CBCS SYLLABUS (UPDATED)

FOR

THREE YEARS UNDER-GRADUATE COURSE

IN

PHYSIOLOGY (HONOURS)

(*w.e.f. 2017*)

COOCHBEHAR PANCHANAN BARMA UNIVERSITY

COOCHBEHAR

WEST BENGAL

PIN 736101

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1. Introduction

The syllabus for Physiology at undergraduate level using the Choice Based Credit system has been framed in compliance with UGC CBCS Guidelines. The purpose of the course is to standardize physiology teaching at undergraduate level throughout the state.

The main objective of framing this new syllabus is to give the students a holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Physiology.

The course content also lists new practical exercises, so that the students get a hands-on experience of the latest techniques that are in current usage both in the advanced research laboratories and in Industry. Animal experiments with toad have been excluded as per the guide line of the UGC. More human experiments have been included. The syllabus will equip all undergraduate students with knowledge on basic physiological mechanisms with references to their implications in pathogenesis of disease and the physiological basis of their management.

2. Scheme for CBCS Curriculum

2.1 Credit Distribution across Courses

		Credits	
Course Type	**Total Papers**	**Theory + Practical**	**Theory***
Core Courses	14	14*4 =56 14*2 =28	14*5 =70 14*1=14
Discipline Specific Electives	4	4*4=16 4*2=8	4*5=20 4*1=4
Generic Electives	4	4*4=16 4*2=8	4*5=20 4*1=4
Ability Enhancement Language Courses	2	1*2=2 (ENG / MIL) 1*4=4 (ENVS)	1*2=2 (ENG / MIL) 1*4=4 (ENVS)
Skill Enhancement Courses	2	2*2=4	2*2=4
Totals	**26**	**142**	**142**

*Tutorials of 1 Credit will be conducted in case there is no practical component

2.2 Scheme for CBCS Curriculum in Physiology (Honours)

SEMESTER –I

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UG/PHYH/ 101/C-1	**CT-1: Cellular Basis of Physiology** **CP-1: Cellular Basis of Physiology Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 102/C-2	**CT-2:Biological Physics and Enzymes** **CP-2:Biological Physics and Enzymes Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 103/GE-1	**Any one of the following** **GET-1: Community and Public Health** **GPT-1: Community and Public Health Lab** **Or** **GET1: Instrumentation** **GEP1: Instrumentation Lab**	4 2	10	25 15	50	4	N.A	4
UG/104/ AECC-1	Environmental Studies	4	10	40	50	2	N.A	N.A
Total in Semester - I		**22**	**40**	**160**	**200**	**14**		**12**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER –II

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UG/PHYH/ 201/C-3	**CT-3: Physiology of Nerve and Muscle Cells** **CP-3: Physiology of Nerve and Muscle Cells Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 202/C-4	**CT-4:Chemistry of Biomolecules** **CP-4:Chemistry of Biomolecules Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 203/GE-2	**Any one of the following** **GET-2: Developmental Biology and Embryology** **GEP-2: Developmental Biology and Embryology Lab**	4 2	10	25 15	50	4	N.A	4
UG/204/ AECC-2	English/Hind/MIL	2	10	40	50	2	N.A	N.A
Total in Semester - II		**20**	**40**	**160**	**200**	**14**		**12**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER –III

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	TotalLec.	Tu.		Pr.
UG/PHYH/ 301/C-5	**CT-5: Circulating Body Fluids** **CP-5: Circulating Body Fluids Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 302/ C-6	**CT-6: Circulation** **CP-6: Circulation Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 303/C-7	**CT-7: Functions of the Nervous System** **CP-7: Functions of the Nervous System Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 304/GE-3	**Any one of the following** **GET-3: Environmental Pollution and Human Health** **GEP-3: Environmental Pollution and Human Health Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 305/SEC-1	**Any one of the following** **SECP-1: Detection of Food Adulteration Lab** **Or** **SECP-1: Hematological Techniques Lab**	2	10	40	50	N.A	N.A	4
Total in Semester - III		**26**	**50**	**200**	**250**	**16**		**20**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER –IV

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UG/PHYH/ 401/C-8	**CT-8: Energy Balance, Metabolism, and Nutrition** **CP-8: Energy Balance, Metabolism, and Nutrition Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 402/C-9	**CT-9: Gastrointestinal Function** **CP-9: Gastrointestinal Function Lab**	4 2	10	25 15	50	4		4
UG/PHYH/ 403/C-10	**CT-10:Respiration** **CP-10: Respiration Lab**	4 2	10	25 15	50	4	N.A	4
UG/ PHYH/ 404/GE-4	**Any one of the following** **GET-4: Biotechnology** **GEP-4: Biotechnology Lab**	4 2	10	25 15	50	4	N.A	4
UG/ PHYH/ 405/SEC-2	**Any one of the following** **SECT-1: Clinical Biochemistry** **Or** **SECT-1: Pathological Microbiology and Bio-Medical Technology**	2	10	40	50	2	N.A	N.A
Total in Semester - IV		**26**	**50**	**200**	**250**	**18**		**16**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER – V

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UG/ PHYH/ 501/C-11	**CT-11: Special Senses** **CP-11: Special Senses Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 502/C-12	**CT-12: Endocrinology** **CP-12: Endocrinology Lab**	4 2	10	25 15	50	4		4
UG/ PHYH/ 503/DSE-1	**Any one of the following** **DSET-1: Biological Statistics** **DSEP-1:Biological Statistics Lab** **Or** **DSET-1: Microbiology and Immunology** **DSEP-1: Microbiology and Immunology Lab**	4 2	10	25 15	50	4	N.A	4
UG/ PHYH/ 504/DSE-2	**Any one of the following** **DSET-2: Human Nutrition and Dietetics** **DSET-2: Human Nutrition and Dietetics Lab** **Or** **DSET-2: Genetics and Molecular Biology** **DSEP-2: Genetics and Molecular Biology Lab**	4 2	10	25 15	50	4	N.A	4
Total in Semester – V		**24**	**40**	**160**	**200**	**16**		**16**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER – VI

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.Pr.	
UG/PHYH/ 601/C-13	**CT13: Reproduction** **CP13: Reproduction Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 602/C-14	**CP14: Formation and Excretion of Urine** **CP14: Formation and Excretion of Urine Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 603/DSE-3	**Any one of the following** **DSET-3: Ergonomics and Occupational Physiology** **DSEP-3 : Ergonomics and Occupational Physiology Lab** **Or** **DSET-3: Environmental Physiology** **DSEP-3: Environmental Physiology Lab**	4 2	10	25 15	50	4	N.A	4
UG/PHYH/ 604/DSE-4	**Any one of the following** **DSET-4: Sports and Exercise Physiology** **DSEP-4: Sports and Exercise Physiology Lab** **Or** **DSET-4: Nano-biotechnology and Bioinformatics** [* In case of DSET-4 (Or) Lecture hour = 18]	4 2 6	10 10	25 15 40	50 50	4 6	N.A N.A	4 N.A
Total in Semester – VI		**24**	**40**	**160**		**20016***		**16**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SC = Subject Code, C= Core Course, AECC= Ability Enhancement Compulsory Course, SEC= Skill Enhancement Course, GE= Generic Elective, DSE= Discipline Specific Elective IA= Internal Assessment, ESE= End-Semester Examination, Lec.=Lecture, Tu.= Tutorial, and Prc.=Practical

2.3 Choices for Discipline Specific Electives

Discipline Specific Elective – 1	Discipline Specific Elective – 2	Discipline Specific Elective – 3	Discipline Specific Elective – 4
DSET-1: Biological Statistics DSEP-1: Biological Statistics Lab Or DSET-1: Microbiology and Immunology DSEP-1: Microbiology and Immunology Lab	DSET-2: Human Nutrition and Dietetics DSEP-2: Human Nutrition and Dietetics Lab Or DSET-2: Genetics and Molecular Biology DSEP-2: Genetics and Molecular Biology Lab	DSET-3: Ergonomics and Occupational Physiology DSEP-3 : Ergonomics and Occupational Physiology Lab Or DSET-3: Environmental Physiology DSEP-3: Environmental Physiology Lab	DSET-4: Sports and Exercise Physiology DSEP-4: Sports and Exercise Physiology Lab Or DSET-4: Nano-Biotechnology and Bioinformatics

2.4 Choices of Skill Enhancement Courses

Skill Enhancement Course-1	Skill Enhancement Course-2
SECP-1: **Detection of Food Adulteration Lab** **Or** **SECP-1: Hematological Techniques Lab**	**SECT-1: Clinical Biochemistry** **or** **SECT-1: Pathological Microbiology and Bio-Medical Technology**

3. Core Courses

Semester – I

3.1 Core T1 – Cellular Basis of Physiology

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25]

4 Credits

Unit 1

1. Physiology – An Introduction; Scopes and Branches of Physiology
2. Body Fluid Components – Blood, Lymph, Tissue fluid, CSF, Synovial fluid (Composition and function)
3. Organ Systems, Tissues - Special emphasis on connective tissue, areolar tissue, and Cells - ciliated epithelium and glandular cells.
4. Functional Morphology of Cell – Mitochondria, Ribosome, Lysosome, Golgi body and Endoplasmic Reticulum
5. Transport Across cell Membranes - Active, Passive, Carrier mediated, Antiport and Symport.
6. Intercellular Communication – Gap junction, Tight junction, Intercalated disc, Desmosomes.

Unit 2

1. Cell Cycle – Different phases of cell cycles, regulation, check points of cell cycle.
2. Cell Division
   a. Mitosis
   b. Meiosis – Special emphasis on Homologous, Heterologous, Chiasma, Crossing over, Recombination, Disjunction of chromosome.
3. Homeostasis – General concept of types of homeostasis.
4. Aging – Etiology, Physiology, Metabolic changes and Management.

3.2 Core P1 – Cellular Basis of Physiology Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15]

2 Credits

List of Practical:

1. Introduction on: Principle, use and function of different components of microscope.
2. Introduction on permanent slides - Applied value.
3. ***Study and Identification of Stained Sections of Different Mammalian Tissues and Organs:*** Bone, Cartilage, Trachea, Lungs, Spleen, Lymph gland, Esophagus, Stomach, Duodenum, Ileum, Jejunum, large Intestine, Liver, Kidney, Ureter, Salivary glands, Pancreas, Adrenal gland, Thyroid gland, Testes, Ovary, Spinal Cord, Cerebral cortex, Cerebellum, Skin, Cardiac muscle, Skeletal muscle, Smooth muscle, Artery, Vein, Tongue, Uterus.

3.3 Core T2 – Biological Physics and Enzymes

[Theory: Credits 4 (4 Lectures /Week)/ Marks 25]

Unit 1

1. Study of units for Measuring Concentration of solutes: Normality, Moles, Equivalents, Osmoles
2. Principles of dilution, Definition of pH, Buffer, Operating Principle of Buffer (Brief idea), Acids and Bases.

Unit 2

1. Chemical Bonds and Molecular Forces in Biomolecules.
2. Colloids - Definition, Types, Properties and Importance.
3. Osmosis and Diffusion – Definition and Physiological importance.
4. Surface tension, Specific Gravity – Definition and Physiological importance.
5. Viscosity and Resistance – Definition and Physiological importance.
6. Flow and Pressure – Biophysical aspect and Physiological importance
    a. Laminar and Streamline flow
    b. Poiseuille-Hagen Formula
    c. Laws of Laplace
7. Dialysis and Ultracentrifugation – Definition, Principle, Application.
8. Thermodynamics -1st Law, 2nd Law, Entropy, Enthalpy, Gibbs Free Energy, Physiological Steady State - General concept and application in human body.

Unit 3

1. Electrophoresis – Gel, SDS-Page, Immunoelectrophoresis - Principle, Technique, and Applied value.
2. Autoradiography - Definition, Principle and Applied value.
3. Cell Fractionation Techniques
4. Radioisotopic Tracer Techniques – Process and Applied value.
5. Nanoparticles and its applications in Physiology
6. Chromatography - Principle, Technique, Applied value of major types (Paper Chromatography,TLC, Gel filtration, Ion-exchange, Immuno-affinity), HPLC (in brief).

