COURSES OF STUDIES

FOR

MASTER DEGREE COURSE

IN

SCIENCE

M.SC (LIFE SCIENCE)

Choice Based Credit System(CBCS)

First & Second Semester Examination – 2020-21

Third & Fourth Semester Examination – 2021-22

GOVERNMENT AUTONOMOUS COLLEGE,
PHULBANI, KANDHAMAL

SYLLABI FOR CBCS COURSE

SEMESTER	CORE COURSE (CC)	CORE ELECTIVE (CE)
I	CC – 1.1	-
	CC – 1.2	-
	CC – 1.3	-
	CC – 1.4	-
	CC – 1.5(P)	-
II	CC – 2.1	-
	CC – 2.2	-
	CC – 2.3	-
	CC – 2.4	-
	CC – 2.5(P)	-
III	CC – 3.1	-
	CC – 3.2	-
	-	CE – 3.3
	-	CC – 3.4(P)
IV	CC – 4.1	-
	-	CE – 4.2
	-	CE – 4.3
	-	CE – 4.4 (Project)

YEAR & SEMESTER-WISE PAPERS & CREDITS AT A GLANCE

Year	Paper Code	Title of the paper	Total Marks (MS+ES)	No. of Credits
FIRST YEAR		**FIRST SEMESTER**	**500**	**30**
	CC– 1.1	Cell Biology	20+80=100	06
	CC– 1.2	Genetics & Bioinformatics	20+80=100	06
	CC– 1.3	Biochemistry & Biophysics	20+80=100	06
	CC– 1.4	Evolution & Taxonomy	20+80=100	06
	CC– 1.5	Practical related to paper 1.1, 1.2, 1.3 &1.4	100	06
		SECOND SEMESTER	**500**	**30**
	CC– 2.1	Molecular Biology & Genetic Engineering	20+80=100	06
	CC– 2.2	Microbiology & Resource Biology	20+80=100	06
	CC– 2.3	Biostatistics & Instrumentation	20+80=100	06
	CC– 2.4	Ecology & Conservation Biology	20+80=100	06
	CC– 2.5	Practical related to paper 2.1, 2.2, 2.3 &2.4	100	06
SECOND YEAR		**THIRD SEMESTER**	**400**	**24**
		Stream Paper – A – Plant Science / B – Animal Science		
	CC– 3.1	A – Plant Diversity B – Animal Diversity & Animal Behaviour	20+80=100	06
	CC– 3.2	A – Plant Physiology B – Animal Physiology & Endocrinology	20+80=100	06
		Special Paper : (Any one) *I - Environment Biotechnology & Conservation Biology* *II – Biochemistry & Molecular Biology*		
	CE– 3.3	I – Ecology & Toxicology II – Protein Chemistry	20+80=100	06
	CC– 3.4	Practical Related to Paper 3.1 & 3.2	100	06
		FOURTH SEMESTER	**400**	**24**
	CC– 4.1	A – Plant Development & Plant Biotechnology B – Animal Development & Animal Biotechnology	20+80=100	06
	CE– 4.2	I – Environment Management II – Biochemistry	20+80=100	06
	CE– 4.3	I – Conservation Biology II – Genomics	20+80=100	06
	CE– 4.4	Project Work	100	06

CC– **Core Courses,** CE– **Core Elective**

Total Papers=18, Total Marks=1800, Total Credits=108

SEMESTER – I

CC-1.1 : CELL BIOLOGY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Cell Theory, General organization of Prokaryotic and Eukaryotic cells.

Plasma membrane: Composition and dynamics, membrane carbohydrates and their role in cell recognition, membrane modifications.

Transport across membranes: Zonula occludens, Zonula adherens, Macula adherens, Gap junction (Nexus), Plasmodesmata (Structure, role in movement of molecules & macromolecules), major types of membrane transport

Social context of cells: Cell junction, cell adhesion and extra-cellular matrix.

Cell motility: Cilia and flagella of prokaryotes and eukaryotes.

Cell Wall: Structure & functions, biogenesis, growth

UNIT – II

Chromatin organization: Histones and nonhistone chromosomal proteins, nucleosomes and higher order structures, centromere, kinetochore and telomere, lampbrush chromosome, polytene chromosome, telocentric chromosome, Inter-phase chromatin, euchromatin and heterochromatin, karyotype and its significance.

Nucleus: Ultrastructure and function of nucleus, nuclear envelope, nuclear pore, nucleolus.

Cytoskeleton: Microtubules, intermediate filaments and microfilaments, macromolecular trafficking into and out of nucleus.

Molecular events & mechanisms of cell division: Cell cycle (molecular models and events, regulators and checkpoints in cell cycle, meiosis, cytokinesis (Role of mitotic spindle in determining cytoplasmic cleavage site)

UNIT – III

Chloroplast: Structure, genome organization, gene expression, RNA editing, nucleo-chloroplastic interaction.

Mitochondria: Structure, genome organization, biogenesis, electron transport system (mechanism & energetics), oxidative phosphorylation, photophosphorylation & chemiosmotic concept.

Protein sorting: Transport of proteins into mitochondria and lysosomes.

Vesicular traffic: Coated and un-coated vesicles, transport of secretory materials, endocytosis

UNIT – IV

Phylogeny of Immune system: Innate and acquired Immunity, haematopoiesis and differentiation, cells & organs of the immune system, nature and biology of antigens and super antigens, structure and function of antibody molecule, generation of humoral and cell mediated immune response, BCR and TCR, generation of diversity

UNIT – V

Major histocompatibility complex and MHC restriction, antigen processing and presentation, complement system, cytokines- types and their role in immune regulation.

Disorders of Immune system: Hypersensitivity, Immunotolerance, Autoimmunity, Transplantation, Vaccines, Interferons and Episomes.

Apoptosis: extrinsic & intrinsic pathways

Reference Books:

1. Alberts et al: Essential Cell Biology (1998, Garland)
2. Alberts et al: Molecular Biology of the Cell (2002, Garland)
3. Bostock & Sumner: Eukaryotic Chromosome (1987, North-Holland)
4. DeRobertis & DeRobertis: Cell and Molecular Biology (1987, Lee & Febiger)
5. Griffith et al: Modern Genetic Analysis (2002, Freeman)
6. Hartl & Jones: Essential Genetics: A Genomic Perspective (2002, Jones & Bartlet)
7. Karp: Cell and Molecular Biology (2002, John Wiley & Sons)
8. Lodish et al: Molecular Cell Biology (2000, Freeman)
9. Pollard & Earnshaw: Cell Biology (2002, Saunders)
10. Kuby's Immunology, 5th edition, By R. A. Goldsby et al.
11. Clinical Immunology By Brostoff, Seaddin, Male and Roitt

12. Fundamentals of immunology By William Paul.
13. Immunology by Janeway
14. Principles of Immunology by N.V. Shastri, Himalaya Publishing House
15. Cellular and Molecular Immunology- Abul Abbas and Andrew Lichtman
16. Immunology-Weir

CC-1.2 : GENETICS & BOINFORMATICS

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Mendel's laws of inheritance: Chromosomal basis, modern interpretation & deviation.

