

M.Sc. BIOSCIENCES

(CBCS Semester Scheme)
Scheme of Teaching and Examination
(As per the University Guidelines)

I SEMESTER:

Paper Code & Title	Teaching Hrs/ week	Exam Hrs.	Marks Exams.	Marks IA	Total Marks	Credits
BS 401: Basic Biochemistry	04	03	70	30	100	4
BS 402: Genetics & Biometrics	04	03	70	30	100	4
BS 403: Cell Biology	04	03	70	30	100	4
BS 404: Basic Microbiology	04	03	70	30	100	4
BS 405: Basic Biochemistry Lab.	04	03	35	15	50	2
BS 406: Genetics & Biometrics Lab.	04	03	35	15	50	2
BS 407: Cell Biology Lab.	04	03	35	15	50	2
BS 408: Basic Microbiology Lab.	04	03	35	15	50	2
Total					600	24
Seminar	01	-	-	25	25	1
						25

II SEMESTER:

Paper Code & Title	Teaching Hrs/ week	Exam Hrs.	Marks Exams.	Marks IA	Total Marks	Credits
BS 451: Biochemistry & Biophysics	04	03	70	30	100	4
BS 452: Molecular Genetics	04	03	70	30	100	4
BS 453: Molecular Biology	04	03	70	30	100	4
BS 454: Applied Microbiology	04	03	70	30	100	4
BS 455: Biochemistry & Biophysics Lab.	04	03	35	15	50	2
BS 456: Molecular Genetics Lab.	04	03	35	15	50	2
BS 457: Molecular Biology Lab.	04	03	35	15	50	2
BS 458: Applied Microbiology Lab.	04	03	35	15	50	2
Total					600	24
Seminar	01	-	-	25	25	1
						25

IA = Internal Assessment

III SEMESTER:

Paper Code & Title	Teaching Hrs/ week	Exam Hrs.	Marks Exams.	Marks IA	Total Marks	Credits
BS 501: Biodiversity (Choice Based Paper)	04	03	70	30	100	4
BS 502: Biotechnology	04	03	70	30	100	4
BS 503: Comparative Physiology	04	03	70	30	100	4
BS 504: Ecotoxicology	04	03	70	30	100	4
BS 505: Biotechnology Lab.	04	03	35	15	50	2
BS 506: Comparative Physiology Lab.	04	03	35	15	50	2
BS 507: Aquatic Biology Lab.	04	03	35	15	50	2
BS 508: Ecotoxicology Lab.	04	03	35	15	50	2
Total					600	24
Seminar	01	-	-	25	25	1
						25

IV SEMESTER:

Paper Code & Title	Teaching Hrs/ week	Exam Hrs.	Marks Exams.	Marks IA	Total Marks	Credits
BS 551: Biotechnology & Bioinformatics	04	03	70	30	100	4
BS 552: Environmental Physiology	04	03	70	30	100	4
BS 553: Applied Ecology	04	03	70	30	100	4
BS 554: Developmental Biology	04	03	70	30	100	4
BS 555: Biotechnology & Bioinformatics Lab.	04	03	35	15	50	2
BS 556: Environmental Physiology Lab.	04	03	35	15	50	2
BS 557: Applied Ecology Lab.	04	03	35	15	50	2
BS 558: Developmental Biology Lab.	04	03	35	15	50	2
Total					600	24
Seminar	01	-	-	25	25	1
						25

IA = Internal Assessment

SYLLABUS

I SEMESTER

THEORY PAPERS

BS 401 - BASIC BIOCHEMISTRY

Unit I (13 hours)

Carbohydrates: Classification, chemistry and properties of monosaccharides, disaccharides, polysaccharides, glycoproteins, peptidoglycans.
Lipids. Classification, chemistry and properties of lipids.

Unit II (13 hours)

Proteins and amino acids. Classification, chemistry and properties of proteins and amino acids. Primary, secondary, tertiary and domain structure of proteins. Reverse turn and Ramachandran plot. Helix - coil, transition. Energy terms in biopolymers. Conformational calculations, hydrogen bonding, hydrophobic, electrostatic and Vander Waal's interactions.

Lipoprotein metabolism and associated disorders. Triacylglycerol biosynthesis and role of adipose tissues. Biosynthesis, transport and excretion of cholesterol and sterols.

Unit III (13 hours)

Metabolism of carbohydrates: Pathways and regulation. Glycogenogenesis and Glycogenolysis. Anaerobic glycolysis, Citric acid cycle, Hexose monophosphate shunt. Gluconeogenesis. Coordinated control of metabolism.

Metabolism of lipids. Biosynthesis of fatty acids, oxidation of fat and fatty acids - beta, alpha and Omega oxidation. Ketogenesis and ketolysis. Biosynthesis of phospholipids.

Unit IV (13 hours)

Protein and amino acid metabolism. Nitrogen balance, transamination and deamination. Catabolism of phenylalanine, tyrosine, tryptophan, sulphur containing amino acids, creatine and creatinine. Urea cycle and disorders.

REFERENCES

1. Campbell, P.N. and Smith, A.D. (1982). Biochemistry Illustrated. Churchill Livingstone, New York.
2. Christian, G.D. (1986). Analytical Chemistry. John Wiley and Sons, New York.
3. Conn, E.E., Stumrf, P.F., Bruenning, G. and Doi, R.H. Outlines of Biochemistry. Wiley Eastern Ltd., New Delhi.
4. Cryton - Protein Chemistry
5. Das, D. (1987). Biophysics and Biophysical Chemistry. Academic Publishers, Calcutta.
6. Dasgupta, S.K. (1977). Biochemistry. Vol. 1, 2 and 3. MacMillan Company of India. Delhi.
7. David Rawn. Biochemistry.
8. Devlin, T.M. (1982). Text book of biochemistry with clinical correlations. John Wiley and Sons, New York.
9. Ewing, G.W. (1985). Instrumental methods of chemical analysis. McGraw Hill Book Company, New York.
10. Kaplan, A. and Szabo, L.L. (1983). Clinical Biochemistry. Interpretation and Techniques. Lea and Febiger, Philadelphia.
11. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry. CBS Publishers and Distributors, New Delhi.
12. Lehninger, L. Biochemistry. Kalyani Publishers, New Delhi.
13. Mahler, H.R. and Cordes, E.H. Basic biological chemistry. A Harper's International Edition.
14. Martin Jr., J. W., Mayes, P.A. and Rodwell V.W. (1981). Harper's Review of Biochemistry. Lange Medical, California.

BS 402 - GENETICS AND BIOMETRICS

Unit I (13 hours)

Historical perspectives and scope of Genetics; Principles of Mendelian inheritance; Modifications of Mendelian monohybrid and dihybrid ratios-Incomplete dominance, Codominance, Lethal genes and Multiple alleles.

Cytological basis of inheritance: Linkage and crossing over; Genetic mapping of chromosomes. Sex determination, Sex linked inheritance (*Drosophila* and Man). Sex related traits, genetic disorders.

Unit II (13 hours)

Genetics of Bacteria: Transformation, transduction, Conjugation - Plasmids. Extra chromosomal inheritance with examples. Genomic organization in prokaryotes and eukaryotes. Laws of DNA constancy and C - value paradox.

Mutations: Classification, Biochemical basis for mutations; Detection of mutations - mutagenicity testing.

Unit III (13 hours)

Biological data-frequency distribution, graphical and diagrammatic representations; Measures of Central tendency - Mean, Median and Mode; Measure of Dispersion - Range, Variance, Standard deviation, Coefficient of variation, Diversity Index.

Populations versus sample - sampling techniques; Standard error, Confidence limits.

Random experiment-probability. Binomial, poisson and Normal distributions and their applications in genetics.

Unit IV (13 hours)

Simple linear Regression and Correlation analysis. Analysis of variance, principles of experimental design. Multiple regression.

Tests of significance- Normal, χ^2 , (Chi-square), 't' and F tests; Testing for goodness of fit.

One-way analysis of variance (ANOVA) and Two-way analysis of variance. Statistical packages.

