UNIVERSITY OF CALCUTTA

Notification No. CSR/12/18

It is notified for information of all concerned that the Syndicate in its meeting held on 28.05.2018 (vide Item No. 14) approved the Syllabi of different subjects in Undergraduate Honours / General / Major courses of studies (CBCS) under this University, as laid down in the accompanying pamphlet:

List of the subjects

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Subject</th>
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<th>Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anthropology (Honours / General)</td>
<td>29</td>
<td>Mathematics (Honours / General)</td>
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<td>2</td>
<td>Arabic (Honours / General)</td>
<td>30</td>
<td>Microbiology (Honours / General)</td>
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<td>3</td>
<td>Persian (Honours / General)</td>
<td>31</td>
<td>Mol. Biology (General)</td>
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<td>4</td>
<td>Bengali (Honours / General / LCC2 / AECC1)</td>
<td>32</td>
<td>Philosophy (Honours / General)</td>
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<tr>
<td>5</td>
<td>Bio-Chemistry (Honours / General)</td>
<td>33</td>
<td>Physical Education (General)</td>
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<td>6</td>
<td>Botany (Honours / General)</td>
<td>34</td>
<td>Physics (Honours / General)</td>
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<td>7</td>
<td>Chemistry (Honours / General)</td>
<td>35</td>
<td>Physiology (Honours / General)</td>
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<td>8</td>
<td>Computer Science (Honours / General)</td>
<td>36</td>
<td>Political Science (Honours / General)</td>
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<tr>
<td>9</td>
<td>Defence Studies (General)</td>
<td>37</td>
<td>Psychology (Honours / General)</td>
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<td>10</td>
<td>Economics (Honours / General)</td>
<td>38</td>
<td>Sanskrit (Honours / General)</td>
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<td>11</td>
<td>Education (Honours / General)</td>
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<td>Social Science (General)</td>
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<td>12</td>
<td>Electronics (Honours / General)</td>
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<td>Sociology (Honours / General)</td>
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<tr>
<td>13</td>
<td>English ((Honours / General / LCC1 / LCC2 / AECC1))</td>
<td>41</td>
<td>Statistics (Honours / General)</td>
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<tr>
<td>14</td>
<td>Environmental Science (Honours / General)</td>
<td>42</td>
<td>Urdu (Honours / General / LCC2 / AECC1)</td>
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<tr>
<td>15</td>
<td>Environmental Studies (AECC2)</td>
<td>43</td>
<td>Women Studies (General)</td>
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<td>16</td>
<td>Film Studies (General)</td>
<td>44</td>
<td>Zoology (Honours / General)</td>
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<td>17</td>
<td>Food Nutrition (Honours / General)</td>
<td>45</td>
<td>Industrial Fish and Fisheries – IFFV (Major)</td>
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<tr>
<td>18</td>
<td>French (General)</td>
<td>46</td>
<td>Sericulture – SRTV (Major)</td>
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<td>19</td>
<td>Geography (Honours / General)</td>
<td>47</td>
<td>Computer Applications – CMAV (Major)</td>
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<td>20</td>
<td>Geology (Honours / General)</td>
<td>48</td>
<td>Tourism and Travel Management – TTMV (Major)</td>
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<td>21</td>
<td>Hindi (Honours / General / LCC2 / AECC1)</td>
<td>49</td>
<td>Advertising Sales Promotion and Sales Management – ASPV (Major)</td>
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<tr>
<td>22</td>
<td>History (Honours / General)</td>
<td>50</td>
<td>Communicative English – CMEV (Major)</td>
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<td>23</td>
<td>Islamic History Culture (Honours / General)</td>
<td>51</td>
<td>Clinical Nutrition and Dietetics CNDV (Major)</td>
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<td>24</td>
<td>Home Science Extension Education (General)</td>
<td>52</td>
<td>Bachelor of Business Administration (BBA) (Honours)</td>
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<tr>
<td>25</td>
<td>House Hold Art (General)</td>
<td>53</td>
<td>Bachelor of Fashion and Apparel Design – B.F.A.D. (Honours)</td>
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<tr>
<td>26</td>
<td>Human Development (Honours / General)</td>
<td>54</td>
<td>Bachelor of Fine Art (B.F.A.) (Honours)</td>
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<tr>
<td>27</td>
<td>Human Rights (General)</td>
<td>55</td>
<td>B. Music (Honours / General) and Music (General)</td>
</tr>
</tbody>
</table>

28 Journalism and Mass Communication (Honours / General)

The above shall be effective from the academic session 2018-2019.

SENATE HOUSE
KOLKATA-700073
The 4th June, 2018

(Dr. Santanu Paul)
Deputy Registrar
CORE COURSES (CC)

Semester 1
CC--1. Cellular Basis of Physiology, Genetics & Enzymes
CC--2. Biophysical Principles and Chemistry of Biomolecules

Semester 2
CC--3. Cell Signalling & Nerve-muscle Physiology
CC--4. Nervous System

Semester 3
CC--5. Blood and Body Fluids
CC--6. Cardiovascular System
CC--7. Respiratory System

Semester 4
CC--8. Digestion and Metabolism
CC--9. Molecular Biology
CC--10. Nutrition and Dietetics Public Health

Semester 5
CC--11. Special Senses
CC--12. Endocrinology

Semester 6
CC--13. Reproductive Physiology & Developmental Biology
CC--14. Excretory Physiology

GENERIC ELECTIVE (GE)

GE- 1 is equivalent to CC-1 of one general subject in Semester 1
GE- 2 is equivalent to CC-2 of one general subject in Semester 2
GE- 3 is equivalent to CC-3 of one general subject in Semester 3
GE- 4 is equivalent to CC-4 of one general subject in Semester 4

Discipline Specific Electives (DSE)

DSE – A (ONE course in Semester 5 & ONE course in Semester 6)
1. Biostatistics
2. Microbiology & Immunology
3. Ergonomics  
4. Community and Public Health