Non-Mendelian inheritance: Epistasis or modified mendelian dihybrid ratios, maternal effect, cytoplasmic inheritance.

Multiple allele in human (ABO blood group); eye colour in Drosophila, self incompatibility in plants; Polygenic inheritance, pleiotrophy.

Linkage: Types, detection & test for linkage, construction of linkage maps, identification of particular linkage groups within specific chromosome.

Crossing over: Relationship between genetic and cytological crossing over, relationship between crossing over and chaisma formation, molecular mechanism of crossing over, three point test cross in Drosophila, gene mapping

UNIT – II

Meiotic behavior of chromosomes: Primary & secondary non-disjunction, genic balance theory of sex determination, sex determination in humans and Drosophila with special reference to SRY and sex lethal genes, sex determination in plants with special reference to Melandrium.

Mitotic Recombination: Recombination within gene, gene mapping

Sex linkage: Sex linked genes in man, sex chromosome disorders in man, sex influenced dominance by sex-linked gene expression.

Interference and coincidence

UNIT – III

Structural and numerical alterations in chromosomes: Spontaneous and induced mutations, physical and chemical mutagens, chromosomal aberrations, meiotic behavior of deletion, duplication, inversion and translocation

UNIT – IV

Overview, history, features & scope of bioinformatics

FASTA and Multi-FASTA file formats

Resources, databases and Tools of NCBI, NIG, EBI, PIR and Swiss-Prot

Protein structure classification databases –CATH and SCOP

Submission & retrieval of data from Gen Bank, DDBJ, EMBL and PDB databases

UNIT – V

Sequence alignment: Concept of alignment and gap penalties, scoring matrices – PAM and BLOSUM, alignment of pairs of sequences – Dot matrix method.

Pairwise alignment using BLAST

Multiple alignment using CLUSTAL

Reference Books:

1. Brooker: Genetics : Analysis and Principles (1999, Addison-Wesley)
2. Gardner et al: Principles of Genetics (1991, John Wiley)
3. Griffith et al: Modern Genetic Analysis (2002, Freeman)
4. Hartl and Jones: Essential Genetics: A Genomic Perspective (2002, Jones & Bartlet)
5. Karp: Cell and Molecular Biology (2002, John Wiley & Sons)
6. Russell: Genetics (2002, Benjamin Cummings)
7. Snustad and Simmons: Principles of Genetics (2003, John Wiley)
8. Bostock & Sumner: Eukaryotic Chromosome (1987, North-Holland)
9. Lewin, Genes VIII (2004, Wiley)
10. Barnes & Gray: Bioinformatics for geneticists (2003, Wiley)

11. Lesk: Bioinformatics (2nd ed 2006, Oxford)
12. Westhead et al: Bioinformatics Instant Notes (Indian ed 2003, Viva Books)
13. Mount, Bioinformatics (2nd ed 2006, CBS)
14. Hunt and Livesey: Functional Genomics (2006, Oxford)
15. Campbel: Discovering Genomics, Proteomics and Bioinformatics (2006, LPE)
16. Baxevanis and Ouellettee: Bioinformatics – A practical guide to the analysis of genes and proteins (2001, John Wiley & Sons)

CC-1.3 : BIOCHEMISTRY & BIOPHYSICS

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Concept of biomolecules: chemical composition and bonding, three dimensional structures, Chemical reactivity, macromolecules and their monomeric subunits

Gibbs Danann membrane equilibrium, membrane potential

Electromagnetic radiation: Types, interaction with living matters with reference to UV & visible radiations.

Weak interactions in aqueous system: Ionization of water, weak acids, weak bases, buffers and buffering capacity

Principle of bioenergetics: Bioenergetics and thermodynamics, phosphoryl group transfers and ATP, biological oxidation-reduction reactions, kinetic order of reaction

UNIT – II

Proteins: Classification and properties of amino acids, Levels of protein structure, protein denaturation and folding. Amino acid catabolism (transamination, oxidative deamination and urea cycle) Protein degradation (proteosomal pathway) and Solid phase synthesis of peptides

UNIT – III

Carbohydrates: Classification, configuration and conformation of monosaccharides, sugar derivatives, important disaccharides, structural and storage polysaccharides, glucosaminoglycans, proteoglycans, glycoproteins and glycolipids.

Carbohydrate metabolism: Glycolysis, TCA cycle, pentose-phosphate pathway, gluconeogenesis, glycogen metabolism, regulation of carbohydrate metabolism, oxidative phosphorylation, electron transport and ATP synthesis

UNIT – IV

Enzymes: General properties, nomenclature and classification, extraction and assay, enzyme kinetics and its significance, Brigg's-Halden modification, determination of Vmax and Km enzyme inhibition, determination of Ki

Mechanism of enzyme action: general acid-base catalysis, covalent catalysis, metal catalysis

Mechanism of action of Carboxy Peptidase, Ribonuclease, Lysozyme and Chymotrypsin;

Enzyme regulation: allosteric regulation, covalent modification, zymogenic activation

UNIT – V

Lipids: Classification, storage lipids, structural lipids (glycerophospholipid and sphingolipids), signaling lipids, cofactors, terpenes, and pigments, coenzymes and vitamins,

biosynthesis and oxidation of fatty acids, regulation of fatty acid metabolism.

Nucleic acids: Structure & types, biosynthesis of nucleotides.

Reference Books:

1. Nelson et al: Lehninger Principles of Biochemistry (3rd Ed.), MacMillan Worth, 2000
2. Berg et al.: Biochemistry (5th Ed.), Freeman, 2002
3. Mathews et al.: Biochemistry (3rd Ed.), Pearson, 2004
4. Zubay et al: Principles in Biochemistry (2nd Ed.), WCB, 1995
5. Rawn: Biochemistry, Neil Patterson, 1989
6. Bender, D.A.: Amino acid metabolism, John Wiley & Sons, 1985
7. Grisolia, S. et al. : The Urea Cycle, John Wiley & Sons, 1976
8. Voet & Voet: Biochemistry Vol. I & II (3rd Ed.), Wiley, 2004.

CC-1.4 : EVOLUTION & TAXONOMY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Evolutionary mechanisms: Evidences and theories of evolution, variation and selection as underlying mechanisms of evolution, types and rates of mutation in population, mechanism of isolation, origin of species

UNIT – II

Evolutionary trends: Micro, macro and mega patterns of evolution, molecular and genomic evolution, gene flow, gene duplication and mosaic evolution, concept of gene pool, gene frequencies – equilibrium frequency (Hardy-Weinberg equilibrium), shift in gene frequency with & without selection.

Survey of life through different geological era, mass extinctions and role of extinction in evolution, biological and cultural evolution of man.

