GENERAL INSTRUCTIONS AND COURSE CURRICULUM

FOR
CHOICE BASED CREDIT SYSTEM  
(CBCS-ANNUAL)

FOR

B.Sc. (HONS.)  
BIOCHEMISTRY

(EFFECTIVE FROM JULY, 2018)

DEPARTMENT OF BIOTECHNOLOGY  
HIMACHAL PRADESH UNIVERSITY,  
SUMMER HILL, SHIMLA-171005.
### SCHEME FOR CHOICE BASED CREDIT SYSTEM FOR B.Sc. HONOURS BIOCHEMISTRY

<table>
<thead>
<tr>
<th>Years</th>
<th>CORE COURSE (12)</th>
<th>Credits</th>
<th>Ability Enhancement Compulsory Course (AECC), (2)</th>
<th>Credits</th>
<th>Skill Enhancement Course (SEC), (4)</th>
<th>Credits</th>
<th>Discipline Specific Elective: (DSE), (6)</th>
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<td>BIOCHEM1C01TH</td>
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<td>III</td>
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<td>Any2 SEC Subjects in year III</td>
<td>8</td>
<td>Any 8 DSE Subjects in III year from the list (Theory=4 &amp; Practical=2)</td>
<td>48</td>
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</table>

Core Course Total Credits = 72  
AECC Total Credits = 8  
SE Total Credits = 20  
Discipline Specific Total Credits = 48

Total Credits: 72+8+20+48 = 148  
TH: Theory  
PR : Practical  
C: Core Courses; AECC: Ability Enhancement Compulsory Course; SEC: Skill Enhancement Courses; DSE: Discipline Specific Elective
Structure of B.Sc. (Hons) Biochemistry under CBCS

Core Course

BIOCHEM1C01: Molecules of Life
BIOCHEM1C02: Cell Biology
BIOCHEM1C03: Proteins
BIOCHEM1C04: Enzymes
BIOCHEM1C05: Biochemistry of Cell
BIOCHEM1C06: Intermediary Metabolism

BIOCHEM2C07: Metabolism of Carbohydrates and Lipids
BIOCHEM2C08: Membrane Biology and Bioenergetics
BIOCHEM2C09: Metabolism of Amino Acids and Nucleotides
BIOCHEM2C10: Human Physiology
BIOCHEM2C11: Gene Organization, Replication and Repair
BIOCHEM2C12: Hormone: Biochemistry and Function

Skill Enhancement Elective Course
(Any 3 SEC Subject in IInd year and any 2 SEC subjects in IIIrd year from the list)

II Year (any 3 subjects)
BIOCHEM2SEC01: Tools and Techniques in Biochemistry
BIOCHEM2SEC02: Protein Purification Techniques
BIOCHEM2SEC03: Clinical Biochemistry
BIOCHEM2SEC04: Research Methodology

IIIrd year (any 2 subjects)
BIOCHEM3SEC05: Bioinformatics
BIOCHEM3SEC06: Recombinant DNA Technology
BIOCHEM3SEC07: Basics of forensic science

Discipline Specific Elective
(Any 8 DSE Subjects in IIIrd year from the list)

BIOCHEM3DSE01: Concepts in Genetics
BIOCHEM3DSE02: Immunology
BIOCHEM3DSE03: Nutritional Biochemistry
BIOCHEM3DSE04: Basic Microbiology
BIOCHEM3DSE05: Molecular basis of non-infectious human diseases
BIOCHEM3DSE06: Molecular basis of infectious diseases
BIOCHEM3DSE07: Gene Expression and Regulation
BIOCHEM3DSE08: Advanced cell biology
BIOCHEM3DSE09: Plant Biochemistry
BIOCHEM3DSE10: Developmental Biology
BIOCHEM3DSE11: Genetic Engineering and Biotechnology

Ability Enhancement Compulsory Course

ENGL103: English Communication
ENVS1AECC02: Environment Science

CHOICE BASED CREDIT SYSTEM

B.Sc. (Hons.) Biochemistry

<table>
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<tr>
<th></th>
<th>IInd Year</th>
<th>IIIrd year</th>
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<tr>
<td>IInd Year</td>
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<tr>
<td>BIOCHEM1C01</td>
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<td>Human Physiology</td>
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</table>

C : Core Courses
AECC : Ability Enhancement Compulsory Course
SEC : Skill Enhancement Courses
DSE : Discipline Specific Elective
I. The B.Sc. (Honors) Biochemistry will be of three years duration Choice Based Credit System [CBCS] course.

II. There will be broadly three types of courses for B.Sc. (Honors) Biochemistry degree program.

1. The Core Courses (12 courses for honors; and 8 discipline specific papers) will be of 6- credits each including 2 credits assigned to the practical component. Thus a candidate will have to pass 12 courses for earning 12 X 6 = 72 credits during three years. Each of the 6-credits courses will carry 100 marks. These 100 marks will be split into marks assigned for Theory [TH]: 50 marks; Practical [PR]: 20 marks and Internal Assessment [IA]: 30. The Internal Assessment [30 marks] will include one Multi Choice Questions (MCQ)-based examination of 10 marks, Classroom Attendance Incentive marks (5 marks), Presentation/Assignment of 5 marks and Lab Seminar/Lab Assignment of 10 marks. The Lab-based practical will be of 2-hours [One credit]. A total of 12 X 6 = 72 credits could be accumulated under these courses during the Honors degree program.

2. The Elective Courses will be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of study or which provides an extended scope or which enables an exposure to some other discipline/ subject/ domain or nurtures the candidate’s proficiency / skill. The Elective Courses will include;
   - Discipline Specific Elective [DSE] Courses: A total of 8 courses offered under the main discipline/ subject of study is referred to as Discipline Specific Elective. These courses are discipline related and/ or interdisciplinary in nature. A total of 8 X 6 = 48 credits could be accumulated under DSE courses during the Honors degree program.

3. Ability Enhancement Compulsory Courses [AECC]: Ability Enhancement Courses are of two types; Ability Enhancement Compulsory Courses [AECC] and Skill Enhancement Courses [SEC]. A total of 7 X 4 = 28 credits could be accumulated under these courses during the Honors degree program i.e. 2 X 4 = 8 credits for AECC, and 5 X 4 = 20 credits for SEC courses.

   The AECC courses are the mandatory courses based upon the content that leads to knowledge enhancement; i. Environment Science and ii. English/ Hindi/ MIL Communication. All these are mandatory courses for obtaining a B.Sc. (Honors) degree in the concerned subject. These courses are mandatory for all disciplines. SEC courses are value-based and/ or skill-based and are aimed at providing hands-on-training, competencies, skills etc. A minimum of four such courses for obtaining an Honors degree are selected amongst the courses designed to provide value-based and/ or skill-based knowledge and may contain both theory and lab/ hands-on training. The main purpose of these courses is to provide students life-skills in hands-on mode so as to increase their employability.

