-inflammatory drugs (NSAIDs): types, mechanism of action, and side effects

Unit 8: Autonomic Nervous System and Pharmacology

8.1 Autonomic nervous system: structure, function, and neurotransmitters

8.2 Pharmacology of autonomic nervous system: agonists, antagonists, and modulators

PRACTICAL (MJC-17)

Course content: Experimental Physiology

1.1 Dose response curve of oxytocin on uterine muscle tone

1.2 Dose response curve of adrenaline on intestinal smooth muscle movement

1.3 Effect of different electrolytes (K+, Na+, Ca+2, etc) on the contractility of intestinal smooth muscle

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.

MINOR COURS (MNC)

SEMESTER VII

Course Name: **Environmental Physiology**

Course Code: **BSCPHYMN701**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: MNC-6</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- *Explain the principles of thermoregulation and its importance in different environments.*
- *Describe the physiological responses to environmental stressors such as temperature, humidity, and altitude.*
- *Discuss the physiological adaptations of animals to different environmental conditions such as desert, Arctic, and aquatic environments.*
- *Explain the principles of respiratory physiology and its adaptation to different environments.*
- *Describe the physiological responses to environmental pollutants such as air, water, and soil pollution.*
- *Analyze the impact of climate change on physiological processes and ecosystems.*
- *Explain the principles of ecological physiology and its importance in understanding ecosystem function.*
- *Discuss the physiological basis of behavioral adaptations to environmental changes.*
- *Apply environmental physiological principles to real-world problems such as conservation, wildlife management, and environmental health.*

THEORY (MNC-6)

Course content: Environmental Physiology

Unit 1: Introduction to Environmental Physiology

1.3 Definition and scope of Environmental Physiology

1.4 Interactions between organisms and their environment

Unit 2: Temperature Regulation

2.6 Thermoregulation: definition and importance

2.7 Heat gain and loss: radiation, conduction, convection, evaporation

2.8 Cold stress

2.9 Thermoregulatory mechanisms: behavioral, physiological, biochemical

2.10 Temperature tolerance: limits, adaptations, acclimatization

Unit 3: Environmental Stress and Adaptation

3.5 Environmental stress: definition, types (physical, chemical, biological)

3.6 Stress response: physiological, biochemical, behavioral

3.7 Adaptation

3.8 Acclimatization: definition, mechanisms, importance

Unit 4: Ecophysiology of Extreme Environments

4.4 Extreme environments: definition, types (high altitude, deep sea)

4.5 Behavioral adaptations: migration, hibernation, aestivation

4.6 Biodiversity

Unit 5: Environmental Toxicology

5.4 Environmental toxicology: definition, importance

5.5 Types of toxins: physical, chemical, biological

5.6 Toxicological responses: physiological, biochemical, behavioral

Unit 6: Environmental Pollution

6.2 Air pollution, water pollution, noise pollution

PRACTICAL (MNC-6)

Course content: Environmental Physiology

1.5 Measurement of noise by Sound level meter.

1.6 Measurement of illumination level by lux meter

1.7 Measurement of environmental temperature - dry bulb and wet bulb, relative humidity, air velocity.

1.8 Determination of, BOD and COD in water by titration method

References/ Suggested Readings:

1. Environmental Physiology of Animals" by Pat Willmer, Graham Stone, and Ian Johnston - A comprehensive textbook covering various aspects of environmental physiology.
2. Environmental Physiology by A. Hemantaranjan

Basic Structural Framework of the Syllabus:

SEMESTER VIII:

SEMESTER	COURSE TYPE	PAPER CODE	PAPER NAME	CREDIT	MARKS
VIII	MAJOR- MJC-18	BSCPHYMJ801	SPORTS AND EXERCISE PHYSIOLOGY	5	100
VIII	MAJOR- MJC-19	BSCPHYMJ802	STRESS PHYSIOLOGY	5	100
VIII	MAJOR- MJC-20	BSCPHYMJ803	SOCIAL PHYSIOLOGY AND NUTRITION	5	100
VIII	MAJOR- MJC-21	BSCPHYMJ804	INSTRUMENTATION AND BIOTECHNOLOGY	5	100
VIII	MINOR- MNC-7	BSCPHYMN801	SOCIAL PHYSIOLOGY AND NUTRITION	5	100

MAJOR COURS (MJC)

SEMESTER VIII

Course Name: **Sports and Exercise Physiology**

Course Code: **BSCPHYMJ801**

<table>
<tr><td>Course Type:

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(Theory + Practical)</td><td colspan="2">Course Details: MJC-18</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

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

THEORY (MJC-18)