Formation and types of fossils & their significance

UNIT – III

Biosystematics and Taxonomy: Definition and basic concepts, history, importance and applications of biosystematics in biology, different attributes of biosystematics.

Trends in biosystematics - Concepts of different conventional and newer aspects like chemotaxonomy, cyto-taxonomy and molecular taxonomy

UNIT – IV

Dimensions of speciation and taxonomic characters: Species concepts - species category, different species concepts, modes of specification, sub-species and other intraspecific categories, theories of biological classification, hierarchy of categories, software tools for building phylogenetic tree

UNIT – V

Taxonomic procedures: Taxonomic collections, preservation, curetting, process of identification

International Code of Zoological Nomenclature (ICZN) –& Botanical nomenclature (ICBN): Its operative principles, interpretation and application of important rules, formation of scientific names of various taxa.

Evaluation of biodiversity indices: Shannon-Winner Index, Dominance index, Similarity and dissimilarity index and Association Index

Reference Books:

1. Invertebrate Fossils by Moore, R.C., Lalicker, C.G. & Fischer, A.G., 1952, McGraw Hill.
2. Principles of Paleontology by Raup, D.M. & Stanley, S.M., 1985, W.H. Freeman & Co.
3. Vertebrate Paleontology by Romer, A.S., 1966, University Chicago Press
4. Principle of Animal Taxonomy; G.G. Simpson. Oxford IBH Publishing Company.
5. Elements of Taxonomy. E. Mayer.
6. The diversity of life (The College Edition), E.O. Wilson. W.W. Northern & co.
7. Theory and Practice of Animal Taxonomy. V.C. Kapoor. Oxford & IBH Publishing Co. Pvt. LTD.
8. Advancement in Invertebrate Taxonomy and Biodiversity. Rajeev Gupta. Agrobios International.
9. Principles of animal taxonomy by G.G. Simpson

CC-1.5 : PRACTICAL

Full Marks: 100
End Sem : 100/6hrs

1. Study of mitosis and meiosis
2. Preparation of karyotype and Pedigree analysis
3. Preparation of salivary gland chromosome of Drosophlila.
4. Various experimental methods of harvesting of cells (testes, bone marrow)
5. Study of barr body from Buccal mucosa
6. Population genetics and Hardy-Weinberg Law (Blood group, Ear lobe)
7. Estimation of protein by Biuret, Lowry method.
8. Estimation of Carbohydrate by Anthrone method.
9. Estimation of lipid by Vanillin method.

10. Assay of Enzyme activity of Urease/ alkaline phosphatase (Effect of temperature, substrate, concentration and time)
11. Determination of Absorbance maxima of bromophenol blue & validation of Beer's law.
12. Determination of pKa value of Glycine
13. Determination of percentage of casein content of milk
14. Antigen-Antibody interaction: Blood grouping
15. Preparation of Blood smear for differential count and type of leucocytes
16. Study of Lymphoid organs
17. Study of fossils.

SEMESTER – II

CC-2.1 : MOLECULAR BIOLOGY & GENETIC ENGINEERING

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

DNA replication: Replication in prokaryotes & eukaryotes, D-loop model of DNA replication, DNA replication in single stranded DNA, rolling circle replication, DNA synthesis by reverse transcription, telomere replication.

DNA Repair: mismatch repair, base excision, nucleotide excision, direct repair, SOS repair

UNIT – II

Prokaryotic transcription & Regulation: Mechanism of transcription, Principle of gene regulation, The operon concept, lac- & trp-operon. Processing of trna and rrna.

Eukaryotic transcription and regulation: RNA polymerases structure and assembly, Eukaryotic Promoters and enhancers, General and specific transcription factors, transcriptional repressors, Mechanism of transcription regulation, Transcriptional and post-transcriptional gene silencing.

Modifications in RNA: 5'-cap formation, transcription termination, 3'-end processing and Polyadenylation, splicing, editing, synthesis and processing of non-coding nrRNAs

UNIT – III

Prokaryotic and eukaryotic translation: The translation machinery, mechanism of initiation, Elongation and termination.

Co- and post-translational modifications of proteins.

Cell Signaling: Signaling molecules and signal receptors, second messengers, G protein coupled. Receptors, activation of gene transcription by G protein coupled receptors.

UNIT – IV

Scope of Genetic engineering, milestones in genetic engineering.

Molecular tools: Enzymes (Nucleases, Restriction endonucleases, Phosphomonoesterase, Alkaline Phosphatase, Polynucleotide kinase, DNA ligase, DNA polymerases, Reverse transcriptase, terminal Deoxynucleotidyl transferase, Poly A polymerase), Hosts (E. Coli, yeast, animal cells and Plant cells) and Vectors (Plasmids, Bacteriophages, Cosmids, Phagemids and artificial chromosomes).

Cloning, Gene library & cDNA library.

UNIT – V

Molecular techniques in genetic engineering: Isolation of DNA and RNA, probes, polymerase chain reaction, restriction fragment length polymorphism, genome sequencing (shortgun and paired end strategies and comparative genome analysis), study of gene expression, gene silencing, human genome project.

Reference Books:

1. Genome by T.A. Brown.
2. DNA Science. A First Course in Recombinant Technology by Mickloss and Freyer
3. Molecular Biotechnology by S.B. Primrose
4. Principles of gene manipulation by Primrose, Twyman and Old
5. Molecular Biotechnology by Glick and Pasternack.
6. Molecular Biology by Weaver
7. Genes and Genomes by Singer and Berg

8. Selected papers from Scientific journals
9. Technical literature from Stratagene, Promega, Novagen, New Englan Biolab etc.
10. Albert et al.: Molecular Biology of the Cell (4th Ed.), Garland Publishing Inc., 2002
11. Lodish et al.: Molecular Cell Biology (5th Ed.), Freeman and Company, 2004
12. Berg et al.: Biochemistry (5th Ed.), Freeman and Company, 2002
13. Murray et al.: Harper's Biochemistry (26th Ed.), Appleton & Lange, 2003.

CC-2.2 : MICROBIOLOGY & RESOURCE BIOLOGY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

History and development of microbiology: General features of Bergy's manual for classification of microbes, isolation, culture and maintenance of microorganisms, isolation and screening of industrially important microbes, microbial growth, continuous culture (chemostat), factors influencing growth of microbes.

Role of microbes in agriculture and industry: Production of antibiotics, beverages, enzymes, milk product, vaccines production, Fermentation

UNIT – II

Bacteria: General features Archaea, Structure, Genetic Recombination in bacteria (Transformation, Conjugation and Transduction), General features and pathogenecity of mycoplasma, Rickttsia and Spirochaetes.

Virus: General characteristics and classification of viruses, nature, morphology and chemistry of virus, transmission of virus, virus-vector relationship, replication of bacteriophage.

Plant virus- TMV, structure, transmission, pathogenicity and replication

Animal viruses - HIV, structure, transmission, pathogenicity and replication

Viroids and Prions

UNIT – III

Application and importance of microbiology: Bacterial diseases of man (microbes in air, water and soil), Viral diseases of man, Microbial diseases of plants.