REFERENCES

1. Arnold, E. 1979. II Edn. Introductory statistics for Biology, London.
2. Campbell, R.C. 1983. Statistics for Biologists II Edn., Cambridge Press.
3. Fraser, F.C. and James J. Nora, 1986. Genetics of Man. Lea and Febiger, Philadelphia.
4. Friefelder, D. 1987. Molecular Biology II Edn. Jones and Bartlett Pub. Inc., Boston.
5. Gardner, E.J., M.J. Simmons & D.P. Snustad, 1991. Principles of Genetics. 8th Ed. John Wiley and Sons, Inc., New York.
6. Hartl, D. L., D. Freifelder and L.A. Snyder, 1988. Basic Genetics. Jones and Bartlett Publishers, Boston.
7. Hollaender A. (Ed). 1971-76. Chemical Mutagens. Principles and Methods for their Detection. Vols. 1, 2 & 3. Plenum Press, New York.
8. Jha, A.P. 1993. Genes and Evolution. MacMillan India Ltd., New Delhi.
9. Lewin, B. 1997. Genes VI, Oxford University Press, New York
10. Marther, K. and J. L. Jinks, 1977. Introduction to Biometrical Genetics. Chapman and Hall.
11. Norman, T. J. and Bailey. II Edn. Statistical methods in Biology. Hodder and Stoughton Ltd.
12. Peter J. Russell, 1998. Genetics. The Benjamin/Cummings Publishing Company, Inc.

BS 403 - CELL BIOLOGY

Unit I (13 hours)

Structure of pro-and eukaryotic cells. Structure and organisation of Endoplasmic reticulum, liposomes. Golgi complex and protein sorting, ribosomes and nucleus. Structure of mitochondrion, chloroplast, their genetic organization and their semiautonomous nature.

Unit II (13 hours)

Structure and organization of plasma membranes, model membranes, Glycoconjugates and proteins in membrane system. Ion transport: Na^+/K^+ ATPase
Cell division (mitosis and meiosis). Cell cycle, cell to cell interaction - cell junctions and intercellular communication.

Unit III(13 hours)

Secretory and endocytotic pathway. Cytoskeleton-microtubules, microfilaments, intermediary filaments. Centriole, cilia, flagella and cell motility.
Eukaryotic chromosome - General structure and molecular organization. Nucleosome model of chromatin structure, Giant chromosomes, Structure and function of centromere and telomere.

Unit IV (13 hours)

Principles and applications of light, Phasecontrast, fluorescence, scanning and transmission electron microscopy. Autoradiography, cytophotometry and flowcytometry and centrifugation. Cytochemical and histochemical staining techniques.

REFERENCES

1. C.J. Avers (1986). Molecular Cell Biology. Addison - Wesley Publishing Company, England.
2. J. Brachet (1985). Molecular Cytology. Vol.I &II. The cell cycles. Academic Press, Inc.
3. C.F.A. Culling (1974). Handbook of Histopathological and histochemical Techniques. 3rd Edition. Butterworths.
4. J.H. Darnell, Lodish and D. Baltimore (1995). Molecular Cell Biology. Scientific American Books, New York.
5. C.P. Swanson and P.L. Webster (1989). The Cell. 5th edition. Prentice Hall of India Pvt. Ltd., New Delhi.
6. Sadova, E., 1993. Cell Biology. Jones and Bartlett Publishers, London.
7. Kleinsmith, L.J. and Kish, V.M., 1995. Principles of Cell and Molecular Biology. 2nd Edition. Harper Collins College Publishers,
8. Thorpe, N.O., 1984. Cell Biology. John Wiley and Sons, New York.
9. Ladish, H., Baltimore, D., Berk, A., Zipursky, S.W., Matsudaira, P. & Darnell, S., 1995. Molecular Cell Biology. Scientific American Books. Freeman & Company, New York.
10. Lowey, A.G., Siekevitz, P., Mesninger, J.R. and Gallant, J.A.N., 1987. Principles of Cell structure and function.

BS 404 - BASIC MICROBIOLOGY

UNIT I (13 hrs)

Introduction to microbiology, historical perspectives, contributions of early microbiologists, Koch Postulates. Branches and scope of microbiology. Origin and evolution of microorganisms, discovery of anaerobic life, evolutionary chronology, trends in evolution of archaeobacteria, eubacteria and eukaryotes. Evolution of prokaryotic and eukaryotic metabolism. Modern methods of tracing and analysis of evolution.

UNIT II (13 hrs)

Microbial diversity, habitats, life cycles, structure and classification of bacteria, cyanobacteria, actinomycetes, fungi and viruses. Pathogenic microorganisms: bacteria, mycoplasmas, rickettsias, chlamydias and protozoa.

Microbial nutrition and cultivation: Nutritional categories of microorganisms, role of microbial nutrients; cultivation of aerobes, anaerobes and facultatives, obligate pathogens and viruses. Selective media, selective isolation and methods of preservation of microbes.

UNIT III (13 hrs)

Microbial growth, population and growth curves, generation time, batch and continuous cultures (e.g. chemostat, turbidostat), measurement of growth, microbiological assays (e.g. antibiotics, amino acids and vitamins).

Factors affecting growth and death of microorganisms: temperature, pH, water activity, O-R potential, salinity, hydrostatic pressure, disinfectants, antiseptics and chemotherapeutic agents. Methods of sterilization.

UNIT IV (13 hrs)

Microbial metabolism: Energy sources and classification; metabolism in autotrophs, heterotrophs; hexose and pentose phosphate pathways; synthesis of peptidoclycan, intermediary metabolism and secondary metabolites. Aerobic and anaerobic respiration, fermentation, electron transport system and substrate phosphorylation.

REFERENCES

1. Biology of microorganisms. Brock TB and Madigon MT. Prentice Hall.
2. Element of Microbiology. Pelczar J. and Chan ECS. Mac Graw Hill New York.
3. General Microbiology. Schlegel HG, Cambridge Univ. Press.
4. Microbial Biology. Rosenberg E and Cohen IR. Saunders Coll. Pub.
5. The Microbial World. Stanier RY et al., Prentice Hall New Delhi.
6. Introductory Mycology. Alexopoulous, GJ., Wiley Eastern Limited., New Delhi
7. Microbial Ecology. Atlas RM and Bartha R. Benjamin-Cummings Sci. Press, USA
8. Microbial Ecology. Cambell R. Blackwell Scientid\fic Pub., London
9. Medical Microbiology. Cruickshank R. Churchill Livingstone, London
10. Bacterial Metabolism. Doelle HW, Academic Press, London
11. Instant Notes in Microbiology. Nickilin et al., Via Books Pvt. Ltd., New Delhi
12. Methods in Microbiology. Norris JR. Academic Press, London
13. Introduction to Fungi. Webster J. Cambridge University Press, Cambridge.

BS 405 - BIOCHEMISTRY LAB.

Qualitative tests for the identification of monosaccharides, disaccharides and polysaccharides. Qualitative tests for the proteins, lipids and NPN substances.
Precipitation reactions of proteins.
Spectrophotometric estimation of serum protein, blood sugar, urine creatinine, blood urea, plant phenolics and ascorbic acid.

BS 406 - GENETICS & BIOMETRICS LAB.

Salient features and method of maintenance of *Drosophila melanogaster* culture.
Techniques for handling and examining the flies.
Preparation of salivary gland chromosomes of *D. melanogaster* and identification of different arms.
Preparation of salivary gland chromosomes in *D. nasuta*
Study of Meiosis in *Rhoeo discolor*.
Identification of blood types in man.
Electrophoretic study of proteins and enzymes
Experiments to demonstrate patterns of inheritance of a few characters (Crossing).
Study of (i) mating behaviour in *Drosophila* (ii) somatic mitosis in *Drosophila*.
Biochemical separation of eye pigments in *Drosophila*; Genetic problems.

BS 407 - CELL BIOLOGY LAB.

Study of Microscope.
Study of cell division and chromosomes.
a) Mitosis - onion root tips. b) Meiosis - Grasshopper and *Allium cepa*.
Cytological observation of mitochondria and chloroplast by vital staining; Staining of blood cells and differential counting of blood cells.
Micrometry and camera lucida drawings.
Chemical induction of chromosomal aberration in *Allium cepa* and grasshoppers.
Study of 8-Hydroxy quinoline effect on cell division.
Microtomy and histochemical localization of carbohydrates, proteins and counter.
Differential staining of tissue sections of liver, intestine, stomach, ovary, spleen and kidney.

