DAV UNIVERSITY, JALANDHAR

Scheme of Courses for
Bachelor of Science - Biochemistry (Honours)

(Program ID – 2)

Course Syllabus for Semesters 1-6

Course Scheme Applicable to Admissions in 2018

Semester 1

S.No.	Paper Code	Course Title	L	T	P	Credits	Course Type
1.	**BCH101**	Biomolecules	4	1	0	4	**Core**
2.	**ENG151A**	English Communication	3	0	0	3	**AECC**
3.	**BCH213**	Fundamentals of Genetics	4	0	0	4	**Core**
4.		Generic Elective I	4	0	0	4	**Generic Elective I**
5.	**BCH102**	Biomolecules Laboratory	0	0	3	2	**Core**
6.	**ENG152**	English Communication Laboratory	0	0	2	1	**AECC**
7.	**BCH214**	Fundamentals of Genetics Laboratory	0	0	3	2	**Core**
8.		Generic Elective I Laboratory	0	0	3	2	**Generic Elective I**
		Total	**15**	**1**	**11**	**22**	

Generic Electives (Student has an option to choose any one elective and its corresponding laboratory course)

S.No.	Paper Code	Course Title	L	T	P	Credits	Course Type
1.	**BOT131**	Plant Diversity	4	0	0	4	**Generic Elective I**
2.	**BOT132**	Plant Diversity Laboratory	0	0	3	2	**Generic Elective I**
3.	**ZOO301**	Fundamentals of Animal Development	4	0	0	4	**Generic Elective I**
4.	**ZOO302**	Fundamentals of Animal Development Laboratory	0	0	3	2	**Generic Elective I**

L: Lecture
T: Tutorial
P: Practical
AECC: Ability Enhancement Compulsory Course

Semester 2

S.No.	Paper Code	Course Title	L	T	P	Credits	Course Type
1.	**BCH103**	Metabolism	4	0	0	4	**Core**
2.	**EVS100**	Environmental Studies	4	0	0	4	**AECC**
3.	**BTY121**	Cell Biology	4	0	0	4	**Core**
4.		Generic Elective II	4	0	0	4	**Generic Elective II**
5.	**BCH104**	Metabolism Laboratory	0	0	3	2	**Core**
6.		Generic Elective II Laboratory	0	0	3	2	**Generic Elective II**
7.	**BTY122**	Cell Biology Laboratory	0	0	3	2	**Core**
8.	**SGS107**	Human Values and General Studies	4	0	0	4	**AECC**
		Total	**20**	**0**	**9**	**26**	

Generic Electives (Student has an option to choose any one elective and its corresponding laboratory course)

S.No.	Paper Code	Course Title	L	T	P	Credits	Course Type
1.	**CHE157**	General Chemistry –I	4	0	0	4	**Generic Elective II**
2.	**CHE158**	General Chemistry –I Laboratory	0	0	3	2	**Generic Elective II**
3.	**PHY155A**	Modern Physics	4	0	0	4	**Generic Elective II**
4.	**PHY156**	Modern Physics Laboratory	0	0	3	2	**Generic Elective II**

L: Lecture
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AECC: Ability Enhancement Compulsory Course

Semester 3

S.No.	Paper Code	Course Title	L	T	P	Credits	Course Type
1.	**ZOO101**	Animal Diversity I	4	1	0	4	**Core**
2.	**BCH215**	Introduction to Clinical Biochemistry	4	0	0	4	**Skill Enhancement Elective (SEC)**
3.	**BCH216**	Membrane Biology and Bioenergetics	4	0	0	4	**Core**
4.	**MIC111**	Introduction to Microbiology	4	0	0	4	**Discipline-Specific Elective (DSE)**
5.		Generic Elective III	4	0	0	4	**Generic Elective III**
6.	**ZOO102**	Animal Diversity I Laboratory	0	0	3	2	**Core**
7.	**BCH217**	Membrane Biology and Bioenergetics Laboratory	0	0	3	2	**Core**
8.	**MIC112**	Introduction to Microbiology Laboratory	0	0	3	2	**Discipline-Specific Elective (DSE)**
9.		Generic Elective III Laboratory	0	0	3	2	**Generic Elective III**
		Total	**20**	**0**	**12**	**28**	

Generic Electives (Student has an option to choose any one elective and its corresponding laboratory course)

S.No.	Paper Code	Course Title	L	T	P	Credits	Course Type
1.	**BOT241**	Plant Physiology and Metabolism	4	0	0	4	**Generic Elective III**
2.	**BOT242**	Plant Physiology and Metabolism Laboratory	0	0	3	2	**Generic Elective III**
3.	**MIC221**	Microbial Physiology	4	0	0	4	**Generic Elective III**
4.	**MIC222**	Microbial Physiology Laboratory	0	0	3	2	**Generic Elective III**

L: Lecture **T: Tutorial** **P: Practical**

Semester 4

S.No.	Paper Code	Course Title	L	T	P	Credits	Course Type
1.	**BCH218**	Proteins and Enzymes	4	0	0	4	**Core**
2.	**ZOO103**	Animal Diversity II	4	0	0	4	**Core**
3.	**BTY241**	Molecular Biology	4	0	0	4	**Core**
4.	**BCH220**	Bioinformatics	4	0	0	4	**Skill Enhancement Course (SEC)**
5.		Generic Elective IV	4	0	0	4	**Generic Elective IV**
6.	**BCH219**	Proteins and Enzymes Laboratory	0	0	3	2	**Core**
7.	**ZOO104**	Animal Diversity II Laboratory	0	0	3	2	**Core**
8.	**BTY242**	Molecular Biology Laboratory	0	0	3	2	**Core**
9.		Generic Elective IV Laboratory	0	0	3	2	**Generic Elective IV**
		Total	**20**	**0**	**12**	**28**	

Generic Electives (Student has an option to choose any one elective and its corresponding laboratory course)

S.No.	Paper Code	Course Title	L	T	P	Credits	Course Type
1.	**CHE257**	General Chemistry - II	4	0	0	4	**Generic Elective IV**
2.	**CHE258**	General Chemistry - II Laboratory	0	0	3	2	**Generic Elective IV**
3.	**CHE115**	Organic Chemistry - I	4	0	0	4	**Generic Elective IV**
4.	**CHE116**	Organic Chemistry – I Laboratory	0	0	4	2	**Generic Elective IV**

L: Lecture
T: Tutorial
P: Practical

Semester 5

S.No.	Paper Code	Course Title	L	T	P	Credits	Course Type
1.	**BCH323**	Introduction to Nutritional Biochemistry	4	0	0	4	**Discipline-Specific Elective (DSE)**
2.	**BCH325**	Molecular Basis of Infectious and Non-infectious Diseases	4	0	0	4	**Core**
3.	**ZOO257**	Human Physiology	4	0	0	4	**Core**
4.	**BTY353**	Recombinant DNA Technology	4	0	0	4	**Core**
5.	**BCH324**	Introduction to Nutritional Biochemistry Laboratory	0	0	3	2	**Discipline-Specific Elective (DSE)**
6.	**BCH326**	Molecular Basis of Infectious and Non-infectious Diseases Laboratory	0	0	3	2	**Core**
7.	**ZOO258**	Human Physiology Laboratory	0	0	3	2	**Core**
8.	**BTY354**	Recombinant DNA Technology Laboratory	0	0	3	2	**Core**
		Total	**16**	**0**	**12**	**24**	

L: Lecture
T: Tutorial
P: Practical

Semester 6

S.No.	Paper Code	Course Title	L	T	P	Credits	Course Type
1.	**BCH327**	Fundamentals of Immunology	4	0	0	4	**Core**
2.	**BCH329**	Tools and Techniques in Life Sciences	4	0	0	4	**Core**
3.	**BCH330**	Advanced Cell Biology	4	0	0	4	**Discipline-Specific Elective (DSE)**
4.	**BCH203**	Endocrinology	4	0	0	4	**Core**
5.	**BCH328**	Fundamentals of Immunology Laboratory	0	0	3	2	**Core**
6.	**BCH331**	Advanced Cell Biology Laboratory	0	0	3	2	**Discipline-Specific Elective (DSE) Laboratory**
7.	**BCH204**	Endocrinology Laboratory	0	0	3	2	**Core**
		Total	**16**	**0**	**9**	**22**	

L: Lecture
T: Tutorial
P: Practical

Course Title: Biomolecules
Course Code :BCH101

L	T	P	Credits	Marks
4	1	0	4	100

Course Objectives: This course introduces students to the importance of biochemistry and covers various biomolecules, with a brief overview of their chemistry, their functions and their relevance to physiology and disease.

Unit A (15 hours)

Introduction to Biochemistry

Water as a biological solvent. Weak acids and bases. pH and buffers. Henderson-Hasselbalch equation. Physiological buffers. Fitness of the aqueous environment for living organisms.

Carbohydrates

Structure of monosaccharides. Stereoisomerism and optical isomerism of sugars. Reactions of aldehyde and ketone groups. Ring structure and anomeric forms, mutarotation. Reactions of sugars due to hydroxyl groups. Important derivatives of monosaccharides,disaccharides and trisaccharides (structure, function and occurrence of important ones). Structure, occurrence and biological importance of monosaccharides, oligosaccharides and polysaccharides - cellulose, chitin, agar, algenic acids, pectins, proteoglycans, sialic acids, blood group polysaccharides, glycogen and starch. Bacterial cell wall polysaccharides. Glycoproteins.

Unit B (15 hours)

Proteins

Introduction to proteins. Classification based on solubility, shape, composition and functions. Amino acids: common structural features, stereoisomerism and RS system of designating optical isomers. Classification and structures of standard amino acids as zwitterion in aqueous solutions. Physical and chemical properties of amino acids. Titration of amino acids. Separation of amino acids. Essential amino acids.

Structure of peptide bond. Peptide sequencing. Chemical and enzymatic cleavage of polypeptide chains and separation of peptides. Levels of structure in protein architecture. denaturation and renaturation of proteins. Behaviour of proteins in solutions. Salting in and salting out of proteins. Structure and biological functions of fibrous proteins (keratins, collagen and elastin), globular proteins (haemoglobin, myoglobin), lipoproteins, metalloproteins, glycoproteins and nucleoproteins.

Unit C (15 hours)

Nucleic Acids

Nature of genetic material. Evidence that DNA is the genetic material. Composition of DNA and RNA. Generalized structural plan and Nomenclature of nucleic acids. DNA

double helix. Structure and roles of different types of RNA. Size of DNA in prokaryotes and eukaryotes. Central dogma of molecular biology. Concepts of gene, genome and chromosome.

Unit D (15 hours)

Lipids

Definition and classification of lipids. Fatty acids: introduction, classification, nomenclature, structure and properties of saturated and unsaturated fatty acids. Essential fatty acids, prostaglandins. Triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats – hydrolysis, saponification value, rancidity of fats, Reichert-Meissel Number and reaction of glycerol. Biological significance of fats. Glycerophospholipids (lecithins, lysolecithins, cephalins, phosphatidylserine, phosphatidylinositol, plasmalogens), sphingomyelins, glycolipids – cerebrosides, gangliosides. Properties and functions of phospholipids, isoprenoids and sterols.

Recommended Books

1. Lehninger Principles of Biochemistry (2017), 7th edition,Nelson DL & Cox MM, WH Freeman & Company, New York, ISBN: 9781464126116.

2. Biochemistry (2010), 4th edition, Voet D & Voet JG, John Wiley & Sons Inc., Singapore, ISBN: 9780470570951.

3. Harper's Illustrated Biochemistry (2015), 30th edition,Murray, R.K., Granner, D.K. and Rodwell, V.W. McGraw Hill Company Inc. Singapore, ISBN: 9780071825344.

L	T	P	Credits	Marks
0	0	3	2	50

Course Title: Biomolecules Laboratory
Couse Code: BCH102

Experiments:

1. Preparation of normal, molar and percent solutions.
2. Titration curve of Glycine.
3. Buffer preparation.
4. Qualitative tests for Carbohydrates, Lipids, Amino acids, Proteins, Nucleic acids
5. Preparation of casein from milk and determination of its isoelectric point.
6. Titrimetric analysis of Vitamin C.
7. Demonstration of Lambert-Beers law for para-nitrophenol.

Course Title: Basic Communication Skills
Course Code : ENG151A

L	T	P	Credits	Marks
3	0	0	3	75

Course Objective:

- To enhance students' vocabulary and comprehensive skills through prescribed texts.
- To hone students' writing skills.

Learning Outcomes: Students will be able to improve their writing skills as well as will enrich their word power.

