BHARATHIAR UNIVERSITY, COIMBATORE
B.Sc. BIOTECHNOLOGY DEGREE COURSE
SCHEME OF EXAMINATION - CBCS PATTERN

For the students admitted during the academic year 2011– 2012 batch onwards

Part	Study Components	Course title	Ins. hrs/ week	Examinations				Credit
				Dur.Hrs.	CIA	Marks	Total Marks	
	Semester I							
I	Language – I		6	3	25	75	100	4
II	English – I		6	3	25	75	100	4
III	Core Paper I - Cell biology		4	3	25	75	100	4
	Core Paper II - Biochemistry		4	3	25	75	100	4
	Practical I (Cell Biology & Biochemistry)		2	-	-	-	-	-
	Allied A : Chemistry I		4	3	20	55	75	3
	Allied Practical		2	-	-	-	-	-
IV	Environmental Studies #		2	3	-	50	50	2
	Semester II							
I	Language – II		6	3	25	75	100	4
II	English – II		6	3	25	75	100	4
III	Core Paper III – Microbiology		5	3	25	75	100	4
	Core Practical I (Cell Biology & Biochemistry)		4	3	40	60	100	4
	Allied A : Chemistry II		4	3	20	55	75	3
	Allied Practical (Chemistry)		3	3	20	30	50	2
IV	Value Education – Human Rights #		2	3	-	50	50	2
	Semester III							
I	Language – III		6	3	25	75	100	4
II	English – III		6	3	25	75	100	4
III	Core Paper IV - Bioinstrumentation		4	3	25	75	100	4
	Core Paper V- Genetics		4	3	25	75	100	4
	Core Practical II		2	-	-	-	-	-
	Allied B: Paper I – Basic Mathematics		3	3	20	55	75	3
IV	Skill based Subject 1 - Human Physiology		3	3	20	55	75	3
	Tamil @ / Advanced Tamil# (OR) Non-major elective - I (Yoga for Human Excellence# / Women's Rights#/ Constitution of India #)		2	3	50		50	2

	Semester IV						
I	Language – IV	6	3	25	75	100	4
II	English – IV	6	3	25	75	100	4
III	Core Paper VI- Molecular Genetics	4	3	25	75	100	4
	Core Practical – II (Microbiology & Genetics)	3	3	40	60	100	4
	Allied B : Paper II – Computer applications	4	3	20	55	75	3
	Allied Practical (Computer applications))	2	3	20	30	50	2
IV	Skill based Subject 2 -Human Pathology	3	3	20	55	75	3
	Tamil @ /Advanced Tamil # (OR) Non-major elective -II (General Awareness#)	2	3	50		50	2
	Semester V						
III	Core paper VII Plant & Animal Biotechnology	4	3	25	75	100	4
	Core Paper VIII Immunology	4	3	25	75	100	4
	Core Paper IX Environmental Biotechnology	4	3	25	75	100	4
	Core Paper X rDNA technology	4	3	25	75	100	4
	Core Practical III Immunology and Plant Tissue Culture	4	-	-	-	-	-
	Core Practical IV Microbial Biotechnology & rDNA technology	3	-	-	-	-	-
	Elective 1	4	3	25	75	100	4
IV	Skill based Subject 3 Diagnostic tools	3	3	20	55	75	3
	Semester VI						
III	Core Paper XI – Microbial Biotechnology	5	3	25	75	100	4
	Core Practical III- Immunology and Plant Tissue Culture	6	3	40	60	100	4
	Core Practical IV Microbial Biotechnology & rDNA technology	6	6	40	60	100	4
	Elective – II	5	3	20	55	75	3
	Elective – III	5	3	20	55	75	3
IV	Skill Based Subject 4 - Pharmacology	3	3	20	55	75	3
V	Extension Activities @	-	-	50	-	50	2
	Total					3500	140

@ No University Examinations. Only Continuous Internal Assessment (CIA)

No Continuous Internal Assessment (CIA). Only University Examinations.

List of Elective papers (Colleges can choose any one of the paper as electives)		
Elective – I	A	Agricultural Biotechnology
	B	Bioremediation
	C	Introduction to Bioinformatics
Elective – II	A	Medical Biotechnology
	B	Biotechnological approach for waste water treatment
	C	Genomics
Elective - III	A	Industrial Biotechnology
	B	Bioethics & Biosafety

	C	Proteomics

CORE PAPER: I
Subject Title: CELL BIOLOGY

Subject description: This course presents the types and structural details of the basic unit by which all the living things are made of (the cell).

Goals: To make the student to understood the concept of cell and their activities.