III. Practical [PR] component has been included in every core and discipline specific elective paper. The list of practicals to be conducted by the candidates has been provided alongside each of such courses. The marks (20 marks) for the practical examination will be split as follows;

   - Write up of Practical : 4 marks
   - Performance of practicals : 7 marks
   - Practical record/ notebook : 3 marks
   - Viva voce : 6 marks
IV. **Classroom Attendance Incentive:** Those candidates who have greater than 75% attendance (for those participating in Co-curricular activities, 25% will be added to per cent attendance) will be awarded CAI marks as follows:

- $\geq 75\%$ but $< 80\%$ 1 marks
- $\geq 80\%$ but $< 85\%$ 2 marks
- $\geq 85\%$ but $< 90\%$ 3 marks
- $\geq 90\%$ but $< 95\%$ 4 marks
- $\geq 95\%$ to 100% 5 marks

V. The candidate has to secure minimum pass marks individually in Theory paper, Practical as well as Internal Assessment to earn full credits in the concerned course. A candidate thus failing in any of these components shall be considered failed in that course.

VI. The admission to B.Sc. (Honors) Biochemistry programme of Himachal Pradesh University will be as per guidelines of Himachal Pradesh University, Shimla from time to time.

i. The candidate should have passed 10+2 (class XII) Examination or its equivalent from a recognized Board/ University with any of the three subjects out of Physics, Chemistry and Biology or any other science subject with 50% or equivalent grade (for SC/ ST candidates marks of eligibility will be 45% or equivalent grade).

ii. In case of candidates who are studying in University/Board/College/Schools in any of the foreign countries the eligibility/Qualifying marks will be the same as recognized/equivalent to 10+2 by the University or the association of the Indian University with 50% marks of equivalent grade (for SC/ ST candidates, eligibility will be 45% marks or equivalent grade).

iii. The candidate who has appeared in the qualifying examination but whose result has so far not been declared can also apply but his/her eligibility for the entrance test will be purely provisional subject to the condition that he/she has to produced a passing certificate scoring at least the minimum percentage of marks as prescribed for the qualifying examination on the day and the specified time of counseling.

The candidate shall not be more than 22 years of age as on 01st July of the year of admission. Date of birth as recorded in the Secondary Education Board/University Certificate Only will be considered as authentic.
B.Sc. (HONORS) BIOCHEMISTRY

(CBCS STRUCTURE)

CORE COURSES
COURSE- BIOCHEMICAL
MOLECULES OF LIFE

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 The foundations of biochemistry (4 Periods)
Cellular and chemical foundations of life. Water: Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment.

Unit 2 Carbohydrates and glycochemistry (16 Periods)

Unit 3 Lipids and vitamins (20 Periods)

Unit 4 Amino acids and nucleic acids (20 Periods)

PRACTICALS

1. Safety measures in laboratories.
2. Preparation of normal and molar solutions.
3. Preparation of buffers.
4. Determination of pKa of acetic acid and glycine.
5. Qualitative tests for carbohydrates, lipids, amino acids, proteins and nucleic acids.
7. Estimation of vitamin C.

SUGGESTED READINGS
COURSE- BIOCHEM1C02TH
CELL BIOLOGY

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction to cell biology (12 Periods)
Prokaryotic (archaea and eubacteria) and eukaryotic cell (animal and plant cells), cells as experimental models. Tools of cell biology: Light microscopy, phase contrast microscopy, fluorescence microscopy, confocal microscopy, electron microscopy, FACS. Centrifugation for subcellular fractionation.

Unit 2 Structure of different cell organelles (24 Periods)

Unit 3 Cell wall and extracellular matrix (14 Periods)

Unit 4 Cell cycle, cell death and cell renewal (10 Periods)

COURSE- BIOCHEM1C02PR
CELL BIOLOGY

PRACTICALS
1. Visualization of animal and plant cell by methylene blue.
2. Identification of different stages of mitosis in onion root tip.
3. Identification of different stages of meiosis in grasshopper testis.
4. Micrographs of different cell components (dry lab).
5. Sub-cellular fractionation.
6. Visualization of nuclear fraction by acetoarmine stain.
7. Staining and visualization of mitochondria by Janus green stain.

SUGGESTED READINGS
COURSE- BIOCHEM1C03TH

PROTEINS

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover the entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction to amino acids, peptides and proteins (14 Periods)

Unit 2 Extraction and characterization of proteins for downstream processing (28 Periods)

Unit 3 Protein folding and protein structure databases (6 Periods)

Unit 4 Myoglobin, haemoglobin and specialized proteins (12 Periods)
COURSE- BIOCHEM1C03PR
PROTEINS

PRACTICALS
1. Estimation of proteins using UV absorbance and Biuret method.
3. Isoelectric pH of casein.
5. Separation of albumin from serum using anion-exchange chromatography.
6. SDS-PAGE analysis of proteins.

SUGGESTED READINGS
COURSE- BIOCHEMIC04TH
ENZYMES

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction to enzymes (10 Periods)
Nature of enzymes - protein and non-protein (ribozyme). Cofactor and prosthetic group, apoenzyme, holoenzyme. IUBMB classification of enzymes. Factors affecting the rate of chemical reactions, collision theory, activation energy and transition state theory, catalysis, reaction rates and thermodynamics of reaction. Features of enzyme catalysis, catalytic power and specificity of enzymes (concept of active site), Fischer’s lock and key hypothesis, Koshland’s induced fit hypothesis.

Unit 2 Mechanism of action of enzymes and enzyme kinetics (20 Periods)

Unit 3 Regulation of enzyme activity (16 Periods)

Unit 4 Enzyme inhibition and Applications of enzymes (14 Periods)
Enzyme inhibition: Reversible inhibition (competitive, uncompetitive, non-competitive, mixed and substrate). Mechanism based inhibitors - antibiotics as inhibitors. Application of enzymes in diagnostics (SGPT, SGOT, creatine kinase, alkaline and acid phosphatases), enzyme immunoassay (HRPO), enzyme therapy (Streptokinase). Immobilized enzymes.

COURSE- BIOCHEMIC04PR
ENZYMES

PRACTICALS
1. Partial purification of acid phosphatase from germinating mung bean.
2. Assay of enzyme activity and specific activity, e.g. acid phosphatase.
3. Effect of pH on enzyme activity.
4. Determination of K_m and V_max using Lineweaver-Burk graph.
5. Enzyme inhibition - calculation of Ki for competitive inhibition.
6. Continuous assay of lactate dehydrogenase.
7. Coupled assay of glucose-6-phosphate dehydrogenase.

SUGGESTED READINGS
COURSE- BIOCHEM1C05TH
BIOCHEMISTRY OF CELL

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Biomolecules in their cellular environment, Amino acids and peptides (16 Periods)

Unit 2 Sugars and polysaccharides (10 Periods)
Basic chemistry of sugars, optical activity. Disaccharides, trisaccharides and polysaccharides - their distribution and biological role.

Unit 3 Nucleosides, nucleotides and nucleic acids (10 Periods)
Structures and chemistry, DNA structures and their importance, different types of RNA. Unusual DNA structures, other functions of nucleotides.

