

**SYLLABUS  
FOR TWO YEARS**

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**MASTER OF SCIENCE (MSc)  
COURSE  
IN  
PHYSIOLOGY**

**(Under the Choice-Based-Credit system (CBCS) w.e.f. the Academic year 2014)**



**UNIVERSITY OF KALYANI  
KALYANI – 741235**

# NADIA , WESTBENGAL , INDIA

## Department of Physiology

### Frame work of the Syllabus

The entire syllabus for 2 (two) years Master of Science (M.Sc.) course in Physiology is divided into 4 (four) semester and 400 marks are allotted for each semester. Thus, a total marks of 1600 and minimum 96 credits is required for qualify. The entire syllabus having 4 (four) semesters (4 X 400 = 1600 marks ),In each paper 60% marks earmarked for term-end examination and remaining 40% marks for class test, attendance , oral , group discussion , assignments , continuous evaluation etc. One hour lecture session for the entire semester period would be allotted one credit ; however in case of practical laboratory classes / tutorial two classes is equivalent to one credit . The M.Sc degree in Physiology will be awarded to the student who completed a total of minimum 96 credits ( Minimum in Hard core 60 credits, Minimum of Soft core 24 credits and Minimum in optional 12) . A candidate opt to complete a maximum of 8 extra credit will be acquired add on proficiency diploma in Physiology)

The frame work of the syllabus as per semesters is given bellow.

#### First Semester

	Credit				Total Marks/Points
	L	T	P	Total	
<b>Course 101 ( Theory) Hard core</b>	4	1	-	5	100
<b>Course 102 ( Theory) Hard core</b>	4	1	-	5	100
<b>Course 103 ( Practical) Hard Core</b>	-	-	3	3	100
<b>Course 104 ( Practical) Hard Core</b>	-	-	2	2	50
<b>Course 105 (Seminar) Elective</b>			3	3	50

#### Second Semester

	Credit				Total Marks/Points
	L	T	P	Total	
<b>Course 201 (Theory) Hard Core</b>	4	-	-	4	100
<b>Course 202 (Theory) Hard Core</b>	4	1	-	5	100
<b>Course 203 (Theory) Elective</b>	2	1		3	50
<b>Course 204 (Practical) Hard Core</b>		-	1	1	50
<b>Course 205 ( Practical) Hard core</b>			1	1	50
<b>Course 206 (Group project) Elective</b>			4	4	50

**Third Semester**

	Credit				Total Marks/ Points
	L	T	P	Total	
<b>Course 301 (Theory) Hard Core</b>	4	1	-	5	100
<b>Course 302 (Theory) Hard Core</b>	4	1	-	5	100
<b>Course 303 (Practical) Hard Core</b>	-	-	1	1	50
<b>Course 304 (Practical) Hard Core</b>	-	-	1	1	50
<b>Course 305 (Practical) Hard Core</b>	-	-	2	2	50
<b>Course 306 (Review) Elective</b>			4	4	50

**Fourth Semester**

	Credit				Total Marks/ Points
	L	T	P	Total	
<b>Course 401 (Theory) Soft core</b>	4	1	-	5	100
<b>Course 402 (Theory) Soft Core</b>	4	1	-	5	100
<b>Course 403 (Practical) Soft Core</b>	-	-	2	2	100
<b>Course 404 (Practical) Soft Core</b>	-	-	2	2	50
<b>Course 405 (Project) Soft Core</b>	-	-	6	6	50

**L = Lecture    T= Tutorial    P= Practical**

**Total 1600 Marks**

**Total Maximum of 74 Credit**

**Minimum credits required to qualify is 64 Credits ( Minimum of 40 credits in hard core , Minimum of 16 credits in Soft core and Minimum of 08 credits in Elective)**

## Summary of the Syllabus

### First Semester : 400 Marks

	Topics	Marks (Term end Examination + Internal Assessment)	No. of hours of theoretical Lecture/ Practical I	Tutorial/ Assignment II	Total Credit (Credit for I +II)
Course 101 Hard core	Cellular Physiology , Molecular Physiology Nanophysiology , Hematology Cardiovascular Physiology.	100 ( 60+40*)	60 (4hours/ week)	30 (2 hours/ week)	4+1=5
Course 102 Hard Core	Physiological Chemistry, Chemistry of Metabolism Ergonomics Exercise Physiology.	100 ( 60+40*)	60 (6 hours / week)	30 (2 hours/ week)	4+1=5
Course 103 Hard Core	Physiological and Environmental Practical Chemistry.	100 ( 60+40*)	90 (6 hours /week)		3
Course 104 Hard Core	Human and Environmental Experiment.	50 ( 30+20*)	60 (4 hours / Week)		2
Course 105 Elective	Seminar on Physiological Topic (one seminar is compulsory .Option should be given for Maximum three seminars)	50 (30+20*)		30 2 hours / week ( for each seminar)	1 for each Seminar
*Indicate internal assessment marks. Option should be given for Internal assessment between Oral presentation/ Group discussion/ assignment / continuous evaluation		Total 400 Marks Minimum 16 credits Maximum 18 credits			

## Second Semester: 400 Marks

	Topics	Marks (Term end Examination + Internal Assessment)	No. of hours of theoretical Lecture/ Practical I	Tutorial/ Assignment II	Total Credit (Credit for I +II)
Course 201 Hard Core	Neurophysiology , Muscle Physiology Physiology of Special Senses.	100 ( 60+40*)	60 (4 hours/ week)	-----	4 + 0=4
Course 202 Hard Core	Respiratory Physiology , Renal Physiology, Endocrine Physiology, Stress Physiology,	100 ( 60+40*)	60 (4 hours/ week)	30 (2hours/ week)	4+1=5
Course 203 Elective	One from the followings: 1. Environmental physiology 2. Occupational Physiology 3. Cancer biology	50 ( 30+20*)	30 (2 hours/ week)	15 (1 hours/ week)	2+1=3
Course 204 Hard Core	Experimental Physiology Practical.	50 ( 30+20*)	30 (2 hours/ week)		1
Course 205 Hard Core	Histology and Histological Chemistry Practical	50 ( 30+20*)	30 (2 hours/ week)		1
Course 206 Elective	Group project work or Seminar. (One group project or seminar is compulsory. Option should be given for maximum two)	50 (30+20*)	60 (4hours/ week)for each		2 for each
* Indicate internal assessment marks. Option should be given for Internal assessment between Oral presentation/ Group discussion/ assignment / continuous evaluation		<b>Total 400 Marks    Minimum 16 Credits Maximum 18 Credits</b>			