**DSE - B (ONE course in Semester 5 & ONE course in Semester 6)**
1. Chronobiology and Stress Physiology  
2. Advanced Molecular Biology and Nanotechnology  
3. Toxicology and Pharmacology  
4. Work, Exercise and Sports Physiology

**Ability Enhancement Compulsory Courses(AECC)**

**AECC- 1:** Communicative English or any other Modern Indian Language in Semester 1  
**AECC-2:** Environmental Studies in Semester 2

**Skill Enhancement Course (SEC)**

**SEC -- A (ONE course in Semester 3)**
1. Hematological Techniques  
2. Clinical Biochemistry

**SEC -- B (ONE course in Semester 4)**
1. Detection of Food Additives /Adulterants and Xenobiotics  
2. Bio-Medical Technology and Bioinformatics
### UNIVERSITY OF CALCUTTA
### PHYSIOLOGY (HONS.) SYLLABUS FOR CBCS

#### Credit Distribution Across Courses

<table>
<thead>
<tr>
<th>COURSE TYPE</th>
<th>TOTAL PAPERS</th>
<th>CREDITS</th>
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<tr>
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<td>THEORY+ PRACTICAL</td>
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<td>Core Courses</td>
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<td>Discipline Specific Electives</td>
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<td>4X2=8</td>
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<tr>
<td>Generic Electives</td>
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<td>4X4=16</td>
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<td>(Contents of the Syllabus to be found in the ‘General Course Syllabus’ for the respective subjects)</td>
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<td>4X2=8</td>
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<tr>
<td>Skill Enhancement Courses</td>
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<tr>
<td><strong>TOTALS</strong></td>
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### Core Courses

1. Cellular Basis of Physiology, Genetics & Enzymes
2. Biophysical Principles and Chemistry of Biomolecules
3. Cell Signalling & Nerve-muscle Physiology
4. Nervous System
5. Blood and Body Fluids
6. Cardiovascular System
7. Respiratory System
8. Digestion and Metabolism
9. Molecular Biology
10. Nutrition and Dietetics
11. Special Senses
12. Endocrinology
13. Reproductive Physiology & Developmental Biology
14. Excretory Physiology
Outline of Courses and Credits in each Semester

**Semester I**

**CC1TH.**
Cellular Basis of Physiology

- **Cell Structure and function**—Electron microscopic structure and functions of Nucleus, endoplasmic reticulum, ribosomes, Golgi bodies, mitochondria, lysosomes, peroxisomes, cytoskeletal elements, centrosomes and plasma membrane.

- **Cellular transport**—Passive and active transport. Ion channels, ionophores.

- **Intercellular communication**—Basic idea of tight junctions, gap junctions, adherens junctions, desmosomes and cell adhesion molecules. Extracellular matrix components.

**Genetics**

- **Cell cycle**—Events and regulatory role of cyclin. Cell division—Mitosis & Meiosis—phases and significance. Crossing-over, Linkage.

- **Enzymes**

**CC1P.**
1. Study of various stages of meiosis from grasshopper testis
2. Cell viability study by Trypan blue staining
3. Osmotic fragility test of goat blood R.B.C
4. Staining of adipose tissue using Sudan III or IV.

**CC2TH.**

Biophysical Principles

- **Diffusion**—Its characteristics, factors influencing and physiological
Applications.

- **Osmosis**: Osmotic pressure – laws, determination – freezing point depression method and physiological applications.

- **Surface tension & viscosity**: Physiological applications.

- **pH& Buffer**: Henderson Hasselbach - equation (quantitative problems). Determination of pH.

- **Colloids**: Classification, properties – optical, electrical, electrokinetic. Physiological importance of colloids.

- **Gibbs-Donnan membrane equilibrium**.


- **Instruments**: Principles of construction, uses and advantages and disadvantages: Compound microscope, Phase contrast microscope, Fluorescence microscope, Polarizing microscope, Confocal microscopy, Transmission and Scanning electron microscope. Photoelectric colorimeter, Spectrophotometer and pH meter.


- **Polysaccharides** – Starch, Glycogen, Dextrin, Cellulose, Glycosaminoglycans, Glycoproteins, Sialic acids.


- **Peptides and Proteins**: Structure and properties of peptide bonds -- Phi and Psi angles. Reactions with Sanger’s and Edman’s reagent. Biuret reaction. Different levels of protein structure -- Primary, Secondary (α-helix and β-pleated sheet), Tertiary and Quaternary. Forces stabilizing the structures. Denaturation and Renaturation.

- **Purine and Pyrimidine**: Structure, nomenclature and tautomism.

CC2P.
1. Qualitative tests for the identification of physiologically important substances: Hydrochloric acid, Lactic Acid, Uric Acid, Albumin, Gelatin, Peptone, Starch, Dextrin, Glucose, Fructose, Lactose, Sucrose, Urea, Acetone, Glycerol and Bile salts
2. Preparation Of Buffer and pH measurement.

Semester II

CC3TH.
Cell Signalling:
Cell surface receptor proteins – ion channel coupled, G-protein coupled and enzyme-coupled. Intracellular messengers – cAMP, cGMP, IP3, DAG, Protein kinases, Ca\(^{2+}\),CO,NO. Signal transduction pathways: Phosphatidylinositides, MAP kinase, JAK-STAT, SMAD.

Nerve:

Muscle:
tension and velocity relationships. Chemical, thermal and electrical changes in skeletal muscle during contraction and relaxation. Electromyography. (4)

CC3P.
1. Staining of isolated nerve fiber by silver nitrate method.
2. Staining of skeletal & cardiac muscle by methylene blue.
3. Staining of collagen in tissue sections. (2)

CC4TH.