Unit 4 Lipids, Vitamins, coenzymes and metal ions and signalling molecules (24 Periods)
Various classes of lipids and their distribution, storage lipids, structural lipids in membranes, lipids as signals, cofactors and pigments. Occurrence and nutritional role. Coenzymes and their role in metabolism. Metal ion containing biomolecules - heme, porphyrins and cyanocobalamin; their biological significance. Second messengers - cAMP, cGMP, IP3, diacyl glycerol, Ca²⁺, NO. Brief account of their importance and role in signalling and signal transduction.

COURSE- BIOCHEM1C05PR
BIOCHEMISTRY OF CELL

PRACTICALS
2. Qualitative tests for biomolecules - carbohydrates, lipids, amino acids, proteins, bases and nucleic acids.
5. Estimation of ascorbic acid in fruit juices.

SUGGESTED READINGS
COURSE- BIOCHEMIC06TH
INTERMEDIARY METABOLISM

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/ units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Basic concepts and design of metabolism (8 Periods)
The nature of metabolism. Role of oxidation and reduction and coupling of these. ATP as energy currency.

Unit 2 Carbohydrate metabolism (18 Periods)

Unit 3 Photosynthesis, Calvin cycle and pentose phosphate pathway (16 Periods)
The light reaction, chlorophyll, accessory pigments, reaction centres, two photo systems, generation of proton gradient and NADPH, Calvin cycle, synthesis of glucose, starch, sucrose, regulation, C4 pathway. Pentose phosphate pathway, importance and regulation. Fatty acid synthesis and degradation: TAG as energy source, β oxidation of fatty acids in mitochondria and peroxisomes, ketone bodies. Biosynthesis of fatty acids - elongation and unsaturation of fatty acids. Regulation of fatty acid oxidation and synthesis.

Unit 4 Amino acid catabolism and anabolism (18 Periods)
Protein degradation to amino acids, urea cycle, feeder pathways into TCA cycle. Nitrogen fixation, synthesis of non-essential amino acids. Nucleotide metabolism: Biosynthesis - de novo and salvage pathways, regulation of nucleotide synthesis by feedback inhibition, degradation and excretion. Integration of metabolism: Brief role of hormones - catecholamines, insulin, glucagon; metabolic shifts to provide fuel to brain during fasting and starvation, role of cortisol in signalling stress - increase in gluconeogenesis and muscle protein breakdown.

COURSE- BIOCHEMIC06PR
INTERMEDIARY METABOLISM

PRACTICALS
1. Alcohol fermentation by yeast.
2. H2S production, indole production and ammonia production by bacteria.
3. Urea estimation.
4. Uric acid estimation.
5. Nitrogen fixation by cyanobacteria.

SUGGESTED READINGS
COURSE- BIOCHEM2C07TH
METABOLISM OF CARBOHYDRATES AND LIPIDS

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Basic design of metabolism (9 Periods)
Autotrophs, heterotrophs, metabolic pathways, catabolism, anabolism, ATP as energy currency, reducing power of the cell. Starve-feed cycle: Well-fed state, early fasting state, fasting state, early re-fed state, energy requirements, reserves and caloric homeostasis, five phases of glucose homeostasis.

Unit 2 Carbohydrate metabolism (26 Periods)

Unit 3 Fatty acid metabolism (12 Periods)
Digestion, mobilisation and transport of cholesterol and triacylglycerols, fatty acid transport to mitochondria, β oxidation of saturated, unsaturated, odd and even numbered and branched chain fatty acids, regulation of fatty acid oxidation, peroxisomal oxidation, ω oxidation, ketone bodies metabolism, ketoacidosis. Fatty acid synthase complex. Synthesis of saturated, unsaturated, odd and even chain fatty acids and regulation.

Unit 4 Biosynthesis of membrane lipids (13 Periods)

COURSE- BIOCHEM2C07PR
METABOLISM OF CARBOHYDRATES AND LIPIDS

PRACTICALS
1. Estimation of blood glucose.
2. Sugar fermentation of microorganisms.
3. Assay of salivary amylase.
4. Isolation of lecithin, identification by TLC, and its estimation.
5. Isolation of cholesterol from egg yolk and its estimation.

SUGGESTED READINGS
COURSE- BIOCHEM2C08TH
MEMBRANE BIOLOGY AND BIOENERGETICS

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction to biomembranes (16 Periods)

Unit 2 Membrane transport (16 Periods)

Unit 3 Introduction to bioenergetics (10 Periods)
Laws of thermodynamics, state functions, equilibrium constant, coupled reactions, energy charge, ATP cycle, phosphorylation potential, phosphoryl group transfers. Chemical basis of high standard energy of hydrolysis of ATP, other phosphorylated compounds and thioesters. Redox reactions, standard redox potentials and Nernst equation. Universal electron carriers.

Unit 4 Oxidative phosphorylation and photophosphorylation (18 Periods)
COURSE- BIOCHEM2C08PR
MEMBRANE BIOLOGY AND BIOENERGETICS

PRACTICALS

1. Effect of lipid composition on the permeability of a lipid monolayer.
2. Determination of CMC of detergents.
3. RBC ghost cell preparation and to study the effect of detergents on membranes.
4. Separation of photosynthetic pigments by TLC.
5. Isolation of mitochondria from liver and assay of marker enzyme SDH.
6. Study photosynthetic O2 evolution in hydrilla plant.
7. Isolation of chloroplast from spinach leaves, estimation of chlorophyll and photosynthetic activity.

SUGGESTED READINGS

COURSE- BIOCHEM2C09TH
METABOLISM OF AMINO ACIDS AND NUCLEOTIDES

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Overview of amino acid metabolism (18 Periods)

Unit 2 Biosynthesis of amino acids (16 Periods)

Unit 3 Metabolism of purine and pyrimidine nucleotides (20 Periods)

Unit 4 Integration of metabolism (6 Periods)
Integration of metabolic pathways (carbohydrate, lipid and amino acid metabolic pathways), tissue specific metabolism (brain, muscle, and liver).

COURSE- BIOCHEM2C09PR
METABOLISM OF AMINO ACIDS AND NUCLEOTIDES

PRACTICALS
1. Assay of serum transaminases – SGOT and SGPT.
2. Estimation of serum urea.
3. Estimation of serum uric acid.

SUGGESTED READINGS
COURSE- BIOCHEM2C10TH  
HUMAN PHYSIOLOGY

Year end examination: 50 marks  
Practical examination: 20 marks  
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics' units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Homeostasis and respiration (16 Periods) 

Unit 2 Cardiovascular and renal physiology (16 Periods) 

Unit 3 Gastrointestinal, hepatic physiology and Musculoskeletal system (10 Periods) 
Histology of the gastrointestinal tract. Propulsion and motility of food and digested material. Enteric reflexes, secretory functions of the gastrointestinal tract, digestion and absorption of macro and micronutrients. Peptic ulcer, Sprue, celiac disease, IBD, regurgitation, diarrhoea and constipation. Anatomy of the hepatic lobule and blood flow into the liver. Formation and secretion of bile. Enterohepatic cycle, reticuloendothelial system, metabolic importance of liver. Liver function tests. Jaundice, liver cirrhosis and fatty liver. Musculoskeletal system: Bone structure and formation. Physiology of muscle contraction in striated and non-striated muscle.