Unit A

Applied Grammar (Socio-Cultural Context)

1. Parts of Speech: Noun, Pronoun, Adjective, Verb, Adverb, Preposition, Conjunction, Interjection 5 hours
2. Tenses (Rules and Usages in Socio-cultural contexts) 6 hour
3. Modals: Can, Could, May, Might, Will, Would, Shall, Should, Must, Ought to 5hours
4. Passive/Active 5 hours
5. Reported/Reporting Speech 5 hour

Unit B

Reading (Communicative Approach to be Followed)

1. J M Synge: Riders to the Sea (One Act Play) 7 hours
2. Anton Chekhov : Joy (Short Story) 5 hours
3. Swami Vivekanand : The Secret of Work (Prose) 7 hours

Unit C

Writing

1. Essay Writing and Letter Writing 5Hours
2. Report Writing 5 hours
3. Group Discussion & Facing an Interview 5hours

References:

a. Books

1. Kumar, Sanjay and PushpLata. *Communication Skills*. India: OUP, 2012. Print.
2. Vandana, R. Singh. *The Written Word* by. New Delhi: Oxford University Press, 2008. Print.

b. Websites

1. www.youtube.com (to download videos for panel discussions). Web.
2. www.letterwritingguide.com. Web.
3. www.teach-nology.com. Web.
4. www.englishforeveryone.org. Web.
5. www.dailywritingtips.com. Web.
6. www.englishwsheets.com. Web.
7. www.mindtools.com. Web.

Course Title : Basic Communication Skill Laboratory
Course Code: ENG152

L	T	P	Credits	Marks
0	0	2	1	25

No. Of Lectures: 30

Course Objective:

- To improve fluency in speaking English.
- To promote interactive skills through Group Discussions and role plays.

Learning Outcome: Students will get exposure to speaking through the above mentioned interactive exercises. In addition, they will develop a technical understanding of language learning software, which will further improve their communicative skills.

Unit A

Speaking/Listening

1. Movie-Clippings 10 hours
2. Role Plays 10 hours
3. Group Discussions 10 hours

References:

Books

1. Gangal, J. K. *A Practical Course In Spoken English.* India: Phi Private Limited, 2012. Print.
2. Kumar, Sanjay and Pushp Lata. *Communication Skills*. India: OUP, 2012. Print.

Websites

1. www.youtube.com (to download videos for panel discussions). Web.
2. www.englishforeveryone.org. Web.
3. www.talkenglish.com. Web.
4. www.mindtools.com. Web.

Course Title: Fundamentals of Genetics
Course Code: BCH213

L	T	P	Credits	Marks
4	0	0	4	100

Unit A (15 hours)

Introduction to model organisms and Mendelism

Model organisms: *Escherichia coli, Saccharomyces cerevisiae, Drosophila melanogaster, Caenorhabditis elegans, Danio rerio* and *Arabidopsis thaliana*, Basic principles of heredity.

Applications of Mendel's principles & chromosomal basis of heredity

Laws of probability & binomial expansion, formulating and testing genetic hypothesis, chromosomal basis of Mendelism - Sutton and Boveri hypothesis with experimental evidences.

Extensions of Mendelism

Allelic variation and gene function - dominance relationships, multiple alleles, lethal alleles and null alleles. Pleiotropy gene interaction - epistatic and non-epistatic, interaction between gene(s) and environment. Penetrance and expressivity, norm of reaction and phenocopy.

Unit B (15 hours)

Genetic definition of a gene

Complementation test, limitations of cis-trans test, intragenic complementation, rII locus of phage T4 and concept of cistron

Genetics of bacteria and viruses

Mechanism of genetic exchange - conjugation, transformation and transduction. Gene mapping in bacteria.

Linkage, crossing over and mapping techniques

Linkage and crossing over, genetic mapping in eukaryotes, centromere mapping with ordered tetrads, cytogenetic mapping with deletions and duplications in Drosophila, detection of linked loci by pedigree analysis in humans and somatic cell hybridization for positioning genes on chromosomes.

Unit C (15 hours)

Human pedigree analysis

Pedigree conventions, characteristics of dominant and recessive inheritance. Applications of pedigree analysis.

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

Extranuclear inheritance, tests for organelle heredity and maternal effect, epigenetic mechanisms of transcriptional regulation & genomic imprinting.

Unit D (15 hours)

Chromosomal aberrations

Variations in chromosome number- monosomy and trisomy of sex and autosomes. Variations in chromosome structure - inversions, deletions, duplications and translocations.

Inheritance of complex traits & population genetics

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.

Recommended Books

1. Genetics (2012) 6th edition, Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 9781118092422.

2. Genetics - A Conceptual Approach (2012), 4th edition, Pierce, B.A., W.H. Freeman & Co. (New York), ISBN: 9781429276061.

3. An Introduction to Genetic Analysis (2010), 10th edition, Griffiths, A.J.F, Wessler, S. R, Carroll, S. B. and Doebley, J., W.H. Freeman & Company (New York), ISBN: 1429229438.

Course Title:Fundamentals of Genetics Laboratory
Course Code: BCH214

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Preparation of mitotic and meiotic spreads for analysis of various stages of celldivision.
2. Induction of polyploidy in onion roots.
3. Smear technique to demonstrate sex chromatin in buccal epithelial cells.
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.

L	T	P	Credits	Marks
4	0	0	4	100

Course Title : Plant Diversity
Course Code: BOT131

Course Objectives:
To acquaint the students about the morphology, biology and importance of prokaryotes, eukaryotes, algal organisms, fungal organisms, lichens, bryophytes and pteridophytes.

Learning Outcome
The course will enable students to know the earlier plants, their vegetative and reproductive structures and their importance.

Unit A

Viruses: Discovery, general structure, replication (general account), DNA virus (T-phage); Lytic and lysogenic cycle, RNA virus (TMV); Economic importance; Bacteria – Discovery, General characteristics and cell structure; Reproduction – vegetative, asexual and recombination (conjugation, transformation and transduction); Economic importance.

Unit B

Algae: General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Nostoc, Chlamydomonas, Oedogonium, Vaucheria, Fucus, Polysiphonia*. Economic importance of algae.

Fungi: Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium*, *Alternaria* (Ascomycota), *Puccinia*, *Agaricus* (Basidiomycota); Symbiotic Associations-Lichens: General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

Unit C

Introduction to Archegoniate: Unifying features of archegoniates, Transition to land habit, Alternation of generations.
Bryophytes: General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification (up to family), morphology, anatomy and reproduction of *Marchantia* and *Funaria*. Ecology and economic importance of bryophytes with special mention of *Sphagnum*.

Unit D

Pteridophytes: General characteristics, classification, Early land plants (*Cooksonia* and *Rhynia*). Classification (up to family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Pteris*. Heterospory and seed habit, stellar evolution.Ecological and economical importance of Pteridophytes.
Gymnosperms: General characteristics; Classification (up to family), morphology, anatomy and reproduction of *Cycas* and *Pinus*. Ecological and economical importance.

Course Title : Plant Diversity Laboratory
Course Code: BOT132

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. EMs/Models of viruses – T-Phage and TMV, Line drawing/Photograph of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium; Binary Fission; Conjugation; Structure of root nodule.
3. Gram staining
4. Study of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas* (electron micrographs), *Oedogonium*, *Vaucheria*, *Fucus** and *Polysiphonia* through temporary preparations and permanent slides. (* Fucus - Specimen and permanent slides)
5. *Rhizopus* and *Penicillium*: Asexual stage from temporary mounts and sexual structures through permanent slides.
6. *Alternaria*: Specimens/photographs and tease mounts.
7. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberryleaves; section/tease mounts of spores on Wheat and permanent slides of both the hosts.
8. *Agaricus*: Specimens of button stage and full grown mushroom; Sectioning of gills of *Agaricus*.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose)
10. Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)
11. *Marchantia*- morphology of thallus, w.m. rhizoids and scales, v.s. thallus through gemma cup, w.m. gemmae (all temporary slides), v.s. antheridiophore, archegoniophore, l.s. sporophyte (all permanent slides).
12. *Funaria*- morphology, w.m. leaf, rhizoids, operculum, peristome, annulus, spores(temporary slides); permanent slides showing antheridial and archegonial heads, l.s. capsule and protonema.
13. *Selaginella*- morphology, w.m. leaf with ligule, t.s. stem, w.m. strobilus, w.m.microsporophyll and megasporophyll (temporary slides), l.s. strobilus (permanent slide).
14. *Equisetum*- morphology, t.s. internode, l.s. strobilus, t.s. strobilus, w.m. sporangiophore,w.m. spores (wet and dry)(temporary slides); t.s rhizome (permanent slide).
15. *Pteris*- morphology, t.s. rachis, v.s. sporophyll, w.m. sporangium, w.m. spores (temporary slides), t.s. rhizome, w.m. prothallus with sex organs and young sporophyte (permanent slide).
16. *Cycas*- morphology (coralloid roots, bulbil, leaf), t.s. coralloid root, t.s. rachis, v.s. leaflet, v.s. microsporophyll, w.m. spores (temporary slides), l.s. ovule, t.s. root (permanent slide).
17. *Pinus*- morphology (long and dwarf shoots, w.m. dwarf shoot, male and female), w.m.dwarf shoot, t.s. needle, t.s. stem, l.s./t.s. male cone, w.m. microsporophyll, w.m. microspores (temporary slides), l.s. female cone, t.l.s. & r.l.s. stem (permanent slide).

Recommended Books

1. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West. Press Pvt. Ltd. Delhi. 2nd edition.
2. Tortora, G.J., Funke, B.R., Case, C.L. (2010). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 10th edition.

3. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi & Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley and Sons (Asia), Singapore. 4th edition.
5. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R., (2005). Biology. Tata McGraw Hill, Delhi, India.
6. Vashishta, P.C., Sinha, A.K., Kumar, A., (2010). Pteridophyta, S. Chand. Delhi, India.
7. Bhatnagar, S.P. and Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers, New Delhi, India.
8. Parihar, N.S. (1991). An introduction to Embryophyta. Vol. I. Bryophyta. Central Book Depot, Allahabad.

L	T	P	Credits	Marks
4	0	0	4	100

Course Title: Fundamentals of Animal Development
Course Code: ZOO301

Course Objective: To give students a brief overview of the developmental processes in animals.

UnitA 10 hours

- Introduction to developmental biology
- Gametogenesis: spermatogenesis and oogenesis, vitellogenesis, egg membranes.

Unit B 12 hours

- Fertilization: sperm-egg interactions-biochemical events, post fertilization events,
- Parthenogenesis
- Embryonic Development: Types of animal eggs, patterns of cleavage, blastulation, gastrulation, fate maps and cell lineage

UnitC 9 hours

- Implantation and Decidualization in mammals
- Extra embryonic membranes, types and physiology of placenta
- Cell Differentaiation, Organizer-Concept, Induction process
- Organogenesis of heart, kidney, nervous system and sense organs.

UnitD 9 hours

- Post embryonic development-insects and amphibians
- Genes in development
- Regeneration in invertebrates and vertebrates, development of immune system in vertebrates
- Gerontology-ageing, concepts and models
- Teratogenesis

Recommended Books

1. Balinsky, B.I. and Fabian, B. C., An Introduction to Embryology, 5th ed., Saunders,
   Philadelphia (2012).
2. Gilbert, S. F., Developmental Biology, 9th ed., Sinauer Associaters Inc Publishers (2010).
3. Browder, L.W., Developmental Biology, 3rd ed., Saunders College Publishing (1991).
4. Muller, W. A., Developmental Biology, Springer (1997).
5. Rastogi, V. B. and Jayaraj M. S., Developmental Biology, Kedar Nath Ram Nath, Meerut
   (2009)
6. Wolpert, L. et al., Principles of Development, 2nd ed., Oxford (2001)
7. Wright, S. J., A Photographic Atlas of Developmental Biology, Morton PublishingCompany (2005).

Course Title: Fundamentals of Animal Development Laboratory
Course Code: ZOO302

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

The following practicals will be conducted using charts/models/e-resources.

- Study of the development of frog from zygote upto 7mm embryo.
- Study of developmental stages of chick embryo
- Study of *Amphioxus* and *Herdmania* larvae
- Study of life cycle of butterfly and moth
- Study of different invertebrate larvae

Course Title:Metabolism
Course Code:BCH103

L	T	P	Credits	Marks
4	1	0	4	100

Course Objectives: The course is designed to survey the major metabolic pathways involved in energy generation and synthesis of biomolecules.

Unit A (15 hours)

Introduction to Metabolism

General features of metabolism, experimental approaches to study metabolism – intact organisms, bacterial mutants, tissue slices, and radioisotopes. Bioenergetics-Concept of free energy, standard free energy, determination of ΔG for a reaction. Relationship between equilibrium constant and standard free energy change, biological standard state and standard free energy change in metabolic reactions.