The Nervous System
- Structural organization of different parts of brain and spinal cord. Reflex action – definition, reflex arc, classification and properties.
- Autonomic nervous system: organization, outflow, ganglia, centers and functions. Chemical transmission in autonomic nervous systems.
- Ascending and descending tracts: origin, courses, termination and functions.
- Functions of the spinal cord with special reference to functional changes following hemisection and complete section of spinal cord. Pain production, perception and regulation. Referred pain.
- Muscle spindle and golgi tendon organ: their structure, innervations and functions, postural reflexes. Decorticate, decerebrate rigidity and spinal animal.
- Brain: Structure, nerve connections and functions of brainstem, cerebellum, reticular formation, hypothalamus, thalamus, basal nuclei and cerebral cortex- Speech and aphasia. Structure and functions of vestibular apparatus.

Molecular neurobiology: General concept of ionotropic and metabotropic receptors. Structure, sub-types and functions of nicotinic and muscarinic acetylcholine receptors, adrenoceptors, glutamate receptors (NMDA and AMPA receptors), GABA, opiate, serotonin, dopamine and histamine receptors. (4)

CC4P.
1. Basic concepts of brain imaging. Identification of different structures of
human brain using CT scan and MRI images.
2. Study and use of Kymograph, induction coil, key. Gastrocnemius-sciatic nerve preparation and kymographic recording of isotonic muscle twitch, effects of two successive stimuli and load (afterload) on muscle twitch. (2)

Semester III

CC5TH.

Physiology of Blood and Body Fluids

Bone marrow: Formed elements of blood—origin, formation, functions and fate.

Plasma proteins Origin and functions.

Erythropoiesis Role of erythropoietin and leucopoiesis.


Blood volume: Regulation and determination by dye and radioisotope methods.


Lymph and tissue fluids: Formation, circulation, functions and fate.

Lymphatic organs: Histological structures and functions of lymph gland and spleen. Splenomegaly causes and effects.

Circulatory disorder: Oedema. (4)

CC5P.


Preparation and staining of bone marrow. Measurement of diameter of megakaryocytes. Reticulocyte staining. (2)

CC6TH

Cardiovascular System


Cardiac cycle: Pressure and volume changes. Heart sounds. Murmurs.

Cardiac output: Measurement by application of Fick’s principle & factors affecting.

Starling’s law of heart.

Electrocardiography: The normal electrocardiogram, electrocardiographic leads, vectorial analysis, the vectorcardiogram and the mean electrical axis of heart. The His bundle electrogram.

Principles of Echocardiography.

Cardiac Arrhythmias &. Myocardial Infarctions.

The pulse: Arterial and venous.
Hemodynamics of blood flow.
Cardiac and vasomotor centers, baroreceptors and chemoreceptors,
nervation of the heart and blood vessels, cardiac and vasomotor reflexes.
Cardiovascular homeostasis – neural and chemical control of cardiac
functions and blood vessels.
**Blood pressure:** Its measurement and factors affecting. Cardiovascular adjustment after haemorrhage. (4)

**CC6P.**
1. **Cardiovascular Physiology Experiments:** Determination of Blood pressure by Auscultatory Method. Determination of mean pressure, pulse pressure and pulse rate. Preparation of Amphibian Ringer Solution. Interpretation of Kymographic recording of the movements of perfused heart of toad and the effects of acetylcholine and adrenaline on the contraction of heart. ECG. (2)

**CC7TH.**
**Respiratory System**
**Anatomy and histology** of the lung and airways.
**Mechanics of breathing:** Role of respiratory muscles, glottis. Compliance of lungs and chest wall, pressure-volume relationships, alveolar surface tension and surfactant, work of breathing.
**Spirometry:** Lung volumes and capacities. Dead space.
**Pulmonary Circulation:** Ventilation-perfusion ratio.
**Transport of gases in body:** Partial pressure and composition of normal atmospheric gases in inspired, expired, alveolar airs and blood. Oxygen dissociation curve of hemoglobin and myoglobin – factors affecting. Carbon dioxide dissociation curve. Regulation of respiration -- neural and chemical, respiratory centers, chemoreceptors, baroreceptors, pulmonary receptors.
**Disorders of Breathing:** Hypoxia: Types & effects. Asphyxia, Voluntary hyperpnoea, Apnoea, Cyanosis, Periodic breathing, Asthma, Emphysema. Non-respiratory functions of lung. (4)

**CC7P.**
1. **Respiratory Human Experiments:** Pneumographic recording of effects of hyperventilation, breath-holding and talking. Lung function tests using Spirometry (Digital) and analysis of the results. (2)

**Semester IV**

**CC8TH.**
**Digestion**
Anatomy and histology of alimentary canal.
Digestive glands – histological structures of salivary glands, pancreas, liver.
Deglutition. Movements of alimentary canal and their regulations.
Composition, functions and regulation of the secretion of salivary, gastric,
pancreatic and intestinal juices and bile. Enterohepatic circulation.  
Digestion and absorption of carbohydrates, lipids, proteins and nucleic acids.  
Defecation. GALT. Basic concepts of Peptic Ulcer, Jaundice and Gallstones.

**Metabolism**  

**Carbohydrate** :Glycolysis, R-L cycle. TCA cycle, Gluconeogenesis - Cori cycle, Anaplerotic reactions and Amphibolic nature of TCA cycle. Pentose phosphate pathway. Glycogenesis and Glycogenolysis.

*Hormonal regulation of the above mentioned biochemical pathways not required.*


**Purines and Pyrimidines**– Biosynthesis :*de novo* and salvage pathways.  
Catabolism.  
*Regulation of the above mentioned biochemical pathways/cycle not required.* (4)

**CC8P.**  
1. **Dale’s Experiment** :Kymographic recording of normal movements of rat’s intestine using Dale’s apparatus and effects of acetylcholine and adrenaline on normal intestinal movements of rats.  
2. **Biochemical estimations:**  
Quantitative estimation of amino nitrogen by Sorensen’s formol titration method (percentage as well as total quantity to be done). (2)

**CC9TH.**  
**Molecular Biology**  

**Methodologies** : Chromatography: Principles and uses of : TLC, Gel filtration, Affinity chromatography, ion-exchange chromatography. Electrophoresis: Principles and method, uses of Agarose gel electrophoresis, SDS – PAGE. Ultracentrifugation: moving boundary
and density gradient ultracentrifugation. Radioactivity – Classification and properties. Their use – radiolabelling of biomolecules and its detection by autoradiography. Principles of RIA, ELISA. Western, Northern and Southern blotting techniques. Polymerase chain reaction-basic concept.