Unit 4 Reproductive physiology and Neurochemistry and neurophysiology (18 Periods) 
COURSE- BIOCHEM2C10PR
HUMAN PHYSIOLOGY

PRACTICALS
1. Hematology.
   a. RBC and WBC counting
   b. Differential leucocyte count.
   c. Clotting time.
2. Estimation of haemoglobin.
4. Determination of total iron binding capacity.
5. Pulmonary function tests, spirometry and measurement of blood pressure.
7. Histology of connective tissue, liver and brain permanent slides.
8. Case studies (Renal clearance, GFR, ECG).

SUGGESTED READINGS
**COURSE- BIOCHEM2C11TH**

**GENE ORGANIZATION, REPLICATION AND REPAIR**

Year end examination: 50 marks  
Practical examination: 20 marks  
Internal Assessment: 30 marks

**Note:** The Examiner will set a total of nine (9) questions covering all topics/ units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

**Unit 1 Structure of DNA, genes and genomic organization**  
(16 Periods)
DNA structure, features of the double helix, various forms of DNA, denaturation and reassociation of DNA. Genome sequence and chromosome diversity, definition of a gene, organization of genes in viruses, bacteria, animals and plants. Nucleosome structure and packaging of DNA into higher order structures.

**Unit 2 Replication of DNA**  
(20 Periods)
The chemistry of DNA synthesis, DNA polymerase, the replication fork, origin of replication, enzymes and proteins in DNA replication, various modes of replication, stages of replication of *E. coli* chromosome, relationship between replication and cell division, replication in eukaryotes. Comparison of replication in prokaryotes and eukaryotes. Inhibitors of DNA replication and applications in medicine. Supercoiling of DNA and its importance, topoisomerases, critical role of topoisomerases in cell, topoisomerase inhibitors and their application in medicine.

**Unit 3 Recombination and transposition of DNA**  
(12 Periods)
Homologous recombination, proteins and enzymes in recombination, site-specific recombination, serine and tyrosine recombinases, biological roles of site-specific recombination, transposition, three classes of transposable elements, importance of transposable elements in horizontal transfer of genes and evolution.

**Unit 4 Molecular basis of mutations and DNA repair**  
(12 Periods)

**CCOURSE- BIOCHEM2C11PR**

**GENE ORGANIZATION, REPLICATION AND REPAIR**

**PRACTICALS**

1. Verification of Chargaff’s rule by paper chromatography.
2. Ultraviolet absorption spectrum of DNA and RNA.
3. Determination of DNA and RNA concentration by A260nm.
4. Determination of the melting temperature and GC content of DNA.
5. To study the viscosity of DNA solutions.
6. Isolation of chromosomal DNA from *E. coli* cells.

**SUGGESTED READINGS**

COURSE- BIOCHEM2C12TH
HORMONE : BIOCHEMISTRY AND FUNCTION

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/ units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction to endocrinology (8 Periods)

Unit 2 Hormone mediated signaling (14 Periods)

Unit 3 Hypothalamic, pituitary and thyroid hormones (20 Periods)

Unit 4 Pancreatic, GI tract, adrenal and reproductive hormones (18 Periods)

COURSE- BIOCHEM2C12PR
HORMONE: BIOCHEMISTRY AND FUNCTION

PRACTICALS
1. Glucose tolerance test.
2. Estimation of serum Ca^{2+}.
4. HCG based pregnancy test.
5. Estimation of serum electrolytes.
6. Case studies.

SUGGESTED READINGS
B.Sc. (HONOURS) BIOCHEMISTRY (CBCS STRUCTURE)

SKILL ENHANCEMENT ELECTIVE COURSES
COURSE- BIOCHEM2SEC01TH
TOOLS AND TECHNIQUES IN BIOCHEMISTRY

Year end examination: 70 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/ units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing seven (7) short-answer type questions of 2 marks each that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Biochemical reagents and solutions (12 Periods)

Unit 2 pH and concept of Buffer (18 Periods)
Concept of a buffer, Henderson-Hasselbach equation, working of a pH meter, Preparation of a buffer of given pH and molarity such as acetate buffer, phosphate buffer, tris buffer, citrate buffer etc.

Unit 3 Spectrophotometric techniques (15 Periods)
Principle and instrumentation of UV-visible and fluorescence spectroscopy, Determination of the absorption maxima and molar extinction coefficient (of a relevant organic molecule). Determination of concentration of a protein solution by Lowry/BCA method and Bradford, and measurement of fluorescence spectrum using NAD/FAD/Vitamin B12 or FITC.

Unit 4 Introduction and importance of virtual labs in biochemistry (15 Periods)
Identification and classification of carbohydrates, acid-base titration of amino acid, isolation of protein from the natural sources, qualitative analysis of carbohydrate, iso-electric precipitation of protein: casein from milk, quantitative estimation of ninhydrin, estimation of saponification value of fats and oils, separation of aminoacids by TLC, detection of adulteration in milk, qualitative analysis of amino acid, estimation of iodine value of fats and oil, titration curve of amino acid, and detection of blood glucose by glucose estimation method.

SUGGESTED READINGS
4. Vlab.amrita.edu
COURSE - BIOCHEM2SEC02TH

PROTEIN PURIFICATION TECHNIQUES

Year end examination: 70 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing seven (7) short-answer type questions of 2 marks each that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Purification of a protein from a complex mixture (native or heterologously expressed) involving the following methods/technique (20 Periods)
Protein concentration (BSA, human serum) by using salting out, acetone or alcohol; dialysis, preparation of the sample, separation of protein by ion-exchange chromatography, gel filtration chromatography and affinity chromatography.

Unit 2 Characterization of a protein from a complex mixture (native or heterologously expressed) involving the following methods/techniques (10 Periods)
Electrophoresis: Native, reducing and non reducing SDS-PAGE; separation of serum proteins and bovine serum albumin.

Unit 3 Spectral analysis (10 Periods)
Wavelength scanning, absorption spectra of sodium azide, NADP, FAD, haemoglobin etc.

Unit 4 Protein; structure-function analysis (20 Periods)
Sequence to structure prediction and its understating, structure-function relationship. Introduction to molecular docking and concept of free energy.

SUGGESTED READINGS
COURSE- BIOCHEM2SEC03TH
CLINICAL BIOCHEMISTRY

Year end examination: 70 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing seven (7) short-answer type questions of 2 marks each that will cover entire course will be compulsary. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction
Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations. Collection of blood and storage; separation and storage of serum.

Unit 2 Evaluation of biochemical changes in diseases

Unit 3 Assessment of glucose metabolism in blood and lipid profile

Unit 4 Liver, renal function and cardiovascular tests for diseases and urine analysis
Use of urine strip / dipstick method for urine analysis. Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin. Estimation of bilirubin (direct and indirect), Quantitative determination of serum creatinine and urea, Estimation of creatine kinase MB.

SUGGESTED READINGS
COURSE- BIOCHEM2SEC04TH
RESEARCH METHODOLOGY

Year end examination: 70 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing seven (7) short-answer questions of 2 marks each that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction to research methodology (5 Periods)
Objectives and motivation in research.