Carbohydrate Metabolism

Reactions and energetics of glycolysis. Alcoholic and lactic acid fermentations. Reactions and energetics of TCA cycle. Gluconeogenesis, glycogenesis and glycogenolysis. Reactions and physiological significance of pentose phosphate pathway. Regulation of glycolysis and TCA cycle..

Unit B (10 hours)

Electron Transport Chain and Oxidative Phosphorylation

Structure of mitochondria. Sequence of electron carriers. Sites of ATP production. Inhibitors of electron transport chain. Chemiosmotic hypothesis. Inhibitors and uncouplers of oxidative phosphorylation. Transport of reducing potentials into mitochondria. Photophosphorylation.

Unit C (20 hours)

Lipid Metabolism

Introduction. Hydrolysis of triacylglycerols. Transport of fatty acids into mitochondria. B-oxidation of saturated fatty acids. ATP yield from fatty acid oxidation. Biosynthesis of saturated and unsaturated fatty acids. Metabolism of ketone bodies. Oxidation of unsaturated and odd chain fatty acids. Biosynthesis of triglycerides and important phospholipids, glycolipids, sphingolipids and cholesterol. Regulation of cholesterol metabolism.

Amino Acid Metabolism

General reactions of amino acid metabolism – transamination, oxidative deamination and decarboxylation. Urea cycle. Degradation and biosynthesis of amino acids. Glycogenic and ketogenic amino acids.

Unit D (15 hours)

Nucleotide Metabolism

Sources of atoms in the purine and pyrimidine nucleotides. Biosynthesis and degradation of purines and pyrimidines. Regulation of purine and pyrimidine biosynthesis.

Recommended Books

1. Lehninger Principles of Biochemistry (2017), 7th edition,Nelson DL & Cox MM, WH Freeman & Company, New York, ISBN: 9781464126116.

2. Biochemistry (2010), 4th edition, Voet D & Voet JG, John Wiley & Sons Inc., Singapore, ISBN: 9780470570951.

3. Harper's Illustrated Biochemistry (2015), 30th edition,Murray, R.K., Granner, D.K. and Rodwell, V.W. McGraw Hill Company Inc. Singapore, ISBN: 978-0071825344.

4. Outlines of Biochemistry (2010). 5th edition,Conn, E.E., Stumpf, P.K., Bruening, G., and Doi, R.H., John Wiley & Sons Inc,ISBN: 9788126509300.

Course Title: Metabolism Laboratory
Course Code: BCH104

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Estimation of blood glucose.
2. Estimation of cholesterol.
3. Sugar Fermentation in Microorganisms.
4. Estimation of Glucose 6-P.
5. Assay of serum transaminases.
6. Estimation of Urea.
7. Estimation of Uric acid.
8. Estimation of Creatinine

Course Title: Environmental Studies
Course Code: EVS100

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: This course aims at understanding the students in aspects of environmental problems, its potential impacts on global ecosystem and its inhabitants, solutions for these problems as well as environmental ethics which they should adopt to attain sustainable development.

Unit A

Introduction to Environmental Studies

- Definition, components and types of Environment.
- Meaning of Environmental Studies and its Multidisciplinary nature;
- Scope and importance; Concept of sustainability and sustainable development.

6 hours

Natural Resources: Renewable and Non---Renewable Resources

- Land resources and landuse 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, growing energy needs, case studies.

8 hours

Unit B

Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

2 hours

Biodiversity and Conservation

Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic 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, biologicalinvasions; Conservation of biodiversity: In---situ and Ex---situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

8 hours

Unit C

Environmental Pollution

Environmental Pollution: types, causes, effects and controls; Air, water, soil and noise pollution

- Nuclear hazards and human health risks

- Solid waste management: Control measures of urban and industrial waste.
- Pollution case studies. **8 hours**

Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

7 hours

Unit D

Human Communities and the Environment

- 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, case studies (e.g., CNG vehicles in Delhi).

6 hours

Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site---Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems---pond, river, Delhi Ridge, etc.

5 hours

Suggested Readings:

1. Carson, R. 2002. Silent Spring. Houghton Mifflin Harcourt.
2. Gadgil, M., &Guha, R.1993. This Fissured Land: An Ecological History of India. Univ. of California Press.
3. Gleeson, B. and Low, N. (eds.) 1999.Global Ethics and Environment, London, Routledge.
4. Gleick, P. H. 1993. Water in Crisis. Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute, Oxford Univ. Press.
5. Groom, Martha J., Gary K. Meffe, and Carl Ronald Carroll.Principles of Conservation Biology. Sunderland: Sinauer Associates, 2006.
6. Grumbine, R. Edward, and Pandit, M.K. 2013. Threats from India's Himalaya dams. Science, 339: 36---37.
7. McCully, P. 1996. Rivers no more: the environmental effects of dams(pp. 29---64). Zed Books.
8. McNeill, John R. 2000. Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum, E.P., Odum, H.T. & Andrews, J. 1971.Fundamentals of Ecology. Philadelphia: Saunders.

10. Pepper, I.L., Gerba, C.P. &Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
11. Rao, M.N. &Datta, A.K. 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.
12. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012.Environment. 8th edition. John Wiley & Sons.
13. Rosencranz, A., Divan, S., & Noble, M. L. 2001. Environmental law and policy in India. Tripathi 1992.
14. Sengupta, R. 2003. Ecology and economics: An approach to sustainable development. OUP.
15. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. Ecology, Environmental Science and Conservation. S. Chand Publishing, New Delhi.
16. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). 2013. Conservation Biology: Voices from the Tropics. John Wiley & Sons.
17. Thapar, V. 1998. Land of the Tiger: A Natural History of the Indian Subcontinent.
18. Warren, C. E. 1971. Biology and Water Pollution Control. WB Saunders.
19. Wilson, E. O. 2006.The Creation: An appeal to save life on earth. New York: Norton.

L	T	P	Credits	Marks
4	0	0	4	100

Course Title: Cell Biology
Course Code: BTY121

Course Objectives: To study in detail about the cell which encompasses the cell structure, structure and functions oforganelles, locomotion, life cycle and division.To impart knowledge to students about the basics of stem cells and their applications as well as tointroduce them to the world of cellular differentiation and cloning.

Unit A **(18 hours)**

Cells and organelles

Inroduction: Cell as a basic unit of living system, Biochemical composition of cell, the cell theory, ultrastrcuture of cell.

Cytoskeleton: The Nature of the Cytoskeleton and endomembrane system, intermediate filaments, microtubules, cilia and centrioles, actin filaments, actin-binding proteins.

Cell membranes: Architecture and dynamics (models); Membrane composition, the lipid bilayer/membrane; A summary of membrane functions - simple diffusion, Facilitated transports, Active transport, Endocytosis, Pinocytosis, Phagocytosis, Exocytosis. Introduction to important receptors in cell membrane.

Unit B **(16 hours)**

Molecule and Protein Trafficking

The compartmentalization of higher cells, transport of molecules into and out of organeller membranes, the endoplasmic reticulum, transport from the ER through the Golgi Apparatus, transport from the trans Golgi network to lysosomes, transport from the plasma membrane via endosome: Endocytosis, molecular mechanisms of vesicular transport; introduction to transit peptide, signal peptide and translocons.

Unit C **(10 hours)**

Nucleus and Cell Cycle

Genome organization, structure and function of nucleus, nuclear envelope, structure of chromatin, nucleosome and chromosome, cell cycle, mitosis and meiosis.

Unit D **(16 hours)**

Eukaryotic cell organelles and functions

Structure and functions of the following cell organelles: endoplasmic reticulum, Golgi complex, lysosome, ribosome and mitochondria. Principles & applications of differential centrifugation in the fractionation of cellular organelles and Svedberg unit; endosymbiotic theories.

Recommended Books

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. *Molecular Biology of the Cell*. 5th Edition. Garland Science. 2007. Print.
2. Lodish, H.F. *Molecular Cell Biology*. 6th Edition. W.H. Freeman & Company. 2007. Print.
3. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G.P. *The World of the Cell.* 7th Edition. Benjamin Cummings. 2008. Print.
4. Powar, C.B. *Cell Biology*. Himalaya Publishing House. 2007. Print.

L	T	P	Credits	Marks
0	0	3	2	50

Course Title : Cell Biology lab
Course Code: BTY122

Experiments:

1. Understanding principle, working and handling of light microscope and microtome.
2. Understanding microscope adjustments, light sources, microscopic measurements, calibration and types of microscopes available.
3. Observation of microorganisms under phase contrast microscope and dark-field microscope.
4. Preparation of different types of stains
5. Cytological preparations, Fixation, dehydration and staining
6. Squash preparation of meiotic and mitotic cells
7. Embedding and sectioning.
8. Examination of various stages of mitosis and meiosis

Course Title: General Chemistry-I
Course Code: CHE157

L	T	P	Credits	Marks
4	0	0	4	100

ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

Section A: Inorganic Chemistry-1 (30 Periods)

Atomic Structure: Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers *n, l* and *m.* Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (ms). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

Chemical Bonding and Molecular Structure
Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizabilty. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds. MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO+. Comparison of VB and MO approaches.

Section B: Organic Chemistry-1 (30 Periods)

Fundamentals of Organic Chemistry
Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of

organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Huckel's rule.

Stereochemistry
Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newman, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L *cis – trans* nomenclature; CIP Rules: R/ S (for up to 2 chiral carbon atoms) and E / Z Nomenclature (for up to two C=C systems).

Aliphatic Hydrocarbons
Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.
Alkanes: (Up to 5 Carbons). *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.
Alkenes: (Up to 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.
Alkynes: (Up to 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$ ozonolysis and oxidation with hot alk. $KMnO_4$

Recommended Books

• J. D. Lee: *A new Concise Inorganic Chemistry*, E L. B. S.
• F. A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley.
• Douglas, McDaniel and Alexader: *Concepts and Models in Inorganic Chemistry*, John Wiley.
• James E. Huheey, *Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication.
• T. W. Graham Solomon: *Organic Chemistry, John Wiley and Sons*.
• Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
• E. L. Eliel: *Stereochemistry of Carbon Compounds*, Tata McGraw Hill.
• I. L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
• R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
• Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand

Course Title : General Chemistry-I-Laboratory
Course Code: CHE158

L	T	P	Credits	Marks
0	0	3	3	50

Experiments:

Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

2. Estimation of oxalic acid by titrating it with $KMnO_4$.

3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ with internal indicator.

5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$.

Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements).

2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given):

(a) Identify and separate the components of a given mixture of 2 amino acids (glycine,
aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography

(b) Identify and separate the sugars present in the given mixture by paper chromatography.

Course Title: Modern Physics
Course Code: PHY155A

L	T	P	Credits	Marks
4	0	0	4	100

Course Objectives: The aim and objective of the course on Modern Physics for the student of B.Sc. (Hons.) Chemistry is to equip them with the knowledge of wave particle duality, quantum mechanics and atomic nucleus and radioactivity

Unit A (10 hours)

Wave Particle Duality

Quantum theory of light, Xrays and their diffraction, Compton effect, pair production, Wave Properties of Particles;de Broglie waves, waves of probability, the wave equation, phase and group velocities, particle diffraction, uncertainty principle and its applications.

Unit B (11 hours)

Quantum Mechanics

Difference between classical and quantum mechanics, wave function and wave equations. Schrodinger's equation, time dependent and steady state forms, Expectation values, particle in a box, reflection and transmission by a barrier, tunnel effect, harmonic oscillator.

Unit C (12 hours)

Quantum Theory of Hydrogen Atom

Schrodinger's equation for the hydrogen atom, separation of variables, quantum numbers, principal quantum number, orbital quantum number, Magnetic quantum number, electron probability density, radiative transitions, selection rules. Zeeman Effect, Anomalous Zeeman effect, X-ray Spectra.

Unit D (12 hours)

Atomic Nucleus and Radioactivity

Nonexistence of electrons in the nucleus, The neutron, stable nuclei, nuclear sizes and shapes, binding energy, liquid drop model, shell model, meson theory of nuclear forces Radioactivity; Radioactive decay, Half-life, radioactive dating, radioactive series, alpha decay and its theory, beta decay, gammadecay, radiation hazards and radiation units.

Recommended Books

1. Beiser, A. *Concepts of Modem Physics*: McGraw Hill, 1987.
2. Ghatak and Loknatham. *Quantum Mechanics*:(Springer), 2004.
3. Kuhn, H. *Atomic Spectra*:. (Longman Green). 1969.
4. Hyde, K. *Basic ideas and Concepts in Nuclear Physics*: (Institute of Physics), 2004

Course Title : Modern Physics Lab
Course Code: PHY156

L	T	P	Credits	Marks
0	0	3	2	50

Objectives: The laboratory exercises have been so designed that the students learn to verify some of the concepts learnt in the theory courses. They are trained in carrying out precise measurements and handling sensitive equipment.