BS 408 - BASIC MICROBIOLOGY LAB.

Introduction to basic techniques and instrumentation in microbiology
Microscopic observations of microorganisms and micrometry
Staining techniques: Properties of stains, microbial smear preparation, simple and differential staining for morphological studies, Gram's staining, endospore staining, intracellular lipids, acid-fast staining, flagella, viability tests and relief (negative) staining;
Microbial motility tests.
Microbial culture media, microbial growth, sterilization of media and glassware, filter sterilization, stock culture, subculture, maintenance of culture. Techniques of microbial isolation.

II SEMESTER

THEORY PAPERS

BS 451 - BIOCHEMISTRY & BIOPHYSICS

Unit I (13 hours)

Biosynthesis of purine, pyrimidine nucleotides and nucleic acids.

Principles and applications of tracer technique biology. Radiation dosimetry. Radioactive isotopes and half life of an isotope. Effects of radiation on biological system. Cerenkov radiation. Liquid scintillation counter and radiation measurement.

Unit II (13 hours)

Enzymes - Classification - IUPAC; Enzyme unit, Isozyme ribozyme and abzyme. Factors affecting the velocity of an enzyme catalyzed reaction. Multienzyme complex. Enzyme kinetics (negative and positive cooperativity). Control of an enzyme activity- Covalent modification, zymogen activation; allosteric regulation; induction and repression of enzymes. Activation and inhibitors of enzymes. Active sites. Enzyme specificity. Coenzymes.

Unit III (13 hours)

Bioenergetics: Thermodynamic principles in biology. Concept of free energy. Energy rich bonds. Coupled reactions, oxidative phosphorylation, group transfer. Biological energy transducers.

Principles and applications of Thin Layer Chromatography, Gel filtration, ion exchange and affinity chromatography. HPLC, Electrophoresis, electrofocusing and ultracentrifugation (Velocity and buoyant density).

Unit IV (13 hours)

Principles of biophysical methods used for the analysis of biopolymer structure. X-ray diffraction, fluorescence UV, ORD, CD, visible NMR and ESR spectroscopy. Atomic absorption spectroscopy and plasma emission spectroscopy.

REFERENCES

1. Ottaway, J.H. and Apps, D.K. (1984). Biochemistry. The English Language Book Society.
2. Page, D.S. (1978). Principles of biological chemistry. Willard Grant Press, Boston, U.S.A.
3. Rastogi, S.C. (1993). Biochemistry. Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. Sastri, M.N. (1996). Separation methods. Himalaya Publishing House, Bombay.
5. Skoog, D.A., West, D.M. and Holler, F.J. (1988). Fundamentals of Analytical Chemistry. Saunders College Publishing, New York.
6. Strayer. Biochemistry. W. H. Freeman and Company, San Francisco.
7. Trehan, K. Biochemistry. Wiley Eastern Ltd, New Delhi.
8. Weil, J.H. (1996). General Biochemistry. New Age International Ltd., New Delhi.
12. Willard, H.H., Merrit Jr. L.L., Dean, J.A. and Settle Jr. F.A. (1986). Instrumental methods of analysis. CBS Publishers and Distributors, Delhi.
10. Wills, E.D. Biochemical Basis of Medicine.
11. Wilson, K. and Goulding, K.W. (1986). A biologist's guide to principles and techniques of practical biochemistry. ELBS.
12. Wilson, K. and Walker, J. (1996). Practical biochemistry. Principles and Techniques. Cambridge Low Price Editions.
13. Yudkin, F.D. & Offord, R.E. (1980). Comprehensive Biochemistry. ELBS.
14. Zubay, G. (1988). Biochemistry. MacMillan Publishing Company, New York.

BS 452 - MOLECULAR GENETICS

Unit I (13 hours)

Identification of genetic material. Gene structure and organization-Fine structure of gene. Colinear genes, overlapping genes, split genes, jumping genes. Immunoglobulin gene family.

Molecular mapping of genome. Genetic and physical maps. *In situ* hybridization for genome analysis, molecular markers in genome analysis. RAPD and RFLP analysis.

Unit II (13 hours)

Applications of RFLP in forensic, disease prognosis and germplasm maintenance.

Gene regulation: prokaryotes - positive and negative controls. Lac Operon and Tryptophan operon; Eukaryotes - Tissue specific gene expression and hormonal control of gene expression.

Unit III (13 hours)

Genetics of Viruses: Life cycle of virulent bacteriophages. Temperate phages and prophage. RNA phages, tumor viruses and viroids. Genetic recombination in phages. Host cell restriction. Molecular biology phage infection.

Somatic cell genetics: Cell fusion and hybrids, agents and mechanism of fusion. Heterokaryon-chromosome segregation.

Unit IV (13 hours)

Population Genetics: Hardy Weinberg law of genetic equilibrium; Models of speciation; DNA polymorphism and principles of DNA fingerprinting.

Human genetics: Techniques in human chromosome analysis molecular cytogenetic approach; Mendelian and chromosome based heritable diseases in humans; Human genome project.

REFERENCES

1. Obe, G. (Ed.) 1984. Mutagens in Man. Springer-Verlag, Berlin.
2. Obe, G. and A. Basler, 1987. Cytogenetics - Basic and Applied. Springer-Verlag, Berlin.
3. Obe, G. (Ed.) 1990, 1993. Advances in Mutagenesis Research. Vol. 1, 2 & 3. Springer-Verlag, Berlin.
4. Pollard, J.H., 1977. A Handbook of numerical and statistical techniques.
5. Schlieff, R. 1986. Genetics and Molecular Biology. Addison-Wiley Pub. Co., Massachusetts.
6. Sinnot, E.W., L.C. Dunn and T. Dobzhansky, 1985. Principles of Genetics. Tata McGraw Hill Publishing Company Ltd., New Delhi.
7. Stent, G.S. and R. Calender, 1986. Molecular Genetics CBS Publishers and Distributors, New Delhi.
8. Strickberger, M.W. 1986. Genetics (III Edn.), McMillan Publishing Company, New York.
9. Suzuki, D. and P. Knudson, 1989. Genetics the ethics of Engineering, Unwin Hyman, London.
10. Tamarin, R.H. 1997. Principles of Genetics, 2nd ed. P.W.S. Publishers, Boston.
11. Watson, J.D. et al, 1987. Molecular Biology of the Genes. 4th Edn. The Benjamin Cummings Pub. Co. Inc., California.
12. Peter Snustad. Principles of Genetics. John Wiley and Sons, New York.

BS 453 - MOLECULAR BIOLOGY

Unit I (13 hours)

Protein synthesis in prokaryotes and eukaryotes - Organization of transcriptional units. Mechanism of DNA transcription in prokaryotes and eukaryotes. RNA processing (capping, polyadenylation, splicing, introns and exons).

Unit II (13 hours)

Heterochromatization, transposition, regulatory sequences and transacting factors. Environmental control of gene expression. Structure of nucleic acids; structure of DNA, forms of DNA repetitive DNA and DNA replications. DNA polymerases. DNA ligases, topoisomerases, gyrases, methylases, nucleases and restricting endonucleases. Ribonucleoproteins. Structure of m-RNA. Three dimensional structure of t-RNA. Genetic code.

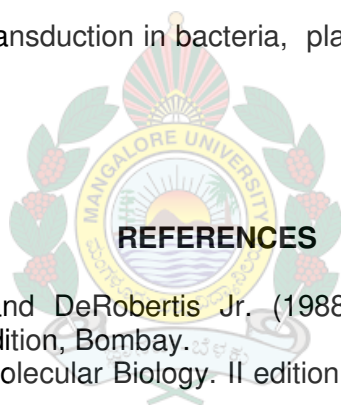
Unit III (13 hours)

Biochemistry and molecular biology of Cancer. Oncogenes, protooncogenes and tumor suppressor genes. Chemical carcinogenesis, malignant growth. Metoplasia, neoplasia, cell transformation mechanisms. Mismatch repair pathway and cancer.