Unit 4

1. A study of Enzymes:
    a. Structure and classification, Coenzymes, Prosthetic Groups, Apoenzyme, Holoenzyme.
    b. Mechanism of enzyme action
    c. Hyperbolic and linear transformation enzyme Kinetics
    d. Michaelis constant
    e. Different types of Enzyme Inhibitions
    f. Modulation of Enzymes Activities, feedback regulation, covalent modification
    g. Factors regulating enzyme activities
    h. Isoenzymes, Allosteric enzymes
    i. Pro-enzymes
    j. Ribozymes, Abzymes, Antizymes, Synzymes, Immobilized enzymes
    k. Rate limiting enzymes – Definition and features.

3.4 Core P2 – Biological Physics and Enzymes Lab
[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15]

2 Credits

List of Practical

1. Determination of Systolic, Diastolic, Pulse and Mean Blood Pressure by non-invasive methods (Auscultatory Method).
2. Determination of enzyme activities (e.g., SOD, CAT, Amylase, Transaminase etc.).
3. Demonstration of oncotic pressure of colloidal solutions.

Suggested Readings

1. Rastogy, S. C. (2005). Cell and molecular biology. New Age International Publishers.
2. Das, D. (2008). Biochemistry. Academic Publishers.
3. Das, D. (2004). Biophysics and Biophysical Chemistry. Fifth Edition. Academic Publishers
4. Satyanarayana, U. and Chakrapani. U. (2013). Biochemistry. 4th Edition. Elsevier India.
5. Keele, C.A., Neil, E., Toels N. (1982). Samson Wright's Applied Physiology. Thirteenth Edition. Oxford University Press.
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8. Eroschenko, V.P. (2012). Difiore's Atlas of Histology: With Functional Correlations. Twelfth Edition. Lippincott Williams Wilkins Company.
9. 16. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education, Inc. U.S.A. 8th edition.
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11. Mahapatra, A.B.S.M. (2014). Essentials of Medical Physiology. Forth Edition. Current Books International.
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13. Khurana, I. (2015).Medical Physiology. 2nd Edition. Elsevier India.
14. Chatterjee, C.C. (2016). Human Physiology Volume 1. Eleventh Coloured Edition. CBS. Publishers and Distributers Pvt. Ltd.
15. Chaudhuri, S.K.(2008). Concise Medical Physiology. Sixth Edition. NCBA.
16. Roy, R.N. A.(2015). Text Book of Biophysics. New Central Book Agency (P) Ltd.
17. Alberts, B. Johnson, A. Lewis, J. Raff. M. (2008). Molecular Biology of the Cell.
18. Note Books on Practical Biochemistry. Published by The Physiological Society of India. Kolkata.
19. Note Books on Practical Histology. Published by The Physiological Society of India. Kolkata.
20. Babaharik Sharir Bigyan. Jogen Debnath (2008). Shreedhar Prokashani, Kolkata.
21. Pal, G.K. Pal, P. (2013).Textbook of Practical Physiology. Third Edition. Universities Press

Semester – II

3.5 Core T3 – Physiology of Nerve and Muscle Cells

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] **4 Credits**

Excitable Tissue: Nerve

1. Introduction
2. Nerve Cells
3. Excitation and Conduction
4. Different Electrical Events – Depolarization, Repolarization and Hyperpolarization.
5. Ionic Basis of Excitation and Conduction
6. Properties of Mixed Nerves
7. Nerve Fiber Types and Function
8. Neurotrophins – Definition, Chemical nature and Function.
9. Glia cells.

Excitable Tissue: Muscle

1. Introduction
2. Skeletal Muscle
    a. Morphology – Structure and Function.
    b. Electrical Phenomena and Ionic Fluxes
    c. Contractile Responses
    d. Energy Sources and Metabolism
    e. Properties of Muscle in the Intact Organism
3. Cardiac Muscle
    a. Morphology – Structure and Function.
    b. Electrical Properties
    c. Mechanical Properties
    d. Metabolism
    e. Pacemaker Tissue

4. Smooth Muscle
    a. Morphology – Structure and Function.
    b. Visceral Smooth Muscle
    c. Multi-Unit Smooth Muscle

Synaptic and Junctional Transmission

1. Introduction
2. Synaptic Transmission
    a. Functional Anatomy
    b. Electrical Events at Synapses
    c. Inhibition and Facilitation at Synapses
    d. Chemical Transmission of Synaptic Activity
    e. Principal Neurotransmitter Systems
    f. Synaptic Plasticity and Learning

3. Neuromuscular Transmission
    a. Neuromuscular Junction – Anatomy, Mechanism of Signal Transduction and Function.
    b. Denervation Hypersensitivity (In brief)

Initiation of Impulses in Sense Organs

1. Introduction
2. Sense Organs and Receptors
3. Electrical and Ionic Events in Receptors
4. "Coding" of Sensory Information

3.6 Core P3 – Physiology of Nerves and Muscle Cells Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Study of Kymograph, Induction coil, Key and other instruments used to study mechanical responses of skeletal muscle. Kymographic recording of the effect of temperature on cardiac muscle.

2. Isolation and Staining of nerve fibres with node(s) of Ranvier ($AgNO_3$) and muscle fibres (Methylene blue).

3. Demonstration of muscle(skeletal) twitch curve and calculation of Latent period, Contraction period, Relaxation period, Maximum height of contraction from the normal curve (Curve to be provided), Interpretation.

4. Human experiments:
 a) Phenomenon of Human Fatigue by Mosso's Ergograph and Hand grip spring dynamometer
 b) Examination of the motor system:
  i) Bulk of muscles—Inspection and palpation
  ii) Tone of muscles --Hypotonia ,Hypertonia
  iii)Strength of muscles : Grading of muscle strength
  iv)Reflexes –Superficial , Deep and Organic
  v)Coordination of movements—Upper limb and Lower limb
  vi) Gait -- Bone and Joints
  vii)Presence or absence of involuntary movements

3.7 Core T4 – Chemistry of Biomolecules

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] **4 Credits**

Carbohydrates

1. Classification of Carbohydrates
2. Structure and isomerisms of Carbohydrates
3. Properties and chemical reactions of Carbohydrates
4. Functions of Carbohydrates

Lipids

1. Classification of lipids and Fatty Acids
2. Structure of lipids
3. Properties and chemical reactions of lipids
4. Functions of lipids

Proteins

1. Classification, structure, properties and chemical reactions of Amino Acids
2. Structural features and Bio-physical properties of Peptide Bond, Dihedral/Torsion Angles
3. Three-Dimensional Structure of Proteins
3. Properties and chemical reactions of Peptides and Proteins
4. Functions of Proteins

DNAs and RNAs

1. Classification and structure of nucleosides and nucleotides
2. Structure of DNA and RNA
3. Types of DNA and RNA
4. Functions of DNA and RNA

3.8 Core P4 – Chemistry of Biomolecules Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15]

List of Practical

1. Introduction of qualitative assessment of physiologically important biomolecules.
2. Qualitative tests for the identification of physiologically important substances:
   Hydrochloric acid, lactic Acid, Uric Acid, Glucose, Galactose, Fructose, Sucrose, Lactose, Albumin, Gelatin, Peptone, Starch, Dextrin, Urea, Glycerol, Bile salts- Systematic analysis and Confirmatory test.

Suggested Readings

1. Mahapatra, A.B.S.M. (2011). Essentials of Medical Physiology Practical. First Edition. Current Books International'.
2. Ghai, C.L. A Text Book of Practical Physiology. 8th Edition. Jaypee.
3. Hall J.E. (2016).Guyton & Hall Textbook of Medical Physiology. Second South Asia Edition.
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16. Charles Nobach .The Human Nervous System. Mc Graw Hill Book Co.
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18. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.
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22. Chadha, P.V. Handbook of Experimental Physiology and Biochemistry. Jaypee Brothers Medical Publishers.
23. Babaharik Sharir Bigyan: Jogen Debnath, Shreedhar Prokashani, Kolkata.
24. Murray, R.K. Granner, D.K. Mayes, P.A. Rodwell, V.W. (2000). Harper's Biochemistry. 25th Edition. McGraw-Hill.
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Semester – III

3.9 Core T5 - Circulating Body Fluids

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] **4 Credits**

Concepts in theory

1. Introduction
2. Blood – Components and general function.
3. Bone Marrow – Red and yellow
4. White Blood Cells
5. Immune Mechanisms
6. Platelets
7. Red Blood Cells – Erythropoiesis, Hemoglobin-types, synthesis and fate.
8. Blood Types – Group and Rh typing.
9. Plasma, Hemostasis – Definition, factors, modern concept and abnormalities in Hemostasis.
10. Lymph – Formation, circulation, Function.
11. Clinical implication of different components of blood.

3.10 Core P5 – Circulating Body Fluids Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Preparation and staining of blood film with Leishman's stain.
2. Identification of the blood corpuscles.
3. Differential count of WBC.
4. Total count of RBC and WBC.
5. Bleeding time and clotting time.
6. Hemoglobin estimation.
7. Preparation of haemin crystal.
8. Preparation and staining of bone marrow and identification of different stages of blood cells.
    a. Measurement of diameter of megakaryocyte.
9. Reticulocyte staining.
10. Blood group determination and Rh typing.

3.11 Core T6 – Circulation

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Origin of the Heart Beat and the Electrical Activity of the heart

1. Introduction
2. Origin and Spread of Cardiac Excitation
3. The Electrocardiogram – Electrical Axis of heart, Einthoven Law and Tangle, Leads and different waves.
4. Cardiac Arrhythmias
5. Electrocardiographic Findings in Other Cardiac & Systemic Diseases, hypertrophy and cardiac myopathy

The Heart as a Pump

1. Introduction
2. Mechanical Events of the Cardiac Cycle
3. Cardiac Output - Definition, types, factors and measurement.

Dynamics of Blood & Lymph Flow

1. Introduction
2. Anatomic and Biophysical Considerations of
    a. Arterial and Arteriolar Circulation
    b. Capillary Circulation
    c. Lymphatic Circulation and Interstitial Fluid Volume
    d. Venous Circulation

Cardiovascular regulatory Mechanisms

1.Introduction
2. Local Regulatory Mechanisms

3. Substances Secreted by the Endothelium
4. Systemic Regulation by Hormones and Nervous system

Circulation Through special Regions

1. Introduction
2. Cerebral Circulation
    a. Anatomic Considerations
    b. Cerebrospinal Fluid
    c. The Blood-Brain Barrier
    d. Cerebral Blood Flow
    e. Regulation of Cerebral Circulation
    f. Brain Metabolism and Oxygen Requirements
3. Anatomy, Regulation and Peculiarities of
    a. Coronary Circulation
    b. Splanchnic Circulation
    c. Circulation of the skin
    d. Placental & Fetal Circulation

Cardiovascular Homeostasis in Health & Disease

1. Introduction
2. Compensation for Gravitational Effects
3. Exercise
4. Inflammation and Wound Healing (in brief)
5. Shock (in brief)
6. Hypertension (in brief)
7. Heart Failure, stroke (in brief)

3.12 Core P6 – Circulation Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Demonstration of kymogram regarding the effects of excess calcium and potassium ion concentration, acetylcholine,adrenaline (through perfusion fluid) on the movement of heart-- - Interpretation.
2. Recording of systemic arterial blood pressure : Effect of posture and exercise.
3. Recording of 12- lead electrocardiogram.. Computation of HR, PQ interval, QRS complex, PR interval from electrocardiogram -- Interpretation.