Note:

1.Students are expected to perform at least eighteen experiments out of following list.

2. The experiments performed in first semester cannot be repeated in second Semester.

3.The examination for both the courses will be of 3 hours duration.

4. Total marks of practical will include 20% weightage of Continuous Assessment and 80% end semester exam including Notebook / Viva / Performance/ written test**.**

List of Experiments : Experimental skills: General Precautions for measurements and handling of equipment, representation of measurements, Fitting of given data to a straight line, and Error analysis, Significant figures and interpretation of results.

1. Determination of Planck's constant using photocell.
2. Study of Solar Cell characteristics.
3. To find half-life period of a given radioactive substance using GM counter.
4. Study of C.R.O. as display and measuring device, Study of Sinewave, square wave signals(half wave and full wave rectification).
5. Determination of ionization potential of mercury.
6. Study of excitations of a given atom by Franck Hertz set up.
7. To determine charge to mass ratio (e/m) of an electron by Thomson method.
8. Study of Arc emission spectrum of given samples (Fe and Cu).
9. To determine the heat capacity of given materials.
10. To find conductivity of given semiconductor crystal using four probe method.
11. To determine the Hall coefficient and mobility of given semiconductors.
12. To determine the operating plateau and dead time of a given G.M. Counter.
13. To find the coefficient of thermal conductivity of a bad conductor by Lee's method.

14. To find the ionization potential of mercury using gas filled diode.
15. To determine the thermionic work function of tungsten using directly heated Diode.
16. To determine the speed of light in air.
17. To study the various laws of thermal radiation.
18. To demonstrate diaparaferro magnetism in an inhomogeneous magnetic field.
19. To measure the wave lengths of Balmar series of visible emission line from Hydrogen.
20. To determine the electronic charge by Millikan oil drop method.

Course Title: Human Values and General Studies
Course Code: SGS107

L	T	P	Credits	Marks
4	0	0	4	100

Course Objectives

a) To sensitize students about the role and importance of human values and ethics in personal, social and professional life.
b) To enable students to understand and appreciate ethical concerns relevant to modern lives.
c) To prepare a foundation for appearing in various competitive examinations
d) To sensitize the students about the current issues and events of national and international importance
e) To provide opportunity to the students to study inter disciplinary subjects like Geography, Science, Economy, Polity, History, International Relations etc.

Unit A
Human Values

1. **Concept of Human Values:** Meaning, Types and Importance of Values.**2 Hours**
2. **Value Education :** Basic guidelines for value education **2 Hours**
3. **Value crisis and its redressal 1 Hour**

Being Good and Responsible

1. Self Exploration and Self Evaluation **2 Hours**
2. Acquiring Core Values for Self Development**2 Hours**
3. Living in Harmony with Self, Family and Society **3 Hours**
4. Values enshrined in the Constitution: Liberty, Equality, Fraternity and Fundamental Duties. **3 Hours**

Unit B
Value – based living

1. Vedic values of life **2 Hours**
2. *Karma Yoga* and *Jnana Yoga* **2 Hours**
3. *Ashta Marga* and *Tri-Ratna* **2 Hours**

Ethical Living*:*

1. Personal Ethics **2 Hours**
2. Professional Ethics **3 Hours**
3. Ethics in Education **2 Hours**

Unit C
General Geography
World Geography 3 Hours
The Universe, The Solar System, The Earth, Atmosphere, The World we live in, Countries rich in Minerals, Wonders of the World, Biggest and Smallest.
Indian Geography 3 Hours
Location, Area and Dimensions, Physical Presence, Indian States and Union Territories, Important sites and Monuments, Largest-Longest and Highest in India.
General History 3 Hours
Glimpses of India History, Ancient Indian, Medieval India, Modern India, Various Phases of Indian National Movement, Prominent Personalities, Glimpses of Punjab history with special reference to period of Sikh Gurus
Glimpses of World History 3 Hours

Important Events of World History, Revolutions and Wars of Independence, Political Philosophies like Nazism, Fascism, Communism, Capitalism, Liberalism etc.

Indian Polity: Constitution of India 3 Hours

Important Provisions, Basic Structure, Union Government, Union Legislature and Executive, State Government: State Legislature and Executive, Indian Judiciary, The Election Commission, Panachayati Raj System, RTI etc.

General Economy 3 Hours

The process of liberalization, privatization, globalization and Major World Issues, Indian Economy, Indian Financial System, Major Economic Issues, Economic Terminology.

Unit D

General Science 3 Hours

General appreciation and understandings of science including the matters of everyday observation and experience, Inventions and Discoveries

Sports and Recreation 3 Hours

The World of Sports and recreation, Who's Who is sports, Major Events, Awards and Honours. Famous personalities, Festivals, Arts and Artists

Current Affairs 3 Hours

National and International Issues and Events in News, Governments Schemes and Policy Decisions

Miscellaneous Information

Who is who 2 Hours

Books and Authors, Persons in News, Awards and Honours, Abbreviations and Sports

References:

1. Human Values, A N Tripathi, New Age International Publishers, New Delhi, Third Edition, 2009
2. Professional Ethics, R. Surbiramanian, Oxford University Press, New Delhi, 2013.
3. Human Values and Professional Ethics, Rishabh Anand, Satya Prakashan, New Delhi, 2012
4. Human Values and Professional Ethics, Sanjeev Bhalla, Satya Prakashan, New Delhi, 2012.
5. Human Values and Professional Ethics, Ritu Soryan Dhanpat Rai & Co. Pvt. Ltd., First Edition, 2010.
6. Human Values and Professional Ethics by Suresh Jayshree, Raghavan B S, S Chand & Co. Ltd. , 2007.
7. Human Values and Professional Ethics, Yogendra Singh, Ankur Garg, Aitbs publishers, 2011.
8. Human Values and Professional Ethics, Vrinder Kumar, Kalyani Publishers, Ludhiana, 2013.
9. Human Values and Professional Ethics, R R Gaur, R. Sangal, GP Bagaria, Excel Books, New Delhi 2010.
10. Values and Ethics, Dr. Bramwell Osula, Dr. Saroj Upadhyay, Asian Books Pvt. Ltd., 2011.
11. Indian Philosophy, S. Radhakrishnan, George Allen & Unwin Ltd., New York: Humanities Press INC, 1929.
12. Essentials of Hinduism, Jainism and Buddhism, A N Dwivedi, Books Today, New Delhi – 1979
13. Dayanand : His life and work, Suraj Bhan, DAVCMC, New Delhi – 2001.

14. Esence of Vedas, Kapil Dev Dwivedi, Katyayan Vedic Sahitya Prakashan, Hoshiarpur, 1990.
15. Vedic Concepts, Prof. B B Chaubey, Katyayan Vedic Sahitya Prakashan, Hoshiarpur, 1990.
16. Advance Objective General Knowledge, R. S. Aggarwal, S. Chand Publisher (2013)
17. Concise General Knowledge Manual 2013, S. Sen, Unique Publishers,2013
18. Encyclopedia of General Knowledge and General Awareness by R P Verma, Penguin Books Ltd (2010)
19. General Knowledge Manual 2013-14, Edgar Thorpe and Showick Thorpe, The Pearson, Delhi.
20. General Knowledge Manual 2018-19, Muktikanta Mohanty, Macmillan Publishers India Ltd., Delhi.
21. India 2018, Government of India (Ministry of Information Broadcasting), Publication Division, 2018.
22. Manorama Year Book 2018-19, Mammen Methew, Malayalam Manorama Publishers, Kottayam, 2018.
23. Spectrum's Handbook of General Studies – 2018-19, Spectrum Books (P) Ltd., New Delhi

Current Affairs

Magazines

Economic and Political Weekly, Yojna, the Week, India Today, Frontline, Spectrum. Competition Success Review, Competition Master, Civil Services Chronicle, Current Affairs, World Atlas Book.

Newspapers

The Hindu, Times of India, The Hindustan Times, The Tribune.

Course Title: Animal Diversity I
Course Code: ZOO101

L	T	P	Credits	Marks
4	0	0	4	100

Course Objectives: To acquaint students with the general characters and classification of invertebrate phyla and the affinities between different groups. To impart knowledge regarding the morphological, anatomical and physiological make up of a few representative organisms from each phylum.

Unit A

- Description of animal diversity. Principles of classification-salient features and classification upto orders in non-chordates. Structural organization in different classes of non-chordates. — 6 hours
- **Protozoa:** locomotion, osmoregulation, nutrition and reproduction in Protozoa. — 6 hours

Unit B

- Origin of Metazoa-metamerism and symmetry. — 4 hours
- **Porifera:** skeleton and canal system. — 3 hours
- **Coelenterata:** corals and coral reefs, polymorphism in Hydrozoa. — 4 hours
- **Platyhelminthes:** reproduction, variation in life cycles, parasitic adaptations and evolution of parasitism in Helminthes. — 4 hours
- **Nematoda:** pseudocoelom, parasitic adaptations — 4 hours

Unit C

- **Annelida:** coelom, metamerism, excretion. — 5 hours
- **Arthropoda:** vision, respiration and larval forms. Social life in insects. — 10 hours

Unit D

- **Mollusca:** torsion and detorsion, shell and respiration. — 10 hours
- **Echinodermata:** water vascular system and larval forms. — 5 hours

Recommended Books

1. Kotpal, R.L., Modern Text Book of Zoology Invertebrates, 10th ed., Rastogi Publishers, Meerut, 2012.
2. Kotpal, R.L., Minor phyla, 5th ed., Rastogi Publishers, Meerut, 2006.
3. Dhami, P.S. and Dhami, J.K., Invertebrate Zoology, 5th ed., R. Chand & Co., New Delhi, 2004.
4. Parker, T.J. and Haswell, W.A., Text book of Zoology, Invertebrates, 7th ed., Vol. I (eds. A.J. Marshall & W.D. Williams), CBS Publishers & Distributors., Delhi, 1992.
5. Hyman L.H. The Invertebrates. Vol. I, II, III, IV and V. McGraw Hill Book Company. Inc., New York. London. Toronto, 1959.

Course Title: Animal Diversity I Lab
Course Code: ZOO102

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

General survey of invertebrate phyla through charts, models and e-resources:

- Protozoa: *Amoeba,Euglena,Paramecium* and *Vorticella*, *Balantidium*, *Nyctotherus*, *Opalina*, Radiolarians and Foraminiferans.
- Porifera: *Sycon*, *Grantia,Spongilla*, *Euplectella,Hyalonema,Chalina,Euspongia,* Temporary mounts of gemmules and spicules of *Sycon.*
- Coelenterata: *Hydra, Obelia, Porpita, Velella, Physalia, Aurelia, Metridium, Alcyonium, Tubipora, Zooanthus, Madrepora, Favia, Fungia, Gorgoni*, *Pennatula, Sertularia, Plumularia, Pennaria, Bougainvillea, s*tatocyst of *Aurelia.*
- Platyhelminthes: *Planaria, Fasciola* (W.M. & T.S.), *larval stages of Fasciola, Taenia* (scolex, proglottids-mature and gravid), *Ascaris* (male and female).
- Annelida: *Pheretima,* T.S. of typhlosolar region, setae, pharyngeal nephridia, septal nephridium and integumentary nephridium of *Pheretima, Eutyphoeus, Lumbricus, Nereis, parapodium of Nereis*, *Heteronereis, Polynoe, Aphrodite, Amphitrite, Chaetopterus, Anodonta, Mytilus, Pholas, Pecten, Haliotis, Aplysia, Doris, Limax, Pila, Sepia, Octopus, Nautilus, Chiton* and *Anodonta. Arenicola, Hirudinaria, Pontobdella*.
- Arthropoda: *Peripatus, Lepisma,* cockroach,trachea and mouth parts of cockroach, grasshopper, praying mantis, earwig, dragonfly, termite (queen and other castes), ant, butterfly, moth, beetle, wasp, honeybee, crab, prawn, *Lepas*, *Balanus, Apus, Limulus*, scorpion, spider, millipede andcentipede*, Cypris, Cyclops, Daphnia*, Prawn, Gill and statocyst of Prawn.
- Mollusca: *Anodonta, Mytilus, Pholas, Pecten, Haliotis, Aplysia, Doris, Limax, Pila,* Glochidium larva and radula of *Pila,Sepia, Octopus, Nautilus, Chiton* and *Anodonta.*

Demonstration of anatomy of the following animals through charts/models/e-resources

- Earthworm: digestive, reproductive and nervous systems
- Cockroach: digestive, nervous and reproductive systems, mouth parts of cockroach
- Prawn: digestive and nervous systems. Appendages and gills of prawn.
- *Anodonta*: digestive and nervous systems,
- *Pila*: digestive and nervous systems, radula of *Pila*

Asterias: Aristotle's lantern, tube feet.