Unit IV (13 hours)

Molecular basis of signal transduction in bacteria, plant and animals. Cell adhesion and contact inhibition.

Molecular Recombination.



REFERENCES

1. 1. E.M.F. DeRobertis and DeRobertis Jr. (1988). Cell and Molecular Biology. 18th edition. Indian Edition, Bombay.
2. D. Friefelder (1987). Molecular Biology. II edition. Jones and Bartlett Publishers Inc. Boston.
3. B. Lewin (ed.), (1997). Genes. VI edition, John Wiley and Sons, New York.
4. R. Schlieff (1986). Genetics and Molecular Biology. Addison-Wesley Publishing Company.
5. J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner (1987). Molecular Biology of the Gene. Vol. I&II. General Principles. 4th edition. The Benjamin Cummings Publishing Company, Inc.
6. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson (1995). Molecular Biology of the Cell, II edition, Garland Publishing Company Ltd. New York and London.
7. Twayman, R.M., 1998. Advanced Molecular Biology. Viva Books Pvt. Ltd., New Delhi.
8. Malecinski, G.M. and Freifelder, D., 1998. Essentials of Molecular Biology. 3rd Edition. Jones and Bworlett Publishers, Boston.
9. Sadova, E., 1993. Cell Biology. Jones and Bartlett Publishers, London.
10. Kleinsmith, L.J. and Kish, V.M., 1995. Principles of Cell and Molecular Biology. 2nd Edition. Harper Collins College Publishers,

BS 454 - APPLIED MICROBIOLOGY

UNIT I (13 hrs)

Immunology: Immunity, classification of immunity; Host defence: cellular, tissue and humoral immunity; Acquired immunity; Microbial defence: invasion, antigens, toxins; Antibodies: Production, structure, classification and functions. Antigen-antibody reactions. Autoimmune diseases, acquired immune deficiency syndrome, immunization and vaccines.

UNIT II (13 hrs)

Fermentation: Ethanol, lactic acid, mixed acids, 2-3 butanediol, clostridial and propionic acid fermentation with emphasis on their ecological niches, merits and demerits.

Food Microbiology: Classification of foods and oriental foods; Basic principles of food spoilage and methods of food preservation; Milk and milk products, milk microflora and their estimation, milk-borne diseases and prevention; Food poisoning, food-borne diseases and prevention.

UNIT III (13 hrs)

Soil Microbiology: Soil microflora and methods of their estimation, role of soil microorganisms, bioconversion and decomposition. Biological nitrogen fixation (symbiotic and non-symbiotic), microbial phosphorus solubilization and their importance in soil fertility and agriculture.

Aquatic Microbiology: Microbes in water and methods of their estimation (e.g. MPN), drinking water microbial standards and water purification; Water-borne diseases and prevention.

UNIT IV (13 hrs)

Microbial Ecology: Microbial symbiosis, mutualism, plant-microbe interactions (e.g. mycorrhizas), animal-microbe interactions (human, ruminants and non-ruminants). Microbes in hydrothermal vents and coral reefs.

Air Microbiology: Microflora of air and methods of their estimation, monitoring air allergens, air-borne diseases and prevention.

REFERENCES

1. Biology of microorganisms. Brock TB and Madigan MT. Prentice Hall.
2. Element of Microbiology. Pelczar J. and Chan ECS. Mac Graw Hill New York
3. General Microbiology. Schlegel HG, Cambridge Univ. Press.
4. Microbial Biology. Rosenberg E and Cohen IR. Saunders Coll. Pub.
5. The Microbial World. Stanier RY et al., Prentice Hall New Delhi.
6. Microbial Ecology. Atlas RM and Bartha R. Benjamin-Cummings Sci. Press, USA
7. Medical Microbiology. Cruickshank R. Churchill Livingstone, London
8. Bacterial Metabolism. Doelle HW, Academic Press, London
9. Instant Notes in Microbiology. Nicklin et al., Via Books Pvt. Ltd., New Delhi
10. Methods in Microbiology. Norris JR. Academic Press, London
11. Food Microbiology. Adams MR and Moss MO, Panima Publ., New Delhi
12. Microbiology and Immunology Concepts. Barrett JT, Lippincott-Raven, USA
13. Industrial Microbiology. Casida LE. Wiley Eastern Ltd., New delhi
14. Immunology. Elgert KD. Jon Wiley and Sons, USA
15. Advances in Agricultural Microbiology. Subba Rao NS, Oxford and IBH Pub., New Delhi

BS 455 - BIOCHEMISTRY & BIOPHYSICS LAB.

Colorimetry, Beer-Lamberts Law, Verification, pH meter and its applications. Flamephotometry and its application in the estimation of serum, calcium, potassium and lithium and sodium. Microkjeldhal estimation of protein.

Electrophoresis and separation of plasma protein. Paper and thin layer chromatographic identification of amino acids and carbohydrate.

Estimation of nucleic acids; HPLC; Qualitative tests for the identification of monosaccharides, disaccharides and polysaccharides. Qualitative tests for the proteins, lipids and NPN substances.

Precipitation reactions of proteins. Spectrophotometric estimation of serum protein, blood sugar, urine creatinine, blood urea, plant phenolics and ascorbic acid.

BS 456 - MOLECULAR GENETICS LAB.

Demonstration of barr body or sex chromatin ; Chiasma frequency in the meiotic chromosome and meiosis

Human chromosomal analysis using karyotyping; Genotoxicity testing using micronucleus test

Culturing human cell lines enzymatic dissegregation sub culturing and derivations of cell lines.

Measurements of DNA contents in cells and DNA isolation from plant and human cell lines. Isolation and measurement of RNA contents from cells; Characterization of chromosomes by various banding techniques.

Analysis of chromosomal abnormalities.

Fluorescence staining techniques of the chromosomes.

Lymphocyte culture; Toxicity testing on cell lines; Cancer cell culturing; Dermatoglyphics

1. Demo a) Southern & b) Northern blotting techniques
2. Study of restriction sites at DNA

BS 457 - MOLECULAR BIOLOGY LAB.

Induction of chromosomal anomaly in mouse sperm abnormality assay. Micronucleus test.

Human lymphocyte culture and preparation and observation of human chromosome.

- a) Isolation of DNA from *E. coli*
- b) Isolation of DNA from wheat leaves
- c) Isolation of RNA from yeast
- d) Isolation of RNA from plant tissue

Induction of cancer; Chromosome banding techniques

BS 458 - APPLIED MICROBIOLOGY LAB.

Quantitative and qualitative assessment of microflora of soil, water and air by direct and indirect methods.

Selective isolation of microbes (bacteria, actinomycetes, yeasts and fungi)

Studies on symbiotic association of microorganisms (rhizobia, cyanobacteria and arbuscular mycorrhizae)

Simple and special morphological and biochemical tests for identification of bacteria and fungi

Assessment of microbial quality of drinking water and milk

Microbiological assays (antibiotics and amino acids)

III SEMESTER

THEORY PAPERS

BS 501- Biodiversity (Choice-based paper)

Unit I (13 hours)

Basic concepts and definitions, scope, biosphere, habitats, food chain, food web. Levels of Biodiversity Organizations – Genetic diversity, Species diversity and Ecosystem diversity. Indian ecological/geographical diversity : Himalayan Region, Deserts, Semiarid region, Gangetic plains. Western Ghats, Coastal region. Hotspots of biodiversity, IUCN categories of threat. Causes and prevention of Plant and Animal biodiversity loss. Centers of diversity study.

Unit II (13 hours)

Microbial diversity : Bacteria, Cyanobacteria, Fungi and lichens, algae, protozoa and viruses, habitat. Mushrooms – edible and nonedible. Plant and animal association with microbes. Beneficial and harmful microbes, Culture, Cultivation of bacteria. Microbial products.

Unit III (13 hours)

Plant diversity : Lower and higher group of plants, plant ecosystem and its classification. Major ecosystem types, tropical forests, temperate forests. Arid and Semiarid ecosystems, boreal forests, Arctic and Alpine systems, grasslands, wetland ecosystem. Marine ecosystems, Epiphytes, parasites and orchids. Values and uses of plant diversity. Conservation strategies – Ex-situ and In-situ conservation, protected ecosystems – biosphere reserves, national parks, game sanctuaries, botanical gardens, sacred groves.