Objectives: On successful completion of the subject the student should have understood the Structural features, Organelles and the cellular mechanisms.

UNIT I

Cell as a basic unit: discovery of the cells, classification of cell types, development of cell theory, early chemical investigation in cell biology. Prokaryotic and Eukaryotic cell organization.

UNIT II

Cell transport phenomenon: membrane architecture. Active, Passive, diffusion and osmosis. Chemistry of carbohydrates, lipids, proteins and nucleic acids.

UNIT III

Structure and function of cytoplasmic compartments of the cell: ribosome and protein synthesis, energy flow through mitochondrion, chloroplast and photosynthesis, Golgi apparatus, lysozymes and micro bodies, endoplasmic reticulum, vacuoles, peroxysomes, lysozomes and Nuclear compartment. Heterochromatin and euchromatin, polytene chromosomes.

UNIT IV

Cell division in prokaryotes and eukaryotes: Cell cycle, mitosis, meiosis, crossing over and characteristics of cancer. Apoptosis, Stem cell. Prions.

UNIT V

Integrative and specialized cellular events, cell-cell signaling, specialized cells nerve cells, sperm cells, microfilaments, microtubules, muscle cells. Cells of vision, Nucleo-cytoplasmic interaction, cell cloning.

REFERENCES:

1. Cell and molecular biology, 3rd edition, Philip Sheeler, Donal E Bianchi, John Wiley
2. Molecular biology of cell, Alberts et al
3. Molecular cell biology, Lodish, Baltimore, Scientific American books, 1994
4. Molecular and cell biology, Stephen L Wolfe, Wordsworth Publishing company 1993
5. Cell biology. Sadava
6. Cell and Molecular Biology De Roberties

CORE PAPER: II
Subject Title: BIOCHEMISTRY

Subject description: This course presents the chemical reactions or metabolic functions in the living system and their regulations.

Goals: To make the student to understood the concept of biochemical regulations

Objectives: On successful completion of the subject the student should have understood: Basic Structure and metabolism of Biomolecules.

UNIT I

Structure of atoms and biomolecules: Atomic theory, Valency, Atomic weight, Molecular weight, Molarity. Chemical Bonding - Electrostatic, Covalent, Ionic and Vander waals, Structure of water molecules, properties and ionization of Water, pH and buffers. Laws of Thermodynamics.

UNIT II

Enzymes and co-enzymes, IUB classification and nomenclature of enzymes, regulation of enzyme activity, active sites, activators and inhibitors; Isoenzymes, allosteric enzymes.

UNIT III

Definition, Nomenclature, Classifications and Structures of sugars. Structural features of polysaccharides. Glycolysis, TCA cycle, Glycogen breakdown and synthesis, Gluconeogenesis, Bioconversion of pentoses and hexoses,

UNIT IV

Definition, Nomenclature, Classifications and Structure of lipids, Metabolism of lipids: Fatty acid biosynthesis and oxidations.

Amino acids and peptides – classifications, Structural Organization of protein (primary, secondary, tertiary and Quaternary), Functions of proteins.

UNIT: V

Definition, Nomenclature, Classifications and Structure of nucleic acids, Biosynthesis and degradation of nucleic acids (purines and pyrimidines) Integration of metabolism and regulations.

REFERENCES:

1. Boyer.R., (2002) Concepts in Biochemistry 2nd ed. Brooks / Cole publishing company New York.
2. David L. Nelson and M. Cox (2003) Lehninger's Principles of Biochemistry, 3rd Ed, Worth publication New York
3. Voet and Voet (1995) Fundamentals of Biochemistry, 2nd Edition, John Wiley and sons inc., New York.
4. Geoffery L Zubay (1995) Principles of Biochemistry, WCB publishers, London
5. Murrey RK., D.K. Granner, P.A. Mayers and V.W. Rodwell, (2003) Harper's Biochemistry, Prentice –Hall Int, Boston
6. Outlines of Biochemistry Conn & Stumph

PRACTICAL I
(LAB IN CELL BIOLOGY AND BIOCHEMISTRY)

1. Microscopy
2. Cell Types - Microbial, animal and Plant cells
3. Fraction of Cellular components - Demonstration.
4. Mitotic Preparation - Onion Root Tip
5. Estimation of Protein - Lowry's method.
6. Estimation of DNA by DPA Method
7. Estimation of RNA by Orcinol method
8. Estimation of Sugars by Anthrone method
9. Estimation of total free amino acids - Sulfovanicillin method.
10. Estimation of Lipids
11. Analysis of Oils- Iodine Number- Saponification Value -Acid Number.
12. Quantification of Vitamin C.
13. Paper Chromatography.
14. Preparation of Buffer- Phosphate, Acetate, Tris.
15. Principles of Colorimeter, Spectrophotometer and pH.
16. Determination of Normality, Molarity, Molality, Percent Solution.