Course Title: Introduction to Clinical Biochemistry
Course Code: BCH215

L	T	P	Credits	Marks
4	0	0	4	100

Unit A (15 hours)

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.

Exercises

- Collection of blood and storage.
- Separation and storage of serum.

Evaluation of biochemical changes in diseases

Basic hepatic, renal and cardiovascular physiology. Biochemical symptoms associated with disease and their evaluation. Diagnostic biochemical profile.

Unit B (15 hours)

Assessment of glucose metabolism in blood

Clinical significance of variations in blood glucose. Diabetes mellitus.

Exercises

- Estimation of blood glucose by glucose oxidase peroxidase method.

Lipid profile

Composition and functions of lipoproteins. Clinical significance of elevated lipoprotein.

Exercises

- Estimation of triglycerides.

Unit C (15 hours)

Liver function tests

Exercises

- Estimation of bilirubin (direct and indirect).

Renal function tests and urine analysis

Use of urine strip / dipstick method for urine analysis.

Exercises

- Quantitative determination of serum creatinine and urea.

Unit D (15 hours)

Tests for cardiovascular diseases

Involvement of enzymes in diagnostics of heart disease including aspartate transaminase, isoenzymes of creatine kinase and lactate dehydrogenase and troponin.

Exercises

- Estimation of creatine kinase MB.

Recommended Books

1. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. I (2010), Mukherjee, K.L., Tata Mc Graw–Hill Publishing Company Limited (New Delhi). ISBN:9780070076594 / ISBN:9780070076631

2. Medical Laboratory Technology - a Procedure Manual for Routine Diagnostic Tests Vol. II (2010), Mukherjee, K.L., Tata Mc Graw – Hill Publishing Company Ltd. (New Delhi), ISBN: 9780070076648.

3. Medical Biochemistry (2005) 2nd edition, Baynes, J.W. and Dominiczak, M.H., Elsevier Mosby Ltd. (Philadelphia), ISBN:0723433410.

4. Experimental Biochemistry: A Student Companion (2005) Rao, B.S. and Deshpande, V., IK International Pvt. Ltd. (New Delhi), ISBN:8188237418.

Course Title: Membrane Biology and Bioenergetics
Course Code: BCH216

L	T	P	Credits	Marks
4	0	0	4	100

Unit A (15 hours)

Introduction to biomembranes

Composition of biomembranes - prokaryotic, eukaryotic, neuronal and subcellular membranes. Study of membrane proteins. Fluid mosaic model with experimental proof. Monolayer, planer bilayer and liposomes as model membrane systems.

Membrane structures

Polymorphic structures of amphiphilic molecules in aqueous solutions - micelles and bilayers. CMC, critical packing parameter. Membrane asymmetry. Macro and micro domains in membranes. Membrane skeleton, lipid rafts, caveolae and tight junctions. RBC membrane architecture.

Unit B (15 hours)

Membrane dynamics

Lateral, transverse and rotational motion of lipids and proteins. Techniques used to study membrane dynamics - FRAP, TNBS labeling etc. Transition studies of lipid bilayer, transition temperature. Membrane fluidity, factors affecting membrane fluidity.

Membrane transport

Thermodynamics of transport. Simple diffusion and facilitated diffusion. Passive transport - glucose transporter, anion transporter and porins. Primary active transporters - P type ATPases, V type ATPases, F type ATPases. Secondary active transporters - lactose permease, Na+-glucose symporter. ABC family of transporters - MDR, CFTR. Group translocation. Ion channels - voltage-gated ion channels (Na+/K+ voltage-gated channel), ligand-gated ion channels (acetyl choline receptor), aquaporins, bacteriorhodopsin. Ionophores - valinomycin, gramicidin.

Vesicular transport and membrane fusion

Types of vesicle transport and their function - clathrin, COP I and COP II coated vesicles. Molecular mechanism of vesicular transport. Membrane fusion. Receptor mediated endocytosis of transferrin. Membrane biogenesis

Unit C (15 hours)

Introduction to bioenergetics

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.

Oxidative phosphorylation

Mitochondria. Electron transport chain - its organization and function. Inhibitors of ETC and uncouplers. Peter Mitchell's chemiosmotic hypothesis. Proton motive force. Fo F1ATP synthase, structure and mechanism of ATP synthesis. Metabolite transporters in mitochondria. Regulation of oxidative phosphorylation. ROS production and antioxidant mechanisms. Thermogenesis. Alternative respiratory pathways in plants.

Unit D (15 hours)

Photophosphorylation

General features of photophosphorylation, historical background, Hills reaction, photosynthetic pigments, light harvesting systems of plants and microbes and resonance energy transfer. Bacterial photophosphorylation in purple bacteria, Green sulfur bacteria and Halobacterium salinarum. Photophosphorylation in plants - structure of chloroplast, molecular architecture of Photosystem I and Photosystem II, Z-scheme of photosynthetic electron flow, oxygen evolving complex and action of herbicides. Cyclic photophosphorylation and its significance. Photo inhibition. Evolution of oxygenic photosynthesis.

Recommended Books

1. Lehninger: Principles of Biochemistry (2013) 6th edition, Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 9781464109621.

2. Molecular Cell Biology (2013) 7th edition, Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York), ISBN: 9781464109812.

3. Biochemistry (2010) 4th edition, Garret, R. H. and Grisham, C.M., Cengage Learning (Boston), ISBN: 9780495114642.

4. Principles of Biochemistry (2008) 3rd edition, Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN: 9780470233962

Course Title: Membrane Biology and Bioenergetics Laboratory
Course Code: BCH217

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Determination of CMC of detergents.
2. RBC ghost cell preparation and to study the effect of detergents on membranes.
3. Separation of photosynthetic pigments by TLC.
4. Isolation of mitochondria from liver and assay of marker enzyme SDH.
5. Study photosynthetic O_2 evolution in hydrilla plant.
6. Isolation of chloroplast from spinach leaves, estimation of chlorophyll and photosynthetic activity.
7. Study of changes in erythrocyte membrane permeability under hypotonic and hypertonic consitions.

Course Title: Introduction to Microbiology
Course Code: MIC111

L	T	P	Credits	Marks
4	0	0	4	100

Unit A (15 hours)

History of Development of Microbiology
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, Development of the field of soil microbiology: Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A.Waksman
Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich, Elie Metchnikoff, Edward Jenner

Unit B (40 hours)

Diversity of Microbial World

A. Systems of classification
Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms

B. 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.

• **Algae**
History of phycology with emphasis on contributions of Indian scientists; General characteristics of algae including occurrence, thallus organization, algae cell ultra structure, pigments, flagella, eyespot food reserves and vegetative, asexual and sexual reproduction. Different types of life cycles in algae with suitable examples: Haplobiontic, Haplontic, Diplontic, Diplobiontic and Diplohaplontic life cycles. Applications of algae in agriculture, industry, environment and food.

• **Fungi**
Historical developments in the field of Mycology including 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 parasexual mechanism.
Economic importance of fungi with examples in agriculture, environment, Industry, medicine, food, biodeterioration and mycotoxins.

• **Protozoa**
General characteristics with special reference to *Amoeba, Paramecium, Plasmodium, Leishmania and Giardia*

Unit C (5 hours)

An overview of Scope of Microbiology

Recommended Books

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
3. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
4.Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
5. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T.Brown Publishers.
6. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGrawHill Book Company.
7. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th edition. McMillan.

Course Title: Introduction to Microbiology Laboratory
Course Code: MIC112

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Microbiology Good 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) used in the microbiology laboratory.
3. Preparation of culture media for bacterial cultivation.
4. Sterilization of medium using Autoclave and assessment for sterility
5. Sterilization of glassware using Hot Air Oven and assessment for sterility
6. Sterilization of heat sensitive material by membrane filtration and assessment for sterility
7. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.
8. Study of *Rhizopus*, *Penicillium*, *Aspergillus* using temporary mounts
9. Study of *Spirogyra* and *Chlamydomonas, Volvox* using temporary Mounts
10. Study of the following protozoans using permanent mounts/photographs: *Amoeba*, *Entamoeba*, *Paramecium* and *Plasmodium*

Course Title: Plant Physiology and Metabolism
Course Code: BOT241

L	T	P	Credits	Marks
4	0	0	4	100

Objectives:
To acquaint the students about the basic aspects of plant physiology.

Learning Outcome
The course will enable students to know the earlier plants, their vegetative and reproductive structures and their importance.

Unit A

Plant-water relations: Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.
Mineral nutrition: Essential elements, macro and micronutrients; Criteria of essentiality of elements; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps.

Unit B

Translocation in phloem: Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading
Photosynthesis: Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

Unit C

Respiration: Glycolysis, anaerobic respiration, TCA cycle; Oxidative phosphorylation, Glyoxylate, Oxidative Pentose Phosphate Pathway.
Enzymes: Structure and properties; Mechanism of enzyme catalysis and enzyme inhibition.
Nitrogen metabolism: Biological nitrogen fixation; Nitrate and ammonia assimilation.

Unit D

Plant growth regulators: Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.
Plant response to light and temperature: Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

Course Title: Plant Physiology and Metabolism Laboratory
Course Code: BOT242

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. To study the effect of two environmental factors (light and wind) on transpiration by excised twig.
3. Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.
4. Demonstration of Hill reaction.
5. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.
6. To study the effect of light intensity and bicarbonate concentration on O_2 evolution in photosynthesis.
7. Comparison of the rate of respiration in any two parts of a plant.
8. Separation of amino acids by paper chromatography.

Demonstration experiments (any four)

1. Bolting.
2. Effect of auxins on rooting.
3. Suction due to transpiration.
4. R.Q.
5. Respiration in roots.

Recommended Books

1. Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
2. Hopkins, W.G., Huner, N.P., (2009). Introduction to Plant Physiology. John Wiley & Sons, U.S.A. 4th Edition.
3. Bajracharya, D., (1999). Experiments in Plant Physiology- A Laboratory Manual. Narosa Publishing House, New Delhi.

Course Title: Microbial Physiology
Course Code: MIC221

L	T	P	Credits	Marks
4	0	0	4	100

Unit A **(20 hours)**

Microbial Growth and Effect of Environment on Microbial Growth

Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophilic.
Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.

Nutrient uptake and Transport
Passive and facilitated diffusion , Primary and secondary active transport, concept of uniport, symport and antiport Group translocation Iron uptake

Unit B **(10 hours)**

Chemoheterotrophic Metabolism - Aerobic Respiration

Concept of aerobic respiration, anaerobic respiration and fermentation. Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors.

Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction), Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways

Unit C **(20 hours)**

Chemolithotrophic and Phototrophic Metabolism

Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction). Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic *vs.* oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria

Unit D **(10 hours)**

Nitrogen Metabolism - an overview, Introduction to biological nitrogen fixation, Ammonia assimilation, Assimilatory nitrate reduction, dissimilatory nitrate reduction, denitrification

Recommended Books

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.
5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition,McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition.McGraw Hill Higher Education.

Course Title: Microbial Physiology Laboratory
Course Code: MIC222

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
3. Effect of temperature on growth of *E. coli*
4. Effect of pH on growth of *E. coli*
5. Effect of carbon and nitrogen sources on growth of *E.coli*
6. Effect of salt on growth of *E. coli.*
7. Demonstration of alcoholic fermentation
8. Demonstration of the thermal death time and decimal reduction time of *E. coli.*

Course Title: Proteins and Enzymes
Course Code: BCH218

L	T	P	Credits	Marks
4	0	0	4	100

Unit A **(15 hours)**

Introduction to proteins

Polypeptides and proteins. Subunit structures, conjugated proteins, diversity of function.

Isolation and analysis of proteins

Techniques to isolate and analyze proteins- salt fractionation, ion-exchange chromatography, gel permeation, HPLC, SDS-PAGE, IEF. Protein primary structure - sequencing by Edman degradation, use of enzymes and chemical reagents to obtain overlap peptides. Synthesis of peptides using Merrifeld method.

Unit B **(15 hours)**

Introduction to protein three-dimensional structures

Secondary structure: alpha-helices and beta-sheets, Ramachandran maps. Nature of non-covalent bonds and covalent bonds in protein folding. Tertiary and quaternary structures.

Myoglobin and haemoglobin - structure and function

Oxygen binding curves, cooperativity models for haemoglobin.