Unit IV (13 hours)

Animal diversity : Lower and higher group of animals, their ecological niches. Zoogeographical regions of the world and India. Biodiversity hotspots, Animals in temperate, tropical and boreal forests, cave and mountains. Coastal ecosystems, mangrove and estuaries, coral reefs. Wildlife conservation and wildlife conservation act. Sanctuaries and National parks.

REFERENCES

1. APHA, 1992. Standard methods for examination of water and waste water. 19th Ed. APHA, New York, USA.
2. Daniel, J.C. A century of natural history. Bombay natural History Society, Bombay. M 697pp.
3. Dwivedi, A.P., 1993. Forests. International book Distributors, Dehra Dun. 352 pp.
4. Eugene, P. Odum, 1983. Basic Ecology. Saunders College, London.
5. Gugjisberg, C.A.W., 1970. Man and Wildlife, Arco Publishing Company Inc., New York.
6. Gulland, J.A., 1971. The fish resources of the Ocean, FAO/Fishery News (Books) Limited, England. 255 pp.
7. Gutierrez, A.P., 1996. Applied population ecology. John Wiley and Sons, Inc. New York. 300 pp.
8. Haywood, V.H. and Watson, R.T., 1995. Global biodiversity assessment. United Nations Environmental Programme, New York.
9. Jhingran, V.G., 1988. Fish and Fisheries of India. Hindustan Publishers, New Delhi. 666 pp.
10. Korringa, P., 1976. Farming of marine organisms law in the food chain. Elsevier, Amsterdam. 264 pp.
11. Levinton, J.S., 1982. Marine ecology, Prentice Hall, Englewood Cliffs. 526 pp.
12. Lieth, H., 1989. Tropical rain forest ecosystems. Elsevier, Amsterdam. 713 pp.
13. Southwood, T.R.E., 1978. Ecological methods, Chapman and Hall, London. 524 pp.
14. Tiwari, S.K., 1985. Readings in Indian Zoogeography. Today and Tomorrow's Printers and Publishers, New Delhi. 604 pp.

15. John Brown et al., 1989. Sea water: Its composition properties and behaviour. Open University Publications, Pergamon Press, England.
16. Nybakkan, J.N., 1982. Marine Biology – An ecological approach. Harper and Raw Publ., New York.
17. Qasim, S.Z., 1998. Glimpses of the Indian Ocean. Universities Press, Hyderabad. 206 pp.
18. Reddy, P.A., 2000. Wetland ecology. Cambridge University Press, London. 614 pp.
19. Davis, C.C., 1995. The marine and fershwater plankton. Michigan State University, Michigan. 502 pp.
20. Krishnamoorthy, K.V 2003. An advanced textbook on Biodiversity. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi. pp. 260.
21. Brummit, R.K. 1992, Vascular Plant Families and Genera, Royal Botanic Gardens, Kew, England.
22. IUCN, 1992. Protected Areas of the World: A Review of National Systems (4 Vols.) WCMC, Cambridge and IUCN Commission on National Parks and Protected Areas, IUCN, Gland, Switzerland.
23. IUCN, 1993. Draft IUCN Red List Categories. IUCN, Gland, Switzerland.
24. IUCN, 1994b. Guidelines for Protected Area Management Categories. WCMC, Cambridge and IUCN Commission on National Parks and Protected Areas. Gland, Switzerland.
25. IUCN, 1995. IUCN Red List Categories. IUCN, Gland, Switzerland.
26. Janzen, d.h. 1986. Tropical dry forests- the most endangered major tropical ecosystem. In: Wilson, E.O. and Peters, F.M. (eds.) Biodiversity. National Academy Press, Washington DC, pp. 130-137.
27. Krishnamurthy, K.V. 1999. The *Nandavanas* of medieval India. Lecture, C.P.R. Foundation, Chennai, Tamil Nadu, India (mimeographed).
28. Krishnamurthy, K.V. and Ureti, D.K. 2001. Reproductive Biology of Lichens. In: Johri, B.M. and Srivastava, P.S. (Eds.) Reproductive Biology of Plants. Narosa Publishing House, New Delhi. pp. 127-147.
29. Kushalappa, C.G. and Bhagwat, S.A. 2001. Sacred groves: Biodiversity, threats and conservation. In: Uma Shanker, R., Ganeshaiah, K.N. and Bawa, K.S. (Eds.) Forest Genetic Resources: Status, Threats and Conservation Strategies. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, pp. 21-29.
30. Lovelock, J,E. 1988a. The Earth as a living system. In: Wilson, E.O. and Peters, F.M. (Eds.) Biodiversity. National Academy Press, Washington DC, pp. 486-489.
31. Magurran, A.E. 1998. Ecological Diversity and its Measurememnt. Princeton Univ. Press, Princeton, NJ.
32. Pearce, D.W. and D. Moran 1994. The Economic Value of Biological Diversity. Earthscan London.

BS 502 - BIOTECHNOLOGY

UNIT I (13 hrs)

Aims and scope of biotechnology, basic concepts of biotechnology, traditional and modern biotechnology. Microbial Biotechnology: Fermentation techniques: Fermenters and bioreactors. Batch, submerged (SmF), solid substrate (SSF) and continuous fermentation. Fermented foods, oriental foods, silage, probiotics, single cell proteins, production of hormones and growth factors. Microbial polysaccharides, bioplastics, cell immobilization and its applications. Biopesticides (fungi, bacteria and viruses). Biofertilizers, plant-growth promoting microorganisms, biocontrol agents and bioprotectants. Transgenic microbes and their applications.

UNIT II (13 hrs)

Plant Biotechnology: Plant tissue culture laboratory and aseptic techniques, culture media, callus induction, organogenesis, somatic embryogenesis, micropropagation, production of secondary metabolites, selective markers, somaclonal variation, synthetic seeds and cryopreservation. Haploid production: pollen, anther and ovule cultures. Cell suspension culture, protoplast culture, protoplast fusion and hybridoma technology. Transgenic plants, production of disease-, salinity-, pest-, herbicide-, drought-resistant and high yielding varieties of plants. Production of improved varieties using Ti plasmids. Application of rhizobia and mycorrhizas in plant tissue culture. Plant-derived vaccines and antibodies.

UNIT III (13 hrs)

Animal Biotechnology: Animal cell culture techniques, culture media, primary and secondary cell cultures, cell lines and cell strains and growth factors. Stem cells, gene expression in cell culture, organ culture, cytotoxicity and genotoxicity tests employing cultured cells. Immunological techniques: immunodiagnosis, ELISA, RIA, immunoblotting and immunofluorescence. Hybridoma technology, production and application of monoclonal antibodies. In vitro fertilization, embryo transfer, super ovulation and cloning. Juvenile hormone analogues.

Transgenic animals and their uses. Animals as bioréactors.

UNIT IV (13 hrs)

Biodeterioration of food commodities and industrial products (e.g. plantation products, wood, paper, textile, leather and paints) and its prevention. Fermentation of plantation products (e.g. tea, coffee and cocoa). Methods of downstream processing of biological molecules produced by microbial, plant or animal cells. Biotechnological applications in sericulture, silviculture, wild life conservation and management.

REFERENCES

1. Comprehensive Biotechnology, Vol. 1, 2, 3 & 4 Murray Moo Young, Pergamon Press
2. Industrial Biotechnology, Cruger & Cruge
3. Microbial Biotechnology, Alexander, G, WH Freeman and Company
4. Microbial Technology. Peppler, Vol. 1 & 2
5. Biotechnology in Agriculture and Forestry. Bajaj YPS series. Springer Verlag Pub.
6. Biotechnology of Higher Plants - Russell.
7. Plant Cell and Tissue Culture. A Lab manual. Reinert J. Narosa Pub.
8. Plant Biotechnology. Mantell and Smith. Cambridge Univ. Press.
9. Animal Transgenesis and Cloning by Louis-Marie Houdebine John Wiley & Sons.
10. Animal Cell Culture and Technology by Michael Butler BIOS Scientific Publishers.
11. Basic Cell Culture: A Practical Approach (Practical Approach Series) by J. M. Davis, Oxford university press, oxford.