3.13 Core T7 - Functions of the Nervous System

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] **4 Credits**

Reflexes

1. Introduction of Reflex-Conditioned, Uncondition, Mono synaptic, disynaptic and Poly synaptic. Reflex Arch- Component.
2. Monosynaptic Reflexes: The Stretch Reflex
3. Polysynaptic Reflexes: The Withdrawal Reflex
4. General Properties of Reflexes

Cutaneous, Deep & Visceral Sensory and Motor Pathways.

1. Introduction of Neural Pathways-
2. Origin, Course, Termination and Function of
    a) Touch
    b) Proprioception
    c) Temperature
    d) Pain
    e) Pyramidal and Extrapyramidal Pathways

Arousal Mechanisms, Sleep, and the Electrical Activity of the Brain

1. Introduction
2. The Reticular Formation and the Reticular Activating System
3. The Thalamus and the Cerebral Cortex
4. Evoked Cortical Potentials
5. The Electroencephalogram
6. Physiological Basis of the EEG, Consciousness, and Sleep
7. Interpretation of abnormal EEG pattern

Control of Posture and Movement

1. Introduction
2. General Principles
3. Corticospinal and Corticobulbar System
4. Anatomy and Function
5. Posture and its regulation
6. Basal Ganglia
7. Cerebellum
8. Movement disorders

The Autonomic Nervous System

1. Introduction
2. Anatomic Organization of Autonomic Outflow
3. Chemical Transmission at autonomic Junctions
4. Responses of Effector Organs to Autonomic Nerve Impulses
5. Cholinergic and Adrenergic Discharge

Central Regulation of Visceral Function

1. Introduction
2. Medulla Oblongata
3. Hypothalamus

a. Anatomic Considerations
b. Hypothalamic Function
c. Relation to Autonomic Function
d. Relation to Sleep
e. Relation to Cyclic Phenomena
f. Hunger
g. Thirst
h. Control of Posterior Pituitary Secretion
i. Control of Anterior pituitary Secretion
j. Temperature Regulation, fever

1. Introduction
2. Anatomic Considerations
3. Limbic Functions
4. Sexual Behavior
5. Fear and Rage

Higher Functions of the Nervous System

1.Introduction
2. Learning – General concept and Memory – Short term and Long term
4. Functions of the Neocortex
5. Disorders relating learning and memory

3.14 Core P7 – Functions of the Nervous System Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Experiments on superficial (plantar) and deep (knee jerk) reflex
2. Measurement of grip strength
3. Reaction time by stick drop test
4. Short term memory test (shape, picture word)
5. Two point discrimination test

Suggesyed Readings:

1. Chatterjee, C.C. (2016). Human Physiology Volume 1. Eleventh Coloured Edition. CBS. Publishers and Distributers Pvt. Ltd.
2. Hall J.E. (2016).Guyton & Hall Textbook of Medical Physiology. Second South Asia Edition.
4. Mahapatra, A.B.S.M. (2014). Essentials of Medical Physiology. Fourth Edition. Current Books International.
5. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.
6. Khurana, I. (2015).Medical Physiology. 2nd Edition. Elsevier India.
7. Chatterjee, C.C. (2016). Human Physiology Volume 2. Eleventh Coloured Edition. CBS.
8. Core Text Book Of Neuro-Anatomy, by M.B.Carpenter: the Williams and Wilkins Company.
9. Berg, J.M. (Author), Tymoczko, J.L. Stryer, L. (2006). Biochemistry: International Edition
10. Charles Nobach .The Human Nervous System. Mc Graw Hill Book Co.
11. Berne , R.M. and Levy M.N. Physiology. C.V.Mosby Co.
12. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.

13. Barrett, K. E. Barman, S.M., Boitano, S. Brooks, H.L. (2012).Ganong's Review of Medical Physiology. 24th Edition. Lange Medical Book. Prentice-Hall International.
14. Pal, G.K. Pal, P. (2013).Textbook of Practical Physiology. Third Edition. Universities.
15. Shepherd.G.M. Neurobiology. Oxford University Press.
16. Chadha, P.V. Handbook of Experimental Physiology and Biochemistry. Jaypee Brothers Medical Publishers.
17. Babaharik Sharir Bigyan: Jogen Debnath, Shreedhar Prokashani, Kolkata.

Semester – IV

3.15 Core T8 - Energy Balance, Metabolism, and Nutrition

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Concepts in theory

1. Introduction
2. Energy metabolism and Biological Oxidation, Mitochondrial Electron Transport Chain, Oxidative phosphorylation, High energy compounds.
3. Carbohydrate metabolism – Glycolysis, Krebs Cycle, Glycogenesis, Glycogenolysis, Neoglucogenesis, HMP shunt, R-L cycle, Cori cycle, glucose-alanine cycle.
4. Protein metabolism – Deamination, Transamination, Urea-Ornithine cycle, Biosynthesis of specialized products form amino acids, Metabolism of glycine-serine-alanine, phenylalanine and tyrosine, sulphur containing amino acids, and tryptophan.
5. Fat metabolism – Beta-oxidation, alpha- and omega-oxidation, ketone body formation and fate, cholesterol biosynthesis, Cytosolic fatty acid biosynthesis, Biosynthesis of phospholipids and their metabolism, Metabolism of triglycerides, Lipoproteins.
6. Purine & Pyrimidine metabolism – Biosynthesis and catabolism of nucleosides and nucleotides.
7. Integration of carbohydrate, fat and protein metabolism, One Carbon and two carbon metabolisms.
8. Nutrition – BMR, RQ, RDA, SDA, NPU, Biological value of proteins, vitamins and minerals – Brief idea.

3.16 Core P8 - Energy Balance, Metabolism, and Nutrition Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Biochemical Estimation

1. Introduction on colorimetric study.
2. Estimation of glucose and sucrose by Benedict's method - Percentage and total quantity.
3. Estimation of amino nitrogen (Sorensen's Formol titration method) Percentage and total quantity.
4. Estimation of percentage quantity of lactose in milk by Benedict's method.
5. Estimation of free and total acidity in gastric juice.

3.17 Core T9 - Gastrointestinal Function

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Digestion and Absorption

1. Introduction
2. Carbohydrates
3. Proteins and Nucleic Acids
4. Lipids
5. Absorption of Water and Electrolytes
6. Absorption of Vitamins and Minerals

Regulation of Gastrointestinal Function

1. Introduction
2. General Considerations – Gastrointestinal motility and function.
3. Gastrointestinal hormones
4. Mouth and Esophagus
5. Stomach
6. Exocrine Portion of the Pancreas
7. Liver and Biliary System
8. Small Intestine
9. Colon

3.18 Core P9 – Gastrointestinal Function Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Introduction on Dale's Apparatus and preparation of Ringer Lock solution.
2. Kymographic recording of normal movements of rat's intestine in Dale's Apparatus.
3. Effects of hypoxia, acetylcholine and adrenaline on normal intestinal movements.

3.19 Core T10 – Respiration

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Pulmonary Function

1. Introduction
2. Properties of Gases
3. Anatomy of the Lungs
4. Mechanics of breathing – Mechanism, Resistances of breathing , surfactant, compliance.
5. Gas Exchange in the lungs
6. Pulmonary Circulation
7. Other Functions of the Respiratory System –Excretory, body defense function of lungs.

Gas Transport Between the Lungs and the Tissues

1. Introduction
2. Oxygen Transport – Mechanism, dissociation curve and factor regulating it.
3. Carbon Dioxide Transport –Mechanism, dissociation curve and factor regulating it.
4. Respiratory acidosis and alkalosis

Regulation of Respiration

1. Introduction
2. Neural control of Breathing – Respiratory center, respiratory reflexes.
3. Chemical Control of Breathing
4. Nonchemical Influences on Respiration – in brief

Respiratory Adjustments in Health and Disease

1. Introduction
2. Effects of Exercise

3. Other Forms of Hypoxia (Histotexic, anaemic and hypokinetic)
4. Oxygen Therapy
5. Hypercapnia and Hypocapnia
6. Other Respiratory Abnormalities (Mountain sickness, apnoea, dyspnea, dysbarism, Chyne Stroke Breathing and HAPO.
7. Effects of Increased Barometric Pressure – Caisson disease etc.
8. Artificial Respiration – Methods in brief and significance.

3.20 Core P10 – Respiration Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Measurement of peak expiratory flow rate
2. Measurement of oxygen saturation by pulse oxymeter before and after exercise
3. Measurement of forced expiratory volume (FEV) in first second and first 10 second.
4. Demonstration on digital spirometer for lung function test (PFT).

Suggested Readings:

1. Srilakshmi, B. (2016). Nutrition Science. Fifth Edition. New Age International Publishers.
2. Srilakshmi, B. (2014). Dietetics. Seventh Edition. New Age International Publishers.
3. Das S. Textbook of Normal and Therapeutic Nutrition. Academic Publishers.
4. Das S. (2016).Textbook of Community Nutrition. 2nd Edition. Academic Publishers.
5. Basu, P. Nutritional Biochemistry. Academic Publishers.
6. Srilakshmi, B. (2015). Food Science. Sixth Edition. Age International Publishers.
7. Swaminathan, M. (2012). Handbook of Food and Nutrition. Jain Book Agency.
8. Swaminathan, M. (2015). Essentials of Food and Nutrition. Vol. I AND Vol. II. The Bangalore Printing and Publishing Co., Ltd.
9. Chatterjee, C.C. (2016). Human Physiology Volume 1. Eleventh Coloured Edition. CBS.
10. Hall J.E. (2016). Guyton & Hall Textbook of Medical Physiology. Second South Asia Edition.
11. Mahapatra, A.B.S.M. (2014). Essentials of Medical Physiology. Fourth Edition. Current Books International.
12. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.
13. Khurana, I. (2015).Medical Physiology. 2nd Edition. Elsevier India.
14. Berne , R.M. and Levy M.N. Physiology. C.V.Mosby Co.
15. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.
16. Barrett, K. E. Barman, S.M., Boitano, S. Brooks, H.L. (2012).Ganong's Review of Medical Physiology. 24th Edition. Lange Medical Book. Prentice-Hall International.
17. Pal, G.K. Pal, P. (2013).Textbook of Practical Physiology. Third Edition. Universities.

18. Shepherd.G.M. Neurobiology. Oxford University Press.
19. Chadha, P.V. Handbook of Experimental Physiology and Biochemistry. Jaypee Brothers Medical Publishers.
20. Babaharik Sharir Bigyan: Jogen Debnath, Shreedhar Prokashani, Kolkata.
Mukherjee, K.L. (2004). Medical Laboratory Technology. Vol. I, Vol. II and Vol. III. Tata McGraw-Hill.
21. Hinkle, J.L. Kerry H. Cheever, K.H. (2013). Brunner & Suddarth's Handbook of Laboratory and Diagnostic Tests. 2nd Edition. LWW Publisher.
22. Godkar , P.B. Godkar. O.D.(2014). Textbook of Medical Laboratory Technology. 14th Edition.

Semester – V

3.21 Core T11 - Special Senses

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] **4 Credits**

Vision

1. Introduction
2. Anatomic Considerations – Eye.
3. The Image-Forming Mechanism (accommodation and visual acuity)
4. The Photoreceptor Mechanism: Genesis of Electrical Responses
5. Visual Pathways and effects of lesions of these pathways
6. Color Vision
7. Other Aspects of Visual Function – Monocular, Binocular, Equilibrium and Posture.
8. Eye Movements – Lateral and Rotational.
9. Errors in visual process**.**

Hearing and Equilibrium

1. Introduction
2. Anatomic considerations
3. Hair cells
4. Mechanism of hearing
5. Vestibular function
6. Loss of hearing – Audiometry, test for Conductive deafness, Neural deafness and Central deafness.

Smell and Taste

1. Introduction
2. Smell
3. Receptors and Pathways
4. Physiology of Olfaction
5. Taste

a. Receptor Organs and Pathways

b. Physiology of Taste, Taste adaptation and Masking effect.

3.22 Core P11 – Special Senses Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Principles of fixation and staining,
2. Staining and identification of fixed nervous tissue.
3. Determination of visual acuity by Snellen's chart / Landolt's C chart.
4. Determination of colour blindness by Ishihara chart.
5. Perimetry.
6. Audiometry.