### Third Semester : 400 Marks

	Topics	Marks (Term end Examination + Internal Assessment)	No. of hours of theoretical Lecture/ Practical I	Tutorial/ Assignmen t II	Total Credit (Credit for I +II)
Course 301 Hard Core	Gastro intestinal Physiology , Human Nutrition and Dietetics , Reproductive Physiology , Embryology , Human Population and Human Genetics.	100 ( 60+40*)	60 ( 4 hours/ Week)	30 ( 2 hours/ Week)	4+1=5
Course 302 Hard Core	Microbiology , Immunology , Chrono-physiology Application of Biostatistics and Computer Science in understanding Physiology Physiological Instrumentation.	100 ( 60+40*)	60 ( 4 hours/ Week)	30 ( 2 hours/ Week)	4+1=5
Course 303 Hard Core	Practical on Microbiology and Immunology.	50 ( 30+20*)	30 ( 4 hours/ Week)		1
Course 304 Hard Core	Practical on Hematology	50 ( 30+20*)	30 ( 4 hours/ Week)		1
Course 305 Hard Core	Practical on Computer application and Physiological Statistics.	50 (30+20*)	60 ( 4 hours/ Week)		2
Course 306 Elective	Review work and seminar ( At least one Review is compulsory Option should be given for Maximum two Review)	50 (30+20*)	60 ( 4 hours/ Week) for each		2 for each
<ul style="list-style-type: none"> <li>• <b>*Indicate internal assessment marks.</b> <b>Option should be given for Internal assessment between Oral presentation/ Group discussion/ assignment / continuous evaluation</b></li> </ul>		<b>Total 400 Marks</b>	<b>Minimum 16 Credits Maximum 18 Credits</b>		

**Fourth Semester : 400 Marks**  
**Special Paper \*\* (Soft Core)**

	Topics	Marks (Term end Examination + Internal Assessment)	No. of hours of theoretical Lecture/ Practical I	Tutorial/ Assignment II	Total Credit (Credit for I +II)
Course 401 (Soft core)	Environmental Physiology (Spl) (Theoretical). Or Ergonomics and Occupational Physiology (Spl)(Theoretical)	100 ( 60+40*)	60 (4 hours/ Week)	30 ( 2 hours/ Week)	4+1=5
Course 402 (Soft core)	Environmental Physiology (Spl) (Theoretical). Or Ergonomics and Occupational Physiology (Spl) (Theoretical)	100 ( 60+40*)	60 ( 4 hours/ Week)	30 ( 2 hours/ Week)	4+1=5
Course 403 (Soft core)	Environmental Physiology special Paper ( Practical). Or Ergonomics and Occupational Physiology special Paper ( Practical).	100 ( 60+40*)	60 ( 4hours/ Week)		2
Course 404 (Soft core)	Environmental Physiology special Paper ( Practical). Or Ergonomics and Occupational Physiology special Paper ( Practical).	50 (30+20*)	60 ( 4 hours/ Week)		2
Course 405 (Soft core)	Project work and Seminar. At least one Project work is compulsory Option should be given for maximum three project work	50 (30+20*)	60 ( 4 hours/ Week) for each		2 for each
*Indicate internal assessment marks. Option should be given for Internal assessment between Oral presentation/ Group discussion/ assignment / continuous evaluation		<b>Total 400 Marks</b>	<b>Minimum 16 Credits Maximum 20 Credits</b>		

\*\*Now two multidisciplinary soft core paper (i) Environmental Physiology and (ii) Ergonomics and Occupational Physiology will be offered and number of soft ore papers will be increased subsequently subject to the creation of laboratory spaces.

# SYLLABUS IN DETAIL

**FIRST SEMESTER : 400 MARKS**

**Course-101 (100 Marks : Credit = 5)**

**Hard core**

**No. of Hours of Lectures in Theoretical courses = 60 (4 hours per week)**

**No. of hours of tutorial / assignment = 30 (2 hours per week)**

**Course-101 : Cellular Physiology , Molecular Physiology , Nanophysiology ,  
Hematology and Cardiovascular Physiology**

## **A) Cellular Physiology**

- I. Cellular Membranes and Transmembrane Transport of Solutes and Water.
- II. Ionic Equilibrium and Resting Membrane Potentials
- III. Generation and Conduction of Action Potentials
- IV. Synaptic Transmission
- V. Membrane Receptors, Second Messengers, and Signal Transduction Pathways
- VI. Apoptosis

## **B) Molecular Physiology**

- I. Realm of Molecular Physiology
- II. Bio-molecules
- III. Nucleotides and Nucleic Acids
- IV. Amino Acids
- V. Proteins
- VI. DNA Replication and Repair
- VII. Transcription and RNA Processing
- VIII. Translation
- IX. Regulation of Gene expression

## **C) Nanophysiology**

- I. Nanotechnology
- II. Physiological Applications of Nanoparticles
- III. Nanotoxicology

## **D) Hematology**

- I. Concept of Circulating Body Fluids
- II. Leukocytes : Ultra structure and Functions
- III. Thrombocyte (Platelet) and Hemostasis
- IV. Erythrocyte (RBC)
- V. Blood Types and Transfusion

## **B) Cardiovascular Physiology**

- I. Functional Anatomy of Cardiac Muscle
- II. Excitation – Contraction Coupling in Cardiac Muscle
- III. Electrical Activity of the heart
- IV. Hemodynamics
- V. Cardiovascular Regulatory Mechanisms
- VI. Special Circulations