Industrial microbiology, Biomineralization, Microbial leaching

UNIT – IV

Microbial toxins: types, mode of actions and pathogenicity, bacterial toxins (endo and exotoxins), fungal toxins (toxins of aspergillus, penicillium, fusarium and alternaria), algal toxins (cyanotoxins and dinotoxins).

Chemotherapeutic agents: Aantibiotics and their mode of action (penicillin, fluoroquinolones, tetracycline and aminoglycosides), treatment and prevention by anti-virals and vaccines

UNIT – V

Resource Biology: Mechanism & applications of Apiculture, Sericulture, Aquaculture, Mushroom culture, Biodiesel production, Vermicomposting.

Reference Books:

1. Black: Microbiology – Principle and exploration (2002, John Wiley and Sons)
2. Michael Jr: Microbiology (1993, Tata McGraw Hill)
3. Alford: A textbook of Agricultural Entomology, Blackwell 1999

CC-2.3 : INSTRUMENTATION & ANALYTICAL TECHNIQUES

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Principle of operation and instrumentation of Light, Fluorescence and Electron Microscopes. Ultraviolet-visible absorption spectroscopy: principle, instrumentation and application.

Fluorescence spectrophotometry; principle, instrumentation and application.

Microtomy: Principle, instrumentation & application

UNIT – II

Centrifugation techniques: Basic principles of sedimentation, types of centrifuges, types of rotors, methods in preparatory ultracentrifugation (differential and density gradient centrifugation), fractionation of cell components.

Chromatographic techniques: Principles of chromatography (Adsorption and Partition Chromatography), Planar chromatography (Paper and Thin-layer chromatography), Column Chromatography (Gas chromatography, Gel exclusion chromatography, Ion exchange, chromatography, Affinity chromatography, HPLC)

UNIT – III

Electrophoretic techniques: General principles, support media, electrophoresis of proteins (SDSPAGE, Native gels, gradient gels, isoelectric focusing gels and two dimensional gels), electrophoresis of nucleic acids (agarose, pulse-field and sequencing gels).

Blotting techniques: Southern, northern and western blotting.

Radio-tracer technique: principle and application of radioactivity, radioisotopes in biochemistry, measurement of radioactivity (carbon dating, Geiger-Muller counting and liquid scintillation counting, autoradiography), safety measures

UNIT – IV

Immunological Techniques: Radial and double immunodiffusion, radioimmunoassay, ELISA- Indirect, Direct, sandwich, ELISPOT, preparation and use of monoclonal antibodies

UNIT – V

Statistical Methods: Sampling methods, sampling distribution, measures of central tendency and dispersion, coefficient of variation, probability distribution: normal, binominal and poisson distribution.

Tests of significance: t and chi-square tests.

Analysis of variance: One factor and two factor ANOVA, linear and non-linear regression and correlation

Recommended Books:

1. Boyer: Modern Experimental Biochemistry and Molecular biology (2nd ed 1993, Benjamin/Cumin)
2. Freifelder: Physical Biochemistry (2nd ed 1982, Freeman)
3. Holme and Peck: Analytical Biochemistry (3rd ed 1998, Tata McGraw Hill)
4. Plummer: An Introduction to Practical Biochemistry (3rd ed 1990, Tata-McGraw Hill)
5. Switzer and Garrity: Experimental Biochemistry (92nd ed 1999, Freeman)
6. Wilson and Walker: Principles of Biochemical and Molecular Biological Techniques (6th ed 2006, Cambridge Univ Press)

CC-2.4 : ECOLOGY & CONSERVATION BIOLOGY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Population ecology: population characters, population growth & biotic potential & population interactions.

Community ecology: Species diversity, community niche and random niche model of species association, ecotone and edge effect, competition theory and coexistence; succession - models of succession (monoclimax and polyclimax theories), mechanism of succession in natural communities - facilitation, tolerance, and inhibition.

Abiotic and biotic components: primary and secondary production, methods of measuring productivity, pattern of primary production and biomass in the major ecosystem of the world. Energy flow: sources and pattern, food chain and food web in terrestrial and aquatic ecosystems

UNIT – II

Classification of resources: non-renewable resources, mineral resources, renewable resources. Biogas, Biomass, Solar energy, Coal, Wind mills

UNIT – III

Types of biodiversity, threats to biodiversity (overexploitation, habitat destruction, alien species, human activities), mega biodiversity countries, keystone species, Biodiversity hot spots in India, wetland biodiversity, rare, endangered & threatened species of India, remote sensing & its application

UNIT – IV

Conservation: *in situ* and *ex situ* conservation, Sanctuaries, National parks & Biosphere reserves in India, Biological diversity act 2002, Wild life protection act of India, Forest conservation act of India, Organizations in wildlife conservation (BNHS, IUCN, WWF, SITES etc.)

UNIT – V

Environmental pollution: Kinds and sources of pollutants, classification of pollutants.
Soil pollutants: sources, types, and effects; modification of plant productivity by soil pollution, effects on soil microflora.
Water & Air pollutants: Sources and effects, role of plants for pollution control.
Waste utilization, harmful effect of insecticides and pesticides.
Global climate change, green house effect, ozone depletion-causes and effects.

Reference Books:

1. Cunningham and Saigo: Environmental Science (5th Ed., McGraw Hill, 1999).
2. Odum : Fundamentals of Ecology (Saunders, 1971).
3. Odum and Barett: Fundamentals of Ecology (EWP, 2005).
4. Primark : A Primer of Conservation Biology (2nd Ed., Sinauer, 2004).
5. Raven, Berg, Johnson: Environment (Saunders. 1993).
6. Sharma: Ecology and Environment (7th Ed., Rastogi, 2000).
7. Turk and Turk: Environmental Science (4th Ed., Saunders, 1993).
8. Wright and Nebel: Environmental Science (8th Ed., Prentice Hall, 2002).
9. M. Kato: The biology of biodiversity (Springer)

CC-2.5 : PRACTICAL

Full Marks: 100
End Sem : 100/6hrs

1. Estimation of DNA
2. Estimation of RNA
3. Separation of proteins, lipids & nucleic acids from tissues and their quantification
4. Isolation of genomic DNA from animal/plant tissue or blood
5. Study of Bacteria by Gram staining
6. Isolation & Maintenance of bacteria by plating, streaking & serial dilution slant & slab cultures, Pure culture method (from soil, water etc.)
7. Antibiotic Assay
8. SDS PAGE (demonstration)
9. Agarose gel electrophoresis (demonstration)
10. Microscopy, Microtomy & Histological techniques.
11. Chromatographic separation of biomolecules
12. Problems related to Mean, Median, Mode, Standard deviation, t-test, Chi-square test, Annova & Correlation.
13. Estimation of DO, CO_2, alkalinity of water samples.
14. Estimation of productivity.
15. Study of diversity indices.
16. Museum Specimen & Slides.