CC9P.
**Biochemical estimations:**
1. Colorimetric methods—
2. Thin layer chromatography.

CC10TH.
**Nutrition and dietetics**
- **Vitamins:** Thiamin, Riboflavin, Niacin, Pyridoxine, Pantothenic Acid, Biotin, Cyanocobalamin, Folic Acid, Ascorbic Acid, Inositol. Vitamins A, D, E and K. Dietary sources, daily requirements, biochemical functions, deficiency symptoms, hypervitaminosis, antivitamins.
- **Minerals:** Sources, biological functions of sodium, potassium, calcium, phosphorus, iron, iodine and fluoride.
- **SDA, RQ and BMR:** Factors affecting. Determination of BMR.

CC10P.
- **Nutrition and Dietetics:**
  1. Composition and nutritional value of common foodstuff.
  2. Diet survey report of a family as per ICMR specification.
  3. Qualitative analysis of milk, potato, flour, rice, pulses.

Semester V

CC11HT:
**Special Senses**
Characteristics of special senses, Sensory Coding -- Weber-Fechner law, Steven's power law.


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**CC11P.**
1. Determination of Visual Acuity by Snellen’s Chart
2. Determination of Colour Blindness by Ishihara Chart.
4. Study and identification of stained sections of different mammalian tissues and organs: Cardiac muscle, Skeletal muscle, Smooth muscle, Trachea, Lung, Hyaline cartilage, Artery, Vein, Cerebellum, Cerebral cortex, Spinal cord,
5. Silver nitrate preparation of corneal cell space.

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**CC12TH.**

**Endocrinology**


**Pineal gland**—Histological structure. Chemical nature, biosynthesis, molecular mechanism of action, functions and regulation of secretion of melatonin.

**Thyroid and Parathyroid**—Histological structure of the glands. Chemical nature, molecular mechanism of action, functions and regulation of secretion of the hormones. Hypo- and hyperactive states of the glands.


**Heart** as an endocrine organ.


**Gastro-intestinal hormones**—Chemical nature, molecular mechanism olfaction, functions and regulation of secretion of the hormones.
CC12P.
1. Study of Effects of Oxytocin and Adrenaline on uterine contractions of albino rat.
2. Study and identification of stained sections of different mammalian tissues and organs: Parotid gland, Submaxillary gland, Sublingual gland, Tongue, Oesophagus, Stomach, Duodenum, Jejunum, Ileum, Large intestine and Liver. (2)

Semester VI
CC13TH.
Reproductive Physiology

Developmental Biology
Sperm and Ovum. Fertilization, Blastulation, Implantation, Gastrulation (Concept of induction, determination and differentiation). Organogenesis: Development of Heart, urinary system and genital system. Fetal Circulation. (4)

CC13P.
1. Study and identification of stained sections of different mammalian tissues and organs: Kidney, Ureter, Skin, Uterus, Testis, Ovary, Thyroid gland, Pancreas, Spleen, Lymph gland.
3. Silver nitrate preparation of urinary bladder for study of cell spaces. (2)

CC14TH.
Excretory System, Environmental Pollutants and Human Health

Environmental Pollutants and Human Health: Sources and effects of Chlorinated hydrocarbons, Organophosphorus, Organocarbamates, Lead, Arsenic, Fluorine, Aluminium, Ionizing and non-ionizing radiations.

CC14P.
1. Identification of normal and abnormal constituents of urine.
2. Staining and identification of histological sections of liver, adrenal gland, thyroid gland, ovary, testes, and kidney.

Suggested Readings

2. Best & Taylor's Physiological Basis of Medical Practice, O.P. Tandon & Y. Tripathi, Lippincott Williams & Wilkins
4. Harper’s Illustrated Biochemistry, V.W. Rodwell and others, Lange
20. Cell & Molecular Biology, EDP De Robertis & EMF De Robertis; Lea & Febiger
23. Textbook of Medical Physiology, Indu Khurana, Elsevier
24. Textbook of Medical Biochemistry, R. Chawla et.al, Wolters-Kluwer
27. Endocrinology, Mac E. Hadley, Pearson Education.
Discipline Specific Electives (DSE)

**Group A**
1. Biostatistics
2. Microbiology & Immunology
3. Ergonomics
4. Community and Public Health

**Group B**
1. Work, Exercise and Sports Physiology
2. Advanced Molecular Biology & Nanotechnology
3. Chronobiology and Stress Physiology
4. Toxicology and Pharmacology

<table>
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<tr>
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<tbody>
<tr>
<td>Group – B 1 &amp; 2 (Anyone)</td>
<td>Group – B 3 &amp; 4 (Anyone)</td>
</tr>
</tbody>
</table>

**Group A**

1. **Biostatistics (DSE A1TH)**
Presentation of data-frequency distribution, frequency polygon, histogram, bar diagram and pie diagram.  
Different classes of statistics-mean median, mode, mean deviation, variance, standard deviation, standard error of the mean. Standard score.  
Testing of hypothesis - Null hypothesis, errors of inference, levels of significance, t-test and z score for significance of difference.  
Distribution-free test - Chi-square test.  
Linear correlation and linear regression.  
One way ANOVA

**DSE A1P**
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. Graphical representation of data in frequency polygon and histogram. Student’s t test for significance of difference between means. Determination of correlation coefficient (r) and computation of linear regression equation.
Statistical analysis and graphical representation of biological data with computer using One way Anova.

Suggested Readings

2. Microbiology & Immunology (DSE A2TH)
Classification of microorganisms. Techniques employed for the identification of microorganisms -- microscopic and biochemical methods.

Control of microbial growth: Physical and Chemical methods used in sterilization, disinfection and pasteurization.