CORE PAPER: III
Subject Title: MICROBIOLOGY

Subject description: This course presents the study of Micro organisms.

Goals: To make the student to understood Micro organisms and their participation in day to day activities.

Objectives: On successful completion of the subject the student should have understood the Role of microorganisms in the diversity

UNIT I:
Definition and scope of microbiology-- A general account on microbial diversity.Basic principles in microscopy, Types of microscopes- light, dark, phase contrast, fluorescent and electron microscope- (Transmission and Scanning electron)

UNIT II:
A detailed account of General structure, growth and reproduction of Bacteria, fungi and Virus. Economic and industrial importance of yeast and moulds.

UNIT III:
Microbiological Media: Types, preparation, methods of sterilization; enumeration of microorganisms in soil, water and air; isolation of microorganisms from Environment and infected tissue; Techniques of pure culture, maintenance and Preservation; Staining: stains and types of staining;

UNIT IV:
Physiology and biochemistry of microbes- Photo-autotrophs, Chemo-autotrophs, Parasitism, Saprophytism, Mutualism and Symbiosis, Commensalisms, endozoic microbes.

UNIT V:
Nitrogen metabolism including Nitrogen fixation (Symbiotic and asymbiotic), Lipid metabolism, Secondary metabolism, microbial pathogens of plants (TMV, Gemini virus), animals (Yersinia pestis, rabies) and humans (HIV, HSV), Role of microbes in biogeochemical cycles.

REFERENCES:
1. Michael T. Madigan John M. Martin & Jack Parker, 1984, Biology of Microorganisms Prentice Hall International, Inc., London.
2. Edward A. Birge, 1992, Modern Microbiology – Principles and application. Wm.C. Brown Publishers, Inc. U.S.A.
3. Gerard J. Tortora, Berdell R. Funke, Christine & L. Case, 2001, Microbiology - An Introduction. Benjamin Cummings, U.S.A.
4. Danial Lim, 1998, Microbiology, McGraw-Hill Companies, New York.
5. Stephen A. Hill, 1984, Methods in Virology. Blackwell Scientific Publication, London.

CORE PAPER: IV
Subject Title: BIOINSTRUMENTATION
(Principles and Applications)

Subject description: This course presents study of Instruments of Biological Importance.

Goals: To make the student to understood the tools used in the laboratory.

Objectives: On successful completion of the subject, the student should have understood the analytical techniques in the field of Biotechnology

UNIT I
pH meter, Buffer of biological importance, Centrifuge- Preparative, Analytical and Ultra, Laminar Air Flow, Autoclave, Hot Air Oven and Incubator.

UNIT II
Spectroscopic Techniques: Colorimeter, Ultraviolet and visible, Infra red and Mass Spectroscopy

UNIT III
Chromatographic Techniques: Paper, Thin Layer, Column, HPLC and GC.
Electrophoresis Techniques: Starch Gel, AGE, PAGE.

UNIT IV
Principle, Instrumentation and application of ECG, EEG, EMG, MRI, CT and PET scan, radioisotopes.

UNIT V
Spectro fluorimeter, Flame photometer, Scintillation counter, Geiger Muller counter, Autoradiography.

REFERENCES:
1. Introductory Practical Biochemistry – S. K. Sawhney and Randhir Singh. Narosa Publishing House
2. Principles of Applied Biomedical Instrumentation- Gedder A and L. E. Balsar,John Wiley and Sons.
3. Modern Experimental Biochemistry 2nd Edition- Boyer, Rodney F.Benjamin and Cummins

CORE PAPER: V
Subject Title: GENETICS

Subject description: This course presents the way characters get transferred through generations and methods to analyze and modify them

Goals: To make the student to understood the concept of genes and their behaviour

Objectives: On successful completion of the subject the student should have understood: Basic genetics and their role

UNIT I
History of Genetics - Mendelian Principles, Segregation, Independent Assortment, Dominance. Multiple alleles, Pseudo alleles, Incomplete dominance, Over dominance and co dominance, complementation test.

UNIT II
Gene interaction, Epistasis, penetrance and expressivity, lethality and lethal genes. Sex determination and sex linkage in diploids, linkage and crossing over, gene mapping. Chromosomal theory of inheritance, maternal effects.