Unit C **(15 hours)**

Introduction to enzyme catalysis

Features of enzyme catalysis, superior catalytic power. General mechanisms of catalysis. Nomenclature.

Enzyme kinetics

Principles of reaction rates, order of reactions and equilibrium constants. Derivation of Michaelis-Menten equation. Significance of Km and Vmax. Catalytic efficiency parameters. Competitive and mixed inhibitions. Kinetics and diagnostic plots. Types of irreversible inhibitors.

Unit D **(15 hours)**

Mechanisms of enzyme action and regulation

Mechanism of action of chymotrypsin. Inhibitors of enzymes - antibiotics. Regulation of enzyme activity and its importance - aspartate transcarbamoylase.

Enzymes in medicine and industry

Enzymes used in clinical biochemistry as reagents, diagnostics and therapy. Role of immobilized enzymes in industry.

Recommended Books

1. Lehninger: Principles of Biochemistry (2013) 6th edition, Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York), ISBN: 19781464109621.

2. Fundamentals of Enzymology (1999) 3rd edition, Price, N.C and Stevens, L., Oxford University Press Inc., (New York), ISBN: 9780198064398.

3. ENZYMES: Biochemistry, Biotechnology, Clinical Chemistry (2008), 2nd edition, Palmer, T and Bonner P, East West Publishers. ISBN: 9788176710596.

Course Title: Proteins and Enzymes Laboratory
Course Code: BCH219

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Protein estimation by UV absorbance and Biuret method.
2. Protein microassay by Lowry/Bradford method.
3. Ammonium sulphate fractionation of crude homogenate from germinated mung bean.
4. Setting up assay for acid phosphatase and activity measurements of the ammonium sulphate fractions (progress curve and effect of pH).
5. Determination of Km and Vmax of enzyme enriched fraction.
6. Inhibition of acid phosphatase activity by inorganic phosphate.

Course Title: Animal Diversity II
Course Code: ZOO103

L	T	P	Credits	Marks
4	1	0	4	100

Course Objective: To acquaint students with the general characters and classification of chordates and the affinities between different groups.

Unit A

- Origin and general characters of chordates with detailed classification of each animal group with special emphasis on salient features and interrelationships — 5 hours
- Hemichordata: Hemichordates as link between non-chordates and chordates — 5 hours
- Urochordata: development, affinities, retrogressive metamorphosis. — 5 hours
- Cephalochordata: development, affinities. — 5 hours

Unit B

- Cyclostomata: migration. — 5 hours
- Pisces: scales, fins, migration, parental care. — 5 hours

Unit C

- Amphibia: Respiration, Parental care. — 6 hours
- Reptilia: Terrestrial adaptations, parental care. — 6 hours

Unit D

- Aves: Respiration, Flight, Endothermy. — 8 hours
- Mammals: Integument, Dentition, Respiration, Reproduction — 10 hours

Recommended Books

1. Dhami, P.S., Dhami, J.K., Chordate Zoology, 5th ed., R. Chand & Co., New Delhi,2006.
2. Kotpal, R.L., Text Book of Zoology- Vertebrates, Rastogi Publications, Meerut, 2012.
3. Parker, T.J., and Haswell, W.A., A Text Book of Zoology Vertebrates, 7th ed. Vol. II(eds. A.J. Marshall & Williams,W.D.), Mac Millan, London, 1972.
4. Dodson, E.O., A Text Book of Zoology, CBS Publishers & Distributors, Delhi, 1976.

Course Title: Animal Diversity II Lab
Course Code: ZOO104

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

General survey of chordates through charts/models and e-resources:

- Hemichordata: *Balanoglossus*
- Protochordata - *Herdmania*, pharynx and spicules of *Herdmania, Molgula, Ciona, Ascidia, Botryllus, Pyrosoma, Salpa, Doliolum, Oikopleura* and *Branchiostoma*, T.S. *Branchiostoma* through different regions
- Cyclostomata – *Myxine, Petromyzon* and *Ammocoetes* larva. Chondrichthyes - *Zygaena, Pristi., Narcine, Trygon* and *Rhinobatos*.
- Actinopterygii – *Polypterus, Acipenser, Lepidosiren, Mystus, Catla, Labeo rohita, Cirrhinus mrigala, Cyprinus carpio, Hippocampus, Syngnathus, Exocoetus, Anabas, Diodon, Ostracion, Tetradon, Echeneis, Lophius, Solea* and *Anguilla,* cycloid and ctenoid scales of fishes.
- Dipneusti (Dipnoi) – Any of the lungfishes.
- Amphibia – *Necturus, Proteus, Amphiuma, Salamandra, Ambystoma, Triton, Hyla, Rhacophorusl chthyophis* and *Axolotl* larva.
- Reptilia- Tortoise, Turtle, *Hemidactylus, Calotes, Draco, Varanus, Phrynosoma, Chamaeleon, Typhlops, Python,Ptyas, Bungarus, Naja, Hydrus, Vipera, Crocodilus, Gavialis* and Alligator.
- Aves : *Anas, Ardea, Milvus, Pavo, Tyto, Alcedo, Eudynamis, Casuarius;* and *Struthio.*
- Mammalia – *Echidna, Ornithorhynchus, Macropus, Erinaceus, Sorex, Loris, Macaca, Manis, Hystrix, Funambulus, Felis, Capra, Canis, Herpestes, Pteropus* and *Leo*.

Demonstration of anatomy of the following animals through charts/models/e-resources
Herdmania: General Anatomy, pharynx and spicules
Labeo: Digestive and reproductive systems, skeleton
Rana: Digestive, arterial, venous and reproductive systems. Skeleton
Varanus: Digestive, arterial, venous and reproductive systems. Skeleton
Hen: Digestive, arterial, venous and reproductive systems. Skeleton
Rat: Digestive, arterial, venous, urinogenital systems, skeleton

Course Title: Molecular biology
CourseCode: BTY241

L	T	P	Credits	Marks
4	0	0	4	100

Course Objectives: The aim is to extend understanding of the molecular mechanisms via which genetic information is stored, expressed and transmitted among generations.

Unit A

DNA structure and replication

DNA as genetic material, Structure of DNA, Types of DNA, Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, DNA polymerases, The replication complex: Pre-primming proteins, primosome, replisome, Rolling circle replication, Unique aspects of eukaryotic chromosome replication, Fidelity of replication.

Unit B

DNA damage, repair and homologous recombination

DNA damage and repair: causes and types of DNA damage, mechanism of DNA repair: Photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, translesion synthesis, recombinational repair, nonhomologous end joining. Homologous recombination: models and mechanism.

Unit C

Transcription and RNA processing

RNA structure and types of RNA, Transcription in prokaryotes: Prokaryotic RNA polymerase, role of sigma factor, promoter, Initiation, elongation and termination of RNA chains Transcription in eukaryotes: Eukaryotic RNA polymerases, transcription factors, promoters, enhancers, mechanism of transcription initiation, promoter clearance and elongation RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing, rRNA and tRNA splicing.

Unit D

Regulation of gene expression and translation

Regulation of gene expression in prokaryotes: Operon concept (inducible and repressible system), Genetic code and its characteristics, Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides,

Fidelity of translation, Inhibitors of translation. Posttranslational modifications of proteins.

Recommended Books

1. Freshney, R. I. *Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications.* 6th Edition. Wiley-Blackwell, 2010. Print.
2. Atala, A. and Lanza, R. *Methods of Tissue Engineering*. 1st Edition. Academic Press. 2001. Print.
3. Harrison, M.A. and Rae, I.F. *General Techniques of Cell Culture*. 1st Edition. Cambridge University Press. 1997. Print.
4. Masters, J.R.W. *Animal Cell Culture: A Practical Approach*. 3rd Edition. Oxford University Press. 2000. Print.
5. Friefelder, D. *Molecular Biology*. 2nd Edition. Narosa Book Distributors Pvt. Ltd. 2008. Print.
6. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. *Molecular Biology of the Cell*. 5th Edition. Garland Science. 2007. Print.

Course Title: Molecular biology laboratory
Course Code: BTY242

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Isolation of DNA from animal and plant tissue using classical methods
2. Isolation of RNA from animal and plant tissue using classical methods
3. Isolation of plasmid DNA from *E. coli* using boiling-prep and alkali lysis method
4. Restriction fragment length polymorphism
5. Agarose gel electrophoresis
6. Polyacrylamide gel electrophoresis
7. Elution of nucleic acids from agarose gel
8. Primer Designing
9. Polymerase Chain Reaction

Course Title: Bioinformatics
Course Code: BCH220

L	T	P	Credits	Marks
4	0	0	4	100

Unit A Introduction to bioinformatics **(10 hours)**

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 B

Biological databases and data retrieval **(20 hours)**

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 (Ras Mol, J mol), file formats.

Exercises

- 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.

Sequence alignment: 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.

Exercises

- BLAST suite of tools for pairwise alignment.
- Multiple sequence alignment using CLUSTALW.

Unit C **(10 hours)**

Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees - maximum parsimony, maximum likelihood and distance methods.

Exercise

- Generating phylogenetic tree using PHYLIP.

Unit D **(20 hours)**

Protein structure prediction and analysis

Levels of protein structure. Protein tertiary structure prediction methods - homology modeling, fold recognition and ab-initio methods. Significance of Ramachandran map.

Exercises

- Primary sequence analyses (Protparam).
- Secondary structure prediction (GOR, nnPredict).
- Tertiary structure prediction (SWISSMODEL).
- Protein structure evaluation - Ramachandran map (PROCHECK).

Genomics: Introduction to genomics, comparative and functional genomics, gene structure in prokaryotes and eukaryotes, gene prediction methods and tools.

Exercise

- Gene prediction using GENSCAN and GLIMMER.

Recommended Books

1. Bioinformatics: Sequence and Genome Analysis (2001), 1st ed., Mount, D.W. Cold Spring Harbor Laborator Press (New York), ISBN: 0879696087.

2. Bioinformatics and Functional Genomics (2003), 1st ed., Pevsner, J., John Wiley & Sons, Inc. (New Jersey), ISBN: 0471210048.

3. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins (2005), 3rd ed., Baxevanis, A.D. and Ouellette, B.F., John Wiley & Sons, Inc. (New Jersey), ISBN: 0471478784.

4. Bioinformatics – Principles and Applications (2008), 1st ed. Ghosh, Z. and Mallick, B., Oxford University Press (India), ISBN: 9780195692303.

Course Title: General Chemistry-II
Course Code: CHE257

L	T	P	Credits	Marks
4	1	0	4	100

CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC CHEMISTRY-I

Section A: Physical Chemistry-1 (30 Lectures)

Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

Chemical Equilibrium:
Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^{o}, Le Chatelier's principle. Relationships between *Kp, Kc* and *Kx* for reactions involving ideal gases.

Ionic Equilibria:
Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases,
pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Section B: Organic Chemistry-2 (30 Lectures)
Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Aromatic hydrocarbons
Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.
Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene).
Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

Alkyl and Aryl Halides
Alkyl Halides (Upto 5 Carbons) Types of Nucleophilic Substitution reactions.
Preparation: from alkenes *and* alcohols.
Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

Aryl Halides *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer
& Gattermann reactions.

Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH2/NH3 or NaNH2.
Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Alcohols: *Preparation:* Preparation of primary, secondary and tertiary alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.
Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. $HNO_{3)}$. Oppeneauer oxidation *Diols:* (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols: (Phenol case) *Preparation:* Cumene hydroperoxide method, from diazonium salts.
Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann
Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann reaction.

Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde)
Preparation: from acid chlorides and from nitriles.
Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH-G derivatives. Iodoform test. Aldol
Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemmensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.

Recommended Books

• T. W. Graham Solomons: *Organic Chemistry, John Wiley and Sons*.
• Peter Sykes: *A Guide Book to Mechanism in Organic Chemistry,* Orient Longman.
• I.L. Finar: *Organic Chemistry* (Vol. I & II), E. L. B. S.
• R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.
• Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry,* S. Chand.
• G. M. Barrow: *Physical Chemistry* Tata McGraw-Hill (2007).
• G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004).
• J. C. Kotz, P. M. Treichel & J. R. Townsend: *General Chemistry* Cengage Lening India Pvt. Ltd., New Delhi (2009).
• B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998).
• R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).