3.23 Core T12 – Endocrinology

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Unit 1

The Thyroid Gland

1. Introduction
2. Anatomic Considerations
3. Formation and Secretion of Thyroid Hormones
4. Transport of Thyroid Hormones
5. Effects of Thyroid Hormones
6. Regulation of Thyroid Secretion
7. Clinical Correlation.

Endocrine Functions of the Pancreas and the Regulation of Carbohydrate Metabolism

1. Introduction
2. Islet Cell Structure
3. Structure, Biosynthesis, and Secretion of Insulin
4. Effects of Insulin
5. Mechanism of action
6. Insulin Excess
7. Regulation of Insulin Secretion
8. Glucagon
9. Other Islet Cell Hormones
10. Hypoglycemia and Diabetes Mellitus in Humans

The Adrenal Medulla and Adrenal Cortex

1 Introduction
2. Adrenal Morphology
3. Adrenal Medulla
a. Structure and Function of Medullary Hormones
b. Regulation of Adrenal Medullary Secretion
4. Adrenal Cortex
a. Structure and Biosynthesis of Adrenocortical Hormones

Unit 2

Hormonal Control of Calcium Metabolism and the Physiology of Bone

1. Introduction
2. Calcium and Phosphate Metabolism
3. Bone Physiology
4. Vitamin D and the Hydroxycholecalciferols
5. The Parathyroid Glands
6. Calcitonin
7. Effects of Other Hormones and Humoral Agents on Calcium Metabolism

The Pituitary Gland

1. Introduction
2. Morphology
3. Posterior pituitary hormones
4. Growth Hormone
5. Physiology of Growth
6. Pituitary Insufficiency
7. Pituitary Hyperfunction in Humans

Endocrine Functions of the Kidneys, Heart, and Pineal Gland

1. Introduction
2. The Renin-Angiotensin System
3. Erythropoietin
4. The Endocrine Function of the Heart: Atrial Natriuretic Peptide
5. Pineal Gland
6. Human chronobiology, biological rhythms; basic concepts and implications

3.24 Core P12 – Endocrinology Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Study of the effects of oxytocin on uterine contraction.
2. Study of the effects of adrenaline on intestinal and uterine movements.
3. Growth chart and interpretation.

Suggested Readings:

1. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.
2. Kronenberg, H.M. Melmed, S. Polonsky, K.S. Larsen, P.R. (2009). Williams Textbook of Endocrinology. Eleventh Edition. Saunders.
3. Ganong, W.F. Review of Medical Physiology. Lange Medical Book. Prentice-Hall International.
4. Ghai, C.L. A Text Book of Practical Physiology. 8th Edition. Jaypee.
5. Hall J.E. (2016).Guyton & Hall Textbook of Medical Physiology. Second South Asia Edition.

6. Mahapatra, A.B.S.M. (2014). Essentials of Medical Physiology. Forth Edition. Current Books International.
7. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.
8. Khurana, I. (2015).Medical Physiology. 2nd Edition. Elsevier India.
9. Chatterjee, C.C. (2016). Human Physiology Volume 2. Eleventh Coloured Edition. CBS. Publishers and Distributers Pvt. Ltd.
10. Chaudhuri, S.K.(2008). Concise Medical Physiology. Sixth Edition. NCBA.

Mukherjee, K.L. (2004). Medical Laboratory Technology. Vol. I, Vol. II and Vol. III. Tata McGraw-Hill.

11. Hinkle, J.L. Kerry H. Cheever, K.H. (2013). Brunner & Suddarth's Handbook of Laboratory and Diagnostic Tests. 2nd Edition. LWW Publisher.
12. Godkar , P.B. Godkar. O.D.(2014). Textbook of Medical Laboratory Technology. 14th Edition.

Semester – VI

3.25 Core T13 – Reproduction

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] **4 Credits**

1. Introduction
2. Sex Differentiation and Development
    a. Chromosomal Sex
    b. Embryology of the Human Reproductive System
    c. Aberrant Sexual Differentiation
    d. Puberty
    e. Precocious and Delayed Puberty
    f. Menopause
3. Pituitary Gonadotropins and Prolactin
4. The male reproductive System
    a. Structure
    b. Gametogenesis and Ejaculation
    c. Endocrine Function of the Testes
    d. Control of Testicular Function
    e. Abnormalities of Testicular Function
5. The Female Reproductive system
    a. The Menstrual Cycle
    b. Ovarian Hormones
    c. Control of Ovarian Function
    d. Abnormalities of Ovarian Function
6. Fertilization
7. Implantation
8. Placenta – Hormones and Function.
9. Pregnancy - Hormonal Regulation and Pregnancy Test.
10. Parturition.

3.26 Core P13 – Reproduction Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Study of estrous cycle
2. Staining and identification of testis, ovary and uterus.
3. Pregnancy test from human urine by kit method.

3.27 Core T14 - Formation and Excretion of Urine

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Renal Functions and Micturition:

1. Introduction
2. Function of Malpighian corpuscles and renal tubule, counter-current mechanism
3. Water Excretion
4. Acidification of the Urine and Bicarbonate Excretion
5. Regulation of Na+ and Cl- Excretion
6. Renal Circulation
7. Diuretics
8. Disorders of Renal Functions
9. Filling of the Bladder
10. Emptying of the Bladder
11. Non-excretory Function of Kidney

3.28 Core P14 - Formation and Excretion of Urine Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Testing of normal constituents of urine (Biochemical Test)
2. Identification of abnormal constituent of urine (Biochemical Test)
3. Microscopic observation of RBC, Pus Cell and Cast in urine.

Suggested Readings:

1. Chatterjee, C.C. (2016). Human Physiology Volume 2. Eleventh Coloured Edition. CBS. Publishers and Distributers Pvt. Ltd.
2. Mahapatra, A.B.S.M. (2014). Essentials of Medical Physiology. Fourth Edition. Current Books International.
3. Sembulingam, K. and Sembulingam, P. (2016). Essentials of Medical Physiology 7th Edition. Jaypee.

4. Khurana, I. (2015).Medical Physiology. 2nd Edition. Elsevier India.
5. Guyton, A.C. Hall, J.E. (2007) Text Book of Medical Physiology. Eleventh Edition. W.B. Saunders Co.
6. Ganong, W.F. Review of Medical Physiology. Lange Medical Book. Prentice-Hall International.
7. Schatten, H. Human Reproduction. Willey.
8. Constantinescu, G.M. Animal Model and Human Reproduction. Willey.
9. Chaudhuri, S.K.(2008). Concise Medical Physiology. Sixth Edition. NCBA.
10. Pal, G.K. Pal, P. (2013).Textbook of Practical Physiology. Third Edition. Universities.

11. Note Books on Practical Biochemistry. Published by The Physiological Society of India. Kolkata.

4. Discipline Specific Elective Courses

4.1 DSE T1 – Biological Statistics

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] **4 Credits**

Concepts in theory

1. Scope of statistics – Principles of statistical analysis of biological data.
2. Basic concepts – variable, parameter, statistics and sampling.
3. Presentation of data-frequency distribution, frequency polygon, histogram, bar diagram and pie diagram.
4. Parameters.
5. Different classes of statistics - mean, median, mode, mean deviation, variance, standard deviation, standard error of mean.
6. Standard score.
7. Degrees of freedom.
8. Probability.
9. Normal distribution.
10. Student's t-distribution.
11. Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, students' t-test and z score for significance of difference.
12. Non Parametric - Chi-square test.

4.2 DSE P1 – Biological Statistics Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] **2 Credits**

List of Practical

1. Computation of mean, median, mode, standard deviation and standard error of the mean with physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects.
2. Graphical representation of data in frequency polygon and histogram.
3. Student's t test for significance of difference between means.

4. Demonstration: Statistical analysis and graphical representation of biological data with computer using One way ANOVA.

OR

4.1 DSE T1 – Microbiology and Immunology

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] **4 Credits**

Microbes

1. Bacterial cell Structure and morphological classification.
2. Different Staining techniques - Gram positive, gram negative, pathogenic and nonpathogenic bacteria.
3. Bacterial culture medium and culture techniques,
3. Sterilization, pasteurization.
3. Nutritional requirements of bacteria, Bacterial growth curve, factors affecting bacterial growth.
4. Bacterial metabolisms.
5. Brief idea about antibiotics, elementary idea of bacteriostatic and bactericidal agents.
6. Bacterial genetics.
7. Viruses - Structure and types, Lytic and lysogenic cycle. Prions – basic ideas and prion diseases.

Overview of Immune System

1. Idea about innate and acquired immunity. Immuno-competent Cells.
2. Humoral and cell mediated immunity. Interaction of T and B cell.
   Antigen,Hapten and Super antigen Antigen-antibody interactions :Application in diagnosis of disease.
3. Immunoglobulin - classification, basic structure and function. Polyclonal and Monoclonal antibody
4. Antigen presentation. Major Histocompatibility Complex (MHC)-Type-I&II.
5. Cytokines and Lymphokines. Activation of complement system.
6. Vaccination – Principles, Universal protocol on Immunization, primary and secondary reaction of vaccination, health reaction due to vaccination, memory cell formation due to vaccination and importance of immunization.
7. Basic principles of immunological detection of pregnancy. Immunohistochemistry.
8. Immunization programme - immunization against Polio, Hepatitis-B, Tetanus, Measles, Whooping cough, Tuberculosis, Rabbies through vaccine, AIDS- causative virus, mode of transmission, effects on human body, preventive measures, and principles of diagnostic test for AIDS (ELISA,Immunoblot).
9. Immunopathology - basic principles of autoimmune disease and transplantation immunology.
10. Hybridoma Technology, Immunodiffusion, Immunoagglutination, Immunofluorescence, RIA, ELISA.

4.2 DSE P1 – Microbiology and Immunology Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] **2 Credits**

List of Practical

1. Gram staining of bacteria and identification of Gram positive and Gram negative bacteria.
2. Haemagglutination test with antibodies of A, B, and D antigen
3. Ouchterlony double diffusion test in agar-gel by KIT. Single radial immuno-diffusion in agarose by KIT.
4. Demonstration : Bacterial Spore staining.

4.3 DSE T2 – Human Nutrition and Dietetics

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] **4 Credits**

Concepts in theory

1. Constituents of food and their significance.
2. Basal metabolic rate -factors, determination by Benedict-Roth apparatus.

3. Respiratory quotient.
4. Specific dynamic action.
5. Basic concept of energy and units.
6. Calorific value of foods.
7. Body calorie requirements – adult consumption unit.
8. Dietary requirements of carbohydrate, protein, lipid and other nutrients.
9. Balanced diet and principles of formulation of balanced diets for growing child, adult man and woman, pregnant woman and lactating woman.
10. Nitrogen balance, essential amino acids, biological value of proteins.
11. Supplementary value of protein.
12. Protein efficiency ratio and net protein utilization of dietary proteins.
13. Dietary fibres.
14. Vitamins.
15. Principle of diet survey.
16. Composition and nutritional value of common food stuffs.
17. Physiology of starvation and obesity.
18. Sources and physiological significances of vitamins and minerals.
19. Space nutrition.

4.4 DSE P2 – Human Nutrition and Dietetics Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Nutrition and Dietetics - Diet Survey (Field Study Record)

1. Diet survey report (hand-written) of a family (as per ICMR specification) : Each student has to submit a report on his/her own family or Neighbouring Family.
2. A report (hand-written) on the basis of field survey from ONE of the followings:

a. Physiological parameters of human (at least three parameters).
b. Anthropometric measurements on human (at least three parameters).
c. Epidemiological studies on human.