**Course-102 (100 Marks: Credit = 5 )**

**Hard core**

**No. of Hours of Lectures in Theoretic courses = 60 (6 hours per week)**

**No. of hours of tutorial / assignment = 30 (2 hours per week)**

**Course-102: Physiological Chemistry , Chemistry of Metabolism, , Ergonomics and Exercise Physiology**

**A) Physiological Chemistry**

- I. Neural Chemistry
- II. Muscular Chemistry
- III. Hormonal Chemistry
- IV. Blood Chemistry
- V. Histological Chemistry

**B) Chemistry of Metabolism**

- I) Introduction to Metabolism
- II) Carbohydrate Metabolism
  - a) Carbohydrate Chemistry
  - b) Glucose Catabolism
  - c) Glycogen Metabolism and Gluconeogenesis
  - d) Citric Acid Cycle
  - e) Electron Transport and Oxidative Phosphorylation
- III. Lipid Metabolism
  - a) Lipid Transport
  - b) Fatty Acid Oxidation
  - c) Fatty Acid Biosynthesis
  - d) Regulation of Fatty Acid Metabolism
  - e) Membrane Lipid Synthesis
  - f) Cholesterol Metabolism
- IV. Amino Acid Metabolism
- V. Mammalian Fuel Metabolism : Integration and Regulation
- VI. Nucleotide Metabolism

**C) Ergonomics**

- I. Man- Machine Interface
- II. Anthropometry and it's applications
- III. System – Design
- IV. Work Organization
- V. Evaluation of Work Environment
- VI. Industrial Safety and Loss Prevention
- VII Assessment of Physiological Work Load

**D) Exercise Physiology**

- I. Bioenergetics
- II. Physiological Responses to Exercise
- III. Physiology of Training
- IV. Physiology of Fitness and Health
- V. Ergogenic Aids

**Course-103 (100 Marks: Credit = 3 )**  
**Hard core: Practical**  
**No. of Hours in Practical course = 90 (6 hours per week)**

**Course-103 : Physiological and Environmental Practical Chemistry**

**A) Practical on Physiological Chemistry**

**I. Preparation of Serum and Plasma**

**II. Collection of Blood for different biochemical analysis**

**III. General Techniques for Analysis**

- a) Colorimetric methods : photoelectric colorimeters
- b) Spectrophotometric method.

**IV. Special Techniques for Analysis**

- a) Electrophoresis : paper electrophoresis , gel electrophoresis.
- b) Chromatography : paper chromatography

**V. Practicals on carbohydrates**

- a) Determination of blood glucose (true) : by Hugget & Nixon , and Hjelm and De Verdier Method.
- b) Determination of blood sugar (true) : by (a) modified Nelson and Somogyi ; and (b) Hagedorn and Jenson Method.
- c) Determination of reducing blood sugar (total) : by modified Folin and Wu Method.

**VI. Practicals on Lipids**

- a) Determination of total cholesterol in serum : by Zlathis and Henly's Ferric Chloride Method.
- b) Determination of total cholesterol in whole blood or serum : by the method of Nath & Ghosh.
- c) Determination of serum triglyceride : by the method of Neri and Fringe.
- d) Determination of serum lipoprotein.
- e) Determination of serum total lipids : by Frings and Dunn method.

**VII. Practicals on Proteins**

- a) Determination of total protein , albumin and globulin in serum : by Biuret method.
- b) Fractionation and identification of serum proteins : by paper and polyacrylamide-gel electrophoresis (PAGE).
- c) Separation and identification of amino acid : by paper chromatography.

**VIII. Practicals on Mineral Nutrients**

- a) Determination of serum calcium : by the method of Kramer and Tisdall and EDTA titration Method.
- b) Determination of acid soluble phosphate of blood : by Fisk and Subba Row Method.

**IX. Practicals on Enzymes**

- a) Determination of Serum Aspartate Amino-transferase (SGOT) : by Reitman and Frankel method.
- b) Determination of Serum Alanine Amino-transferase (SGPT) : by Reitman and Frankel method.
- c) Determination of G-6P dehydrogenase : by Kornberg and Horecker method.

**X. Practicals on Liver Function**

- a) Determination of Serum bilirubin (total & conjugated ) : by Malloy and Evelyn method.
- b) Determination of Serum alkaline phosphatase : by the method of Stolbach and Nath.

**XI. Practicals on Renal Function**

- a) Determination of total blood NPN.
- b) Determination of creatine and creatinine in blood.

**B) Practicals on Environmental Chemistry**

- a) Determination of chloride in natural water by titrimetric method.
- b) Determination of dissolve oxygen (DO) in natural water by Azide modification method.
- c) Determination of Chemical Oxygen Demand (COD) in natural water by titrimetric

- method.
- d) Determination of nitrate in natural water by PDA method.
  - e) Determination of phosphate in natural water by colorimetric method.
  - f) Determination of arsenic in natural water by standard analytical method using spectrophotometer

**Course-104 (50 Marks: Credit = 2)**  
**Hard core : Practical**  
**No. of Hours in Practical course = 60 (4 hours per week)**

**Course-104 : Human and Environmental Experiments**

**A) Human Experiments**

- a) Determination of heart rate in different conditions : by Ten beats method / Polar heart rate recorder.
- b) Determination of diurnal variation of resting heart rate and body temperature : by standard method.
- c) Study of the effect of change of posture on blood pressure (three posture – supine , sitting and standing) : measurement of blood pressure by auscultatory method.
- d) Study of the effect of exercise on blood pressure : by Auscultatory method.
- e) Determination of hemoglobin concentration before and after exercise : by Sahlis acid hematin method.
- f) Examination of motor functions – muscle tone , muscle power and co-ordination of muscle : by standard method and grip strength by hand grip dynamometer.
- g) Determination of visual acuity : by Snellen's chart and Jaeger's chart.
- h) Examination of colour vision : by Ishihara's chart
- i) Anthropometric measurement : by Martin's anthropometric rod and measuring tape.
- j) Determination of body density and fat percentage .
- k) Pulmonary function tests : by Computerized Spirometer.
- l) Study of the effect of posture on vital capacity .
- m) Measurement of VO<sub>2</sub> max : by Queen college Test.
- n) Study of ECG , EMG and EEG : by using Polyrite / other specific machine.