BS 503 - COMPARATIVE PHYSIOLOGY

Unit I (13 hours)

Definition, Scope and facets of comparative physiology.

Gastrointestinal System: Digestive processes and mechanisms of absorption of dietary carbohydrates, proteins and lipids; coordination of digestive and absorptive activities; gastrointestinal disorders.

Nervous system: Neuron and nerve impulse conduction synapses, synaptic transmission and neurotransmitters; reflex mechanisms; functions of the sensory and motor areas of the CNS ; autonomic nervous system.

Unit II (13 hours)

Endocrine system : Endocrine glands - pituitary, thyroid, parathyroid, adrenals, pancreas, ovary, testis and pineal: hormones - release, transport, mechanism of action and biological action; Neurohormones of the hypothalamus; endocrine disorders, Neuroendocrine system in Insecta and Crustacea.

Muscular system: Contraction of skeletal muscle; molecular basis of muscle contraction; energetics of muscular contraction; neuromuscular transmission and excitation contraction coupling ; muscle atrophy and dystrophy.

Unit III (13 hours)

Plant nutrition: Trace elements and their role, major and minor elements in soil and plants; Mineral deficiencies and their rectification, nitrogen, phosphorus and sulfur metabolism.

Water relations in plants: water requirements, mechanism of translocation of water and solutes; Transpiration and anti-transpirants.

Unit IV (13 hours)

Photosynthesis: cyclic and non-cyclic photophosphorylation, electron transport system, carbon dioxide fixation in C_3 & C_4 plants. Factors affecting photosynthesis.

Growth hormones: Biosynthesis, mechanism of action and application of auxins, gibberlins, cytokinins, ethylene, abscisic acid. Phytochromes.

REFERENCES

1. Berne, R.M. & Levy, M.N. 1991. Physiology. The C.V. Mosby Company, St. Louis.
2. Ganong, W.F. 1999. Review of Medical Physiology (19th Edition) Kotheri Book Depot, Bombay.
3. Wilson, J.A. 1979. Principles of Animal Physiology. MacMillan Pub., New York.
4. Hopkins, W.G. (1995). Introduction to Plant Physiology. John Wiley and Sons, Inc. New York.
5. Guyton, A.C. & Hall, J.E. 1996. Text Book of Medical Physiology. 9th Ed. W.B. Saunders Company, Philadelphia.
6. Jenson, D., 1976. Principles of Physiology, Appleton Century Crafts.
7. Gorbman, A & Bern, H.A. 1974. A text book of Comparative Endocrinology. Wiley Eastern.
8. Prosser, C.L. & Brown, 1983. Comparative Animal Physiology. W.B. Saunders Company.
9. Vander, A.J., Sherman, J.H. and Luciano, D.S, 1994. Human physiology – The mechanisms of body function. International edition (6th ed.). McGraw Hill, Inc. New Delhi.
10. Devlin, R.M. 1983. Plant Physiology. CBS Publications & Distributors, New Delhi.
11. Hopkins, W.G. (1995). Introduction to Plant Physiology. John Wiley and Sons, Inc. New York.
12. Kochhar, P.L. 1978. Plant Physiology. Atmaram, New Delhi.
- Noggie, Ray G. 1986. Introductory Plant Physiology. Prentice Hall of India Pvt. Ltd. New Delhi.
13. Prasad M., 1997. Plant Ecophysiology. John Wiley & Sons, New York.
14. Salisbury, F.B. and C.W. Ross, 1992. Plant Physiology. Wordsworth Publishing Company, California.
15. Verma, V. 1975. Plant Physiology. Embkay, New Delhi.

BS 504 - ECOTOXICOLOGY

Unit I (13 hours)

Introduction, definition and various facets of ecotoxicology; Kinds of toxicity, time & dose response relationships; factors influencing the toxicity; Bioassay.

Metabolism of toxic substances: biomagnification, biotransformation and detoxification; Effects of environmental toxicants- sub cellular, cellular, individual, population and ecosystem levels.

Unit II (13 hours)

Atmospheric toxicants: Major sources, types and standards; Primary pollutants- Carbon monoxide, sulphur oxides, nitrogen oxides, particulate matter, hydrocarbons, asbestos and CFC's; Secondary pollutants; Impact of air pollutants on climate-Acid rain, photochemical smog, global warming, ozone depletion and haze.

Toxicity of Alcohol, tobacco & its products, food additives, petroleum & petroleum products..

Unit III (13 hours)

Pesticides: Definition, classification, usage and exposure; Insecticides: Organochlorines - (DDT, cyclohexane, aldrin and endosulfan; Poisoning and treatment; Organophosphates and carbamates-Examples, sources, effects and treatment; herbicides, fungicides, rodenticides, endocrine disrupters. PCBs and Dioxins.

Metal toxicity - History, sources, emissions, effect of mercury, cadmium, arsenic and lead on metabolism and environment.

Unit IV(13 hours)

Environmental Impact Assessment: Elements of EIA-Methods, application and guidelines for setting industries, water treated projects and transport activities.

Toxic risk assessment: Methods, monitoring, importance and surveillance of risk assessment.

Safety standards: Safety measure, safety regulation, protective practices and devices - environmental education.

REFERENCES

1. Boudou, A. 1997. Aquatic toxicology. Vol. I and II.
2. Diwakar Rao, P.L. 1990. Pollution control Hand book, Utility Publications Ltd., Secunderabad. India.
3. Eaton, A. D., Clesceri, L.S. & Greenberg, A.E. 1995. Standard Methods for the Examination of Water and Wastewater. APHA, Washington.
4. Gupki P.K. and Salunke, D.K. 1985. Modern Toxicology. Vol.I, II and III. Metropolitan Publications, Delhi.
5. Hommadi, A.H. 1990. Environmental and Industrial safety. Indian Bibliographics Bureau, Delhi.
6. Jorgensen, S.E., Modelling in Ecotoxicology. Elsevier, Amsterdam.
7. Lewin, S.A. et al., 1988. Ecotoxicology : Problems and approaches. Springer - Verlag, Tokyo, New York.
8. Lewin, S.A. et al., 1989. Ecotoxicology: Problems and approaches. Springer - Verlag, Tokyo, New York.
9. Moriarty, F., 1975. Pollutants and animals : A factual perspective. George Allan & Unwin Ltd., London.
10. Omkar, 1995. Concepts of Toxicology. Chand & Co., Jallandar.
11. Schmitz, R.J. 1996. Introduction to water pollution biology. Asian Books Pvt. Ltd., New Delhi.
12. Trivedi, P.R. and Sudarshan, K. 1995. Global environmental issues. Commonwealth Publications, New Delhi.
12. Vernberg et al., 1981. Biological monitoring of marine pollutants. Academic Press, New York.

BS 506 – BIOTECHNOLOGY LAB.

Production and analysis of vermicompost
 Identification, collection and cultivation of mushrooms
 Submerged and solid-substrate fermentation.
 Production and assessment of enzymes, mycotoxins, organic acids and antibiotics.
 Isolation and induction of root nodules by rhizobia
 Isolation and mass production of arbuscular mycorrhizal spores.
 Plant tissue culture
 Immunological reactions
 Evaluation of nutritional and antinutritional qualities of edible seeds.

BS 506 - COMPARATIVE PHYSIOLOGY LAB.

Gastrointestinal function -

Factors affecting enzyme activities in digestion of food stuffs.
 Quantitative estimation of Enzyme (amylase) activity.

Neuroendocrinology –

Effect of hormones on blood glucose in rats.
 Effect of neurohormones on amphibian heart rates;

Study of estrous cycle in mice;

Study of sperm count, sperm morphology and sperm motility in normal and treated mice.

Muscle Physiology -

Histochemical detection of SDH activity in red and white muscle fibres.

Plant nutrition

Observation of mineral deficiency symptoms in plants.

Water relations

Experiments to demonstrate the diffusion pressure deficit in plant cell.

Determination of stomatal index, stomatal frequency and measurement of stomatal aperture.

Photosynthesis

Separation and estimation of chloroplast pigments.

Growth hormones and their regulation -

Experiments to demonstrate the effect of hormones on shoot apex.

BS 508 - ECOTOXICOLOGY LAB.