Unit 2 Defining the research problem (8 Periods)
Selecting and defining a research problem, Reviewing and conducting literature search, developing a research plan.

Unit 3 Designing of experiment (12 Periods)
Different experimental designs – single and multifactorial design, making measurements and sources of error in measurements, Methods of data collection and record keeping.

Unit 4 Data processing and statistical analysis (35 Periods)
Processing operations, tabulation, and graphical representation, Statistics in research: Concepts of sample and population, Measure of central tendency, dispersion, asymmetry (skewness, kurtosis), Normal distribution (p-value), Statistical tests and hypothesis (Standard error, t-test, chi-square test), and regression analysis, Report writing, Writing a research paper - abstract, introduction, methodology, results and discussion. Based on the teaching above, each student will undertake the following exercises.

1. A teacher (adviser) who would guide the student will discuss with student and identify a topic of mutual interest.
2. The student will collect the literature, collate the information and write the same in the form of a term paper with proper incorporation of references using appropriate software such as EndNote.
3. The student will identify scope of research on the topic and will frame objectives to be addressed in the project through a work plan.
4. The student will write standard operating protocols (SOPs) and identify requirement for equipment and reagents.
5. Each student will be asked to make presentation about the project including literature available, objective sought and work plan including methodologies as described above.

SUGGESTED READINGS
COURSE- BIOCHEM3SEC05TH  
BIOINFORMATICS

Year end examination: 70 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing seven (7) short-answer type questions of 2 marks each that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction to bioinformatics (10 Periods)
Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - genomics, proteomics, computer aided drug design (structure based and ligand based approaches) and Systems Biology. Applications of bioinformatics.

Unit 2 Biological databases and data retrieval (20 Periods)
Introduction to biological databases - primary, secondary and composite databases, NCBI, nucleic acid databases (GenBank, EMBL, DDBJ, NDB), protein databases (PIR, Swiss-Prot, TrEMBL, PDB), metabolic pathway database (KEGG, EcoCyc, and MetaCyc), small molecule databases (PubChem, Drug Bank, ZINC, CSD). Structure viewers (RasMol, J mol), file formats; Sequence retrieval (protein and gene) from NCBI; Structure download (protein and DNA) from PDB; Molecular file formats - FASTA, GenBank, Genpept, GCG, CLUSTAL, Swiss-Prot, FIR; Molecular viewer by visualization software.

Unit 3 Sequence alignment and phylogenetic analysis (15 Periods)
Similarity, identity and homology. Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms, amino acid substitution matrices (PAM and BLOSUM), BLAST and CLUSTALW.
Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees - maximum parsimony, maximum likelihood and distance methods; BLAST suite of tools for pairwise alignment; Multiple sequence alignment using CLUSTALW; Generating phylogenetic tree using PHYLIP.

Unit 4 Protein structure prediction and Genome analysis (15 Periods)
Levels of protein structure. Protein tertiary structure prediction methods - homology modeling, fold recognition and ab-initio methods. Significance of Ramachandran map. Introduction to genomics, comparative and functional genomics, gene structure in prokaryotes and eukaryotes, gene prediction methods and tools. Primary sequence analyses (Protparam); Secondary structure prediction (GOR, nnPredict); Tertiary structure prediction (SWISS MODEL); Protein structure evaluation - Ramachandran map (PROCHECK); Gene prediction using GENSCAN and GLIMMER.

SUGGESTED READINGS
COURSE- BIOCHEM3SEC06TH
RECOMBINANT DNA TECHNOLOGY

Year end examination: 70 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing seven (7) short-answer type questions of 2 marks each that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Work flow for in silico cloning (5 Periods)

Unit 2 Preparation of media, antibiotic solution, culturing of *E. coli*, isolation of single colonies (15 Periods)
Preparation of LB broth and agar; Inoculation of medium; Preparation of glycerol stocks of bacterial strains; Obtaining isolated colonies by streak plate method; Preparation of stock solutions.

Unit 3 Overview of plasmid vectors: methods of isolation and characterization of plasmid by gel electrophoresis (20 Periods)
Isolation of plasmid by alkaline lysis method; Isolation of plasmid DNA using column chromatography (kit); Digestion of plasmid DNA with restriction enzymes and analysis of the fragments.

Unit 4 Cloning of a gene in a vector and functional analysis (20 Periods)
Polymerase chain reaction (parametric optimization, primer designing), ligation, introduction of DNA construct into host cells, selection of recombinants; Amplification of DNA segment/gene of interest by PCR; Purification of PCR product, digestion of insert and vector by restriction enzymes for directional cloning, purification of insert and digested vector by gel extraction; Ligation of vector and insert; Preparation of competent cells of *E. coli* DH5α and transformation with the ligation mixture; Functional selection of recombinants (blue/white selection and eGFP fluorescence.

SUGGESTED READINGS
Note: The Examiner will set a total of nine (9) questions covering all topics/ units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing seven (7) short-answer type questions of 2 marks each that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1     (15 Periods)
Introduction and principles of forensic science, forensic science laboratory and its organization and service, tools and techniques in forensic science, branches of forensic science, causes of crime, role of modus operandi in criminal investigation. Classification of injuries and their medico-legal aspects, method of assessing various types of deaths.

Unit 2     (15 Periods)
Classification of fire arms and explosives, introduction to internal, external and terminal ballistics, Chemical evidence for explosives. General and individual characteristics of handwriting, examination and comparison of handwritings and analysis of ink various samples.

Unit 3     (15 Periods)
Role of the toxicologist, significance of toxicological findings, Fundamental principles of fingerprinting, classification of fingerprints, development of finger print as science for personal identification,

Unit 4     (15 Periods)

SUUGESTED READINGS
3. Analytical Toxicology (1987), Tiwari S.N., Govt. of India Publications, New Delhi, (India).
B.Sc. (HONOURS) BIOCHEMISTRY
(CBCS STRUCTURE)

DISCIPLINE
SPECIFIC
ELECTIVE
COURSE- BIOCHEM3DSE01TH
CONCEPTS IN GENETICS

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction to model organisms and Mendelism (14 Periods)
Model organisms: Escherichia coli, Saccharomyces cerevisiae, Drosophila melanogaster, Caenorhabditis elegans, DaniorerioandArabidopsis thaliana, Basic principles of heredity. Laws of probability & binomial expansion, formulating and testing genetic hypothesis, chromosomal basis of Mendelism -Sutton and Boveri hypothesis with experimental evidences.