Course content: Sports and Exercise Physiology

Unit 1: Sports Physiology and Performance

1.1 Concept of endurance, strength, and speed in sports activities

1.2 Physical training principles and their impact on performance

1.3 Overtraining and detraining

1.4 Warm-up and cool-down exercises

Unit 2: Nutrition, Ergogenic Aids, and Recovery

2.1 Nutritional aspects of sports and exercise

2.2 Ergogenic aids

2.3 Lactate threshold and lactate tolerance,

Unit 4: Aerobic and Anaerobic Power

4.1 Concept of aerobic and anaerobic power

4.2 Factors affecting aerobic and anaerobic power

4.3 Methods of measurement and significance of maximal oxygen consumption

4.4 Excess post-exercise oxygen consumption (EPOC) or O2 debt.

Unit 5: Physical Fitness and Its Assessment

5.1 Concept of physical fitness

5.2 Assessment of physical fitness

PRACTICAL (MJC-18)

Course Content: Experiments on Exercise Physiology

1.1 Sphygmomanometric measurement of arterial blood pressure at rest and after exercise.

1.2 Modified Harvard step test and determination of physical fitness. Recording of recovery heart-rate after standard exercise and graphical plotting.

1.3 Anthropometric measurements (e.g., sitting dimension like sitting height, eye height, shoulder height, elbow rest height, knee height, popliteal height; and standing dimension like stature, shoulder height, elbow height, eye height, knuckle height, knee height).

1.4 Assessment of Musculoskeletal disorder by questionnaire technique

1.5 Pulmonary function tests – FEV, FEV1, FEV1%, FVC, PFR

1.6 Queens College Step Test

1.7 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.

MAJOR COURS (MJC)

SEMESTER VIII

Course Name: **Stress Physiology**

Course Code: **BSCPHYMJ802**

<table>
<tr><td>Course Type:

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(Theory + Practical)</td><td colspan="2">Course Details: MJC-19</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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<tr><td></td><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- *Define and explain the concept of stress and its physiological responses.*
- *Describe the General Adaptation Syndrome (GAS) and its stages.*
- *Identify the neuroendocrine responses to stress, including the hypothalamic-pituitary-adrenal (HPA) axis.*
- *Explain the impact of stress on the immune system and immune function.*
- *Discuss the relationship between stress and various diseases, including cardiovascular disease and mental health disorders.*
- *Describe the behavioral responses to stress, including fight, flight, and freeze.*
- *Apply stress management techniques, including relaxation, exercise, and cognitive-behavioral therapy (CBT).*
- *Analyze the role of epigenetics, microbiome, and neuroimaging in stress physiology.*
- *Evaluate the ethical considerations in stress physiology research.*
- *Design and propose a research study on a topic related to stress physiology.*

THEORY (MJC-19)

Course content: Stress Physiology

Unit 1: Introduction to Stress Physiology

- **1.1** Definition and concept of stress

Unit 2: Stress Response and Adaptation

- **2.1** General Adaptation Syndrome (GAS)
- **2.2** Physiological responses to stress (cardiovascular, respiratory, metabolic)
- **2.3** Neuroendocrine responses to stress (hypothalamic-pituitary-adrenal axis)
- **2.4** Adaptation and coping mechanisms to stress

Unit 3: Stress and the Nervous System

- **3.1** Neurotransmitters and hormones involved in stress response
- **3.2** Brain regions involved in stress processing
- **3.3** Stress and mental health disorders

Unit 4: Stress and the Endocrine System

- **4.1** Hormones involved in stress response
- **4.2** Endocrine glands and their role in stress response
- **4.3** Endocrine disorders related to stress

Unit 5: Stress and the Immune System

- **5.1** Impact of stress on immune function
- **5.2** Immunological disorders related to stress

Unit 6: Stress and Behavior

- **6.1** Behavioral responses to stress
- **6.2** Stress and cognitive function

Unit 7: Stress Management and Interventions

- **7.1** Stress management techniques
- **7.2** Exercise and stress management

PRACTICAL (MJC-19)

Course content: Stress Physiology

1.1 Measurement of blood pressure and heart rate in a resting state and after a stress-inducing task

1.2 Assessment of stress through stress questionnaire and analysis of the data

References/ Suggested Readings

1. Physiology, Stress Reaction, Brianna Chu; Komal Marwaha; Terrence Sanvictores; Ayoola O. Awosika; Derek Ayers.

2. Stress: Endocrine Physiology and Pathophysiology. Constantine Tsigos, Ioannis Kyrou et. Al.,

MAJOR COURS (MJC)