Safety notices in environmental toxicological studies.

Bioassay experiments using different test systems.

Behavioural study of the fish under exposure to toxicants.

Estimation of oxygen consumption by the organism (fish) under stressed condition (physical & chemical).

Experiments on solid waste

Estimation of oil and grease in water sample.

Demonstration of catalase activity in polluted waters.

Spot test for detection of metals, residual chlorine, nitrite poisoning, fluoride toxicity food adulterants and pesticide residues.

Effect of CdCl_2 on germination of Bengal gram.

Effect of toxicants in meristematic tissue (Onion root tips).

GC analysis of pesticide residues in food samples.

IV SEMESTER

THEORY PAPERS

BS 551 - BIOTECHNOLOGY AND BIOINFORMATICS

UNIT I (13 hrs)

Molecular Biotechnology: Gene manipulation, DNA insertion through vectors, clone selection and expression of cloned genes. Expression systems and their applications: Escherichia coli, Streptomyces, yeast, baculovirus and animal cells as cloning hosts. Analysis of DNA-DNA sequences, mutagenesis and gene expression, DNA amplification, PCR and RtpCR techniques and DNA fingerprinting.

UNIT II (13 hrs)

Environmental Biotechnology: Types of agricultural wastes and their utilization – Silage and mushroom production, energy from biomass (biogas), production of compost and vermicompost. Bioremediation: Plant and microbial bioremediation. Solid and liquid waste processing and utilization. Mining microbiology: Microbial ore processing, microbial corrosion and prevention, bioleaching, biomimetic materials and biosensors.

UNIT III (13 hrs)

Marine biotechnology: Mariculture, novel metabolites from marine organisms, mitigation in sea, biofilms, biofouling and its prevention. Patenting life, intellectual property rights, patenting, traditional knowledge and traditional knowledge digital library (TKDL). Biopiracy, plant-related litigations, bioterrorism and biological warfare.

UNIT IV (13 hrs)

Bioinformatics: Structural and functional features of computers. Databases, search engines, internet tools and World Wide Web (WWW). Molecular Modeling Database at NCBI, major web resources for bioinformatics. Phylogeny - Tree definitions, distance matrix methods and parsimony and bootstrapping. DNA and protein sequence Analysis, FASTA, BLAST and GCG Wisconsin/Emboss packages. Genomics and proteomics.

REFERENCES

1. From Genes to Clones. Winnaker. Panima Educational Book agency
2. Genes VII. Lewin, Oxford University Press.
3. Principles of gene manipulation. Old and Primrose- Blackwell scientific Pub.
4. Recombinant DNA technology. Watson JD et al. Scientific American books.
5. Environmental Bio technology, Jogdanand , Himalaya pub House
6. Environmental and Biochemistry Kudesia & Jetley Pragathi Prakashan Pub.
7. Microbial Ecology. Atlas and Bartha
8. Microbial biotechnology. Alexander. G, WH Freeman and com.
9. Sewage and industrial effluent treatment John Arundel, Blackwell science Pub.
10. Waste water engineering, Metcalf & Eddy, McGraw-Hill international.
11. Beginning Perl for bioinformatics. James D. Tisdall
12. Bioinformatics: Sequence and genome analysis. By David W. Mount
13. Bioinformatics. Methods and protocols. By Stephen A. Krawetz, Humana Press
14. Fundamental Concepts of Bioinformatics - Krane & Raymer, Pearson Ed.
15. Introduction to Protein structure. C.I. Branden and J. Tooze, Garland Pub.
16. Introduction to Bioinformatics. Attwood & Parrysmith, Pearson Ed.

BS 552 - ENVIRONMENTAL PHYSIOLOGY

Unit I (13 hours)

Environmental factors like, Heat, cold, oxygen deficiency, salinity, pressure etc. in relation to species, strain, sex, genetic, age and nutrition.

Circulation: Types of heart and body fluids (blood and lymph); buffering properties of blood ; blood circulation ; Physiology and patterns of circulation ; Circulatory physiological features in special environment Viz., high altitude, deep sea diving.

Respiration: Transport of oxygen and carbon dioxide; regulatory mechanisms of respiration, respiratory physiological features in special environments viz. high altitude, deep sea diving; respiratory diseases.

Unit II (13 hours)

Thermoregulation: Physiological adjustments to heat and cold; relationship with circulation & hormonal control.

Osmoregulation and excretion: Osmoregulation in aquatic and terrestrial vertebrates; regulatory mechanisms; general patterns of nitrogen and non-protein nitrogen excretion; physiology of urine formation in mammals; renal diseases.

Receptor system: Sensory receptors-classification and properties; Special senses-neurophysiology of vision, hearing and chemical senses.

Unit III (13 hours)

Principles of plant responses to environment. Problems of environment. Ecotypes - the role of genetics.

Photoperiodism and its significance, endogenous clock and its regulation and development. Physiology of flowering, senescence.

Unit IV (13 hours)

Stress physiology: Plant response to biotic and abiotic stress. Stress tolerance, HR and SAR, water deficit and draught resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress.

Plant adaptation to the radiation environment.

REFERENCES

1. Schmidt-Nielsen, K. 1981. Animal Physiology Adaptations and Environment. Cambridge University Press, Cambridge.
2. Prosser, C.L. & Brown, 1983. Comparative Animal Physiology. W.B. Saunders.
3. Hoar, W.S. 1976. (2nd Edition). General and Comparative Physiology. Prentice Hall of India, New Delhi.
4. Wilson, J.A. 1979. Principles of Animal Physiology. MacMillan Pub., New York.
5. Hopkins, W.G. (1995). Introduction to Plant Physiology. John Wiley and Sons, Inc. New York.
6. Galston, A.W., 1989. Life processes in plants. Springer- Verlag, New York.
7. Nobel P.S., 1999. Physico-chemical and Environmental plant physiology.
8. Academic Press, SAn Diego, U.S.A.
9. Taiz and Zeiser, E., 1998. Plant physiology. Wordsworth Publishing Co., California, U.S.A.
10. Baldwin, E. 1964. An Introduction to comparative biochemistry Cambridge Univ. Press, Cambridge.
11. Berne, R.M. & Levy, M.N. 1991. Physiology. The C.V. Mosby Company, St. Louis.
12. Ganong, W.F. 1971. Review of Medical Physiology (5th Edition) Kotheri Book Depot, Bombay.
13. Guyton, A.C. & Hall, J.E. 1996. Text Book of Medical Physiology. 9th Ed. W.B. Saunders Company, Philadelphia.
14. Jenson, D., 1976. Principles of Physiology, Appleton Century Crafts.

BS 553 - APPLIED ECOLOGY

Unit I (13 hours)

Biodiversity: types, significance, distribution and measurements. Megadiversity countries, hot spots, biodiversity of Western Ghats and Eastern Himalayas.

Wildlife management: Present status of threatened wildlife of Western Ghats. Conservation, Administrative and Judicial measures.

Unit II (13 hours)

Forest and landscape ecology: types of forests and their distribution with reference to Western Ghats. Vegetation mapping. Plant-animal interactions. Integrated pest management. Landscape Ecology - watersheds management.

Unit III (13 hours)

Fisheries: Aquatic resources - fish, mollusca and crustaceans. Aquatic wildlife. Conservation and management of aquatic wildlife. Aquaculture - prawn culture, seaweed culture, oyster culture, mussel culture, fin fish culture and the environment. Aquatic pollution, Eutrophication and shellfish poisoning.

Unit IV (13 hours)

Population ecology: Demography-life tables; population structure-recruitment patterns, settlement and migration; population growth-growth patterns, age and growth, allometry, growth parameters; biotic parameters-predation, prey-predatory dynamics, competition, mutualism and population regulation; life history strategies-life history traits, longevity and survival rates, energy budgets, and reproductive strategies, *k*-selection and *r*-selection.