SEMESTER – III

A. PLANT SCIENCE

CC-3.1A : PLANT DIVERSITY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

An outline classification of cryptogams up to order. Algae-Range of thallus structure and reproduction in Cyanophyta, Chlorophyta, Phaeophyta and Rhodophyta

UNIT – II

Organisation of thallus structure and reproduction. Economic importance of phycomycetes, Ascomycetes and Basidiomycetes.

UNIT – III

Bryophytes - Evolution of gametophyte and sporophyte in Marchantiales, Evolution of sex organs in Bryophyte. Mosses as the most advanced bryophytes. Pteridophytes- Origin of land plants, evolution of vascular tissues, Origin of heterospory and its significance. Fillicates as most advanced groups of pteridophytes

UNIT – IV

Gymnosperms - Origin and outline classification upto order. Characteristics features in the structure and reproduction of important orders. Cycadofillicales as Intermediate group between bryophytes and pteridophytes, cycadales as relic of ancient gymnosperms, phylogenetic position of Ginkgoales, wood anatomy and embryogeny of coniferales, angiospermic character of Gnetales, Palaecobotany-Geological or, process of fossilisation. Fossil gymnosperms

UNIT – V

Origin and evolution of angiosperms. Different systems of classification up to order. International code of Botanical Nomenclature (ICBN), Range of floral structure, affinities and phylogeny of monocot land dicots with special reference to Glumiflorae, Liliflorae Scitaminae, Microspermae, Ranales, Malvales, Tubiflorae and Umbelliflorae

B. ANIMAL SCIENCE

CC-3.1B : ANIMAL DIVERSITY & ANIMAL BEHAVIOUR

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Protozoan diseases in man, Reproduction and canal system in sponges, Coral reef formation & significance, Polymorphism in Coelenterates, Helminth parasites and human diseases, Soil nematodes and plant nematodes,

Excretory structures and functions in Annelids, Metamerism and Segmentation in Annelids

UNIT – II

Crustacean parasites, Vision in insects. Biology of locusts, Biology of termites, Horseshoe crabs and their importance, Torsion in Gastropoda, Nervous system in Cephalopods, Reproduction, development and evolutionary significance of Echinoderms

UNIT – III

Affinities of *Balanoglossus,* Reproduction and colony formation in Urochordates, *Amphioxus* and its special status, Cyclostomes and their affinities.

Luminous organs in fishes, Accessory respiratory organs in fishes,

Origin and evolution of Amphibia, Adaptive radiation in reptiles, Classification of reptiles basing on skull pattern

UNIT – IV

Origin, Plumage and colouration, Nesting habit in birds, Flight adaptation in Birds

Origin and early history of mammals, Systematic position and general characteristics of prototherians and metatherians, Adaptive radiation in marsupials, Adaptive radiation in mammals

UNIT – V

Classification & analysis of behavior patterns, Tools and Techniques in behavioural study, Neural & hormonal control of behavior, Communication in animal.

Social organization of insects and mammals, hormones and behaviour, pheromones and behaviour, Biological rhythms: Circadian, clock, Circannual clock, Orientation & navigation: Migration of fish and bird.

Ecological aspects of behaviour, Habitat selection, Food selection, Aggression, Homing, Territoriality, Mimicry, Host parasite relation.

Reproductive behaviour, Courtship, Mating systems, Parental care

Reference Books

1. Invertebrate structure by Barrington & Nelson
2. Invertebrates by Pough
3. The invertebrates Vol I to VI by LH hyman
4. Protozoology by R Kudo
5. A text book of zoology (vol-I & II) by TJ Parker & WA Haswell
6. Phylum chordata by H Newman
7. The life of vertebrates by JZ Young
8. Biology of Animals. By Ganguly, BB., Sinha, A.K., Adhikari, S., New Central Book Agency, Kolkata
9. Invertebrate Zoology. By Barnes
10. The Invertebrates: Function and Form. By Sherman W and Sherman VG
11. Animal Behavior by J Alcock
12. Principles of animal communications by JW Bradbury

A. PLANT SCIENCE

CC-3.2A : PLANT PHYSIOLOGY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Water relation in plants-Concepts of water potential, principles of absorption of water, ascent of sap, transpiration, stomatal mechanism and transpiration ratio

UNIT – II

Mineral nutrition-Essential elements, hydroponics, absorption of elements, passive and active transport, role of essential elements land deficiency symptoms, translocation of organic materials in phloem.

UNIT – III

Nitrogen metabolism-Bio-chemical mechanism of Nitrogen fixation in free living and symbiotic organisms, Nitrogen cycle

UNIT – IV

Respiration-Aerobic and anaerobic respiration, respiratory quotient, energetics of respiration, electron transport system, action uncouplers, cyanide resistant respiration. HMP pathway,-Oxidation of fatty acids

UNIT – V

Photosynthesis-Principles of light absorption in chloroplast, Organisation of light absorbing systems, mechanism of electron flow, C3, C4 and CAM pathway for carbon reduction, Photorespiration.

B. ANIMAL SCIENCE

CC-3.2B : ANIMAL PHYSIOLOGY & ENDOCRINOLOGY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Mechanism of platelet plug formation, blood coagulation & blood disorders.

The heart: cardiac cycle & its regulation, pulmonary ventilation, regulation of respiration, transport of gases, acid base balance.

Excretory system: mechanism of urine formation, renal mechanism of concentrating & diluting urine, regulation of acid-base balance

Mechanism of contraction in Skeletal, Smooth and Cardiac muscle

UNIT – II

General organization of central nervous system: types, structure and function of neuronal & glial cells, ion channels, Action potential, Electrical & Synaptic transmission, Neurotransmitters & Neuropeptides, Neuromuscular Junction, Blood brain barrier.

Learning & memory, Language & communications, Sleep, dreaming & consciousness, reward, motivation & addiction

UNIT – III

Physiology of male & female reproduction: Testicular events and biosynthesis of testosterone, Folliculogenesis, Ovulation, Luteinization, Estrous cycle, Menstrual cycle, Menopause, role of hormones during pregnancy, Contraception.

Major endocrine disorders-related to reproduction

Endocrinology of implantation, parturition & lactation

UNIT – IV

Chemical messengers: Hormones & their feedback systems, Mechanism of hormone action (fixed membrane- and mobile receptor mechanisms), Hormonal signalling, Pineal, Thymus & Gastrointestinal hormones, Anatomy, chemistry and biological action of Adenohypophysial & Neurohypophysial hormones, Pituitary pathophysiology.

Hypothalamic control of adenohypophysial function, Neuroendocrine system and neurosecretion, Clinical aspects of the hypothalamo-hypophysial system

UNIT – V

Thyroid gland: Anatomy, biosynthesis & function of thyroid hormones, Antithyroid agents and control of thyroid secretion, Parathyroid gland: Anatomy & function of parathyroid hormone.