SEMESTER VIII

Course Name: **Social Physiology and Nutrition**

Course Code: **BSCPHYMJ803**

<table>
<tr><td>Course Type:

Core

(Theory + Practical)</td><td colspan="2">Course Details: MJC-20</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- *Understand and appreciate the diverse socioeconomic, behavioural, sociocultural, biological, environmental, philosophical, and historical factors that influence health, rehabilitation, and human movement*
- *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.*
- *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.*
- *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.*
- *Understand what an adequate and well-balanced diet is.*
- *Examine the several concepts of nutrition.*
- *Explain elements of nutrition.*
- *List rules of adequate and balanced diet.*
- *Learn the physical and social changes taking place during the elderly period of life.*
- *Learn the changes in a body taking place during the ageing period of life*
- *Learn the energy and food demands of the elderly people.*
- *Learn how to make nutritive plans according to those demands*
- *Have knowledge about the diseases caught by the elderly people and their nutritive demands.*
- *Examine the chronic diseases caught by the elderly people.*
- *Learn the nutritive ways peculiar to those diseases.*

- *Make samples of menu planning suitable for the elderly people, growing child, adult man and woman, pregnant woman and lactating woman*

THEORY (MJC-20)

Course content: Social Physiology and Nutrition

Unit 1: Introduction to Social Physiology

1.1 Definition and scope of social physiology

1.2 Importance of social physiology in public health

Unit 2: Population and Family Planning

2.1 Population problem: principles and methods of family planning

2.2 Contraceptive methods

2.3 Infertility and assisted reproductive technologies

Unit 3: Nutrition and Health

3.1 Basal metabolic rate and respiratory quotient

3.2 Calorific value of foods and body calorie requirements

3.3 Dietary requirements of proximate principal of foods

Unit 4: Malnutrition and Nutritional Disorders

4.1 Malnutrition

4.2 Protein-energy malnutrition (PCM): marasmus, kwashiorkor, and marasmic kwashiorkor

4.3 Nutritional disorders: endemic goitre, nutritional anaemias, rickets, osteomalacia, xerophthalmia, and beriberi

Unit 5: Immunization and Prevention of Diseases

5.1 Principles and social importance of immunization

5.2 Vaccines

5.3 Epidemiology and prevention of cholera, malaria, hepatitis, and AIDS

5.4 Role of immunization in public health

Unit 6: Nutrition and Dietetics

6.1 Balanced diet and principles of formulation of balanced diets

6.2 Dietary requirements for growing children, adults, pregnant women, and lactating women

6.3 Nutrition and dietetics in public health

Unit 7: Nutrition and Metabolism [5 marks]

7.1 Nitrogen balance, essential amino acids, and biological value of proteins

7.2 Dietary fibres and their importance in nutrition

7.3 Physiology of starvation and obesity

PRACTICAL (MJC-20)

Course content: Diet Survey and Food Adulteration

1.1 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.

1.2 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. 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.

5. Park's Text Book of Preventive and Social Medicine by K. Park, M/s. Banarsidas Bhanot Publishers.

MAJOR COURS (MJC)

SEMESTER VIII

Course Name: **Biotechnology and Its Applications**

Course Code: **BSCPHYMJ804**

<table>
<tr><td>Course Type:

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(Theory + Practical)</td><td colspan="2">Course Details: MJC-21</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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<tr><td></td><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- *Design and develop instrumentation systems for biotechnological applications.*
- *Apply principles of molecular biology and biochemistry to develop new biotechnology products.*
- *Operate and troubleshoot various types of instrumentation used in biotechnology.*
- *Analyze and interpret data from biotechnological experiments and instrumentation.*
- *Develop and implement laboratory safety protocols and regulations.*
- *Apply principles of spectroscopy and chromatography to analyze biomolecules.*
- *Design and execute experiments using molecular biology and biochemistry techniques.*
- *Develop and implement quality control and quality assurance procedures in biotechnology.*
- *Communicate scientific results and data effectively through written and oral presentations.*
- *Apply critical thinking and problem-solving skills to address complex biotechnological challenges.*

THEORY (MJC-21)