Unit 2 Extention of Mendelism (10 Periods)

Unit 3 Linkage, crossing over and mapping techniques (16 Periods)

Unit 4 Inheritance of complex traits & population genetics (20 Periods)
Inheritance of complex trait, analysis of quantitative traits, narrow and broad sense heritability, quantitative trait loci (QTL) and their identification. Hardy-Weinberg law, predicting allele and genotype frequencies and exceptions to Hardy-Weinberg principle. Evolutionary genetics: Molecular evolution - analysis of nucleotide and amino acid sequences, molecular phylogenies, homologous sequences, phenotypic evolution and speciation. The genetic control of development and sex determination: Model organism for genetic analysis, Drosophila development, maternal effect genes, morphogens and zygotic gene activity in development, sex chromosomes and sex determination, dosage compensation of X-linked genes. Organelle heredity and epigenetics: Extra nuclear inheritance, tests for organelle heredity and maternal effect, epigenetic mechanisms of transcriptional regulation & genomic imprinting.
PRACTICALS
1. Squash preparation of salivary glands of Dipteran larva to observe polytene chromosomes.
2. Induction of polyploidy in onion roots.
3. Smear technique to demonstrate sex chromatin in buccal epithelial cells.
4. Monohybrid crosses in Drosophila for studying autosomal and sex linked inheritance.
5. PTC testing in a population and calculation of allele and genotype frequencies.
6. Study of abnormal human karyotype and pedigrees (dry lab)
7. Conjugation in bacteria

SUGGESTED READINGS
COURSE- BIOCHEM3DSE02TH
IMMUNOLOGY

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/ units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Cells and organs of the immune system (14 Periods)
Hematopoiesis, cells of the immune system, primary and secondary lymphoid organs and tissues (MALT). Innate immunity and leukocyte extravasation: Anatomical barriers, cell types of innate immunity, soluble molecules and membrane associated receptors (PRR), connections between innate and adaptive immunity, cell adhesion molecules, chemokines, leukocyte extravasation, localized and systemic response. Antigens and haptons, factors that dictate immunogenicity, B and T cell epitopes.

Unit 2 Antibody structure and function (14 Periods)
Structure and distribution of classes and subclasses of immunoglobulins (Ig), Ig fold, effector functions of antibody, antigenic determinants on Ig and Ig super family, Generation of receptor diversity: Dreyer-Bennett hypothesis, multigene organization of Ig locus, mechanism of V region DNA rearrangement, ways of antibody diversification. Biology of the B lymphocyte: Antigen independent phase of B cell maturation and selection, humoral response – T-dependent and T-independent response, anatomical distribution of B cell populations.

Unit 3 Complement system, MHC complex and antigen presentation (20 Periods)
Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies. General organization and inheritance of MHC, structure, distribution and role of MHC class I and class II proteins, linkage disequilibrium, pathways of antigen processing and presentation. Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation. General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).

Unit 4 Tolerance, autoimmunity, hypersensitivity and transplantation immunology (12 Periods)
Organ specific and systemic autoimmune diseases, possible mechanisms of induction of autoimmunity, Gell and Coombs classification, IgE mediated (Type I) hypersensitivity, antibody mediated cytotoxic (Type II) hypersensitivity, immune complex mediated (type III) hypersensitivity and delayed type (Type IV) hypersensitivity. Transplantation immunology and vaccines: Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy and privileged sites. Vaccines - active and passive immunization, types of vaccines.

COURSE- BIOCHEM3DSE02PR
IMMUNOLOGY

PRACTICALS
1. Isolation of lymphocytes from blood and macrophages from peritoneal cavity or spleen.
2. Purification of immunoglobulins.
3. Assays based on precipitation reactions - Ouchterlony double diffusion (ODD) and Mancini radial immunodiffusion.
4. Assays based on agglutination reactions - Blood typing (active) & passive agglutination.
5. Enzyme linked immune-sorbent assay (ELISA).

SUGGESTED READINGS
Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction to nutrition and energy metabolism (14 Periods)

Unit 2 Dietary carbohydrates, lipids, proteins and health (20 Periods)

Unit 3 Fat and water soluble vitamins and minerals (16 Periods)

Unit 4 Nutritional status, food and drug interactions and nutraceuticals (10 Periods)
Anthropometric measurements; Z scores, BMI, skinfold, circumference ratios. Biochemical assessment; Basal metabolic panel, Comprehensive metabolic panel, CBC, Urine Analysis, Assessment of Anemia, ROS assessment, GTT and glycosylated Hb, Differential diagnosis of B12 and folate. Nutrient interactions affecting ADME of drugs, Alcohol and nutrient deficiency, Antidepressants, psychoactive drugs and nutrient interactions, Appetite changes with drug intakes and malnutrition. Food as medicine.
COURSE- BIOCHEM3DSE03PR
NUTRITIONAL BIOCHEMISTRY

PRACTICALS
2. Homocysteine estimation.
4. Anthropometric identifications for Kwashiorkor, Marasmus and Obesity.
5. Determination of oxidative stress: TBARS, antioxidant enzymes in hemolysate.
7. Bone densitometry /bone ultrasound test demonstration (visit to a nearby clinic)

SUGGESTED READINGS
Course- Basic Microbiology

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 History of development of microbiology (12 Periods)
Development of microbiology as a discipline, Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Role of microorganisms in fermentation, Germ theory of disease, Development of various microbiological techniques and golden era of microbiology, Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner

Unit 2 Diversity of microbe world (18 Periods)
Binomial Nomenclature, Whittaker’s five kingdom and Carl Woese’s three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms. General characteristics of different groups: acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.

Unit 3 Viruses and bacteria (14 Periods)
An introduction to viruses with special reference to the structure and replication of the following: Poxvirus, Poliovirus, HIV, T4 and λ phage, lytic and lysogenic cycles. An account of typical eubacteria, chlamydiae&rickettsiae (obligate intracellular parasites), mycoplasma, and archaeabacteria (extremophiles). Applications of bacteria in industry, environment and food.

Unit 4 Algae, fungi and protozoa (16 Periods)
History of phycology; General characteristics of algae including occurrence, thallus organization, algae cell ultra, structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Applications of Algae in agriculture, industry, environment and food. Historical developments in the field of Mycology, significant contributions of eminent mycologists. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra-structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction, sexual reproduction, heterokaryosis, heterothallism and parasaexual mechanism. Economic Importance of Fungi in Agriculture, environment, Industry, medicine, food, biodeterioration, mycotoxins. General characteristics with special reference to Amoeba. Scope of Microbiology.

Course- Basic Microbiology

Practicals
1. Microbiology Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter)
3. Preparation and sterilization of culture media for bacterial cultivation
4. Study of different shapes of bacteria, fungi, algae, protozoa using permanent slides/ pictographs
5. Staining of bacteria using Gram stain
6. Isolation of pure cultures of bacteria by streaking method.

Suggested Readings
COURSE- BIOCHEM3DSE05TH
MOLECULAR BASIS OF NON-INFECTIOUS HUMAN DISEASES

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Nutritional disorders
Overview of major and minor nutrient components in the diet. Balanced diet and the concept of RDA. Nutrient deficiencies: Kwashiorkor and Marasmus, Scurvy, beriberi, pellagra and B12 deficiency, Xerophthalmia and Night blindness, Vitamin D deficiency, Vitamin K deficiency. Discuss with relation to biochemical basis for symptoms.

Unit 2 Metabolic and lifestyle disorders
Obesity and eating disorders like Anorexia nervosa and Bulimia. Diabetes mellitus A metabolic syndrome and the relationship with hypertension, obesity, hypothyroidism and stress. Cardiovascular disorders and Atherosclerosis-defining the broad spectrum of ailments that fall in this category, understanding the factors that contribute to the syndrome, stages of disorder and the management of the condition. Irritable bowel syndrome- biochemistry behind the disorder and the influence of diet, stress and environment on the condition.