UNIT III
Chromosomal variation in number, Changes in Chromosomal structure, Chromosomal aberrations, Genetics of Heamoglobin, Transposable elements in prokaryotes and eukaryotes.

UNIT IV
Structure of chromosome, fine structure of Gene, cistron, recon, Structure of Eukaryotic gene, Experimental evidence for DNA as the genetic material, cytoplasmic genetic systems- mitochondria and chloroplast DNA.

UNIT V
Genetic control of Development in Drosophila and Arabidopsis.
Population genetics, calculating gene frequency, factors affecting gene frequency. Genetic drift, Shift, Pedigree analysis and genetic counselling.

REFERENCES:

1. Basic genetics by D.L.Hartl, 1991, Jones and Bartett public.
2. Friedfelder 1987, Microbial genetics, Jones and Bartett public.
3. Molecular Biology of the genes 4th Ed. Watson et.,al, the Benjamin /Cummings coins 1987
4. Molecular by cell biology, 1994.Lodish, Baltimore scientific American books,Inc.
5. Genetics Strickberger.M
6. Genetics by Goodenough

CORE PRACTICAL II
(LAB IN MICROBIOLOGY AND GENETICS)

1. Laboratory rules and regulations of Microbiology
2. Media preparation and sterilization
3. Enumeration of microorganism from soil, water and spoiled food- serial dilution technique.
4. Pure culture technique- Pour plate, spread plate and streak plate methods.
5. Isolation of single colonies of bacteria
6. Selective and differential media.
7. Measurement of growth of bacteria.
8. Staining of bacteria - Gram's, Spore, capsule, acid fast, negative, hanging drop
9. Fungal Staining - Wet Mount technique.
10. IMVIC test
11. Carbohydrate fermentation test, TSI, H2S production test
12. Antibiotic sensitivity test
13. Drosophila – Morphology, Section culture and maintenance.
14. Identification of Mutants - Physical and Chemical Methods.
15. Experiments to determine Mendel's law.
16. Monohybrid and dihybrid cross using plants.
17. Sex chromatin (buccal smear).

Skill Based Subject 1
Subject Title: HUMAN PHYSIOLOGY

Subject description: This course presents the various physiological activities in human being

Goals: To make the student to understood the human physiology

Objectives:

After the completion of the course the student should have understood the various systems in human body and their activities

UNIT I

Muscle- skeletal muscles – composition – functions and properties of plain (smooth) and cardiac muscles – electromyography

Nervous System – organization – basic functions of synapses and transmitter substances – sensory receptors – sense of hearing – taste and smell. Special senses – optics of vision

– function of retina –cortical and brain stem control of motor function. cerebrospinal and brain metabolism

UNIT II

Blood & Body Fluid – blood cell –Haematosis – determination of coagulation – plasma proteins – platelets – leucocytes. Bone marrow – functions of tissue fluid – Lymph nodes
Cardio Vascular System – Heart as pump – rhythmic excitation – electrocardiogram.
Respiratory System- pulmonary ventilation – pulmonary circulation – gaseous exchange - O_2 and CO_2 transport in blood and body fluids – mechanism of breathing - ventilation

UNIT III

Digestive System – digestive tract – gastrointestinal function – motility– secretory functions of alimentary tract – digestion and absorption.
Excretion – functions of kidney – renal associated mechanisms - extra cellular and intracellular fluids – osmalality, Micturition – skin – sweat
Endocrines – pituitary hormones and their control by hypothalamus – thyroid metabolic hormones – adreno-cortical hormones – insulin, glucagons and Diabetes mellitus –. Gonadotrophic hormones –testosterone – estrogen.

REFERENCES:

1. Text book of Medical physiology by Guyton . 8th edition . W B Saunders company. USA
2. Human physiology by Dr.C.Chatterjee I & II. Medical Allied Agency, Kolkatta.
3. Anthony's Text book of Anatomy and Physiology by Gary A. Thiodeare & Kevin T Patton, 2nd edition. Moshi year book, New York
4. Anatomy and Physiology by Ross & Wilson 8th edition. Churchill Livingstone
5. Human physiology by Sarada Subramaniam & K.MadhavanKutty. S.Chand and company, New Delhi
6. Human Physiology by Vander Sherman Luciano McGraw Hill NewYork.

CORE PAPER: VI

Subject Title: MOLECULAR GENETICS

Subject description: This course presents the genetics at molecular level

Goals: On successful completion of the subject the student should have understood the molecular aspects of genetics

UNIT- I

Organization of genome – Structure and function of DNA and RNA. Experiment to prove semiconservative mode of replication. DNA replication in prokaryotes and eukaryotes. Types- unidirectional, bidirectional and theta model replication. Enzymology of replication.