Bacteriology: Bacterial classification based on staining techniques (Gram stain and Acid-fast stain) and morphological aspect. Bacterial structure: cell-wall, LPS layer, pili, flagella, chromosome, plasmid, spores and cysts.

Culture of bacteria: Nutritional requirement – complex and synthetic media, preparation of media; physical factors required for growth (temperature, pH and gaseous requirement); bacterial growth curve: different phases and their significance; quantitative estimation of bacterial growth; continuous growth culture and its utility.

Food microbiology: Beneficial and harmful microorganisms in food, causative organisms of food-borne infections - mode of transmission and methods of prevention.

Bacterial metabolism: Fermentation, Glyoxalate cycle and Entner-Doudoroff pathway.

Bacterial genetics: Transformation, conjugation and transduction.


Virology: Viral structure – virion, prion and bacteriophages; classification of viruses based on nucleic acid composition and host system, replication of bacteriophages – lytic and lysogenic cycle.

Overview of innate and acquired immunity: Elements of acquired immunity: Characteristics of immune response, cells and organs involved in immune response.

Immunogens and antigens: Requirements of immunogenicity, epitopes recognized by B- & T- cells, haptens, adjuvants, cross-reactivity. Antibody structure, classification and functions.


MHC molecules: Structure of class I and II molecules, brief idea of peptide binding by MHC molecules, cellular distribution.

Antigen processing and presentation: T-cell receptor. T-cell maturation and differentiation - thymic selection in brief. B-cell activation & differentiation: thymus dependent and independent antibodies, T-B co-operation, the carrier effect.

Cytokines: Produced by TH1 & TH2 cells, regulating specific immune response only.

Vaccination: Passive and active immunization, types and uses of vaccine.

Toxins and toxoids.

Hybridoma technology

DSE A2P
1. Gram staining of bacteria and identification of Gram positive and Gram negative bacteria.
2. Determination of human blood group using immunological method.
3. Quantitation of antigen or antibody by precipitin test.
4. Isolation and staining of splenocytes.
5. Lactophenol cotton blue staining of yeast cells.

Suggested readings:
1. Microbiology, Pelczar Tata McGrawhill.
2. General Microbiology By Stanier et.al, Prentice Hall.
5. Kuby Immunology by T.J Kindt et.al, W.H Freeman.

3. Ergonomics (DSE A3TH)

Introduction to Ergonomics
A brief history of ergonomics
Multidisciplinary approach to Ergonomics
Definition and scope of Ergonomics
Role of ergonomics in health safety and productivity

Human machine interaction
Introduction to man machine interaction and interfaces
Fundamentals of human computer interaction
Fundamental idea of display and control

Anthropometric considerations in Ergonomics
Definition of anthropometry
Common terminologies used in anthropometry
Different body dimensions measured in anthropometry
Basic Concepts of reach, clearance, posture, range of motion.
Concept of percentile and its calculation and use of percentile values in anthropometry

The work place
Workplace components. Work place stressors and work place risk factors

Environmental Ergonomics
Ergonomic consideration of thermal environment
Ergonomic consideration of visual environment
Ergonomic consideration of environmental noise
Workplace and workplace design
Anthropometric principles in workplace design
Design principles for sitting and standing work

Ergonomic principles of load handling
Fundamentals of manual material handling
Different categories of movement in manual load handling
Ergonomic principles of safe load handling

Musculoskeletal Disorders
Basic idea about the role of skeletal system in movement, categories of joints, role of muscles, soft tissues and bones in movement
Risk factors for musculoskeletal disorders
Different types of musculoskeletal disorders
Evaluation of musculoskeletal disorders by questionnaire technique
Basic concept of OWAS method of work posture analysis.

Ergonomic intervention
Ergonomic principles of reducing work place stressors and improving work efficiency

DSE A3P
1. Determination of heat stress by WBGT indices
2. Assessment of illumination
3. Basic anthropometric measurements
4. Determination of range of motion by goniometer and strength by hand grip dynamometer
5. Assessment of prevalence of musculoskeletal disorder by questionnaire method

Suggested Readings
1. Fitting the task to the man: A textbook of Occupational Ergonomics. KHE Kroemer and E Grandjean. Taylor and Francis.
6. Introduction to Ergonomics, R.S. Bridger, Routledge : Taylor & Francis group

4. Community and Public Health (DSE A 4TH)
Basic idea about community, public health issues.
Malnutrition in a community, over nutrition and possible remedial measures.
Diet management of obese, diabetic, hypertensive individuals and athletes.
Iron and iodine deficiency.
Population problem – principles and methods of family planning. Problem of infertility and Assisted Reproductive Technologies. PCM -- Marasmus, Kwashiorkor, Marasmic Kwashiorkor, endemic goiter, nutritional anemias, rickets, osteomalacia, xerophthalmia, beriberi and their social implications. Principles and social importance of
immunization against diseases. Etiology, epidemiology and prevention -- Communicable
diseases: Cholera, Malaria, Swine flu, Japanese Encephalitis, Rabies, Dengue, Hepatitis
and AIDS; Non-communicable diseases – Hypertension and Obesity.

DSE A4P

1. Calculation of Body Surface Area (using nomogram), Body Mass Index and Ponderal
Index from anthropometric measurements.

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.

Suggested Readings

1. Park’s Textbook of Preventive and Social Medicine, K.Park, M/s. Banarasidas Bhanot, 2015.
2. Communicable Disease Control Handbook, Jeremy Hawker et.al, Blackwell Publishing

Group B

1. Work, Exercise and Sports Physiology (DSE B1TH)

   □ Introduction to work physiology

   Definitions in work and exercise Physiology,
   Fundamental concepts of work; work characteristics, work cycle and work pauses
   Different categories of work
   Different approaches to describe work and work load.

   Physiological basis of work

   Physiology of muscle action
   Physical work load; Static and dynamic work
   Physiological responses to static and dynamic work
   Relationship between oxygen consumption and heart rate
   Effect of heat stress on physiological responses to work load

   Work load assessment

   Physiological assessment of work load, work load classification, cardiovascular and
   respiratory indices for evaluating work load. acceptable work load.