REFERENCES

1. Burn, A.J., Coaker, T.H. and Jepson, P.C., 1987. Integrated pest management. Academic Press, London. 474 pp.
2. Daniel, J.C. A century of natural history. Bombay natural History Society, Bombay. 697 pp.
3. Dwivedi, A.P., 1993. Forests. International book Distributors, Dehra Dun. 352 pp.
4. Eugene, P. Odum, 1983. Basic Ecology. Saunders College, London.
5. Govardhan Veerelapati, 1993. Remote sensing and water management in command areas. International Book Distributors, Lucknow. 353 pp.
6. Green, R.H., 1979. Sampling design and statistical methods for environmental biologists. Wiley, New York. 257 pp.
7. Guggisberg, C.A.W., 1970. Man and Wildlife, Arco Publishing Company Inc., New York.
8. Gulland, J.A., 1971. The fish resources of the Ocean, FAO/Fishery News (Books) Limited, England. 255 pp.
9. Gulland, J.A., 1977. Fish population dynamics. John Wiley & Sons, London. 372 pp.
10. Gulland, J.A., 1983. Fish stock assessment: A manual of basic methods. FAO/Wiley New York. 223 pp.
11. Gutierrez, A.P., 1996. Applied population ecology. John Wiley and Sons, Inc. New York. 300 pp.
12. Hanski, I.A. and Gilpin, M.F., 1997. Metapopulation ecology. Academic Press, San Diego. 512 pp.
13. Haywood, V.H. and Watson, R.T., 1995. Global biodiversity assessment. United Nations Environmental Programme, New York.
14. Jhingran, V.G., 1988. Fish and Fisheries of India. Hindustan Publishers, New Delhi. 666 pp.
15. Korringa, P., 1976. Farming of marine organisms law in the food chain. Elsevier, Amsterdam. 264 pp.
16. Levinton, J.S., 1982. Marine ecology, Prentice Hall, Englewood Cliffs. 526 pp.
17. Lieth, H., 1989. Tropical rain forest ecosystems. Elsevier, Amsterdam. 713 pp.
18. MacArthur, R.H. and Nilson, E.O., 1967. The theory of Island biogeography. Princeton University Press, Princeton.
19. Otto Kinne, 1976. Marine ecology. Vol.III – Cultivation. John Wiley & Sons, London. 577 pp.
20. Paul-Wostl, C., 1995. The dynamic nature of ecosystems. John Wiley & Sons, New

- York. 267 pp.
21. Pianka, E.R., 1983. Evolutionary ecology. Harper and Rav, New York. 416 pp.
 22. Pielou, E.C., mathematical ecology. Wiley, New York, 385 pp.
 23. Pook, R.W., 1974. An introduction to qualitative ecology. McGraw Hill, Tokyo. 532 pp.
 24. Qasim, S.Z., 1999. The Indian Ocean Images and realities. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 340 pp.
 25. Roughgarden, J.J., 1987 Science of ecology. MacMillan, New York. 710 pp.
 26. Sivaraju, V.V., and Balachandran, I., 1994. Ayurvedic drugs and their plant sources. 27. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 570 pp.
 27. Southwood, T.R.E., 1978. Ecological methods, Chapman and Hall, London. 524 pp.
 28. Techniques to maintain biological diversities, 1988. SIRC, London.
 29. Tiwari, S.K., 1985. Readings in Indian Zoogeography. Today and Tomorrow's Printers and Publishers, New Delhi. 604 pp.
 30. Zaika, V.E., 1970. Specific productivity of aquatic invertebrates. Wiley, New York, 154 pp.

BS 554 - DEVELOPMENTAL BIOLOGY

Unit I (13 hours)

Introduction: Chief events in animal development; History of thoughts and conceptual developments; experimental embryology; the concepts of differential gene activity. Gametogenesis in animals: Spermatogenesis; Oogenesis; Molecular events during fertilization.

Unit II (13 hours)

Cell differentiation: Mechanism of gene action during cell differentiation; Factors influencing cellular differentiation.

Creating multicellularity - Cleavage types, gastrulation. Fate maps, concepts of determination. Morphogenetic cell movements-cell adhesion and contact inhibition. Competence and induction, totipotency. Nuclear transfer experiments.

Unit III (13 hours)

Morphogenetic determinants in egg cytoplasm.

Germ cell determinants and germ cell migration.

Early vertebrate development-cell movements, Neurulation, mesoderm and endoderm.

Developmental patterns in metazoans; Body axes - establishment of body axes in mammals. Genetics of axis specification in *Drosophila*.

Homeobox concept - homeotic genes

Unit IV (13 hours)

Metamorphosis: Amphibian metamorphosis - Hormones as mediators of development; Gene regulation during Amphibian metamorphosis; molting in insects- Gene action during insect metamorphosis.

Gamatogenesis in a few plant systems; early development in a typical plant.

REFERENCES

1. Browder, I.N., C.A. Erickson, W.R. Jefeery, 1991. Developmental Biology, 3rd ed. Saunders, Philedephia.
2. Gilberts, E. II. 1986. Gene activity in Early Development. Academic Press. New York.
3. Russo, V.E.A. et al., 1982. Development - the Molecular Genetic Approach. Springer-Verlag-Berten.
4. Cartwazhl, T., 1994. Animal cells as Bio-reactors. Cambridge University Press, New York.
5. Development genetics of higher organism, as prior in developmental biology. MacMillan Press, New York
6. Berrill, N.J. Developmental Biology. Tata McGraw Hill.
7. Developmental Biology : A guide for experimental study. Sineer Associates, Massachusetts.
8. Sussman Maurice. Animal growth and development. Prentice Hall
9. Buttery P.J. Control and Manipulation of animal growth. London.

BS 555- BIOTECHNOLOGY AND BIOINFORMATICS LAB.

Evaluation of soil qualities (e.g. texture, bulk density and water holding capacity)

Evaluation of soil components (e.g. nitrogen, phosphorus, organic carbon)

Pattern of decomposition of organic matter (e.g. leaf and woody litter)

Biogas production

Functional properties of food (e.g. water absorption capacity, gelation, foaming and emulsion)

Basic features of computers and its application

Search engines and internet tools

Analysis of DNA and protein sequences

BS 556 - ENVIRONMENTAL PHYSIOLOGY LAB.

1. Haematology -

a) Determination of blood indices b) Determination of blood pressure.

2. Osmoregulation -

1. Estimation of Fluid balance in an animal.

2. Osmotic relationship in animals at the level of cell as well as entire organism.

3. Excretion -

1. Qualitative tests for excretory products.

2. Demonstration of active transport.

4. Respiration -

1. Estimation of oxygen consumption by the organism under stressed condition (thermal stress).

2. Demonstration of rate of transpiration by photometry.

3. Effect of temperature on the rate of respiration.

5. Seed physiology -

1. Determination of percent viability of seeds by germination method.

2. Determination of amylase activity in germinating seeds.

Radioisotope methodology and its principles (GM Counter and Scintillation Counter)

Effect of salinity on seed germination.

BS 557 - APPLIED ECOLOGY LAB.

Biodiversity

Terrestrial biodiversity

Aquatic biodiversity

Plant-animal interactions

Endangered medicinal plants.

Landscapes analysis through remote sensing data.

Freshwater fishery resources

Marine fishery resources

Estimation of growth parameters

Life-tables

Prey-predator relationships

Field trips

BS 558 - DEVELOPMENTAL BIOLOGY LAB.

Spermatogenesis in male grasshoppers.

Structure of sperms and eggs in a few reproductive animals.

Developmental stages in chick

Embryo development in the laboratory mice.

Developmental stages in *Drosophila*.

Histological identification of germ layers in the developing embryos.

Induced breeding in fishes.

REFERENCES

1. Philips and Joy, 2002. Development of Vertebrate anatomy.
2. Johri, B.M., 2002. Experimental morphogenesis.

MODEL QUESTION PAPER**M.SC. BIOSCIENCES (CHOICE BASED CREDIT SYSTEM)
SEMESTER EXAMINATION – MONTH, YEAR****BS (CODE NO) : TITLE OF THE PAPER****Time : 3 Hours****Max. Marks : 70****Write short notes on any FOUR of the following (not more than 2 pages each):
(4x4=16)**

- a.
- b.
- c.
- d.
- e.
- f.

Write explanatory notes on any FIVE of the following (not more than 3 pages each each):**(5x6=30)**

- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.

**Answer any TWO of the following (about 8 pages each):
(2x12=24)**

- 9.
- 10.
- 11.