**B) Environmental Experiments**

- a) Determination of heat stress indices in working environment : WBGT and CET.
- b) Determination of noise level in working environment : by Sound Level meter.
- c) Determination of illumination level : by Luxmeter.

**Course-105 (50 Marks: Credit= 1 for each Seminar  
Elective**

**No. of Hours in the course = 30 (2 hours per week)for each Seminar**

**Course-105 : Seminar on Physiological Topic**

Marks will be awarded to the Examinee on the basis of their performance in the seminar on a prefixed physiological topic ( That is on the basic of the performance of examinee in the oral presentation and discussion of the topic with examiners). One seminar is compulsory for all. Option should be given for maximum three seminars for additional credits points.

**SECOND SEMESTER : 400 MARKS**

**Course-201 (100 Marks : Credit = 4)**

**Hard core**

**No. of Hours of Lectures in Theoretical courses = 60 (4 hours per week)**

**Course-201 : Neurophysiology , Muscle Physiology and Physiology of Special Senses**

**A) Neurophysiology**

- I. Neurophysiology and Neuroanatomy
- II. The Somatosensory System
- III. Organization of Motor Function
- IV. Higher Functions of the Nervous System
- V. Autonomic Nervous System (ANS)

**B) Muscle Physiology**

**B-1: Skeletal Muscle Physiology**

- I. Molecular Structure of Thick and Thin Filament Proteins
- II. Molecular Organization of Proteins in Thick and Thin Filament
- III. Orientation and Receptor Structure of Sarcotubular System
- IV. Control of Skeletal Muscle Activity
- V. Skeletal Muscle Types
- VI. Modulation of the Force of Contraction
- VII. Modulation of the Force
- VIII. Energy Sources During Contraction
- IX. Growth and Development
- X. Denervation , Re-innervation and Cross- innervation
- XI. Response to Exercise
- XII. Biophysical Properties of Skeletal Muscle

**B-2 : Smooth Muscle Physiology**

- I. Overview of Smooth Muscle Cells
- II. Structure of Smooth Muscle Cells
- III. Control of Activity of Smooth Muscle
- IV. Innervation of Smooth Muscle
- V. Regulation of Contraction
- VI. Regulation of Myoplasmic Calcium Concentration
- VII. Development of Hypertrophy
- VIII. Synthetic and Secretary Functions
- IX. Biophysical Properties of Smooth Muscle

## C) Physiology of Special Senses

### C-1 : Physiology of Vision

- I. Photoreceptors
- II. Retinal circuitry
- III. Receptive Fields for Retinal ganglion Cells
- IV. Visual pathway and Striate Cortex
- V. Image Forming Mechanisms
- VI. Color Vision

### C-2 : Physiology of Hearing and Equilibrium

- I. Sound
- II. The Ear
- III. Sound Transduction
- IV. The Vestibular apparatus
- V. Central Vestibular Pathway
- VI. Vestibular Function

### C-3 : Physiology of Gustation

- I. Taste Receptors
- II. Taste Bud
- III. Central taste Pathways
- IV. Gustatory Transduction

### C-4 : Physiology of Olfaction

- I. Macrosmatic and Microsmatic Animals
- II. Olfactory Receptors
- III. Central Pathways
- V. Olfactory Threshold and Discrimination
- VI. Signal transduction

## Course-202 (100 Marks : Credit = 5)

### Hard core

**No. of Hours of Lectures in Theoretical courses = 60 (4 hours per week)**

**No. of hours of tutorial / assignment = 30 (2 hours per week)**

## Course-202 : Respiratory Physiology, Renal Physiology, Endocrine Physiology and Stress Physiology

### A) Respiratory Physiology

- I. Cells of the Airways
- II. Surfactant
- III. Innervation of lungs and airways
- IV. Mechanics of Respiration
- V. Oxygen Transport
- VI. Carbon Dioxide Transport
- VII. Ventilatory Response to CO<sub>2</sub>
- VIII. Abnormal Ventilation

### B) Renal Physiology

- I. Elements of Renal Function
- II. Anatomy and Physiology of Lower Urinary Tract
- III. Assessment of Renal Function
- IV. Glomerular Filtration
- V. Renal Blood Flow (RBF)

- VI. Regulation of RBF and GFR : By
- VII. Tubular Function
- VIII. Control of Body Fluid Osmolality : Urine Concentration and Dilution
- IX. Role of Kidney in Potassium , Calcium and Phosphate Homeostasis
- X. Role of Kidney in the Regulation of Acid-Base Balance

**C). Endocrine Physiology**

- I. General Principals of Endocrine Physiology
- II. Hormones of the Pancreatic Islets
- III. Endocrine Regulation of Calcium and Phosphate Metabolism
- IV. Hypothalamus and Pituitary gland
- V. Thyroid Gland
- VI. Adrenal Gland
- VII. Gastrointestinal Hormones

**C) Stress Physiology**

- I. Description of Stress
- II. Integration of the Response to Stress

**Course-203 (50 Marks : Credit = 3)**

**Elective**

**No. of Hours of Lectures in Theoretical courses = 30 (2 hours per week)**

**No. of hours of tutorial / assignment = 15 (1 hours per week)**

**One from the flowing will be chosen as Elective Paper**

**203-A: Environmental Physiology**

- I. Man and Environment
- II. Body Temperature and Homeostasis
- III. Environmental Pollution

**203-B: Occupational Physiology**

- I. Manual material handling
- II. Working Posture
- III. Work organization
- IV. Body Temperature and Homeostasis

**203-C: Cancer Biology : An overview of :**

- I. The nature of cancer,
- II. Multi-step Tumorigenesis,
- III. Tumor microenvironment and Tumor immunology.
- IV. Rational treatments of cancer

**Course-204 (50 Marks: Credit = 1)**

**Hard core: Practical**  
**No. of Hours in Practical course = 30 (2 hours per week)**

**Course-204 : Experimental Physiology Practical**

**A) Amphibian Experiments**

**A-1 : Nerve Muscle Experiments**

- a) Study of the effect of increasing strength of stimuli on isotonic muscle contraction of toad.
- b) Study of the genesis of tetanus in a sciatic (nerve) – gastrocnemius (muscle) preparation of toad.
- c) Study of the isometric muscle contraction of toad.
- d) Study of the conduction velocity of nerve in toad.