Pancreas: Anatomy, biosynthesis, chemistry & functions of pancreatic hormones.

Adrenal gland: Anatomy, biosynthesis, functions of cortical & medullary hormones.

Gonads: Anatomy and biological actions of gonadal hormones

Reference Books

1. Guyton's Physiology
2. Human physiology- Tortora
3. Endocrinology - Hadley
4. Endocrinology - Turner & Bagnora
5. Bentley, P. J. Comparative vertebrate endocrinology
6. Bern, H. A. Text book of comparative endocrinology
7. Colour Atlas of Physiology- Thieme
8. Harper's Illustrated Biochemistry (26th Edition)

SPECIAL PAPER – I (ENVIRONMENT BIOTECHNOLOGY & CONSERVATION BIOLOGY)

CE-3.3A : ECOLOGY & TOXICOLOGY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Mechanism of succession in natural communities, energy flow patterns in different ecosystems, Primary production and methods of measurement, Secondary production and yield to man, Ecological efficiencies and production in different regions of the world

UNIT – II

Toxicology: Definition and classification, Toxicants – Toxicity, Acute, sub-acute, chronic, dose effect, LD 50, LC 50 and response safe limits, Toxic agents (Pesticides, Solvents, Metals, Carcinogens, chlorinated-Xenobiotics, Food additives) and their mode of action, Genotoxicology

UNIT – III

Concepts of Environmental Pollution – Classification, sources and nature of Air Pollution, Noise Pollution, Radiation Pollution, Soil Pollution, water pollution.

Sources and types of solid wastes, biomedical wastes

UNIT – IV

Bioaccumulation of toxicants, measurement and kinetic modelling of bioaccumulation, ecophysiology of bioaccumulation, Biofiltration, Biomagnifications, Biotransformation

UNIT – V

Scope and importance of environmental biotechnology in India, Statistical methods in toxicology, Environmental policy and Environmental impact assessment (EIA), Human toxicology and Medical ethics.

SPECIAL PAPER – II (BIOCHEMISTRY & MOLECULAR BIOLOGY)

CE-3.3B : PROTEIN CHEMISTRY & SIGNAL TRANSDUCTION

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Determination of Protein structure: N- & C- terminal determination, Amino acid sequence determination, assignment of disulfide bonds, structural organization of fibrous and globular proteins, Prediction of higher order structure from the amino acid sequences, Molecular chaperones and protein folding.

Stabilization of proteins, Protein denaturation

UNIT – II

Purifications & characterization of proteins: Methods of homogenization, Homogeneity of the purified protein (Native and denaturing electrophoresis, Isoelectrofocussing, Ultracentrifugation)

Methods of separation of proteins by solubility (pH treatment; Salting in & salting out; Changing dielectric constant; Heat treatment), by size and mass (Centrifugation; Dialysis; Ultrafiltration; Gel filtration), by charge/polarity (Ion-exchange chromatography; iso-electric focusing; Electrophoresis; hydrophobic chromoatography), by specific binding (Affinity binding; Affinity elution; Dye-ligand binding; Immunoadsorption, Covalent binding)

UNIT – III

Processing of recombinant proteins: Purification, refolding & characterization of recombinant proteins, site-directed mutagenesis and protein engineering.

Abzymes or catalytic antibodies: Natural & artificial abzymes, physiology, mechanism of action and application.

Ribozymes: Discovery, Types, Structure, mechanism of action and applications of ribozyme technology

UNIT – IV

Enzyme technology: Methods of enzyme immobilization (adsorption, entrapment, direct covalent linking, crosslinking), kinetics of immobilized enzymes, measurement of enzyme activity.

Industrial application of enzymes: Enzymes used in detergents, Application of enzymes in food processing

Medical applications of enzymes

UNIT – V

Signal transduction: Concept of cell-signaling; Ions channels, Transporters and Receptors; Signaling through intracellular receptors (Lipophilic hormones), cell surface receptors-(G protein linked receptors, cAMP, PKA IP3, Ca^{++}- calmodulin, PKC), enzyme linked receptors (tyrosine kinase, serine/threonine kinase), Impairment of signalling & associated diseases

Reference Books

1. Nelson et al: Lehninger Principles of Biochemistry (3rd Ed.), MacMillan Worth, 2000
2. Berg et al.: Biochemistry (5th Ed.), Freeman, 2002
3. Mathews et al.: Biochemistry (3rd Ed.), Pearson, 2004
4. Zubay et al: Principles in Biochemistry (2nd Ed.), WCB, 1995
5. Rawn: Biochemistry, Neil Patterson, 1989
6. Molecular Clonning: A laboratory manual by J. Sambrook and E.F. Fritsch.
7. Molecular Biotechnology by S.B. Primrose

8. Molecular Biotechnology by Glick and Pasternack.
9. Enzymes in industry: Production and application by W. Gerhartz, VCH Publishers, New York
10. Principles of enzymology for technological applications, Butterworth Heinemann Ltd.
11. Enzyme technology by M.F. Chaplin and C. Bucke. Cambridge University Press.
12. Biochemical Engineering by Aiba, Humphery and Mills.

A. PLANT SCIENCE

CC-3.4A : PRACTICAL

Full Marks: 100
End Sem : 100/6hrs

B. ANIMAL SCIENCE

CC-3.4B : PRACTICAL

Full Marks: 100
End Sem : 100/6hrs

1. Study of museum specimens and micro-slides from phylum protozoa to mammalia
   i. Protozoa: Euglena, Plasmodium, Paramoecium,
   ii. Porifera: Sycon, Hyalonema, Euspongia
   iii. Coelenterata: Physalia, Gorgonia, Pennatula, Aurelia, Fungia
   iv. Platyhelminthes: Dugesia, Fasciola, Ascaris, Taenia
   v. Annelida: Hirudinea, Sabella, Aphrodite, !ereis, Heteronereis, Arenicola, Trochophore larva
   vi. Arthropoda: Limulus, Palaemon, Daphnia, Balanus, Lepas, Sacculina, Eupagurus, Scolopendra, termite, louse, wasp, silk moth, dragon fly, Larval forms in Arthropoda, Leaf insect and stick insect
   vii. Mollusca Chiton, Dentalium, Larval forms in Mollusca, Sepia, !autilus, Loligo
   viii. Echinodermata Larval forms, Antedon, Asterias, Echinus, Sea cucumber
   ix. Hemichordata Balanoglossus
   x. Cephalochordata Amphioxus
   xi. Urochordata Salpa, Doliolum, Ascidea
   xii. Cyclostomata Petromyzon , Myxine
   xiii. Pisces Lung fish, Torpedo, Trygon, Exocoetus, Echines, Eel, Clarias, Hippocampus
   xiv. Amphibia Hyla, Alytes, Ichthyophis, Axolotl Larva, Salamander, !ecturus
   xv. Reptilia Chelone, Varanus, Draco, Russel viper, naja naja, Gavialis
   xvi. Aves Psittacula, Dinopium, Type of Beaks, claws and feet
   xvii. Mammalia Echidna, Macropus, Pteropus, Rattus, Squirrel
2. Mounting of mouth parts of mosquito-identification of genera
3. RBC, WBC counting
4. Estimation of Hemoglobin
5. Study of slides of endocrine glands
6. Study of life cycle of different anurans
7. Effect of thyroxin on amphibian development
8. Whole mount preparation of chick embryos
9. Study of Frog development through prepared slides
10. Preparation of culture media
11. Culture of primary chick embryo fibroblast cells.