   Work Organization

   Fundamental concept of work organization
Principles of reducing stress from physical work load

Exercise and Physical fitness

Exercise, physical activity and physical fitness. Benefits of exercise Components of fitness and their evaluation

Physical Working Capacity

Concept of maximal physical working capacity VO2 max, and its estimation by different methods. Factors affecting VO2max. Step test, bicycle ergometry and treadmill exercise for assessment of Physical working capacity.

Bioenergetics

Work power and energy, sources of energy. Aerobic and anaerobic capacity, EPOC, lactate threshold and lactate tolerance and their limitations. Determination of energy cost by direct and indirect methods

Athletic performance based on aerobic capacity and O₂ debt

Training Principles

Training principles, different training methods. Training principles for different sports activities. Over training and detraining and their physiological effects. Ergogenic aids.

Body composition

Determination of Physical growth status. Methodologies for body composition analysis.

DSE B1P

1. Determination of BMI, BSA, PI, waist hip ratio, body fat percentage and body type
2. Determination of VO₂ max by Queen’s College Test and physical fitness by modified Harvard step test
3. Determination of agility, flexibility and anaerobic power by shuttle run, sit and reach and vertical jump test
4. Recording of heart rate and blood pressure during static and dynamic work, determination of workload from heart rate and cardiac indices and classification of work load.

Suggested Readings

5. Fox's Physiological Basis for Exercise and Sport by M. L. Foss. S. J. Keteyian, E. L. Fox, William C Brown Pub
6. The Physiology of Work, K. Rodahl, Taylor & Francis,
2. Advanced Molecular Biology (DSE B2TH)

Repetitive DNA, interrupted genes, gene families, transposons.
Cell-cell communication and quorum sensing in bacteria.
Molecular basis of apoptosis in brief.
Protein sequencing methods, detection of post translation modification of proteins. DNA sequencing methods. Molecular markers in genome analysis. Methods for analysis of gene expression at RNA and protein level, large scale expression, such as Micro array based techniques . RFLP, RAPD and AFLP techniques.Gene Knockout.Point mutations and deletions. Methods for detection of molecules in living cells, in situ localization by techniques such as FISH and GISH.Genomic medicine. Genetic counselling. Outline of ChIP technique.

DSE B2P
1. SDS-PAGE of proteins.
2. Isolation of DNA from animal cells.
3. Estimation of RNA by Orcinol method.

Suggested Readings

3. Chronobiology and Stress Physiology (DSE B3TH)
Different types of physiological rhythms – ultradian, circadian, infradian. Different zeitgebers and their relation with circadian clock.
Hormonal biorhythms and their significance: adrenocortical, pineal and prolactin.
Neural basis of biological clock and role of suprachiasmatic nuclei.
Sleep-wakefulness cycle.
Body temperature rhythm.
Time keeping genes.
Jet-lag and shift work.
Role of Hypothalamic-Pituitary-Adrenal Axis and Sympathoadrenal Medullary Axes in coping stress.
Effects of chronic stress: Immunological, Cardiovascular Disease, Emotional.


DSE3P
1. Project work on assessment of individual differences in human circadian rhythms (chronotype in human population) by questionnaire method among school children and college students.
2. Assessment of environmental heat load.
3. Assessment of noise level using noise level meter.
4. Determination of diurnal and /or circalunar rhythm of body temperature of college going students.

Suggested Readings
3. Biological Rhythms, Vinod Kumar, Narosa Publishers
5. Physiology of Stress, Hans Selye, Jones and Bartlett Publishers

4. Toxicology and Pharmacology (DSE B4TH)

Toxins and Toxicology Factors Affecting toxicity.
LD$_{50}$, LOD$_{50}$, ED$_{50}$, NOEL, LOEL
Concepts of Biomagnification and Bioconcentration
Adrenergic stimulants : Amphetamine and ephedrine. $\alpha$- adrenergic stimulants – Methaxomine and clonidine. $\beta$- adrenergic stimulants – Metaproterenol and salbutamol.
DSE B4P
Kymographic recording of the effects of atropine and propranolol on the perfused heart of a toad.

Suggested Readings
1. Goodman and Gilman’s The Pharmacological basis of Therapeutics, McGraw-Hill.
2. Basic and Clinical Pharmacology by E.G Katzung. Appleton sand Lange.
3. Textbook of Pharmacology by Seth and Seth Elsevier.

Skill Enhancement Course (SEC)

SEC-A (One course in Semester 3)

1. Hematological Techniques
2. Clinical Biochemistry

SEC-B (One course in Semester 4)

1. Detection of Food Additives /Adulterants and Xenobiotics
2. Bioinformatics

SEC-A

1. Haematological techniques


Suggested Readings:
1. Wintrobe’s- Clinical Haematology By J. P. Greer et.al., Wolters Kluwers
2. William’s Haematology By E. Deutler et. Al., McGrawhill
3. **Clinical Biochemistry**

Pathophysiological significance of the following blood constituents: glucose, serum protein, albumin, urea, creatinine, uric acid, bilirubin and ketone bodies. Lipid and thyroid profile in health and disease. Pathophysiological significance of the following serum enzymes and proteins: Lactate dehydrogenase, Creatine kinase, Amylase, Acid and Alkaline phosphatases, β-glucuronidase, Alanine and Aspartate Transaminases, Lipase, γ-glutamyl transpeptidase, Regan Isoenzyme, Cardiac Troponins.

Suggested Readings:

2. Text Book of Medical Biochemistry By M.N.Chatterjea and Rana Shinde, Jaypee.

**SEC-B**

1. **Detection of Food Additives /Adulterants and Xenobiotics**

Definition, examples and health hazards of food additives/adulterants. Tests for identifying Food Adulterants in food samples and their pathophysiological effects: Metanil yellow, Rhodamin B, Saccharin, Monosodium glutamate, Aluminium foil, Chicory, Bisphenol A and Bisphenol S, Margarine, Lead, Arsenic, Mercury, Polychlorinated Biphenyls, Dioxin and Urea.