Unit 3 Multifactorial complex disorders and cancer
Understanding the definition of multifactorial diseases. Polygenic diseases and the relationship of environmental factors and genetic makeup in the onset of diseases. Cancer: characteristics of a transformed cell, causes and stages of Cancer, molecular basis for neoplastic growth and metastasis, Proto-oncogenes and tumor suppressor genes; Cancer causing mutations; Tumor viruses; Biochemical analysis of cancer; Molecular approaches to cancer treatment. Disorders of mood : Schizophrenia, dementia and anxiety disorders. Polycystic ovarian syndrome, Parkinson’s disease, ALS.

Unit 4 Diseases due to misfolded proteins and monogenic disease
Introduction to protein folding and proteosome removal of misfolded proteins; etiology and molecular basis for Alzheimer's, Prion diseases, Huntington's Chorea, sickle cell anemia, Thalassemia. Inborn errors in metabolism: PKU, Alkaptonuria, Maple syrup urine disease; Receptor and transport defects: Cystic fibrosis, Long QT syndrome, familial hypercholesterolemia, Achondroplasia. Hemoglobinopathies and clotting disorders.

COURSE- BIOCHEM3DSE05PR
MOLECULAR BASIS OF NON-INFECTIOUS HUMAN DISEASES

PRACTICALS
1. Anthropometric measurements for normal and high risk individuals and identifications for Kwashiorkor, Marasmus and Obesity
2. Estimation of homocysteine levels in serum
3. Estimation of glycosylated hemoglobin
4. Permanent slides for different types of cancer
5. Diagnostic profile for assessment of CVS and Diabetes mellitus using case studies.
6. Bone densitometry test demonstration (visit to a nearby clinic)

SUGGESTED READINGS
3. The World of the cell, 7th edition (2009)
COURSE-BIOCHEM3DSE06TH
MOLECULAR BASIS OF INFECTIOUS DISEASES

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Classification of infectious agents (12 Periods)

Unit 2 Overview of diseases caused by bacteria (18 Periods)

Unit 3 Overview of diseases caused by Viruses (12 Periods)
Detailed study of AIDS, history, causative agent, pathogenesis, Diagnostics, Drugs and inhibitors. Other viral diseases including hepatitis, influenza, rabies, chikungunya and polio.

Unit 4 Overview of diseases caused by Parasites and other organism (18 Periods)
Detailed study of Malaria, history, causative agents, Vectors, life cycle, Host parasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccine development. Other diseases including leishmaniasis, amoebiasis. Fungal diseases, General characteristics. Medical importance of major groups, pathogenesis, treatment.

COURSE- BIOCHEM3DSE06PR
MOLECULAR BASIS OF INFECTIOUS DISEASES

PRACTICALS
1. Permanent slides of pathogens. Mycobacterium tuberculosis, Leishmania, Plasmodium falciparum
2. WIDAL test
3. Gram staining
4. Acid fast staining 4. PCR based diagnosis
5. Dot Blot ELISA

SUGGESTED READINGS
3. Sherris Medical Microbiology: An Introduction to Infectious Diseases by Kenneth J. Ryan, C. George Ray, Publisher: McGraw-Hill
4. Medical Microbiology by Patrick R. Murray, Ken S. Rosenthal, Michael A. Pfaller, Elsevier Health Sciences
COURSE- BIOCHEM3DSE07TH
GENE EXPRESSION AND REGULATION

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/ units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Biosynthesis of RNA in prokaryotes and eukaryotes (16 Periods)
RNA polymerases, transcription cycle in bacteria, sigma factor, bacterial promoters, identification of DNA binding sites by DNA footprinting, the three stages of RNA synthesis, initiation, elongation and termination, rho-dependent and rho-independent termination. Inhibitors of transcription and applications as anti-microbial drugs. Biosynthesis of RNA in eukaryotes: Comparison between prokaryotic and eukaryotic transcription. Transcription by RNA polymerase II, RNA polymerase II core promoters, general transcription factors, various types of RNA processing, transcription by RNA polymerase I and III. Inhibitors of eukaryotic transcription and their applications. Comparison of fidelity of transcription and replication.

Unit 2 RNA splicing and genetic code (10 Periods)
Chemistry of RNA splicing, the spliceosome machinery, splicing pathways, group I and group II introns, alternative splicing, exon shuffling, RNA editing. The genetic code: Degeneracy of the genetic code, wobble in the anticodon, features of the genetic code, nearly universal code.

Unit 3 Biosynthesis of proteins and protein targeting (16 Periods)
Messenger RNA, transfer RNA, attachment of amino acids to tRNA, the ribosome - initiation, elongation and termination of translation, regulation of translation. Comparison of prokaryotic and eukaryotic protein synthesis. Use of antibiotics in understanding protein synthesis and applications in medicine. Protein targeting and degradation. Post translational modifications, glycosylation, signal sequences for nuclear transport, bacterial signal sequences, import of proteins by receptor mediated endocytosis, specialized systems for protein degradation.

Unit 4 Regulation of gene expression in prokaryotes and eukaryotes (18 Periods)
Principles of gene regulation, negative and positive regulation, concept of operons, regulatory proteins, activators, repressors, DNA binding domains, regulation of lac operon and trp operon, induction of SOS response, synthesis of ribosomal proteins, regulation by genetic recombination, transcriptional regulation in λ bacteriophage. Regulation of gene expression in eukaryotes. Heterochromatin, euchromatin, chromatin remodeling, regulation of galactose metabolism in yeast, regulation by phosphorylation of nuclear transcription factors, regulatory RNAs, riboswitches, RNA interference, synthesis and function of miRNA molecules, phosphorylation of nuclear transcription factors.

COURSE- BIOCHEM3DSE07PR
GENE EXPRESSION AND REGULATION

PRACTICALS
1. Extraction of total nucleic acids from plant tissue.
2. Dauxic growth curve effect.
3. Isolation of mRNA from yeast by affinity chromatography.
4. Effect of inhibitors on protein synthesis.
5. Accumulation of protein due to proteasome inhibitors.

SUGGESTED READINGS
COURSE- BIOCHEM3DSE08TH
ADVANCED CELL BIOLOGY

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Plasma Membrane and Nuclear Transport (10 Periods)
Properties and Composition of Cell Membrane; Structure of Nuclear Envelope; Nuclear Pore Complex; Transport Across Nuclear Envelope; Regulation of Nuclear Protein Import and Export.

Unit 2 Cell-Cell Interaction (18 Periods)
Cell-Cell Interactions and Cell-Matrix Interactions; Components of Extracellular Matrix: Collagen and Non-Collagen Components; Tight Junctions; Gap Junctions; Desmosomes; Hemidesmosomes; Focal Adhesions and Plasmodesmata; Cell Wall; Role of Cell Interaction In Development.