OR

4.3 DSE T2 – Genetics and Molecular Biology

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Genetics:

Basic principles of Mendelian genetics - monohybrid and dihybrid, test and back crosses, Bacterial genetics-transformation, transduction, conjugation (mention of F+ /F- , Hfr strain, function of pillus). Extension of Mendelism - Epistasis and its different types present in plants and animals. Penetrance, expressivity, pleiotropism. Crossing over and molecular recombination, Gene mapping. Numerical and Structural variations in chromosome- autosomal and sex chromosomal anomalies - basic concepts of aneuploids and polyploids. Human Cytogenetics - human karyotype and ideogram, banding technique, use of human cytogenetics in medical science, inborn errors of metabolism, aneuploidy in humans. Sex determination and sex linkage, Blood group genetics.

Molecular Biology

Genes - definition. Chromosome and chromatin structure and molecular organization, DNA- structure, DNA replication, transcription of RNA in prokaryotes, Genetic code – properties and wobble hypothesis, translation in prokaryotes, regulation of gene expression – Operon concept: lac operon, chromosomal aberrations and gene mutations, DNA damage and repair mechanisms, Basic idea and steps of Recombinant DNA technology / genetic engineering and Transgenic Technology and its applications, Basic concepts, principles and applications of Colony hybridization, in situ hybridization, Dot Blot, Southern, Northern, Western Blotting techniques, Polymerase chain reaction (PCR), Gene Therapy.

4.4 DSE P2 – Genetics and Molecular Biology Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. DNA gel electrophoresis (Agarose Gel)
2. Retrieval of amino acid sequence from mRNA
3. Retrieval of codogen in DNA from codon sequence of mRNA

4.5 DSE T3 – Ergonomics and Occupational Physiology

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Concepts in theory

1. Genesis and concept of ergonomics.
2. Importance of ergonomics in occupational health and well-being.
3. Classification of Physiological work load. Concept of work rest cycle.
4. Physical work environment: (a) Thermal environment, its' effect, Heat stress indices, (b) Noise and vibration, its' effect on workers. Occupational deafness, (c) Illumination level and its' effect on visual performances, (d) Ergonomic principles of control of Physical hazards.
5. Static anthropometry, Application of anthropometric data in design.
6. User interface and control display compatibility.
7. Prevention of accidents, concept of Industrial safety.
8. Occupational Diseases: pneumoconiosis, asbestosis, silicosis and work-related musculoskeletal disorders.

4.6 DSE P3 – Ergonomics and Occupational Physiology Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Measurement of working heart rate by ten beats methods.
2. Measurement of blood pressure before and after different grades of exercise.
3. Measurement of Some common anthropometric parameters. Calculation of BSA and BMI from anthropometric data.
4. Measurement of WBGT indices.
5. Measurement of noise level by noise level meter.
6. Demonstration of determination of cardiac cost of specific work.

OR

4.5 DSE T3 – Environmental Physiology and Toxicology

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Unit 1

Toxicology

1. Toxins and Toxicology
2. Factors Affecting toxicity
3. LD50, LOD50, ED50, NOEL, LOEL

4. Concept of Acute and Chronic Effects
5. Birth defects and Teratogens
6. Concepts of Biomagnification and Bioconcentration
7. Popular Food Additives and Food Adulterants
8. Prevention of Food Adulteration Act, 1954
9. Other Food Toxicants: BPA, BPS, Pesticides, PAH, Dioxin, PCB, Heavy Metals: Pb, Hg, Cd, As etc

Environmental Pollutions and Health Hazards

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

Unit 2

Environmental Pollution and Human Health Hazards

1. Air Pollution: definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.
2. Water Pollution: definition, types, health hazards, water pollutants, biochemical oxygen demand (BOD), thermal pollution, concept of safe drinking water standards.
3. Soil Pollution: causes, health hazards, solid waste managements- bioreme- diation, phytoremediation.
4. Sound Pollution: definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards).
5. Radionuclide Pollution: ionizing radiations, effects of ionizing radiation on human health, permissible doses.

Environmental management

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

4.6 DSE P3 – Environmental Physiology and Toxicology Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Measurement of dissolved oxygen.
2. Relative humidity measurement.
3. Suspended particulate matter of specific air sample.
4. LD_{50} measurement from provided graph.
5. Noise intensity measurement by Sound Level Meter.
6. Light intensity measurement by Lux Meter.

4.7 DSE T4 – Sports and Exercise Physiology

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Concepts in theory

1. Importance of regular exercise in health and wellbeing.
2. Basic concept of Bioenergetics, Energy sources during exercise (Phosphagen, Anaerobic system and Aerobic system).

3. Cardio-respiratory responses during different grades of exercise.
4. Concept of excess post exercise oxygen consumption (EPOC), physiological fatigue and recovery.
5. Aerobic work Capacity: Measurement, physiological factors and applications.
6. Training: Principles of physical training, Training to improve aerobic and anaerobic power. Effect of overtraining and detraining.
7. Nutritional supplements and ergogenic aids.
8. Sports injury and its' management.
9. Basic idea sports rehabilitation and sports medicine.

4.8 DSE P4 – Sports and Exercise Physiology Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Measurement of blood pressure before and after different grades of exercise.
2. Recording of recovery heart-rate after standard exercise.
3. Determination of Physical Fitness Index by Harvard Step Test (Modified).
4. Measurement of body fat percentage.
5. Determination of endurance time by hand grip dynamometer.
6. Pneumographic recording of effect of talking, laughing, coughing, breath holding and hyperventilation
7. Determination of VO2max by Queen College Step Test.
8. Six minute walk test.

OR

4.7 DSE T4– Nano-biotechnology and Bioinformatics

[Theory: Credits 6 (6 Lectures/Week)/ Marks 40] 6 Credits

Concepts in theory

1. Introduction to nanoscience and nano-biotechnology.
2. Definition of a Nano system.
3. Types of Nanostructures; Types of Nanocrystals-One Dimensional (1D)-Two Dimensional (2D) -Three Dimensional (3D) nanostructured materials - Quantum dots - Quantum wire; Core/Shell structures.
4. Synthesis of Nanomaterials.
5. Characterization techniques for Nanomaterials: X-ray diffraction; Scanning Electron Microscope (SEM); Atomic force microscopy (AFM); scanning tunneling microscopy (STM), scanning near field optical microscopy (SNOM); Transmission Electron Microscopy (TEM); Infrared spectroscopy (IR).
6. Properties of Nanomaterials: Size dependent properties - Mechanical, Physical and Chemical properties.Types of Nanomaterials: Carbon Nanotubes (CNT) - Metals (Au, Ag) - Metal oxides (TiO2, CeO2, ZnO) – Sem iconductors (Si, Ge, CdS, ZnSe) - Ceramics and Composites. Applications of Nanomaterials in Biology: Biochemical sensors; Imaging; Cancer treatment etc.
7. Toxicity of nanomaterials in the environment – Health threats.
8. Basic concepts and applications of Genomics, Proteomics, and Bioinformatics.

Suggested Readings:

1. Pelczar, M.J. (2001) Microbiology. 5th edition, Tata McGraw-Hill Co, New Delhi.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology. Pearson Benjamin Cummings, USA. 8th edition.
4. Saha, I. Paul. B. (2016). Essential of Biostatistics. 2nd Edition. Academic Publishers.
5. Giri, P.K. Banerjee, J. Statistical Stools and Techniques. Academic Publishers.
6. Das, D. Handbook of Practical Microbiology, Cell Biology Genetics and Biometry. Academic Publishers.
7. Srilakshmi, B. (2016). Nutrition Science. Fifth Edition. New Age International Publishers.
8. Srilakshmi, B. (2014). Dietetics. Seventh Edition. New Age International Publishers.
9. Das S. Textbook of Normal and Therapeutic Nutrition. Academic Publishers.
10. Das S. (2016).Textbook of Community Nutrition. 2nd Edition. Academic Publishers.
11. Basu, P. Nutritional Biochemistry. Academic Publishers.
12. Srilakshmi, B. (2015). Food Science. Sixth Edition. Age International Publishers.
13. Swaminathan, M. (2012). Handbook of Food and Nutrition. Jain Book Agency.
14. Swaminathan, M. (2012). Essentials of Food and Nutrition. Vol. I AND Vol. II. Jain Book Agency.
15. Saha, T.K. (2013). Ecology and Environmental Biology. Books & Allied Ltd.
16. Banerjee, P.K. (2007). Introduction to Biostatistics.
17. Das, D. Das A. (2013). Statistics In Biology And Psychology. Sixth Edition. Academic Publishers.
18. Chad L. Cross Wayne W. Daniel. (2014). Biostatistics: Basic Concepts and Methodology for the Health Sciences. Wiley.
19. Rao, S. (2012). Introduction to Biostatistics and Research Methods. Fifth Edition. PHI.
20. Bhadra, K.A. (2012). Mahajan'S Methods In Biostatistics For Medical Students And Research Workers. Eight Edition.
21. Reddy N. (2015).The Essentials of Forensic Medicine And Toxicology. 33rd Edition.
22. Tripathi, K.D. (2013). Essential of Medical Pharmacology. Seventh Edition. Jaypee.
23. Verma, P.S. and Agarwal, V.K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. S. Chand & Company Pvt. Ltd.
24. David Freifelder. (2008). Molecular Biology. 2nd Edition. Narosa Publishing House.
25. Goodman & Gillman's The Pharmacological Basis Of Therapeutics With DVD (Goodman and Gilman"S the Pharmacological Basis of Therapeutics. 12th Edition. (2011).
26. Berk, A. Kaiser, C.A. Lodish, H, Amon, A. (2016). Molecular Cell Biology
27. Wilson, K. and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. Seventh Edition.
28. Gardner, E.J. Simmons, M.J, Snustad, D.P. (2006) Principles of Genetics. Eighth Edition. Wiley.
29. Ozsoz, M.S. (2012). Electrochemical DNA Biosensors. Pan Stanford Publishing Pte Ltd.
30. Sethi. T. (2012). Miracles Of Nano-tech With Bio-tech: Magic Of Nano-technology With Combination Of Bio-technology Related To Human Beings. Lap Lambert Academic Publishing.

31. Guo, P, Haque., F. (2015). RNA Nanotechnology and Therapeutics (Methods in Molecular Biology). CRC Press Taylor and Francis.
32. Dutta, P.K. Dutta J. (2016). Multifaceted Development and Application of Biopolymers for Biology, Biomedicine and Nanotechnology (Advances in Polymer Science). Springer.
33. Ghosh, J. Mallick B. Bioinformatics: Principles and Applications. Springer.
34. Rastogi S.C. Mendiratta, N. Rastogi, P. (2013). Bioinformatics: Methods and Applications: Genomics, Proteomics and Drug Discovery. Fourth Edition.
35. Mount , David W. (2005). Bioinformatics: Sequence and Genome Analysis
36. Francis Ouellette, B.F. Baxevanis, A.D. (2009).Bioinformatics. 3rd Edition. Wiley.
37. Ananthanarayan, R. Kapil, A. A & P Textbook of Microbiology. 9th Edition.
38. William's Text Book of Endocrinology by J.D.Wilson and D.W.Saunders of Co.
39. Endocrinology. Vols- I, II and III by L.O.DeGroot. W.B.Saunders Co.
40. The Physiology of Reproduction, Vols I, & II , by E.Knobil and J.D.Neil. Raven Press.
41. William D. McArdle, Frank I. Katch, Victor L. Katch. Essentials of Exercise Physiology. 5th International edition. Lippincott Williams and Wilkins.
42. Astrand, P.O.Rodhal. K. Dahl, H.A. (2003). Forth Edition. Mc Graw-Hill Book Co.
43. Shaver, L.G. Essentials of Exercise Physiology. Surjeet Publications.
44. McCormick, E.O. and Sanders, M. Human Factors in Engineering and Design by Tata Mc Graw Hill.
45. Fox, E.L. (1985). Sports Physiology. Saunders College Publishing Holt-Saunders
46. Fox, E.L. Mathews, D.K. The Physiological Basis of Physical Education and Athletics by and. Saunders College Publishing.
47. Durin, J.V.G.A. and Passmore, R. Energy, Work and Leisure. Heinemann Educational Books.
48. Simmons, S. (2006). Principles of Genetics. Fourth Edition. Wiley Asia Student Edition.