Course content: Instrumentation and Biotechnology

Unit 1: Introduction to Biotechnology

1.1 Definition and scope of biotechnology

Unit 2: Animal Cell Culture and Tissue Engineering

2.1 Animal cell culture techniques and applications

2.2 Tissue engineering principles and methods

2.3 Stem cell biology

Unit 3: Genetic Engineering of Animals

3.1 Gene editing technologies

3.2 Transgenic animal production and applications

3.3 Gene therapy, genetically modified organism (GMO), First transgenic cow-Rosie

3.4 Production of Humulin

3.5 Animal model for cystic fibrosis, cancer, rheumatoid arthritis and Alzheimer disease

3.6 Bt cotton

Unit 4: Molecular Diagnosis for Effective Treatment of Disease

5.1 rDNA technology

5.2 PCR

5.3 ELISA

5.4 Alpha1 anti-trypsin for emphysema

Unit 6: Emerging Trends and Applications

6.1 Synthetic biology and bioengineering in animals

6.2 Nanobiotechnology and nanomedicine in animal health

6.3 Future directions and challenges in animal biotechnology

6.4 Bioethics

PRACTICAL (MJC-21)

Course content: Instrumentation and Biotechnology

1.1 Measure the absorbance of different solutions using a spectrophotometer. Plot a calibration curve using a standard solution. Determine the concentration of an unknown solution using the calibration curve.

1.2 Measure the activity of an enzyme using a spectrophotometric assay.

1.3 Analyze the purified protein using SDS-PAGE (sodium dodecyl sulfate-polyacrylamide gel electrophoresis).

1.4 Cell count for assessing cell viability

1.5 Submission of project on topic stipulated by the concerned teacher

References/ Suggested Readings

1. Introduction to Instrumentation in Life Sciences by Prakash S Bisen and Anjana Sharma
2. Bioinstrumentation by N. Arumugam
3. Biological Instrumentation and Methodology by P K Bajpai

MINOR COURS (MNC)

SEMESTER VIII

Course Name: **Social Physiology and Nutrition**

Course Code: **BSCPHYMN801**

<table>
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(Theory + Practical)</td><td colspan="2">Course Details: MNC-7</td><td colspan="2">L-T-P: 3-0-4</td></tr>
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<tr><td>30</td><td>15</td><td>20</td><td>35</td></tr>
</table>

Course Learning Outcomes:

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

- *Understand and appreciate the diverse socioeconomic, behavioural, sociocultural, biological, environmental, philosophical, and historical factors that influence health, rehabilitation, and human movement*
- *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.*
- *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.*
- *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.*
- *Understand what an adequate and well-balanced diet is.*
- *Examine the several concepts of nutrition.*
- *Explain elements of nutrition.*
- *List rules of adequate and balanced diet.*
- *Learn the physical and social changes taking place during the elderly period of life.*
- *Learn the changes in a body taking place during the ageing period of life*
- *Learn the energy and food demands of the elderly people.*
- *Learn how to make nutritive plans according to those demands*
- *Have knowledge about the diseases caught by the elderly people and their nutritive demands.*
- *Examine the chronic diseases caught by the elderly people.*
- *Learn the nutritive ways peculiar to those diseases.*

- *Make samples of menu planning suitable for the elderly people, growing child, adult man and woman, pregnant woman and lactating woman*

THEORY (MNC-7)

Course content: Social Physiology and Nutrition

Unit 1: Introduction to Social Physiology

1.3 Definition and scope of social physiology

1.4 Importance of social physiology in public health

Unit 2: Population and Family Planning

2.4 Population problem: principles and methods of family planning

2.5 Contraceptive methods

2.6 Infertility and assisted reproductive technologies

Unit 3: Nutrition and Health

3.4 Basal metabolic rate and respiratory quotient

3.5 Calorific value of foods and body calorie requirements

3.6 Dietary requirements of proximate principal of foods

Unit 4: Malnutrition and Nutritional Disorders

4.4 Malnutrition

4.5 Protein-energy malnutrition (PCM): marasmus, kwashiorkor, and marasmic kwashiorkor

4.6 Nutritional disorders: endemic goitre, nutritional anaemias, rickets, osteomalacia, xerophthalmia, and beriberi

Unit 5: Immunization and Prevention of Diseases

5.5 Principles and social importance of immunization

5.6 Vaccines

5.7 Epidemiology and prevention of cholera, malaria, hepatitis, and AIDS

5.8 Role of immunization in public health

Unit 6: Nutrition and Dietetics

6.4 Balanced diet and principles of formulation of balanced diets

6.5 Dietary requirements for growing children, adults, pregnant women, and lactating women

6.6 Nutrition and dietetics in public health

Unit 7: Nutrition and Metabolism [5 marks]

7.4 Nitrogen balance, essential amino acids, and biological value of proteins

7.5 Dietary fibres and their importance in nutrition

7.6 Physiology of starvation and obesity

PRACTICAL (MNC-7)

Course content: Diet Survey and Food Adulteration

1.3 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.

1.4 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. 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.

5. Park's Text Book of Preventive and Social Medicine by K. Park, M/s. Banarsidas Bhanot Publishers.