Unit 3 Cell Cycle and Programmed Cell Death (16 Periods)
Overview of The Cell Cycle; Eukaryotic Cell Cycle; Events Of Mitotic Phase; Cytokinesis; Events Of Meiosis And Fertilization; Regulation Of Cell Division And Cell Growth; Apoptosis And Necrosis, Stem Cells And Maintenance of Adult Tissues, Hematopoiesis, Embryonic Stem Cells and Therapeutic Cloning.

Unit 4 Cancer Biology and Advanced Methods in Cell Biology (16 Periods)

PRACTICALS
1. Isolation of organelles by sub-cellular fractionation.
2. Study of cell viability/death assay by use of trypan blue and MTT assay.
4. Identification and study of cancerous cells using permanent slides and photomicrographs.

SUGGESTED READINGS
COURSE- BIOCHEM3DSE09TH
PLANT BIOCHEMISTRY

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/ units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction to plant cell structure, photosynthesis and carbon assimilation and transportation (12 Periods)
Plasma membrane, Vacuole and tonoplast membrane, cell wall, plastids and peroxisomes. Structure of PSI and PSII complexes, Light reaction, Cyclic and non-cyclic photophosphorylation, Calvin cycle and regulation; C4 cycle and Crassulacean acid metabolism (CAM), Photospiiration.

Unit 2 Respiration (12 Periods)
Overview of glycolysis, Alternative reactions of glycolysis, Regulation of plant glycolysis, Translocation of metabolites across mitochondrial membrane, TCA cycle, Alternative NAD(P)H oxidative pathways; Cyanide resistant respiration.

Unit 3 Nitrogen metabolism and regulation of plant growth (18 Periods)

Unit 4 Secondary metabolites and plant tissue culture (18 Periods)
Representatives alkaloid group and their amino acid precursors, function of alkaloids, Examples of major phenolic groups; simple phenylpropanoids, Coumarins, Benzoic acid derivatives, flavonoids, tannins and lignin, biological role of plant phenolics, Classification of terpenoids and representative examples from each class, biological functions of terpenoids. Cell and tissue culture techniques, types of cultures: organ and explants culture, callus culture, cell suspension culture and protoplast culture. Plant regeneration pathways: organogenesis and somatic embryogenesis. Applications of cell and tissue culture and somoclonal variation.

PRACTICALS
1. Induction of hydrolytic enzymes proteinases/amylases/lipase during germination
2. Extraction and assay of Urease from Jack bean
3. Estimation of carotene/ascorbic acid/phenols/tannins in fruits and vegetables
4. Separation of photosynthetic pigments by TLC
5. Culture of plant plants (explants).

SUGGESTED READINGS
COURSE- BIOCHEM3DSE10TH
DEVELOPMENTAL BIOLOGY

Year end examination: 50 marks
Practical examination: 20 marks
Internal Assessment: 30 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

UNIT 1 Gametogenesis and fertilization (10 Periods)
Definition, scope & historical perspective of development Biology, Gametogenesis – Spermatogenesis, Oogenesis Fertilization - Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk.

UNIT 2 Early embryonic development (20 Periods)

UNIT 3 Embryonic differentiation (20 Periods)
Differentiation: Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.

UNIT 4 Organogenesis (10 Periods)
Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germlayers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.

COURSE- BIOCHEM2DSE10PR
DEVELOPMENTAL BIOLOGY

PRACTICALS
1. Identification of developmental stages of chick and frog embryo using permanent mounts
2. Preparation of a temporary stained mount of chick embryo
3. Study of developmental stages of Anopheles.
5. Study of different types of placenta.

SUGGESTED READING
Note: The Examiner will set a total of nine (9) questions covering all topics/ units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

Unit 1 Introduction to recombinant DNA technology (10 Periods)
Overview of recombinant DNA technology. Restriction and modification systems, restriction endonucleases and other enzymes used in manipulating DNA molecules, separation of DNA by gel electrophoresis. Extraction and purification of plasmid and bacteriophage DNA. Joining of DNA fragments: Ligation of DNA molecules. DNA ligase, sticky ends, blunt ends, linkers and adapters. Synthetic oligonucleotides, synthesis and use.

Unit 2 Cloning vectors for prokaryotes and eukaryotes (10 Periods)
Plasmids and bacteriophages as vectors for gene cloning. Cloning vectors based on E. coli plasmids, pBR322, pUC8, pGEM3Z. Cloning vectors based on M13 and λ bacteriophage. Vectors for yeast, higher plants and animals.

Unit 3 Transfection, clone identification, polymerase chain reaction and DNA sequencing (22 Periods)

Unit 4 Expression of cloned genes and Applications of genetic engineering in Biotechnology (18 Periods)
Vectors for expression of foreign genes in E. coli, cassettes and gene fusions. Challenges in producing recombinant protein in E. coli. Production of recombinant protein by eukaryotic cells. Fusion tags and their role in purification of recombinant proteins. Applications of genetic engineering in Biotechnology: Site-directed mutagenesis and protein engineering. Applications in medicine, production of recombinant pharmaceuticals such as insulin, human growth hormone, factor VIII. Recombinant vaccines. Gene therapy. Applications in agriculture: plant genetic engineering, herbicide resistant crops, problems with genetically modified plants, safety concerns.

PRACTICALS
1. Isolation of plasmid DNA from E. coli cells.
2. Amplification of a DNA fragment by PCR.
3. Transformation of E. coli cells with plasmid DNA.

SUGGESTED READINGS
B.Sc. (HONOURS) BIOCHEMISTRY
(CBCS STRUCTURE)

ABILITY ENHANCEMENT COURSES
Course: ENGL103
ENGLISH COMMUNICATION (Theory)
Course: ENVS1AECC02
ENVIRONMENT SCIENCE

Theory examination: 100 marks

Note: The Examiner will set a total of nine (9) questions covering all topics/units of the prescribed course by setting at least two questions from each unit. Out of the nine questions, one question containing ten (10) short-answer type questions of 2 marks each that will cover entire course will be compulsory. The candidate will attempt a total of five questions (one from each unit) including the compulsory question. All questions will carry equal marks.

UNIT I
(20 Periods)
Introduction to environmental studies & ecosystems: Multidisciplinary nature of environmental studies: Scope and importance; What is an ecosystem? The structure and function of ecosystem, Energy flow in an ecosystem, food chains, food webs and ecological succession, forest ecosystem, grassland ecosystem, desert ecosystem, aquatic ecosystems; Levels of biological diversity such as genetic, species and ecosystem diversity; biogeography zones of India, biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation, endangered and endemic species of India, threats to biodiversity, habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions, conservation of biodiversity, in-situ and ex-situ conservation of biodiversity, concept of sustainability and sustainable development.

UNIT II
(15 Periods)
Natural resources & its management and conservation: Land resources and land use change: Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations; Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state); Energy resources: Renewable and non renewable energy sources, use of alternate energy sources and growing energy needs.

UNIT III
(15 Periods)

UNIT IV
(10 Periods)
Environment & social issues: Human population growth: Impacts on environment, human health and welfare; Resettlement and rehabilitation of project affected persons; case studies; Disaster management: floods, earthquake, cyclones and landslides; Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan; Environmental ethics: Role of Indian and other religions and cultures in environmental conservation; environmental communication and public awareness.

SUGGESTED READING