**A-2 : Experiments of Perfused Heart**

- a) Study of the effects of stimulation of vagosympathetic trunk on the perfused heart of toad.
- b) Study of the effects of the stimulation of vagosympathetic trunk on the perfused heart of toad before and after the application of nicotine.
- c) Study of the effects of the stimulation of vagosympathetic trunk before and after the application of atropine.
- d) Study of the effects of the drugs and ions on the perfused heart of toad .

**Drugs :**

- (a) Graded doses of adrenaline hydrochloride  
(1 in 100,00 dilution)
- (b) Graded doses of acetylcholine  
(1 in 100,000 dilution)

**Ions :**

- (a) 1 ml of 1%  $\text{CaCl}_2$  ( $\text{Ca}^{++}$ )
- (b) 1 ml of 1%  $\text{KCl}$  ( $\text{K}^+$ )
- (c) 2ml of 1%  $\text{NaCl}$  ( $\text{Na}^+$ )

**B) Mammalian Experiments**

- a) Study of the effects of the drugs and ions on the isolated perfused heart of rabbit : by Langendorff's method.

**Drugs :**

- (a) Adrenaline
- (b) Acetylcholine

**Ions :**

- (a)  $\text{NaCl}$  ( $\text{Na}^+$ )
- (b)  $\text{KCl}$  ( $\text{K}^+$ )
- (c)  $\text{CaCl}_2$  ( $\text{Ca}^{++}$ )

- b) Study of the effects of the Drugs\* and Ions\* on the motility of isolated mammalian intestine (rat/ rabbit/guinea pig) : by Dale's method.

\* Study in graded effects of the following drugs/ chemicals by taking 0.5-1 ml of each solution in a pipette and putting directly and mixing the solution in the central organ bath :

Acetylcholine	: 1 in 100,000 dilution
Adrenaline	: 1 in 100,00 dilution
Atropine	: 0.01%
Histamine	: 50ug (microgram)
$\text{KCl}$ Solution	: 1%
$\text{CaCl}_2$ Solution	: 1%
Barium Chloride	: 2%

- c) Study of the effects of the drugs\* on isolated mammalian uterine (rat/ rabbit/guinea pig) : by

Dale's method.

\* Study of the effects of Oxytocine , estrogen , progesterone , acetylcholine , and adrenaline on uterine contraction.

### **Course-205 (50 Marks: Credit = 1)**

#### **Hard core : Practical**

**No. of Hours in Practical course = 30 (2 hours per week)**

#### **Course-205 : Histology and Histological Chemistry Practical**

- A) Study of estrus cycle in rat : Proestrus , estrus , metestrus and diestrus.**
- B) Histological Techniques for the Preparation of Paraffin Tissue / Organ sections**
- Isolation and collection of specific tissue / organ mass from sacrificed animal.
  - Fixation of tissue mass.
  - Dehydration , Clearing , Embedding and Paraffin blocking of tissue masses .
  - Cutting of paraffin sections by microtome and preparation of paraffin tissue sections(s) on glass slide.
- C) Frozen Tissue Section (For diagnostic and enzyme histo-chemistry , and non-enzyme histochemistry e.g. lipids and glycogen )**
- D) Staining of Paraffin Tissue / Organ Sections**
- Histological Staining
    - Hematoxylin-Eosin.
    - Iron- Hematoxylin.
    - Weigert's iron Hematoxylin ( for connective tissue )
    - Hematoxylin0 eosin ( for glycogen )
  - Histo-chemical Staining
    - PAS method / Best's carmine method (for glycogen).
    - Oil red method (for fats{degenerating myelin}).
    - PAS & SudanBlack B method (for Glycolipids , neutral fat and myelin).
    - Feulgen & Rossenbeck Nuclear Reaction method (for DNA / deoxyribose)
    - Methylgreen – pyronin method (for RNA).
    - Perl's Prussian blue reaction method ( for endogenous ferric iron).
    - Millon reaction method (for tyrosine).
    - Gomori calcium method / Azo dye coupling method ( for alkaline phosphatase).

### **Course-206 (50 Marks: Credit= 2 for each )**

#### **Elective**

**No. of Hours in the course = 60 (4 hours per week) for each Seminar / Group Project Work**

#### **Course -206 : Seminar or Group Project work**



One Seminar or Group Project work is compulsory for all. Option should be given for Carry out both for additional credits points.

**A) Seminar**

Examinee are to submit a Report on a Recent topic of physiological importance under the supervision of a teacher of the department. Marks will be awarded of the Examinee on the basis of their performance in the seminar on the report and oral presentation on it.

**B) Group Project work and Seminar**

Examinees are to submit Group Project Report or field tour report under the supervision of a Teacher of the department. Marks will be awarded of the Examinee on the basis of their performance in the seminar on the report and oral presentation on it.