5. Skill Enhancement Courses

5.1 SEC P1 – Detection of Food Adulteration Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 40] 2 Credits

Qualitative tests for Food Adulteration

Qualitative tests for identifying Food Adulterants in some food samples:

Metanil yellow, Rhodamin B, Saccharin, Monosodium glutamate, Aluminium foil, Chicory, Bisphenol A and Bisphenol S, Chocolate Brown HT, Margarine, Pb, Hg, As, PCB, Dioxin etc in turmeric powder, besan, laddoo, noodles, chocolate and amriti.

OR

5.1 SEC P1 – Hematological Techniques

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 40] 2 Credits

List of practical

1. Preparation of blood smear and identification of blood cells.
2. Determination of haematocrit, MCV, MCH,MCHC, bleeding time, clotting time etc.
3. Measurement of hemoglobin (Cyanmethemoglobin method) in blood.
4. Preparation of serum.
5. Estimation of SGOT and SGPT.

5.2 SEC T1 – Clinical Biochemistry

Theory: Credits 2 (2 Lectures/Week)/ Marks 40] 2 Credits

Concepts in theory

1. Photo-colorimetric estimation of blood constituents.
2. Estimation of blood glucose by Folin-Wu method
3. Estimation of blood inorganic phosphate by Fiske - Subbarow method
4. Estimation of total serum protein by Biuret method.
5. Estimation of serum albumin by Bromocresol green method.
6. Determination of DNA by diphenylamine reagent.
7. Estimation of serum creatinine by Folin-Wu method.
8. Estimation of serum cholesterol by ferric chloride method.

OR

5.2 SEC T1 – Pathological Microbiology and Bio-Medical Technology

Theory: Credits 2 (4 Lectures/Week)/ Marks 40] 2 Credits

Concepts in theory

1. Staining of gram positive and gram negative bacteria.
2. Identification of tubercular bacteria in sputum (demonstration: with utmost precautionary measure taken before students handle the samples).

3. Demonstration of an ECG machine at work. Handling of Doctor's centrifuge.
4. Handling of colorimeter and spectrophotometer – Working principle and application.

Suggested Reading:

1. Kumar, V. Abbas, A.K. (2014). Robbins & Cotran Pathologic Basis of Disease. Nineth Edition. Elsevier, Saunders.
2. Basu P. Biochemistry Laboratory Manual. Academic Publishers.
3. Jayaraman, J. Laboratory Manual in Biochemistry. 2nd Edition. New Age International Publisher.
4. Kumar, V. Abbas, A.K. (2014). Robbins & Cotran Pathologic Basis of Disease. Nineth Edition. Elsevier, Saunders.
5. Basu P. Biochemistry Laboratory Manual. Academic Publishers.
6. Jayaraman, J. Laboratory Manual in Biochemistry. 2nd Edition. New Age International Publisher.
7. Note Books on Practical Biochemistry. Published by The Physiological Society of India. Kolkata.
5. Rao, S. Practical Biochemistry in Medicine. Academic Publishers.
6. Pelczar, M.J. (2001) Microbiology. 5th edition, Tata McGraw-Hill Co, New Delhi.
7. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
8. Mukherjee, K.L. (2004). Medical Laboratory Technology. Vol. I, Vol. II and Vol. III. Tata McGraw-Hill.
9. Hinkle, J.L. Kerry H. Cheever, K.H. (2013). Brunner & Suddarth's Handbook of Laboratory and Diagnostic Tests. 2nd Edition. LWW Publisher.
10. Godkar , P.B. Godkar. O.D.(2014). Textbook of Medical Laboratory Technology. 14th Edition.
11. Chattopadhyay P. (2011). Practical Physiology. 1st Edition. New Central Book Agency.
12. Manna, M.K. (2005). Practical Physiology. 1st Edition. Sritara Prakasani.

6. Generic Elective Courses

6.1 GE T1 – Community and Public Health

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] **4 Credits**

Concepts in theory

1. Basic idea about community health and public health issues, Malnutrition in a community, over nutrition, issues of obesity; possible remedial measures.
2. Composition and nutritional value of common Indian foodstuffs, rice, wheat, pulses, egg, meat, fish and milk.

3. Dietary fibers. Calorie requirement.
4. Concept of ACU.
5. Principles of formulation of balanced diets for growing child, adult man and woman, pregnant and lactating woman.
6. Diet management of obese, diabetic, hypertensive person and athlete.
7. Basic idea on PCM, marasmus, kwashiorkor and their prevention. Iron and iodine deficiency.
8. Sound pollution as a community health issue; definition, concept of noise, source of extraordinary sound, effects of sound pollution on human health, noise index (noise standards).

6.2 GE P2 – Community and Public Health Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Qualitative assessment of noise.
2. Survey on the status of dietary intake in the surrounding area through visits, etc.
3. Field survey on immunization.
4. Role of ICDS/Anganwadi and Mid-day Meal programme.

OR

6.1 GE T1 – Instrumentation

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Concepts in theory

1. Microscopy, Spectrophotometry and Spectrofluorometry. Principles and uses of paper and thin layer chromatography.
2. Electrophoresis: Principles and method, uses of agarose gel electrophoresis, SDS – PAGE.
3. Staining of DNA/RNA gel by ethidium bromide, Ultracentrifugation: moving boundary and density gradient ultracentrifugation.
4. ELISA, Immunohistochemistry and immunoblotting.

6.2 GE P2 – Instrumentation Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

List of Practical

1. Handling of compound microscope,
2. Measurement of glucose and protein concentration of a sample using spectrophotometer/colorimeter
3. Separation of amino acids through paper chromatography (demonstration).

6.3 GE T2 – Developmental Biology and Embryology

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Concepts in theory

1. General concept of reproductive system
2. Gametogenesis: Spermatogenesis and Oogenesis. Ultra-structure: sperm and ovum in mammals.
3. Egg Membranes, Fertilization: In mammals Cleavage: Cleavage types, cleavage process in mammals.
4. Blastula formation: Mammals, Morphogenetic movements: Types and examples.
5. Gastrulation: General Concept and differentiation.
6. Organogenesis: In general – Onset of activation of different organs and specific features.

6.4 GE P2 – Developmental Biology and Embryology Lab

[Practical: Credits 2/ (4 Practical Classes/Week)/Marks 15] 2 Credits

List of Practical

Hematoxylin and Eosin staining of ovarian tissue sections and identification of Graafian follicle, Corpus Luteum, and demonstration of preserved mammalian embryo.

6.5 GE T3 – Environmental Pollution and Human Health

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] 4 Credits

Air Pollution

Definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.

Water Pollution

Definition, types, health hazards, water pollutants, biochemical oxygen demand (BOD), thermal pollution, concept of safe drinking water standards.

Soil Pollution

Causes, health hazards, solid waste managements- bioreme- diation, phytoremediation.

Sound Pollution

Definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards).

Radionuclide Pollution

Ionizing radiations, effects of ionizing radiation on human health, permissible doses

Arsenic Pollution

Sources, sources of arsenic in ground water, drinking water standard for arsenic (WHO, USEPA), health effects of chronic arsenic poisoning.

6.6 GE P3 – Environmental Pollution and Human Health Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] 2 Credits

Physiological (experimental)

1. Effect of temperature on cardiac rhythm, degree of contraction - analysis on model graphical record.
2. Determination of particulate matter in air sample
3. Measurement of dissolve oxygen.
4. Measurement of noise by sound level meter
5. Measurement of pH of soil.
6. Demonstration: Presence of arsenic in water sample.

6.7 GE T4 – Biotechnology

[Theory: Credits 4 (4 Lectures/Week)/ Marks 25] **4 Credits**

Concepts in theory (20 Marks)

1. Definition
2. History of biotechnology
3. Importance of biotechnology
4. Cloning
5. Gene therapy
6. Transgenic animals
7. Hybridoma Technology
8. Monoclonal antibody
9. DNA finger printing and its application in forensic science
10. Polymerase chain reaction
11. RT-PCR
12. Enzyme immobilization
13. Basic idea of tissue culture and CO_2-incubators.

6.7 GE P4 – Biotechnology Lab

[Practical: Credits 2/ (4 Practical Classes/Week) /Marks 15] **2 Credits**

List of Practical

1. General concept of protein identification(molecular weight) from chromatographic record
2. DNA base pair identification of the unknown from analysis of southern blot record.
3. Demonstration of DNA and RNA quantification.
4. Measurement of concentration of CT-DNA in a solution.

Suggested Readings:

Sadler, T.W. (2014). Langman's Medical Embryology. Thirteen Edition. Lippincott Williams and Wilkins.

Singh, I, (2014). Human Embryology. Tenth Edition. Jaypee Brothers Medical Publishers(P) LTD.

1. Datta. A.K. Essentials of Human Embryology. 6th Edition. Current Books International
2. Hoar, W.S. Hall P.General and Comparative Physiology. Prentice-Hall of India Pvt.Ltd.
3. Posser, C.L. and Brown, E.A. Comparative Animal Physiology by W.B.Saunders.Co.
4. Singh, B.D. (2014).Biotechnology: Expanding Horizons.
5. Pranav Kumar, Usha Mina. (2015). Biotechnology: A Problem Approach
6. Kaushik, A. (2016). Perspectives in Environmental Studies. 4th Edition. New Age International Publisher.
7. Bharucha, E. (2013).Textbook of Environmental Studies for Undergraduate Courses. 2nd Edition. University Grants Commission.
8. Das S. (2016).Textbook of Community Nutrition. 2nd Edition. Academic Publishers.
9. Sadler, T.W. (2005). Medical Embryology. 2005 – Wiley.
10. Agarwal, K. M. Sikdar, P. K. and Deb. S.C. (2002). A Text Book of Environment. Macmillan India Ltd.
11. Pal G. Paribesh O Dushan. Dasgupta Publisher.
12. William P. Cunningham and Mary Ann. Principles of Environmental Science. Tata Mc GrewHill. Publisher.
13. Tyler, G. Miller & Scott Spoolman. An introduction to Environmental science. Cengage Learning Publisher.
14. Ranen Sen. Environmental management. Levant Publisher.
15. Satyanarayana, S. Zade, S., Sitara, S. and Meshram, P. (2009). A textbook of environmental studies. Allied Publisher Pvt.Ltd.
16. Park K. (2017). Park's Text Book of Preventive and Social Medicine. 24th Edition. M/s. Banarsidas Bhanot Publishers.
17. Cromwell , L. Weibell, F.J. .Pfeiffer, E.A. Biomedical Instrumentation and Measurements, by, & Prentice-Hall of India Pvt Ltd.
18. 6. Katz, D. L. and Wild, D. (2013). Jekel's Epidemiology, Biostatistics, Preventive Medicine, and Public Health: With STUDENT CONSULT Online Access, 4e (Jekel's Epidemiology, Biostatistics, Preventive Medicine, Public Health. Fourth edition. Saunders
19. Wallace, R.B. (2007). Maxey-Rosenau-Last Public Health and Preventive Medicine. Fifteen Edition. McGraw-Hill Education.
20. Heymann , D.L. (2008). Control of Communicable Diseases Manual. 19th Edition. American Public Health Association.
21. Magnus, M. (2007). Essentials Of Infectious Disease Epidemiology (Essential Public Health). 1st Edition. Jones & Bartlett Learning.
22. Ghai, P.O. Gupta, P. (2000). Essential Preventive Medicine. Vikas Publishing Pvt. Ltd.
23. Any other reference book related the semester syllabus.