Concept of Xenobiotics- Types, sources and fate. Types of reactions in detoxification and their mechanisms- oxidation, reduction, hydrolysis and conjugation.

Suggested Readings:

1. Harper’s Illustrated Biochemistry By V.W.Rodwell et.al., McGrawhill
2. Text Book of Medical Biochemistry By M.N.Chatterjea and Rana Shinde., Jaypee

2. **Bioinformatics**


Suggested Readings:

University of Calcutta

PHYSIOLOGY (GENERAL) SYLLABUS FOR CBCS

CORE COURSES(CC) / GENERIC ELECTIVE (GEN)

Semester 1
CC-1 / GEN 1
Cellular Basis of Physiology and Genetics
Biophysical Principles, Enzymes and Chemistry of Bio-molecules
Digestion, Absorption & Metabolism

Semester 2
CC-2 / GEN 2
Blood and Body Fluids
Cardiovascular System
Respiratory System

Semester 3
CC-3 / GEN 3
Nerve-muscle Physiology
Nervous System
Special Senses

Semester 4
CC-4 / GEN 4
Endocrinology
Reproductive Function
Excretory Physiology
Discipline Specific Electives (DSE)

DSE -- A (ONE course in Semester 5)

1. Biostatistics
2. Haematology

DSE - B (ONE course in Semester 6)

1. Work, Exercise and Sports Physiology
2. Human Nutrition and Dietetics

Ability Enhancement Compulsory Courses (AECC)

AECC- 1: Communicative English or any other Modern Indian Language in Semester 1
AECC-2: Environmental Studies in Semester 2

Skill Enhancement Course (SEC)

SEC -- A (ONE course in Semester 3)

1. Microbiology & Immunology
2. Clinical Biochemistry

SEC -- B (ONE course in Semester 4)

1. Detection of Food Additives /Adulterants and Xenobiotics
2. Community health and formulation of diet charts.
Outline of Courses and Credits in Each Semester

Semester I

Core Courses (CC). Theoretical (TH)

CC1TH / GEN 1 TH
Cellular Basis of Physiology
Structure and functions of plasma membrane, nucleus and different cell organelles – Endoplasmic reticulum, Golgi bodies, Mitochondria, Lysosome and Peroxisome.

Biophysical Principles, Enzymes and Chemistry of Bio-molecules
Physiological importance of the following physical processes: Diffusion, Osmosis and Surface tension. pH and Buffers – Significance in human body and maintenance of pH in the blood. Colloids - Classification and physiological importance.

Enzymes: Classification, factors affecting enzyme action. Concept of coenzymes and isozymes.


Nucleic acids: Structure of DNA and RNA.

Digestion & Metabolism
Glycolysis, TCA cycle, Importance of Glycogenesis, Glycogenolysis and Gluconeogenesis. Beta oxidation of saturated fatty acid. Importance of Ketone bodies. Deamination & Transamination. Formation of urea. (4)

**CC1P / GEN 1P:**

Examination and staining of fresh tissues: Squamous, Ciliated and Columnar Epithelium by Methylene Blue stain.
Qualitative tests for identification of: Glucose, Fructose, Lactose, Sucrose, Starch, Dextrin, Lactic acid, Hydrochloric acid, Albumin, Acetone, Glycerol and Bile Salts.
Quantitative estimation of amino nitrogen by Sorensen’s formol titration method (percentage to be done) (2)

**Semester II**

**CC2TH / GEN 2TH**-

**Blood and Body Fluids**


**Cardiovascular System**


**Respiratory System**


**CC2P GEN 2P:**

Preparation and staining of human blood film with Leishman’s stain and identification of different types of blood cells. Preparation of hemin crystals. Demonstration- kymographic recording of the unperfused heart of toad and effects of warm and cold saline.
Measurement of systolic and diastolic pressure by sphygmomanometer and determination of pulse and mean pressure.
Measurement of peak expiratory flow rate.
Pneumographic recording of normal respiratory movements and effects of hyperventilation and breath-holding. (2)

Semester III

CC3TH / GEN 3TH

Nerve-muscle Physiology

Different types of muscle and their structure. Red and white muscle. Muscular contraction: structural, mechanical and chemical changes in skeletal muscle during contraction and relaxation. Isotonic and isometric contractions. Properties of muscle: all or none law, beneficial effect, summation, refractory period, tetanus, fatigue.

Nervous System

Special Senses

**Audition:** Structure of ear, auditory pathway, mechanism of hearing.


**CC3P / GEN 3P:**
- Silver Nitrate preparation of nodes of Ranvier.
- Silver nitrate preparation of corneal cell space.
- Examination and staining of skeletal and cardiac muscles by Methylene Blue stain.
- Demonstration: Use of kymograph, induction coil and mercury key. Recording of simple muscle curve with sciatic-gastrocnemius muscle preparation of toad.
- Determination of visual acuity by Snellen's chart / Landolt's C chart.
- Determination of colour blindness by Ishihara chart.
- Exploration of conductive and perceptive deafness by tuning fork method. (2)

**Semester IV**

**CC4TH / GEN 4TH**

**Endocrinology**
- Hormones - classification. Elementary idea of mechanism of hormone action.

*Hypothalamus:* Basic concept of neurohormone.
-Hypothalamo-hypophyseal tract and portal system.

*Pituitary:* Histological structure, hormones, functions. Hypo and hyper active states of pituitary gland.

*Thyroid:* Histological structure. Functions of thyroid hormones ($T_4$, $T_3$).

*Parathyroid:* Histological structure, functions of parathyroid hormone. Tetany.

*Adrenal Cortex:* Histological structure and functions of different hormones.

*Adrenal Medulla:* Histological structure and functions of medullary hormones. The relation of adrenal medulla with the sympathetic nervous system.