**THIRD SEMESTER : 400 MARKS**  
**Course-301 (100 Marks : Credit = 5 )**  
**Hard core**

**No. of Hours of Lectures in Theoretical courses = 60 (4 hours per week)**

**No. of hours of tutorial / assignment = 30 (2 hours per week)**

**Course-301 : Gastro-intestinal Physiology , Human Nutrition and Dietetics ,  
 Reproductive Physiology, Environmental Physiology,  
 Human Population and Human Genetics**

**A) Gastrointestinal Physiology**

- I. Gastrointestinal Regulation and Motility
- II. Mechanism and Cellular Control of Salivary and Pancreatic Secretion
- III. Gastric Secretion
- IV. Functions of Liver and Gall Bladder
- V. Digestion and Absorption

**B) Human Nutrition and Dietetics**

- I. Human Nutrition
- II. Whole Body Metabolism
- III. Dietetics
- IV. Nutrition and Public Health

**C). Reproductive Physiology**

- I. Sexual Differentiation
- II. Common Aspects of Gonadal Function
- III. Age Related Changes in Gonadotropin Secretion
- IV. The Testes
- V. The Ovaries
- VI. Pineal Gland and Gonad
- VII. Pregnancy
- VIII. Lactation

**D) Embryology**

- I. Development of Blastula
- II. Gastrulation
- III. Organogenesis
- IV. Birth defects: role of teratogens
- V. Molecular Basis of Embryo Development.

- VI. Respiratory Distress Syndrome (RDS)
- VII. Fetal Circulation
- VIII. Fetal Respiration
- E) Environmental Physiology**
  - I. Man and Environment
  - II. Respiration in Unusual Environments
  - III. Physiological Toxicology
  - IV. Environmental Pollution and Human health Hazards
- F) Human Population**
  - I. Population Dynamics
  - II. Human Population : World and Indian Scenario
- G) Human Genetics**
  - I. Mendelism
  - II. Molecular Aspects of Human Genetics
  - III. Human Population Genetics
  - IV. Human Genetic Disease
  - V. Human Genetics and Society

### **Course-302 (100 Marks : Credit = 5 )**

#### **Hard core**

**No. of Hours of Lectures in Theoretical courses = 60 (4 hours per week)**

**No. of hours of tutorial / assignment = 30 (2 hours per week)**

**Course-302 : Microbiology , Immunology , Chronophysiology, Application of Statistics and Computer Science in Understanding Physiology and Physiological Instrumentation .**

#### **A) Microbiology**

- I. Science of Micro-organisms : Outline Concept**
- II. Science of Bacteria**
  - a) Morphology and Fine Structure of Bacteria
  - b) Bacterial Reproduction and Growth
  - c) Bacterial Genetics
  - d) World of Bacteria
- III. Microbial Physiology**
- IV. Micro-organisms : Fungi , Algae and Protozoa**
- V. Viruses**
  - a) Viruses of Bacteria
- VI. Viruses of Animals (including insects) and Plant**
- VII. Environmental and Industrial Microbiology**
- VIII. Micro-organisms and Diseases**

#### **B) Immunology**

- I. Overview of the Immune System**
- II. Cells and Organs of the Immune System**
  - a) Organs of the Immune System
- III. Innate Immunity**
- IV. Generation of B-Cell and T-Cell Responses**
  - I. Antigens and Antibodies
  - II. Organization and Expression of Immunoglobulin Genes

- III. Antigen- Antibody Interaction : Principles and Applications
- IV. Complement System
- V. Major Histocompatibility Complex and Antigen Presentation
- VI. T- Cell Receptor
- VII. T-Cell Maturation , Activation , and Differentiation
- VIII. B- Cell Generation , Activation , and Differentiation
- IX. Immune Effectors Mechanisms

## **VI. Tolerance and Autoimmunity**

### **VII. Immune System in Health and Disease**

- I. Transplantation Immunology
- II. Immune Response to Infectious Diseases
- III. Vaccines
- IV. AIDS and Other Immuno-deficiencies
- V. Cancer and the Immune System

### **C) Chronophysiology**

- I. Overview of Chronophysiology
- II. Circadian Rhythm (Circadian Periodicity)
- III. Ultradian Rhythms / Periodicity
- IV. Infradian Rhythms / Periodicity

### **D) Application of Statistics in Understanding Physiology**

- I. Application and Uses of Statistics in Physiology
- II. Definition of Statistical Terms
- III. Sampling
- IV. Significance of Difference in Means
- V. Significance of Difference in Proportion of Large Samples
- VI. Chi-Square Test
- VII. Correlation and Regression
- VIII. Designing and Methodology of an Experiment or a Study
- IX. Graphical Presentation of Data
- X. Demography and Vital Statistics
- XI. Measures of Population and Vital Statistics
- XII. Life Table

### **E) Application of Computer Science in Understanding Physiology**

- I. Computer : Characteristics
- II. Historical Evolutions of Computer
- III. Anatomy of Computer
- IV. Architecture of Computer
- V. Data Presentation and Number System
- VI. Binary Operations
- VII. Boolean Algebra and Logic Gates
- VIII. Communication with a Computer
- IX. Computer Networking
- X. Orientation to Software Packages
- XI. Programming with C++
- XII. Computers in Physiology : Simulation and modeling of Physiological problems , application of computer graphics for solving the problems, molecular modeling and drug designing

### **F) Physiological Instrumentation**

- I. Principle and Use of Physiological Instruments
- II. Methodology

**Course-303 (50 Marks: Credit = 1)**

**Hard core : Practical**

**No. of Hours in Practical course = 30 (4 hours per week)**

## Course- 303 : Practicals on Microbiology and Immunology

### A) Practicals on Microbiology and Immunology

#### I. Microbiological Experiments

- a) Preparation of media for culture of bacteria , molds and yeasts.
- b) Study of morphology by staining : Gram staining , acid fast staining , spore staining , mole and yeast staining .
- c) Isolation , purification and identification of E, Coli by using selective media.
- d) Isolation of pure culture from mixed bacterial culture by streaking , pour plate and spread plate technique .
- e) Determination of bacterial growth curve by O.D.
- f) Bacterial count in saliva , throat swab and tongue swab.
- g) Staining and identification of bacterial found in polluted water (source like sewage , lake water) and soil after their growth in the culture media in the laboratory.
- h) Determination of minimum concentration (MIC) of antibiotics.
- i) Determination of sensitivity of bacteria to different antibiotics.
- J) Estimation of antibiotic and vitamin.
- k) Preparation of plasmids and chromosomal DNA.
- l) Observation of DNA by autoradiography (demonstration)
- m) Southern , Northern , and Western blotting techniques (demonstration)
- n) Polymerase chain reaction (PRC) (demonstration)