Course Title: General Chemistry-II-Lab
Course Code: CHE258

L	T	P	Credits	Marks
0	0	3	2	50

Section A: Physical Chemistry
Thermochemistry
1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

Ionic equilibria
pH measurements
a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.
b) Preparation of buffer solutions:
(i) Sodium acetate-acetic acid
(ii) Ammonium chloride-ammonium hydroxide
Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Section B: Organic Chemistry
1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallization, determination of melting point and calculation of quantitative yields to be done.
(a) Bromination of Phenol/Aniline
(b) Benzoylation of amines/phenols
(c) Oxime and 2, 4 dinitrophenylhydrazone of aldehyde/ketone

Recommended Books
• A.I. Vogel: Textbook of Practical Organic Chemistry, 5th edition, Prentice-Hall.
• F. G. Mann & B. C. Saunders, Practical Organic Chemistry, Orient Longman (1960).
• B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

Course Title: Basics of Organic Chemistry
Course Code: CHE115

L	T	P	Credits	Marks
4	1	0	4	100

Unit A (6 hours)

Organic Compounds: Classification, and Nomenclature, Hybridization, Shapes of molecules, Influence of hybridization on bond properties. *Electronic Displacements:* Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophlicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.Introduction to types of organic reactions and their mechanism: Addition, Elimination and Substitution reactions.

Unit B (18 hours)

Stereochemistry

Fischer Projection, Newmann and Sawhorse Projection formulae and their interconversions; Geometrical isomerism: cis-trans and, syn-anti isomerism E/Z notations with C.I.P rules.*Optical Isomerism:* Optical Activity, Specific Rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral-centres, Distereoisomers, meso structures, Racemic mixture and resolution. Relative and absolute configuration: D/L and R/S designations.

Unit C (24 hours)

Chemistry of Aliphatic Hydrocarbons A. Carbon-Carbon sigma bonds. Chemistry of alkanes: Formation of alkanes, Wurtz Reaction, Wurtz-Fittig Reactions, Free radical substitutions: Halogenation -relative reactivity and selectivity.**B. Carbon-Carbon pi bonds:** Formation of alkenes and alkynes by elimination reactions, Mechanism of E1, E2, E1cb reactions. Saytzeff and Hofmann eliminations. *Reactions of alkenes:* Electrophilic additions their mechanisms (Markownikoff/ Anti Markownikoff addition), mechanism of oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, reduction (catalytic and chemical), syn and anti-hydroxylation (oxidation). 1,2-and 1,4-addition reactions in conjugated dienes and, Diels-Alder reaction; Allylic and benzylic bromination and mechanism, e.g. propene, 1-butene, toluene, ethyl benzene. *Reactions of alkynes:* Acidity, Electrophilic and Nucleophilic additions. Hydration to form carbonyl compounds, Alkylation of terminal alkynes.**C. Cycloalkanes and Conformational Analysis**

Types of cycloalkanes and their relative stability, Baeyer strain theory, Conformation analysis of alkanes: Relative stability: Energy diagrams of cyclohexane: Chair, Boat and Twist boat forms; Relative stability with energy diagrams.

Unit D (12 hours)

Aromatic Hydrocarbons

Aromaticity: Hückel's rule, aromatic character of arenes, cyclic carbocations/carbanions and heterocyclic compounds with suitable examples. Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation/acylation with their mechanism. Directing effects of the groups.

Recommended Books

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).4.
4. Eliel, E. L. & Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
5. Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

Course Title: Organic Chemistry Lab-I
Course Code: CHE116

L	T	P	Credits	Marks
0	0	4	2	50

Time: 04 Hours

Experiments:

1. Checking the calibration of the thermometer.

2. Purification of organic compounds by crystallization using the following solvents:

Water

Alcohol

Alcohol-Water

3. Determination of the melting points of above compounds and unknown organic compounds (Kjeldahl method and electrically heated melting point apparatus).

4. Effect of impurities on the melting point – mixed melting point of two unknown organic compounds.

5. Determination of boiling point of liquid compounds. (boiling point lower than and more than 100 °C by distillation and capillary method)

6. Chromatography

a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography

b. Separation of a mixture of two sugars by ascending paper chromatography

c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)

Recommended Books

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)

2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)

Course Title: Introduction to Nutritional Biochemistry
Course Code: BCH323

L	T	P	Credits	Marks
4	0	0	4	100

Unit A (8 hours)

Introduction to Nutrition and Energy Metabolism

Defining Nutrition, role of nutrients. Unit of energy, Biological oxidation of foodstuff. measurement of energy content of food, Physiological energy value of foods, SDA. Measurement of energy expenditure. Direct and Indirect Calorimetry, factors affecting thermogenesis, energy utilization by cells, energy output – Basal and Resting metabolism, physical activity, factors affecting energy input - hunger, appetite, energy balance Energy expenditure in man. Estimating energy requirements, BMR factors Recommended Nutrient Intakes (RNI) and Recommended Dietary Allowances for different age groups.

Unit B (16 hours)

Dietary carbohydrates and health

Review functions of carbohydrates. Digestion, absorption ,utilization and storage, hormonal regulation of blood glucose. Dietary requirements and source of carbohydrates, Dietary fiber, role of fibre in lipid metabolism, colon function, blood glucose level and GI tract functions.

Dietary lipid and health

Review of classification, sources, functions, digestion, absorption, utilization and storage. Essential Fatty Acids; Functions of EFA, RDA, – excess and deficiency of EFA. Lipotropic factors, role of saturated fat, cholesterol, lipoprotein and triglycerides. Importance of the following: a) Omega – fatty acids. Omega 3/ omega 6 ratio b) Phospholipids c) Cholesterol in the body d) Mono, Polyunsaturated and Saturated Fatty Acids. Dietary implications of fats and oils, Combination ratios of n6 and n3, MUFA, PUFA and SFA.

Unit C (16 hours)

Dietary Proteins and health

Review of functions of proteins in the body, Digestion and absorption. Essential and Non- essential amino acids. Amino Acid Availability Antagonism, Toxicity and Imbalance, Amino acid Supplementation. Effects of deficiency. Food source and Recommended Dietary Allowances for different age group. Amino acid pool. NPU, Biological Value , Nitrogen balance. PEM and Kwashiorkor.

Fat and water soluble Vitamins

Vitamin A, C, E,K and D Dietary sources, RDA, Adsorption, Distribution, Metabolism and excretion(ADME), Deficiency. Role of Vitamin A as an antioxidant, in Visual cycle, dermatology and immunity. Role of Vitamin K in Gamma carboxylation. Role of Vitamin E as an antioxidant. Extra-skeletal role of Vitamin D and its effect on bone

physiology. Hypervitaminosis. Vitamin C role as cofactor in amino acid modifications. Niacin- Metabolic interrelation between tryptophan, Niacin and NAD/ NADP. Vitamin B6-Dietary source, RDA, conversion to Pyridoxal Phosphate. Role in metabolism, Biochemical basis for deficiency symptoms. Vitamin B12 and folate; Dietary source, RDA, absorption, metabolic role Biochemical basis for deficiency symptoms.

Unit D (20 hours)

Minerals

Calcium, Phosphorus and Iron - Distribution in the body digestion, Absorption, Utilization, Transport, Excretion, Balance, Deficiency, Toxicity, Sources, RDA. Calcium: Phosphorus ratio, Role of iron in prevention of anemia. Iodine and iodine cycle. Iodine, Fluoride, Mg, Cu, Zn, Se, Manganese, Chromium, Molybdenum Distribution in the human body, Physiology, Function, deficiency, Toxicity and Sources

Assessment of Nutritional status

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.

Food and drug interactions and Nutriceuticals

Nutrient interactions affecting ADME of drugs, Alcohol and nutrient deficiency, Anti-depressants, psychoactive drugs and nutrient interactions, Appetite changes with drug intakes and malnutrition. Food as medicine

Recommended Books

1. Textbook of Biochemistry with Clinical Correlations (2011); Devlin, T.M. John Wiley & Sons, Inc. (New York), ISBN: 97804710281734.

2. Nutrition for health, fitness and sport (2013); Williams.M.H, Anderson,D.E, Rawson,E.S., McGraw Hill international edition. ISBN: 9780071318167.

3. Krause's Food and Nutrition Care process.(2012); Mahan, L.K., Strings, S.E, Raymond, J. Elsevier's Publications. ISBN:9781437722338.

4. The vitamins, Fundamental aspects in Nutrition and Health (2008); G.F. Coombs Jr. Elsevier's Publications. ISBN: 9780121834937.

5. Principles of Nutritional Assessment (2005); Rosalind Gibson. Oxford University Press. ISBN: 978-0195171693.

Course Title: Introduction to Nutritional Biochemistry Laboratory
Course Code: BCH324

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Bioassay for vitamin B12/B1.

2. Homocysteine estimation.

3. Serum/ urine MMA estimation.

4. Anthropometric identifications for Kwashiorkor, Marasmus and Obesity.

5. Determination of oxidative stress: TBARS, antioxidant enzymes in hemolysate.

6. Vitamin A/E estimation in serum.

7. Bone densitometry /bone ultrasound test demonstration (visit to a nearby clinic).

Course Title: Molecular Basis of Infectious and Non-Infectious Diseases
Course Code: BCH325

L	T	P	Credits	Marks
4	0	0	4	100

Unit A (10 hours)

Multifactorial complex disorders and Cancer: Understanding the definition of multifactorial diseases. Polygenic diseasesand the relationship of environmental factors and genetic makeup in the onsetof 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.

Unit B (20 hours)

Diseases due to mis-folded proteins and monogenic diseases: Introduction to protein folding and proteosome removal of misfolded proteins;etiology and molecular basis for Alzheimer's, Prion diseases, Huntington'sChorea, sickle cell anemia, Thalassemia.

Monogenic diseases: In born errors in metabolism: PKU, Alkaptonuria, Maple syrup urine disease;Receptor and transport defects: Cystic fibrosis, Long QT syndrome, familialhypercholesterolemia, Achondroplasia. Hemoglobinopathies and clottingdisorders.

Unit C (10 hours)

Classification of infectious agents: Bacteria, Viruses, protozoa and fungi. Past and present emerging and reemerginginfectious diseases and pathogens. Source, reservoir andtransmission of pathogens, Antigenic shift and antigenic drift. Host parasiterelationship, types of infections associated with parasitic organisms.

Overviewof viral and bacterial pathogenesis: Infection and evasion.

Unit D (20 hours)

Overview of diseases caused by bacteria: Detailed study of tuberculosis: History, causative agent, molecular basis ofhost specificity, infection and pathogenicity, Diagnostics, Therapeutics,inhibitors and vaccines. Drug resistance and implications on public health. Other bacterial diseases including Typhoid, Diphtheria, and Pneumonia.
Overview of diseases caused by Viruses: Detailed study of AIDS, history, causative agent, pathogenesis, Diagnostics,Drugs and inhibitors. Other viral diseases including hepatitis, influenza, polio.
Overview of diseases caused by Parasites: Detailed study of Malaria, history, causative agents, Vectors, life cycle, Hostparasite interactions, Diagnostics, Drugs and Inhibitors, Resistance, Vaccinedevelopment.
Fungal diseases: General characteristics. Medical importance of major groups, pathogenesis, treatments.

Course Title: Molecular Basis of Infectious and Non-infectious Diseases Laboratory
Course Code: BCH326

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Estimation of glycosylated haemoglobin.
2. Permanent slides for different types of cancer.
3. Diagnostic profile for assessment of CVS and Diabetes mellitus using casestudies.
4. Permanent slides of pathogens. *Mycobacterium tuberculosis*, *Leishmania*,*Plasmodium falciparum*
5. WIDAL test
6. Gram staining
7. Acid fast staining
8. PCR based diagnosis

Course Title: Human Physiology
Course Code: ZOO257

L	T	P	Credits	Marks
4	0	0	4	100

Course Objective: To acquaint students with the functioning of all systems of the human body.

Unit A

- **Nutrition:** Types of nutrition and nutrients; sources and functions of nutrients and the diseases associated with their excess or lesser intake. 2 hours
- **Digestive System:** Alimentary canal; Structure and function of digestive glands; Digestion and absorption of carbohydrates, fats and proteins; Nervous and Hormonal control of Digestion 10 hours

Unit B

- **Respiratory System:** Ventilation; External and Internal Respiration; Transport of oxygen and carbon dioxide in blood; Factors affecting transport of gases. 6 hours
- **Circulatory System:** Composition of blood; Lymph; Blood groups; Blood coagulation**;** Structure of heart; co-ordination of heart beat, Cardiac cycle; ECG 10 hours
- **Excretory System:** Functional anatomy of kidney; Mechanism and regulation of urine formation. 8 hours

Unit C

- **Endocrine System:** Structure of pituitary, thyroid, parathyroid, pancreas, adrenal, ovaries, testes; and the diseases associated with them 7 hours
- **Reproductive System:** Spermatogenesis; Oogenesis; Physiology of male and female reproductive systems; hormonal and neuronal control 7 hours

Unit D

- **Nervous System:** Structure of Neuron; Propagation of nerve impulses (myelinated and non-myelinated nerve fibres); neuromuscular junctions 5 hours
- **Muscular system:** Structure of skeletal muscle, Mechanism of muscle contraction (sliding filament theory) 5 hours

Recommended Books

1. Guyton, A.C., Hall, J.E. Text Book of Medical Physiology, XIIth edition, Harcourt Asia Pvt. Ltd./W.B. Saunders Company, 2011
2. Best, J.P., Best and Taylor's physiological basis of medical practice, 11th ed., William
and Wilkins, 1985.
3. Hoar, W.S., General and comparative physiology, Adaptation and Environment, 3rd ed.,
Cambridge University Press, 1983.
4. Rhoades, R.A., Tanner, G.A., Medical Physiology, 2nd ed., Lippincott Williams and Wilkins, 2003.
5. Tortora, G.J., Derrickson, B.H. Principles of Anatomy and Physiology, XII Edition, John Wiley and Sons, Inc., 2009.