CBCS SYLLABUS (UPDATED)

FOR

THREE YEARS UNDER-GRADUATE COURSE

IN

Physiology (PROGRAMME)

(*w.e.f. 2017*)

COOCHBEHAR PANCHANAN BARMA UNIVERSITY

COOCHBEHAR

WEST BENGAL

PIN 736101

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1. Scheme for CBCS Curriculum

1.1 Credit Distribution across Courses

		Credits	
Course Type	**Total Papers**	**Theory + Practical**	**Theory***
Core Courses	12	12*4 =48 12*2 =24	14*5 =70 14*1=14
Discipline Specific Electives	6	6*4=24 6*2=12	4*5=20 4*1=4
Ability Enhancement Language Courses	2	1*2=2 (ENG / MIL) 1*4=4 (ENVS)	1*2=2 (ENG / MIL) 1*4=4 (ENVS)
Skill Enhancement Courses	4	4*2=8	4*2=8
Totals	24	122	122

1.2 Scheme for CBCS Curriculum inPhysiology (Programme)

SEMESTER –I

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UGP/PHYG/101/ C-1A	**CT-1: Physiological Aspect of Community Health**	4	10	25	50	4	N.A.	4
	CP-1: Physiological Aspect of Community Health Lab	2		15				
	Or							
	CT1: Instruments In Physiology							
	CP1: Instruments In Physiology Lab							
UGP/102/ C-2A	Discipline-2 From another discipline	6	10	40	50			
UGP/103/ C-3A	Discipline-3 From another discipline	6	10	40	50			
UG/ 104/ AECC-ENV	Environmental Studies	4	10	40	50	4	N.A.	N.A.
Total in Semester – I		**22**	**40**	**160**	**200**	**8**		**4**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER –II

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UGP/PHYG/ 201/C-1B	**CT-2: Developmental Aspect of Embryo and Foetus** **CP-2: Developmental Aspect of Embryo and Foetus Lab**	4 2	10	25 15	50	4	N.A.	4
UGP/202/ C-2B	Discipline – 2 From another discipline	6	10	40	50			
UGP/ 203/C-3B	Discipline – 3 From another discipline	6	10	40	50			
UG/204/ AECC-E/MIL	English/MIL	2	10	40	50	4	N.A.	N.A.
Total in Semester – II		**20**	**40**	**160**	**200**	**8**		**4**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

	SEMESTER –III							
Course Code	**Course Title**	**Credit**	**Marks**			**No. of Hours/Week**		
			I.A.	**ESE**	**Total**	**Lec.**	**Tu.**	**Pr.**
UGP/ PHYG/ 301/C-1C	**CT-3: Environmental Hazards and Human Physiology**	4	10	25	50	4	N.A.	4
	CP-3: Environmental Hazards and Human Physiology Lab	2		15				
UGP/302/C-2C	Discipline – 2 From another discipline	6	10	40	50			
UGP/ 303/ C-3C	Discipline – 3 From another discipline	6	10	40	50			
UGP/PHYG/ 304/ SEC-1	**SECP-1: Food Pollutants Lab**	2	10	40	50	N.A.	N.A.	4
Total in Semester – III		**20**	**40**	**160**	**200**	**4**		**8**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER –IV

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UGP/PHYG/ 401/C-1D	**CT-4: Bio-engineering** **CP-4: Bio-engineering Lab**	4 2	10	25 15	50	4	N.A.	4
UGP/ 402/C-2D	Discipline-2	6	10	40	50			
UGP/ 403/C-3D	Discipline-3	6	10	40	50			
UGP/ PHYG/ 404/ SEC-2	**SECP-2: Methods in Hematology Lab**	2	10	40	50	N.A.	N.A.	4
Total in Semester – IV		**20**	**40**	**160**	**200**	**4**		**8**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER – V

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UGP/PHYG/ 501/DSE-1A	Any one of the following **DSET-1: Clinical Microbiology and Immunology** **DSEP-1: Clinical Microbiology and Immunology Lab**	4 2	10	25 15	50	4	N.A.	4
UGP/502/DSE-2A	Discipline – 2 From another discipline	6	10	40	50			
UGP/503/DSE-3A	Discipline – 3 From another discipline	6	10	40	50			
UGP/ PHYG/ 504/SEC-3	**SECT-1: Clinical Microbiology and Laboratory Medicine**	2	10	40	50	2	N.A.	N.A.
Total in Semester – V		**20**	**40**	**160**	**200**	**6**		**4**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

SEMESTER – VI

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			I.A.	ESE	Total	Lec.	Tu.	Pr.
UGP/PHYG/ 601/DSE-1B	Any one of the following **DSET-2: Exercise and Sports Physiology** **DSEP-2: Exercise and Sports Physiology Lab**	4 2	10	25 15	50	4	N.A.	4
UGP/602/DSE-2B	Discipline – 2 From another discipline	6	10	40	50			
UGP/603/DSE-3B	Discipline – 3 From another discipline	6	10	40	50			
UGP/PHYG/ 604/SEC-4	**SECT-2: Applied Biochemistry**	2	10	40	50	4	N.A.	N.A.
Total in Semester – VI		**20**	**40**	**160**	**200**	**8**		**4**

N.B. Theory:- 1 Credit= 1 hour/Week, Practical:- 1 Credit= 2 hours/Week, Tutorial:- 1 Credit= 1 hour/Week

UGP= Under Graduate programme/Pass, S.C.= Subject Code C= Core Course, E/H/MIL= English/ Hindi/ Modern Indian Language, H/MIL/E= Hindi/ Modern Indian Language/ English, AECC-E= Ability Enhancement Compulsory Course-English, AECC-ENV= Ability Enhancement Compulsory Course-Environmental Science, SEC= Skill Enhancement Course, GE= Generic Elective, DSE= Discipline Specific Elective IA= Internal Assessment, ESE= End-Semester Examination, Lec.= Lecture, Tu.= Tutorial, and Pr.=Practical

1.3 Choices for Discipline Specific Electives

DSET-1: Clinical Microbiology and Immunology

DSEP-1: Clinical Microbiology and Immunology Lab

DSET-2: Exercise and Sports Physiology

DSEP-2: Exercise and Sports Physiology Lab

1.4 Choices of Skill Enhancement Courses

SEC P1 – Food Pollutants Lab

SEC P2 – Methods in Hematology Lab

SEC T1 – Clinical Microbiology and Laboratory Medicine

SEC T2 - Applied Biochemistry

2. Core Courses

SEMESTER - I

2.1 CC-1A T1– Physiological Aspect of Community Health

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Concepts in theory

1. Basic idea about community health and public health issues, Malnutrition in a community, over nutrition, issues of obesity; possible remedial measures.
2. Composition and nutritional value of common Indian foodstuffs, rice, wheat, pulses, egg, meat, fish and milk.
3. Dietary fibers. Calorie requirement.
4. Concept of ACU.
5. Principles of formulation of balanced diets for growing child, adult man and woman, pregnant and lactating woman.
6. Diet management of obese, diabetic, hypertensive person and athlete.
7. Basic idea on PCM, marasmus, kwashiorkor and their prevention. Iron and iodine deficiency.
8. Sound pollution as a community health issue; definition, concept of noise, source of extraordinary sound, effects of sound pollution on human health, noise index (noise standards).
9. General concept on communicable and non-communicable diseases - Agents of communicable diseases, food borne, water borne and vector borne communicable diseases.

2.2 CC –1A P1– Physiological Aspect of Community HealthLab

(Practical: Credits 2/ Marks 20) 2 Credits

List of Practical

1. Qualitative assessment of noise.
2. Survey on the status of dietary intake in the surrounding area through visits, etc.
3. Field survey on Immunization.
4. Role of ICDS/Anganwadi and Mid-day meal programme.

Or

2.1 CC-1A T1– Instruments In Physiology

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Concepts in theory

1. Microscopy, Spectrophotometry and Spectrofluorometry. Principles and uses of paper and thin layer chromatography.
2. Electrophoresis: Principles and method, uses of agarose gel electrophoresis, SDS – PAGE.
3. Staining of DNA/RNA gel by ethidium bromide,Ultracentrifugation: moving boundary and density gradient ultracentrifugation.
4. ELISA , Immunoblotting and Immunohistochemistry

2.2 CC –1A P1– Instruments In Physiology Lab

(Practical: Credits 2/ Marks 20) 2 Credits

1. Handling of compound microscope.
2. Measurement of protein concentration of a sample using spectrophotometer and separation of amino acids through paper chromatography (demonstration).

Suggested Readings:

1. Park K. (2017). Park's Text Book of Preventive and Social Medicine.24th Edition.M/s. BanarsidasBhanot Publishers.
2. Cromwell , L. Weibell, F.J. Pfeiffer, E.A. Biomedical Instrumentation and Measurements, by, & Prentice-Hall of India Pvt Ltd.
3. Ananthi, S. (2005). A Textbook of Medical Instruments.New Age International Private Limited.
4. Joseph J. K. Joseph L. G. (1997).Practical HPLC Method Development. 2nd Edition.Wiley-Interscience.
5. Harold M. M. James M. M.(2009). Basic Gas Chromatography.2nd Edition.Wiley-Interscience.
6. Katz, D. L. and Wild, D. (2013). Jekel's Epidemiology, Biostatistics, Preventive Medicine, and Public Health: With STUDENT CONSULT Online Access, 4e (Jekel's Epidemiology, Biostatistics, Preventive Medicine, Public Health.Fourth edition.Saunders.
7. Wallace, R.B. (2007). Maxey-Rosenau-Last Public Health and Preventive Medicine. Fifteen Edition. McGraw-Hill Education.
8. Heymann , D.L. (2008).Control of Communicable Diseases Manual.19th Edition.American Public Health Association.
9. Magnus, M. (2007). Essentials Of Infectious Disease Epidemiology (Essential Public Health).1st Edition.Jones & Bartlett Learning.
10. BabaharikSharirBigyan. Jogen Debnath (2008). Shreedhar Prokashani, Kolkata.
11. Note Books on Practical Histology. Published by The Physiological Society of India.Kolkata.
12. Manna, M.K. (2005). Practical Physiology.1st Edition.SritaraPrakasani.
13. Ghai, P.O. Gupta, P. (2000). Essential Preventive Medicine. Vikas Publishing Pvt. Ltd.

SEMESTER - II

2.3 CC-1B T2 -Developmental Aspect of Embryo and Foetus

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Concepts in theory

1.General concept of reproductive system
2. Gametogenesis: Spermatogenesis and Oogenesis ,Ultra-structure: sperm and ovum in mammals.
3. Egg Membranes, Fertilization: In mammals Cleavage: Cleavage types, cleavage process in mammals.
4. Blastula formation: mammals, Morphogenetic movements: Types and examples.
5. Gastrulation: General Concept, determination, and differentiation.
6. Organogenesis: development of eye as an example of reciprocal and repeated inductive events.

2.4 CC-1B P2 – Developmental Aspect of Embryo and FoetusLab

(Practical: Credits 2/ Marks 20) 2 Credits

List of Practical

1. Hematoxylin and Eosin staining of testicular, ovarian tissue sections.
2. Identification of spermatocytes, spermatids, Graafian follicle, Corpus Luteum.
3. Demonstration of preserved mammalian embryo.

Suggested Readings:

1. Sadler, T.W. (2014). Langman's Medical Embryology. Thirteen Edition.Lippincott Williams and Wilkins.
2. Singh, I, (2014).Human Embryology.Tenth Edition.Jaypee Brothers Medical Publishers(P) LTD.
3. Datta.A.K.Essentials of Human Embryology.6th Edition.Current Books International

   Hoar, W.S. Hall P.General and Comparative Physiology.Prentice-Hall of India Pvt.Ltd.

4. Note Books on Practical Histology. Published by The Physiological Society of India.Kolkata.
5. BabaharikSharirBigyan. Jogen Debnath (2008). Shreedhar Prokashani, Kolkata.
6. Mukherjee, K.L. (2004). Medical Laboratory Technology.Vol.I, Vol. II and Vol. III. Tata McGraw-Hill.
7. Manna, M.K. (2005). Practical Physiology.1st Edition.SritaraPrakasani.