#### II. Immunological Experiments

- a) Identification of B and T-cells by resetting.
- b) Measurement of respiratory burst response of neutrophils – enzyme release assay.
- c) Agglutination tests : blood groupings , preparation tests .
- d) Hemolytic plaque assay .
- e) Experiments on phagocytosis and chemo taxis.
- f) Ouchterlony double diffusion and single radial immunodiffusion (SRID).
- g) Immunoelectrophoresis and counter current electrophoresis.
- h) Enzyme linked immunosorbent assay (ELISA) (demonstration).

## Course-304 (50 Marks: Credit = 1)

### Hard core : Practical

**No. of Hours in Practical course = 30 (4 hours per week)**

#### A) Practical on Hematology

- a) Determination of RBC indices.
- b) Differential leukocyte count: in a blood film stained with Leishman stain.
- c) Determination of ESR : by Westergren method.
- d) Determination of blood group : by rapid slide or test tube method using anti –A and anti – B sera.
- e) Study of the osmotic fragility of RBC : by using hypo and hypertonic saline.
- f) Determination of bleeding and clotting time : bleeding time by **Duke method** and clotting time by **capillary tube method** .
- g) Platelet count : staining by brilliant crystal blue and counting by hemocytometry .
- h) Reticulocyte count : by using supravital stains (brilliant crystal blue / new methylene blue).

## Course-305 (50 Marks: Credit = 2)

### Hard core : Practical

**No. of Hours in Practical course = 60 (4 hours per week)**

#### Course-305: Practical on Computer Applications and Physiological Statistics

**A. Physiological Statistics**

- a) Preparation of frequencies of a variable : by tabulation (frequency distribution table) and drawing (presentation of quantitative data by histogram , frequency curve , polygon , scatter diagram and qualitative data by bar diagram , pie diagram , pictogram etc.).
- b) Calculation of range , mean , standard , deviation (SD) and coefficient of variation from the physiological observations.
- c) Calculation of standard error of mean (SEM) from the physiological observations.
- d) Calculation of probability from parametric tests.
- e) Application of paired and unpaired “t” tests in different physiological observations.
- f) Calculation of correlation and regression co-efficient from physiological observations.
- g) Application X2 test to find the significance in different physiological observations.
- h) Utility of vital statistics in practice of community medicine and public health administration.

**B. Computer Applications**

- a) Binary operations.
- b) Boolean algebra.
- c) Computer operations and data entry.
- d) Computer programming and file management.
- e) Programming on physiological problems.
- f) Computer graphics.

**Course-306 (50 Marks: Credit= 2for each Review Work and Seminar)  
Elective**

**No. of Hours in the course = 60 (4 hours per week) for each Review work and Seminar**

**Course-306 : Review work and Seminar**

One Review work and Seminar is compulsory for all . Option should be given for carrying out maximum two for additional credits points.

**A) Review work and Seminar**

Examinee are to submit a Review Report on a topic of physiological importance under the supervision of a teacher of the department . Marks will be awarded of the examinee on the basis of their performance in the seminar on the report and oral presentation on it.

**FOURTH SEMESTER : 400 MARKS**

**Option should be given to choose between two multidisciplinary soft core papers**

- i) Environmental Physiology and**
- (ii) Ergonomics and Occupational Physiology.**

## **SPECIAL PAPER- ENVIRONMENTAL PHYSIOLOGY**

**Course-401A (100 Marks : Credit = 5 )**

**Soft core**

**No. of Hours of Lectures in Theoretic courses = 60 (4 hours per week)**

**No. of hours of tutorial / assignment = 30 (2 hours per week )**

### **Course -401A : Environmental physiology special paper - 1**

- I. Human and Environment
- II. Human Population and its Physiological Control
- III. Principals of Ecosystem
- IV. Natural Resources
- V. Energy Resources
- VI. Respiration in Unusual Environments

**Course-402A (100 Marks : Credit = 5 )**

**Soft core**

**No. of Hours of Lectures in Theoretic courses = 60 (4 hours per week)**

**No. of hours of tutorial / assignment = 30 (2 hours per week )**

### **Course- 402A : Environmental physiology special paper - 2**

- I. Physiological Toxicology
- II. Environmental and Public Health
- III. Environmental Pollution and Human Health Hazards
- IV. Environmental Management

**Course-403A (100 Marks : Credit =2 )**

**Soft core**

**No. of Hours of hours in practical course = 60 (4 hours per week)**

### **Course- 403A : Practicals on Environmental Physiology special paper**

#### **I. Bio- Chemical Experiments**

- I. Estimation of serum calcium by Karmer and Tisdall method of the animals exposed by ETS , and smoker and non- smoker humans .
- II. Estimation of blood glucose by Nelson Somogy method after chronic exposure of the animals by tobacco smoke / smokers and non- smokers.
- III. Estimation of SGOT and SGPT values.
- IV Measurement of Dissolved Oxygen (DO) and Biochemical Oxygen Demand (BOD) in water sample.
- V. Measurement of chloride in water sample by silver nitrate method.
- VI. Measurement of nitrate in water sample by PDA method.
- VII. Biochemical identification of food additives in some common foods.

#### **II. Micro-Biological Experiments**

- I. Testing of portability of water by coli form count.
- II. Staining and observation of bacteria and fungi in food (curd, milk, bread, fruit, sweets etc.) and water sample ( tube well water , river water , tap water etc.)
  - a) Preparation of Media

- b) Inoculation.
- c) Staining and Identification.