Course Title: Human Physiology Laboratory
Course Code: ZOO258

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

- Identification of food stuffs-starch, sucrose, glucose, proteins and fats.
- Demonstration of osmosis and diffusion.
- Demonstration of the presence of amylase enzyme in saliva. Effect of pH and temperature on enzyme action.
- Determination of coagulation and bleeding time of blood.
- Determination of blood groups of human blood samples.
- Recording of blood pressure of man.
- Enumeration of red blood corpuscles and white blood corpuscles of man.
- Estimation of haemoglobin content in blood.

Course Title: Recombinant DNA technology
Course Code: BTY353

L	T	P	Credits	Marks
4	0	0	4	100

Unit A

Molecular tools and applications -restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR

Unit B

Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription,. Genome mapping, DNA fingerprinting, Applications of Genetic Engineering Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each)

Unit C

Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).

Unit D

Genetic engineering in plants: Use of *Agrobacterium tumefaciens* and Arhizogenes, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

Course Title: Recombinant DNA technology Laboratory
CourseCode: BTY354

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Isolation of chromosomal DNA from plant cells
2. Isolation of chromosomal DNA from *E.coli*
3. Qualitative and quantitative analysis of DNA using spectrophotometer
4. Plasmid DNA isolation
5. Restriction digestion of DNA
6. Making competent cells
7. Transformation of competent cells.
8. Demonstration of PCR

Course Title: Fundamentals of Immunology
Course Code: BCH327

L	T	P	Credits	Marks
4	0	0	4	100

Unit A (10 hours)

Cells and organs of the immune system

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.

Unit B(18 hours)

Immunogens and antigens

Antigens and haptens, factors that dictate immunogenicity, B and T cell epitopes.

Antibody structure and function

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 C(16 hours)

Complement system

Complement activation by classical, alternate and MB lectin pathway, biological consequences of complement activation, regulation and complement deficiencies.

MHC complex and antigen presentation

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.

Biology of the T lymphocyte

Structure and role of T cell receptor, and co-receptor, T cell development, generation of receptor diversity, selection and differentiation.

Cell mediated cytotoxic responses

General properties of effector T cells, cytotoxic T cells (Tc), natural killer cells; NKT cells and antibody dependent cellular cytotoxicity (ADCC).

Unit D(16 hours)

Tolerance, autoimmunity and hypersensitivity (8 hours)

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 (8 hours)

Immunological basis of graft rejection, clinical manifestations, immunosuppressive therapy and privileged sites. Vaccines - active and passive immunization, types of vaccines.

Recommended Books

1. Kuby Immunology (2007) 6th edition, Kindt, T.L., Goldsby, R.A. and Osborne, B.A., W.H Freeman and Company (New York), ISBN: 9780716785903.

2. Immunology: A Short Course (2009) 6th edition, Coico, R and Sunshine, G., John Wiley& sons, Inc (New Jersey), ISBN: 9780470081587.

3. Janeway's Immunobiology (2012) 8th edition, Murphy, K., Mowat, A., and Weaver, C.T., Garland Science (London & New York), ISBN: 9780815342434.

Course Title: Fundamentals of Immunology Laboratory
Course Code: BCH328

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. To perform immunoelectro-phoresis.
2. Differential leukocyte count by geimsa staining.
3. Assays based on precipitation reactions – (i) Ouchterlony double diffusion (ODD) and (ii) Mancini radial immunodiffusion.
4. Assays based on agglutination reactions - Blood typing (active) & passive agglutination.
5. Enzyme linked immune-sorbent assay (ELISA).

Course Title: Tools and Techniques in Life Sciences
Course Code: BCH329

L	T	P	Credits	Marks
4	0	0	4	100

Unit A

Safety practices in the laboratory. Preparation and storage of solutions. Concepts of solution concentration and storing solutions.

Basic weight and measurements: Atomic weight, Weight molecular weight, molecular mass, Gram molecular mass, equivalent weight, density, specific gravity, Expression of solution concentrations, normality equation, Concept of a buffer, Henderson-Hasselbach equation, working of a pH meter, Quantitative transfer of liquids.

Unit B

Spectroscopic techniques: Beer-Lamberts law, light absorption and its transmittance, 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. Introduction to Circular dichorism, IR, NMR, Mass spectroscopy.

Chromatography Techniques: General principles, types and techniques; column chromatography, partition, size exclusion, ion exchange, and affinity chromatography.

Unit C

Centrifugation – Principles of centrifugation, concepts of RCF, different types of instruments and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation

Electrophoretic techniques – Principles of electrophoretic separation. Continuous, zonal and capillary electrophoresis, different types of electrophoresis including paper, cellulose, acetate/nitrate and gel. Electroporation, pulse field gel electrophoresis .

Unit D

Immunochemical techniques – Making antibodies, Enzyme linked immunosorbent assay (ELISA), Cell and tissue staining techniques, Immunocapture, Immunoaffinity chromatography (IAC), Antibody-based biosensors.

Introduction and importance of virtual labs in biochemistry

Recommended Books

1. Physical Biochemistry: Principles and Applications (2010) 2ndedition, Sheehan, D., Wiley Blackwell (West Sussex), ISBN: 9780470856024 / ISBN: 9780470856031.

2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology (1982) 2ndedition, Freifelder, D., W.H. Freeman and Company (New York), ISBN:0716713152.

3. An Introduction to Practical Biochemistry (1998) 3rdedition, Plummer D. T., Tata McGraw Hill Education Pvt. Ltd. (New Delhi), ISBN: 9780070994874.

4. Principles and Techniques of Biochemistry and Molecular Biology (2010) 7th edition; Wilson K, Walker J, Cambridge University Press, ISBN: 9780521178747.

Course Title: Advanced Cell Biology
Course Code: BCH330

L	T	P	Credits	Marks
4	0	0	4	100

Unit A (10 hours)

Plasma Membrane and Nuclear Transport:
Properties and Composition of Cell Membrane; Structure of Nuclear Envelope; Nuclear Pore Complex; Transport Across Nuclear Envelope; Regulation of Nuclear Protein Import and Export.

UnitB (10 hours)

Cell-Cell Interaction: Cell-Cell Interactions and Cell-Matrix Interactions; Components of ExtracellularMatrix: Collagen and Non-Collagen Components; Tight Junctions; Gap Junctions;Desmosomes; Hemidesmosomes; Focal Adhesions And Plasmodesmata; Cell Wall;Role of Cell Interaction In Development.

Unit C (20 hours)

Cell Cycle and Programmed Cell Death: Overview of The Cell Cycle; Eukaryotic Cell Cycle; Cell Cycle Control; 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 D (20 hours)

Advanced Methods in Cell Biology: Ultracentrifugation, Fluorescence Microscopy-FACS, Confocal Microscopy, Electron Microscopy, Plant and Animal Cell Culture, Immunohistochemistry.

Recommended Books

1. Molecular Cell Biology (2013) 7th edition, Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York), ISBN: 9781464109812.

2. Molecular Biology of the Cell (2014). 6th edition, Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. Garland Science, ISBN: 978-0815344322

3. Karp's Cell Biology (2013) 7th edition, Karp G, John Wiley & Sons Inc., Singapore, ISBN: 978-1118318744

Course Title: Advanced Cell Biology Laboratory
Course Code: BCH331

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Isolation of organelles by sub-cellular fractionation.

2. Total leukocyte count using hemocytometer.

3. Total RBC count using hemocytometer.

4. Study of cell viability /death assay by use of trypan blue and MTT assay.

5. Study of apoptosis through analysis of DNA fragmentation patterns using agarose gel electrophoresis.

Course Title: Endocrinology
Course Code: BCH203

L	T	P	Credits	Marks
4	0	0	4	100

Course Objectives: This course introduces students to basic principles of endocrinology. It covers all the major classes of hormones released by various endocrine organs and their mechanism of action.

Unit A (15 hours)

Introduction

History, endocrine glands, hormones as chemical messengers, stimulus for hormone release: change in homeostasis, sensory stimulus and others.

Cell signaling & Mechanism of Hormone action

Receptor study, Binding affinity, specificity, Scatchard plot and purification. G protein linked receptor family; Signal transduction pathways involving G-proteins, Adenyl cyclases, Ca^{+2}, Phosphoinositides, PI-3 Kinase, DAG, cAMP, cGMP, NO, Protein kinases (A,B,C,G), Phosphoprotein phosphatases & Phosphodiesterases. Receptor tyrosine kinase family- EGF receptor family, Insulin receptor family, & Cytokine/erythropoietin receptor family associated with non receptor Tyrosine kinase (Signal transduction pathways involving: SH2 proteins, Ras, IRS-1, Raf, MEK, MAP kinase, JAK-STAT pathway).

Unit B (15 hours)

Intracellular Receptors

Steroid hormone receptors, Thyroid hormone receptors.Sensitisation & Desensitization of receptors; Short term regulation & Long term regulation. Drugs and Toxins affecting cell signaling: Cholera toxin, pertussis toxin, anthrax toxin, Bubonic Plague virulence, Forskolin, theophyllin, Phorbol esters, Seldenafil (Viagra).

Hormones

Structures, Receptor type, Regulation of biosynthesis and release (including feed back mechanism). Physiological and Biochemical actions, & Pathophysiology (hyper & hypo secretion).

Hypothalmic Hormones: CRH, TRH, GnRH, PRL/PRIH, GHRH/GHRIH.

Pituitary Hormones - Anterior Pituitary hormones- Growth hormone, Prolactin,

POMC peptide family, LH, FSH, TSH; Posterior Pituitary : Vasopressin, Oxytocin.

Unit C (15 hours)

Endocrine disorders

Gigantism, Acromegaly, dwarfs, pigmies; Pathophysiology: Diabetes insipidus. Thyroid Hormone (include biosynthesis) Goiter, Graves disease, Cretinism, Myxedema, Hashimoto's disease.

Hormones regulating Ca^{2+} Homeostasis

PTH, Vitamin D, Calcitonin. Pathophysiology : Rickets, Osteomalacia, Osteoporosis.

Pancreatic Hormones: Insulin, Glucagon, Diabetes type I & II.

GI tract Hormones: Gastrin, Secretin, CCK, GIP, Ghrelin.

Unit D (15 hours)

Hormones of Adrenal Cortex

Aldosterone (renin angiotensin system) & cortisol. Pathophysiology: Addisons disease, Conn's syndrome, Cushings syndrome. Hormones of Adrenal Medulla, Epinephrine & norepinephrine.

Reproductive Hormones

Male & female Sex hormones. Interplay of hormones during Reproductive cycle, Pregnancy, Parturition, & Lactation. Oral Contraception.

Other organs with endocrine function: Heart (ANP), Kidney (erythropoietin), Liver (Angiotensinogen, IGF-1), Adipose tissue (Leptin, adiponectin). Pathophysiology: Obesity. Growth factors: PDGF, EGF, IGF-I, II& NGF.

Recommended Books

1. Nelson DL & Cox M.M., Lehninger Principles of Biochemistry, 7th Edition, WH Freeman & Company, New York, 2017. ISBN: 9781464126116.

2. Widmaier, E.P., Raff, H. and Strang, K.T. (2003). Vander, Sherman, Luciano's Human Physiology, 9th Edition, McGraw-Hill Higher Education. ISBN: 9780072437935.

3. Molecular Cell Biology (2013) 7th edition, Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York), ISBN: 9781464109812.

Course Title: Endocrinology Laboratory
Course Code: BCH204

L	T	P	Credits	Marks
0	0	3	2	50

Experiments:

1. Lipid profile- TAG, Lipoproteins, Cholesterol

2. Glucose tolerance test

3. Vitamin D assay

4. Assay of estrogen

5. T3/T4 assay by ELISA

6. Estimation of Calcium.