Brief idea of the origin and functions of renin-angiotensin, prostaglandins, erythropoietin and melatonin. Elementary idea of gastrointestinal hormone.

Reproductive Physiology
Primary and accessory sex organs and secondary sex characters.
Testis: histology, spermatogenesis, testicular hormones and their functions.
Ovary: histology, oogenesis, ovarian hormones and their functions.
Menstrual cycle and its hormonal control.

Excretory Physiology

Structure and functions of skin. Insensible and sensible perspiration Regulation of body temperature — physical and physiological processes involved in it. Physiology of sweat secretion and its regulation.

CC4P / GEN 4P:
Study and Identification of Stained Sections of Different Mammalian Tissues and Organs: Esophagus, Stomach, Small Intestine, Large Intestine, Liver, Lung, Trachea, Spinal cord, Cerebral cortex, Cerebellum, Thyroid Gland, Adrenal Gland, Pancreas, Spleen, Testes, Ovary, Kidney, Artery and Vein.
Identification of:
Normal constituents of urine: Chloride, Sulphate, Phosphate, Creatinine and Urea;
Abnormal constituents of urine: Glucose, Protein, Acetone, Bile pigment and Bile Salt.

Suggested Readings
7. Snatok Sharirbidya, A. Bandopadhyay, Calcutta Book House.
8. diFiore’s Atlas of Histology, V. P. Eroschenko, Wolters-Kluwer
10. Text Book of Medical Physiology, A. C. Guyton, W. B. Saunders Co.
12. Textbook of Medical Physiology, Indu Khurana, Elsevier
Discipline Specific Electives

DSE: GROUP-A

Biological Statistics (DSE A1TH)

Basic concepts— Variable, population, parameter, sample, statistic. Classification of data – qualitative and quantitative, continuous and discontinuous. Presentation of data–frequency distribution, bar diagram, pie diagram, frequency polygon and histogram.

Mean, median, mode, standard deviation and standard error of ungrouped data. Concept of probability, Null and Alternate Hypotheses, Characteristics and uses of Normal and t-distributions. (4)

DSE A1P

Computation of mean, median, mode, standard deviation and standard error of the mean using physiological data like body temperature, pulse rate, respiratory rate, height and weight of human subjects. Graphical representation of data in bar diagram, pie diagram frequency polygon and histogram. (2)

Suggested Readings

Haematology (DSE A2TH):

DSE A2P:
DC of WBC, Estimation of haemoglobin, Blood group determination, Bleeding time and Clotting time. (2)

Suggested Readings
2. Text Book of Medical Biochemistry By M.N.Chatterjea and Rana Shinde., Jaypee

DSE: GROUP - B

Work & Exercise Physiology and Ergonomics (DSE B1TH)

DSE B1P
Measurement of resting and working heart rate using thirty beats and ten beats methods respectively.
Measurement of blood pressure before and after exercise.
Determination of Physical Fitness Index by modified Harvard Step Test.
Measurement of some common anthropometric parameters- stature, weight, eye height (standing), shoulder height, sitting height, knee height (sitting), arm reach from wall, mid-arm circumference, waist circumference, hip circumference, neck circumference, head circumference, chest circumference.
Calculation of BSA and BMI from anthropometric data. (2)

Suggested Readings

Human nutrition and dietetics (DSE B2TH):

DSE B2P:

Diet survey report (hand-written) of a family (as per ICMR specification): Each student has to submit a report on his/her own family. (2)

Suggested Readings
2. Biochemistry, U. Satyanarayan, NCBA

Ability Enhancement Compulsory Courses (AECC)

English / MIL Communication (AECC 1TH):
Environmental Science (AECC 2TH)

Skill Enhancement Course (SEC)

SEC A

Microbiology & Immunology (SECA1)

Beneficial and harmful microorganisms in food.
Elementary knowledge of innate and acquired immunity. Humoral and cell mediated immunity. Toxins and toxoids. Vaccination – Passive and active immunisation, types and uses of vaccine. Immunological basis of allergy and inflammation. (2)

Suggested readings:
1. Microbiology, Pelczar Tata McGrawhill.

Clinical Biochemistry (SEC A2)

Pathophysiological significance of the following blood constituents: glucose, serum protein, albumin, urea, creatinine, uric acid, bilirubin and ketone bodies. Lipid profile in health and diseases. Pathophysiological significance of the following serum enzymes and isozymes: Lactate dehydrogenase, Creatine kinase, Amylase, Acid and Alkaline phosphatases, β-glucuronidase SGPT and SGOT. (2)

SEC B

Detection of Food Additives / Adulterants & Xenobiotics (SEC B1):

Definition of food adulterants/additive. Tests for identifying food adulterants-- Metanil yellow, Rhodamin B, Saccharin, Monosodium glutamate, Aluminium foil, Dioxin, Chicory and Bisphenol.
Concept of Xenobiotics- Types, sources and fate. Types of reactions in detoxification and their mechanisms- oxidation, reduction, hydrolysis and conjugation. (2)

Suggested Readings:
1. Harpers Illustrated Biochemistry By V.W.Rodwell et.al., McGrawhill
2. Text Book of Medical Biochemistry By M.N.Chatterjea and Rana Shinde., Jaypee

Community and Public Health (SEC B2)

Basic idea about community, public health issues. Malnutrition in a community, over nutrition and possible remedial measures. Diet management of obese, diabetic.
Basic idea of PCM and their prevention.
PCM – Marasmus, kwashiorkor. Endemic goiter, rickets, osteomalacia, xerophthalmia, beriberi and their social implications. Etiology, epidemiology and prevention of:
Communicable diseases: Malaria, Dengue, Hepatitis and AIDS; Non-communicable diseases – Hypertension and Obesity.
Principles of formulation of diet chart of growing children, pregnant & lactating women and diabetic patients. 

Suggested Reading

1. Park’s Textbook of Preventive and Social Medicine, K.Park, M/s. Banarasidas Bhanot, 2015.