### **Course-404A (50 Marks : Credit = 2 )**

#### **Soft core**

**No. of Hours of hours in practical course = 60 (4 hours per week )**

#### **Course -404A : Practicals on Environmental Physiology**

##### **I. Physiological (Experimental) Experiments**

- a) Kymographic recoding of the effects of Hg , Pb and as compounds ; and food additives (metanil yellow , rhodamin B , and TOCP) on
  - i) The contraction of perfused heart of toad.
  - ii) The contraction (isometric) of isolated gastrocnemius muscle of toad.
  - iii) The motility of intestinal movements of rats in Dale's bath.
- b) Lung Function Tests in smokers , non – smokers and occupationally exposed individuals in hazardous environment.
- c) Studies of the effect of :
  - i) Temperature on thyroid status.
  - ii) Light on gonads.
  - iii) Iodine on thyroid status.
- d) Measurement of MBT in hypothermic and hyperthermic conditions.
- e) Studies of blood parameters in individuals exposed to occupationally hazardous environment.
  - i) TC , DC , ESR
  - ii) Reticulocyte count.
  - iii) Estimation of Hb
- f) Measurement of noise levels at different zones and studies of the effect of noise on some physiological variables ( BP , light reflex , auditory reflex etc.).

##### **II. Histo- Chemical Experiments**

- a) Histo- chemical studies regarding chronic effect of food additives and arsenic compounds on liver , kidney , intestine , , muscle and lung tissues in rat.

### **SPECIAL PAPER- ERGONOMICS AND OCCUPATIONAL PHYSIOLOGY**

#### **Course-401B (100 Marks : Credit = 5 )**

#### **Soft core**

**No. of Hours of Lectures in Theoretic courses = 60 (4 hours per week)**

**No. of hours of tutorial / assignment = 30 (2 hours per week )**

### **401B : Ergonomics and Occupational Physiology Special Paper -1**

- I. Human and work environment
- II. Physical and chemical aspect of work environment
- III. User interface and principles of design
- IV. Ergonomics for safety and loss prevention
- V. Principles of management in ergonomics

### **Course-402B (100 Marks : Credit =5)**

#### **Soft core**

**No. of Hours of Lectures in Theoretic courses = 60 (4 hours per week)**

**No. of hours of tutorial / assignment = 30 (2 hours per week )**

### **Course -402B : Ergonomics and Occupational Physiology Special Paper**

- I. Physiological job demand
- II. Psychological job demand and cognitive ability
- III. Working hours and shift Work
- IV. Human performance in adverse condition
- V. Occupational Health Problems
- VI. National and International Regulations

### **Course-403B (100 Marks: Credit = 2)**

#### **Soft Core: Practical**

**No. of Hours in Practical course = 60 (4 hours per week)**

### **Course-403B : Ergonomics and Occupational Physiology Special Paper Practical**

#### **I. Experiment on Environmental Ergonomics**

- a) Measurement of noise levels at different working areas.
- b) Measurement of illumination level by Lux meter in different working areas.
- c) Measurement of heat stress indices; WBGT, ET, CET, P<sub>4</sub>SR; Measurement of relative humidity.
- d) Measurement of dust particles in working environment by high volume sampler.

#### **II. Experiment on Design ergonomics**

- a. Anthropometric measurement – Static and Dynamic, Measurement of BMI, BSA, Somatotyping, etc, Anthropometric measurements for different design considerations.
- b. Determination of muscular strength by hand grip dynamometer.
- c. Determination of visual acuity by different charts.



### III. Occupational Ergonomics

- a) Determination of center of gravity of human body under resting and working condition.
- b) Postural analysis- Angular measurement by goniometer. Videography and photography. Different postural analytical methods viz, OWAS, REBA, RULA, LUBA, PATH, etc.
- c) Time study and Motion study, Activity analysis.
- d) NIOSH equation of lifting heavy materials, Lifting index, etc.
- e) Audio-visual reaction time.

**Course – 404B (100 Marks: Credit = 2 )**

**Soft Core : Practical**

**No. of Hours in Practical course = 60 (4 hours per week)**

**Course -404B : Ergonomics and Occupational Physiology Special Paper Practical**

#### I. Physiological Experiments

- a) Measurement of heart rate, blood pressure at rest and at different working conditions. Classification of work load.
- b) Determination of maximal heart rate, cardiac cost and cardiac efficiency by Polar heart rate monitor
- c) Determination of  $\text{VO}_2$  max by direct and indirect methods (Queen college test),
- d) Evaluation of lung function (spirometric method) - Estimation of FVC, SVC FEV<sub>1</sub>, MVV and PEFR.
- e) Determination of hearing loss of different groups of workers by audiometric method
- f) Recording and Interpretation of ECG.
- g) Recording and Interpretation of EMG.

#### II. Experiment on Occupational Physiological Chemistry

- a) Estimation of Hematological parameter like Hb (By Shali's method) and RBC count before and after exercise.
- b) Estimation of Blood glucose level before and after work.
- c) Estimation of Creatine Kinase level before and after work (Kit method)
- d) Estimation of Lactate Dehydrogenase (Kit Method).
- e) Qualitative and quantitative tests of sputum; staining and morphological assessment of macrophages.
- f) Estimation of SGOT and SGPT values.
- g) Estimation of oxidative stress enzymes, Lipid peroxidase, SOD and Catalase.

**Course – 405 (50 Marks : Credit = 2 for each )**

**Soft core**

**No. of Hours of hours in course = 60 (4 hours per week for each project)**

**Course-405 : Project Work and Seminar**

At least one project work is compulsory option should be given for maximum three project work Under the supervision of a teacher of the department each student in the 4<sup>th</sup> semester session will carry out a **project** on a topic of his / her special paper for a period of 6-8 weeks. Students will be evaluated on the basis of the **reports** submitted and oral presentation on the report in a seminar on the scheduled date of examination . Project reports and oral presentation will be evaluated by the examiners conducting the special practical examination.