SEMESTER - III

2.5 CC-1C T3– Environmental Hazards and Human Physiology

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Air Pollution

Definition, sources, air pollutants, effects of air pollution on human health, concept of ozone hole, green house effects and global warming.

Water Pollution

Definition, types, health hazards, water pollutants, biochemical oxygen demand (BOD), thermal pollution, concept of safe drinking water standards.

Soil Pollution

Causes, health hazards, solid waste managements- bioreme- diation, phytoremediation.

Sound Pollution

Definition, concept of noise, source of sound pollution, effects of sound pollution on human health, noise index (noise standards).

Radionuclide Pollution

Ionizing radiations, effects of ionizing radiation on human health, permissible doses

Arsenic Pollution

Sources, sources of arsenic in ground water, drinking water standard for arsenic (WHO, USEPA), health effects of chronic arsenic poisoning.

2.6 CC-1C P3– Environmental Hazards and Human PhysiologyLab

(Practical: Credits 2/ Marks 20) 2 Credits

Physiological (experimental) Experiments

1. Effect of temperature on cardiac rhythm, degree of contraction - analysis on model graphical record.
2. Determination of particulate matter in air sample
3. Measurement of dissolve oxygen.
4. Measurement of noise by sound level meter
5. Measurement of pH of soil.
6. Demonstration: Presence of arsenic in water sample.

Suggested Readings:

1. Agarwal, K. M. Sikdar, P. K. and Deb. S.C. (2002). A Text Book of Environment. Macmillan India Ltd.
2. Pal G. Paribesh O Dushan.Dasgupta Publisher.
3. William P. Cunningham and Mary Ann. Principles of Environmental Science. Tata Mc GrewHill. Publisher.
4. Tyler, G. Miller & Scott Spoolman. An introduction to Environmental science. Cengage Learning Publisher.
5. Note Books on Experimental Physiology. Published by The Physiological Society of India. Kolkata.
6. Babaharik Sharir Bigyan. Jogen Debnath (2008). Shreedhar Prokashani, Kolkata.
7. Manna, M.K. (2005). Practical Physiology. 1st Edition. Sritara Prakasani.

SEMESTER - IV

2.7 CC-1C T4 – Bio-engineering

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Concepts in theory

1. Definition
2. History of biotechnology
3. Importance of biotechnology
4. Cloning - General concept
5. Gene therapy - General concept
6. Transgenic animals -General concept
7. Hybridoma techniques basic concept
8. Monoclonal antibody - General ideal in brief
9. DNA finger printing and its application in forensic science
10. Polymerase chain reaction - A brief concept
11. RT-PCR – A brief concept
12. Enzyme immobilization - A brief concept
13. Basic idea of tissue culture and CO2-incubators. -General concept

2.8 CC-1C P4– Bio-engineering Lab

[Practical: Credits 2/(4 Practical Classes/Week)/Marks 15] 2 Credits

List of Practical

1. General concept of protein identification(molecular weight) from chromatographic record.
2. DNA base pair identification of the unknown from analysis of southern blot record.
3. Demonstration of DNA and RNA quantification.

Suggested Readings:

1. Mount , David W. (2005). Bioinformatics: Sequence and Genome Analysis
2. Francis Ouellette, B.F. Baxevanis, A.D. (2009).Bioinformatics. 3rd Edition.Wiley.
3. Wilson, K. and Walker J. (2010).Principles and Techniques of Biochemistry and Molecular Biology. Seventh Edition.
4. Gardner, E.J. Simmons, M.J, Snustad, D.P. (2006) Principles of Genetics. Eighth Edition. Wiley.

3. Discipline Specific Elective Courses

3.1 DSE T1: Clinical Microbiology and Immunology

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Microbes

1. Structure and morphological classification.
2. Gram positive, gram negative, pathogenic and nonpathogenic bacteria. Sterilization, pasteurization, brief idea about antibiotics.
3. Bacterial growth curve.
4. ,Elementary idea of bacteriostatic and bacteriocidal agents.
5. Viruses- Structure and types, Lytic and lysogenic cycle.

Overview of immune system

1. Idea about innate and acquired immunity. Immuno-competent Cells.
2. Humoral and cellular immunity. T and B cell interaction
3. Antigen, Hapten and Super antigen .Antigen-antibody interaction: Application in diagnosis of disease.
3. Immunoglobulin - classification, basic structure and function. Polyclonal and Monoclonal antibody.
4. Antigen presentation. Major Histocompatibility Complex (MHC –I and II).
6. Cytokines and Lymphokines.
7. Vaccination - principles and importance of immunization.
8. Immunization program - immunization against Polio, Hepatitis-B, Tetanus, Measles,Whooping cough, Tuberculosis, AIDS- causative virus, mode of transmission, effects on human body, preventive measures, principles of diagnostic test for AIDS (ELISA, Western Blot).
10. Immunopathology - basic principles of autoimmune disease.

3.2 DSEP1: – Clinical Microbiology and Immunology Lab

[Practical: Credits 2/(4 Practical Classes/Week)/Marks 15] 2 Credits

List of Practical

1. Gram staining of bacteria and identification of Gram positive and Gram negative bacteria.
2. Agar-gel double diffusion(Ouchterlony) test .Single radial immunodiffusion in agarose by KIT
3. Direct Haemagglutination test with antibodies of A, B and D antigen.
4. Demonstration: Spore Staining.

3.3 DSET2 – Exercise and Sports Physiology

[Theory: Credits 4 (4 Lectures/Week)/Marks 25] 4 Credits

Concepts in theory

1. Importance of regular exercise in health and wellbeing.
2. Basic concept of Bioenergetics, Energy sources during exercise (Phosphagen, Anaerobic system and Aerobic system).
3. Cardio-respiratory responses during different grades of exercise.
4. Concept of excess post exercise oxygen consumption (EPOC), physiological fatigue and recovery.
5. Aerobic work Capacity: Measurement, physiological factors and applications.
6. Training: Principles of physical training, Training to improve aerobic and anaerobic power.
7. Nutritional supplements and ergogenic aids.
8. Sports injury and its' management.

3.4 DSEP2– Exercise and Sports PhysiologyLab

[Practical: Credits 2/(4 Practical Classes/Week)/Marks 15] 2 Credits

List of Practical

1. Measurement of blood pressure before and after exercise.
2. Recording of recovery heart-rate after standard exercise.
3. Determination of Physical Fitness Index by Harvard Step Test (Modified).
5. Measurement of body fat percentage.
7. Determination of muscle strength by hand grip dynamometer.
8. Pneumographic recording of effect of talking, laughing, coughing, breath holding and hyperventilation

Suggested Readings:

8. Pelczar, M.J. (2001) Microbiology. 5th edition, Tata McGraw-Hill Co, New Delhi.
9. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
10. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology. Pearson Benjamin Cummings, USA. 8th edition.
11. Das, D. Handbook of Practical Microbiology, Cell Biology Genetics and Biometry. Academic Publishers.
12. William D. McArdle, Frank I. Katch, Victor L. Katch.Essentials of Exercise Physiology. 5th International edition. Lippincott Williams and Wilkins.
13. Astrand, P.O.Rodhal. K. Dahl, H.A. (2003). Textbook of work Physiology. Forth Edition. Mc Graw-Hill Book Co.
14. Shaver, L.G. Essentials of Exercise Physiology. Surjeet Publications.
15. McCormick, E.O. and Sanders, M. Human Factors in Engineering and Design by Tata Mc Graw Hill.
16. Fox, E.L. (1985). Sports Physiology. Saunders College Publishing Holt-Saunders
17. Fox, E.L. Mathews, D.K. The Physiological Basis of Physical Education and Athletics by and. Saunders College Publishing.
18. Durin, J.V.G.A. and Passmore, R. Energy, Work and Leisure. Heinemann Educational Books.
19. Kindt, J.T. Barbara A. Osborne, B.A. Goldsby, R. (2006)Kuby Immunology. 6th Edition. W. H. Freeman.
20. Doan, T. Melvold, R. , Susan Viselli, S. Waltenbaugh, C. (2012).Immunology. Lippincott Williams and Wilkins. 2nd Edition.
21. Hanningan, B.M. Moore, C.B.T. Quinn, D.G. (2010). Immunology.2nd Edition. Viva Book.

4. Skill Enhancement Courses

4.1 SEC P1 – Food Pollutants Lab

[Practical: Credits 2/(4 Practical Classes/Week)/Marks 40] 2 Credits

Qualitative tests for Food Adulteration

Qualitative tests for identifying Food Adulterants in some food samples:

Metanil yellow, Saccharin, Monosodium glutamate, Aluminium foil, Bisphenol A and Bisphenol S, Chocolate Brown HT, Margarine, Pb, Hg, As, etc. in turmeric powder, besan, laddoo, noodles, chocolate and amriti.

4.2 SEC P2 – Methods in Hematology Lab

[Practical: Credits 2/(4 Practical Classes/Week)/Marks 40] 2 Credits

List of practical

1. Preparation of blood smear and identification of blood cells.
2. Determination of hematocrit, MCV, MCH,MCHC, bleeding time, clotting time etc.
3. Measurement of hemoglobin in blood by Sahlis method.
4. Demonstration of SGOT and SGPT.

a. SEC T1 – Clinical MicrobiologyandLaboratory Medicine

[Theory: Credits 2 (2 Lectures/Week)/Marks 25] 2 Credits

Concepts in theory

1. Staining of gram positive and gram negative bacteria.
2. Brief idea of Identification of tubercular bacteria in sputum (with utmost precautionary measure taken before students handle the samples).
4. ECG Machine - Working principle, procedure of recording and applied value.
5. Handling of Doctor's centrifuge.
6. Spectrophotometer colorimeter and colorimeter: - Working principle and application in Biomedical Laboratory.Procedure of recording and applied value.

4.4 SEC T2 – Applied Biochemistry

[Theory: Credits 2 (2 Lectures/Week)/Marks 25] 2 Credits

Concepts in theory

1. Photo-colorimetric estimation of blood constituents.
2. Measurement of blood glucose by Nelson-Somogyi method
3. Measurement of blood inorganic phosphate by Fiske - Subbarow method
4. Measurement of serum total protein by Biuret method.
5. Determination albumin globulin ratio.
6. Determination of serum amylase by iodometric method.

Suggested Readings:

1. Kumar, V. Abbas, A.K. (2014). Robbins &Cotran Pathologic Basis of Disease. Nineth Edition. Elsevier, Saunders.
2. Basu P. Biochemistry Laboratory Manual. Academic Publishers.
3. Jayaraman, J. Laboratory Manual in Biochemistry. 2nd Edition. New Age International Publisher.
4. Note Books on Practical Biochemistry. Published by The Physiological Society of India. Kolkata.
5. Rao, S. Practical Biochemistry in Medicine. Academic Publishers.
6. Pelczar, M.J. (2001) Microbiology. 5th edition, Tata McGraw-Hill Co, New Delhi.
7. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
8. Mukherjee, K.L. (2004). Medical Laboratory Technology.Vol.I, Vol. II and Vol. III. Tata McGraw-Hill.
9. Hinkle, J.L. Kerry H. Cheever, K.H. (2013). Brunner &Suddarth's Handbook of Laboratory and Diagnostic Tests. 2nd Edition. LWW Publisher.
10. Godkar , P.B. Godkar. O.D.(2014). Textbook of Medical Laboratory Technology. 14th Edition.
11. Kirk, R.S. Sawyer, S. Egan, H. (1991)Pearson's Composition and Analysis of Foods. Longman.
12. Swaminathan, M. (2012). Essentials of Food and Nutrition. Vol. I AND Vol. II. Jain Book Agency.
13. Note Books on Practical Biochemistry. Published by The Physiological Society of India.Kolkata.
14. Manna, M.K. (2005). Practical Physiology. 1st Edition. SritaraPrakasani.
15. Babaharik Sharir Bigyan. Jogen Debnath (2008). Shreedhar Prokashani, Kolkata.