SEMESTER – IV

A. PLANT SCIENCE

CC-4.1A : PLANT DEVELOPMENT & PLANT BIOTECHNOLOGY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Germination and greening: Stored genetic message in seeds, Physiological and molecular changes during germination, Biosynthesis of chlorophylls, targeting and assembly of LHC. Synthesis of Rubisco subunits and their assembly. Leaf development and phyllotaxy.

UNIT – II

Flowering and Senescence Photoperiodism, Biological clock, Biochemical signals involved in flowering, Gene regulation of floral development Transition of flowering, floral meristem. Types of senescence, Physiological significance and regulation of leaf senescence by genes.

UNIT – III

Regulation of plant growth and development Biosynthesis, storage, breakdown and transport, physiological response and mechanism of action of hormones (IAA, GA Ethylene, Cytokinin, and ABA). Physical and chemical properties of photoreceptors; Phytochrome, Phototropin, and Cryptochrome.

UNIT-IV

Organogenesis; Callus mediated plant regeneration, adventitious organogenesis, somatic embryogenesis, induction and maintenance of callus culture, production and analysis of somaclonal variants, cell suspension culture for production of secondary metabolites, biotransformation.

Embryo culture and embryo rescue, protoplast isolation, culture and regeneration, somatic hybridization. protoplast fusion selection of heterokaryotic fusion products, analysis of hybrids, somatic hybrids and cybrids for crop improvement.

UNIT-V

Recombinant DNA technology, Genomic DNA and plasmid DNA isolation and purification, construction of recombinant DNA and expression cassettes, Transformation (mobilisation of vectors into competent bacteria, selection and analysis of recombinant clones, Chromosome walking, Chromosome jumping, genomic DNA and cDNA librarie. Antiscence RNA technology; Regulatory RNA (microRNA), Antisence RNA, construction of antisence vectors, analysis of antisence clones, application of antisence technology

Text books

1. Glick, B. R. and Pasternak (2003). Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, Washington, D. C., USA.
2. Kyte, L. and Kleyn, J. (1996). Plants From Test Tube to: An Introduction to Micro propagation, 3rd Ed. Timber press, Port land, USA

Reference books

1. Pollard, W. J. and Walker (1990). Plant Cell and Tissue Culture Vol VI. Humana press Clifton, USA.
2. Physiology and Bio-Chemistry of Plant Hormones: T.C. Moore, Academic press.
3. Biochemistry: Trehan, K. New Age International Calcutta.
4. Plant Physiology, F.B. Sabsbury and C.W. Rass. 4th Edition, Wordsworth Publishing Company Belmont, USA-1992.
5. Biotechnology P.K. Gupta (1995) Rastogi and Company, Meerut.
6. Glossary of useful plants and economically important plants, Panigrahi, A.K. & Alaka Sahu New Central Book Agency, Calcutta.

B. ANIMAL SCIENCE

CC-4.1B : ANIMAL DEVELOPMENT & ANIMAL BIOTECHNOLOGY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Principles of Developmental Biology: Potency, commitment, specification, induction, competence.

Gametogenesis: Primordial germ cells, Spermatogenesis, Oogenesis, Fertilization: morphological & biochemical events of fertilization, cleavage

Morphogenesis in early embryo: gastrulation, neurulation and primordial organ rudiments, origin and fate of neural crest cells

Placentation: Biochemical aspects

UNIT – II

Post-embryonic development: Growth (cellular, intracellular & organismic level), cell proliferation, role of growth hormone, spatial and temporal gene expression during development, apoptosis and its role in development

Regeneration: Regeneration in invertebrates and vertebrates, modes of regeneration, Role of nervous system in regeneration.

Metamorphosis: Biochemical aspects of metamorphosis in insects and amphibians, nucleocytoplasmic interactions, nuclear transplantation in vertebrate embryos, homeotic genes and homeotic transformation in anuran tadpoles

UNIT – III

Stem cells: Embryonic, adult & transgenic stem cells, stem cell niche, their role in development.

Ageing: Mitochondrial control of ageing, role of oxygen radicals in ageing, Ageless animals and environmental control of ageing, senescence & cell death

Teratogenesis: mechanism, teratogenic agents

UNIT – IV

Equipments and materials for animal cell culture: Design and layout of culture room, Basic Equipments used in cell culture, Sterilization and aseptic techniques

Culture media: Natural media, Synthetic media, Nutritional compounds of media, Role of serum in cell culture

Primary culture and its maintenance: Various techniques of tissue disaggregation, Monolayer and Suspension cultures, Growth curve, Culture of Cell lines, LSE culture, Scaling up of cultured cells, anchorage dependent cell culture, Suspension culture, maintenance of cell lines, Cryopreservation.

UNIT – V

Applications of Biotechnology: Transgenic & knockout animals, *In vitro* fertilization & test tube babies, embryo transfer (application & limitations), Gene therapy, recombinant hormones & vaccines, diagnosis of diseases (AIDS, tuberculosis, cystic fibrosis, cancer, muscular dystrophy), forensic science (DNA fingerprinting for criminal identity & paternity testing)

Reference Books

1. Developmental biology by Gilbert
2. Introduction to embryology by Balinsky
3. Fertilization FT Longo
4. Culture of animal cells by R.I. Freshney
5. Tissue Culture – Methods and Applications by Paul F. Kruse Jr. and M. K. Patterson Jr.
6. Cell Culture Lab Fax by Butler and Dawson.
7. Cell and Tissue culture: Laboratory procedures by Doyle and Griffiths
8. Basic Cell Culture by J.M. Davis

SPECIAL PAPER – I (ENVIRONMENT BIOTECNHOLOGY & CONSERVATION BIOLOGY)

CE-4.2A : ENVIRONMENT MANAGEMENT

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Bioleaching: metal accumulation by flora and fauna, Microbes in metal containing habitat, Metal-microbe interactions, Microbial immobilisation and transformation of metals, Microbial application of metal removal

UNIT – II

Biodegradation of organic pollutants: Microbial processes for degradation, Microbial adaptation to contaminated environment, Microbe-petroleum (Fuels) interactions, Problems and prospects of biomining, Biofuel production with reference to microbes

UNIT – III

Bioremediation of pesticides: Fate of pesticides in the environment, Microbial transformation of pesticides, Plant-microbe interactions, Biofertilizers, Production of microbial insecticides and mycoherbicides, Vermitechnology

UNIT – IV

Bioconversion & waste control: Solid waste processing technology, components of solid waste management, treatment of hazardous wastes, biomedical waste management, role of microbes in decomposition process and waste utilization

UNIT – V

Wastewater treatment and disposal: eutrophication-causes, effects and control, wastewater treatment processes, biological treatment of wastewater.

SPECIAL PAPER – II (BIOCHEMISTRY & MOLECULAR BIOLOGY)

CE-4.2B : BIOCHEMISTRY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Intermediary metabolism and metabolic pathways

Carbohydrates: Glycoconjugates, photosynthetic carbohydrate synthesis, biosynthesis of starch & sucrose, synthesis of cell wall polysaccharides (peptidoglycan, and cellulose), synthesis of glucose in germinating seeds, glycogen metabolism

UNIT – II

Lipids: Biosynthesis and degradation of Cholesterol, Lipid transport and storage, Biosynthesis of eicosanoids: Prostaglandins, leucotrienes and thromboxanes, Structure and function of eicosanoids

UNIT – III

Sources of amino acids: Dietary proteins and intermediates of carbohydrate metabolism, Amino acids as sources for nitrogen. Molecules derived from amino acids: Porphyrin, bilirubin, creatine, glutathione, dopamine, noradrenaline, adrenaline, GABA, serotonin, histamine, melanin, thyroxine.

Synthesis and significance of polyamines.

Amino acid catabolism, Ammonia detoxification, Urea cycle (Reactions and their regulation)

UNIT – IV

Nucleotides

Biosynthesis and regulation of purine and pyrimidine nucleotides

Catabolism of purines and pyrimidines

UNIT – V

Concept of biochemical basis of diseases/disorders

Disorders of enzyme deficiency: Alkaptonuria, Phenylketonuria, Lesh-Nyhan syndrome

Storage & transport associated disease: Hypercholestrolemia and atherosclerosis, Tay-Sachs disease, Gout, glycogen storage disease

Disorders of protein deficiency/defects: Sickle-cell anaemia, Cystic fibrosis, Thalassemia, Diabetes and obesity

Neurological disorders: Hutingston's disease, Alzhemeirs disease, Parkinson's disease

Biochemistry of aging

Reference Books:

1. Nelson et al: Lehninger Principles of Biochemistry (3rd Ed.), MacMillan Worth, 2000
2. Berg et al.: Biochemistry (5th Ed.), Freeman, 2002
3. Mathews et al.: Biochemistry (3rd Ed.), Pearson, 2004
4. Zubay et al: Principles in Biochemistry (2nd Ed.), WCB, 1995
5. Rawn: Biochemistry, Neil Patterson, 1989
6. Bender, D.A.: Amino acid metabolism, John Wiley & Sons, 1985
7. Grisolia, S. et al. : The Urea Cycle, John Wiley & Sons, 1976
8. Voet & Voet: Biochemistry Vol. I & II (3rd Ed.), Wiley, 2004.

SPECIAL PAPER – I (ENVIRONMENT BIOTECNHOLOGY & CONSERVATION BIOLOGY)

CE-4.3A : CONSERVATION BIOLOGY

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Scopes and issues of conservation: basic environmental problems-pollution, land degradation, deforestation, biodiversity loss, eutrophication, oil spillage, radioactive wastes global warming & sea-level changes, ozone layer depletion

UNIT – II

Importance of Conservation: Ethical, Asthetic, Utilitarian and Ecological

Biodiversity: Types of biodiversity, Megabiodiversity countries, Biodiversity Hot spots in India, Natural habitat conservation in Orissa with special references to Chilika, BhitarKanika, Similipal and Mahendragiri, Remote sensing and its application

UNIT – III

Conservation and resource management: Types of resources, Concept of sustainable development, Bioresources, Land use planning, Water and agriculture management, Afforestation and forest management, Coastal zone management, Wild life conservation, Soil conservation.

Legal aspects: Intellectual Property Rights (IPR), Biological Diversity Act 2002, The Biological Diversity Rule 2004, Organizations in wildlife conservation (BNHS, IUCN, WWF, SITES etc.)

UNIT – IV

Biotechnology for resource management and biomass production

In situ and *ex situ* conservation: Germplasm conservation, Gene bank, Frozen zoos Cryopreservation: Cryoprotectants and their physiochemical properties, Cryopreservation of gametes and embryos

UNIT – V

Hormonal manipulation in advancing maturity and reproduction, Development of disease resistant stock, Artificial breeding of domestic and aquatic animals, Bioprospecting of marine organisms, Sea weeds as food, Phycocolloids and Source of pharmaceuticals from marine organisms, Probiotics and Single Cell protein (SCP)

SPECIAL PAPER – II (BIOCHEMISTRY & MOLECULAR BIOLOGY)

CE-4.3B : GENOMICS

Full Marks: 100
Mid Sem : 20/1hr
End Sem : 80/3hrs

UNIT – I

Organization of genome: Denaturation & renaturation kinetics of DNA, unique and repetitive DNA sequences, Chromatin organization: histones and nonhistone chromosomal proteins, nucleosomes and higher order structures, telomere, chromatin modifications

UNIT – II

Mapping of genome: Genetic and physical maps, physical mapping (restriction mapping, fluorescence in situ hybridization, sequence tagged site mapping), simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, molecular markers in genome analysis (RFLP, RAPD, AFLP, SSLPs, STRs and SNPs)

UNIT – III

Genome sequencing: Construction of libraries (genomic and cDNA), sequencing genomes (shortgun and paired end strategies and comparative genome analysis)), packaging, application of sequence information for identification of defective genes

UNIT – IV

DNA transfection: Physical methods (microinjection, electroporation, biolistics, somatic cell fusion, Gene transfer by pronuclear microinjection), Chemical method (liposomes), Virus mediated transfection.

Gene expression systems: prokaryotic (bacteria) & eukaryotic (yeast, mammal) expression systems, Knockout and transgenic technologies, gene silencing

UNIT – V

Mapping transcripts: RNase protection assay, Primer extension, Run-off Transcription and G-less cassette transcription, Reporter gene assays.

DNA-protein interactions: EMSA, DNase foot printing, CHIP

Protein-protein interaction: Yeast two hybrid system, Phage display

Reference Books

1. Molecular Clonning: A laboratory manual by J. Sambrook and E.F. Fritsch.
2. Genome by T.A. Brown.
3. DNA Science. A First Course in Recombinant Technology by Mickloss and Freyer
4. Molecular Biotechnology by S.B. Primrose
5. Principles of gene manipulation by Primrose, Twyman and Old
6. Molecular Biotechnology by Glick and Pasternack.
7. Molecular Biology by Weaver
8. Genes and Genomes by Singer and Berg
9. Selected papers from Scientific journals
10. Technical literature from Stratagene, Promega, Novagen, New Englan Biolab etc.

CE-4.4 : PROJECT WORK

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