UNIT – II
Gene as the unit of expression- Co linearity, Transcription, post transcriptional modifications (mRNA, tRNA,rRNA), transcriptional regulation in prokaryotes (operon concept-lac operon) and eukaryotes, inhibitors of transcription. Elucidation of genetic code.

UNIT – III
Translation of protein – post translational modifications and folding of newly assembled polypeptides, translational regulations, signal sequences and protein export.

UNIT – IV
Gene mutation – Biochemical basis of mutations – types of mutations- spontaneous and induced mutations; Ames test for mutation; DNA damage – types of DNA repair mechanisms – photo reactivation excision repair, post replication recombinant repair, SOS repair

UNIT – V
Recombination - Homologous and non-homologous recombination, including transposition, site-specific recombination. Genetic exchange – bacterial transformation, transduction, conjugation and their mapping.

REFERENCES:
1. Basic Genetics by D.L. Hartl 1991, Jones & Bartett publications.
2. Microbial Genetics, Friefelder 1987 – Jones & Bartnett publications
3. Molecular Biology of the gene 4th edition by Watson et al, The Benjamin / Cummings co
4. Molecular Cell Biology by Lodish 1994, Baltimore Scientific American Brocks

Skill Based Subject: 2
Subject Title: HUMAN PATHOLOGY

Subject description: This course presents the diseases of human being

Goals: To make the student to understood the concept Pathology

Objectives: On successful completion of the subject the student should have understood: Various metabolic disorders and the complications involved

UNIT I:
Disorders of Kidney: acute renal failure, chronic renal failure, proteinuria and nephritic syndrome and urinary calculi.
Disorders of Liver: Hepatitis, acute liver failure, Cirrhosis. Gilbert's, Crigler-Najjar, Dubin-Johnson, Jaundice, and Rotor.

UNIT II:
Diabetes mellitus - Etiology and pathogenesis, diagnosis and management. Diabetes in pregnancy.

Disorders of Plasma proteins and enzymes: Hypoalbuminaemia, hypogammaglobulinaemia, hypergammaglobulinaemia. Alkaline phosphatase, Creatine kinase. Types of hyperlipidaemias. Lipoprotein deficiency-abetalipproteinaemia. Diseases of Heart- Myocardial infarction, Heart failure and Hypertension.

UNIT III:
Disorders of hormones: Acromegaly and gigantism, Cushing's disease, Conn's syndrome, congenital adrenal hyperplasia (CAH). Hyperthyroidism, hypothyroidism, goiter and thyroid cancer.
Metabolic aspects of cancer: Metabolic complications of prostate and lung cancer
Tumour markers: α- Fetoprotein (AFP), Carcinoembryonic antigen (CEA), Para proteins, Human chorionic gonadotrophin (hCG), markers of prostatic cancer, enzymes as tumour markers and Carbohydrate antigen (CA) markers.

REFERENCES:
1. An Illustrated color text of Clinical Biochemistry by Allen Gaw, Robert A.Cowan, illustrated by Robert Britton (1999, second edition, Churchill Living stone press).
2. Color Atlas of Biochemistry (second edition, Thieme Publications, revised and enlarged) by Jan Koolman and Klaus-Heinrich Roehm.
3. Marks' Basic Medical Biochemistry: A Clinical Approach (2nd Edition), by Colleen M. Smith, Allan D. Marks and Michael A. Lieberman.
4. Medical Microbiology by Jawetz.

CORE PAPER: VII
Subject Title: PLANT AND ANIMAL BIOTECHNOLOGY

Subject description: This course presents the application of Plants in Biotechnology

Goals: To make the student to understood usage of Plant and Animal products and exploitation of them in Biotechnology.

Objectives: On successful completion of the subject, the student should have understood: Crop development, Callus culture, Biotechnological applications of plants,
Animal tissue culture, Animal products, production & improvement of them.

Unit I
Introduction to cell and tissue culture, Plant tissue culture media (composition, types and preparation), plant hormones and growth regulators in tissue culture, Preparation of suitable explants for organo genesis. Micropropagation on large scale, somatic embryogenesis, protoplast culture and somatic hybridization, Anther, pollen and ovary culture for production of haploid plants and homozygous lines.

Unit II
Cell culture methods for the secondary metabolite production, somaclonal variation and its significance, Cryopreservation, Gene banks for germplasm conservation.
Plant transformation techniques – Mechanism of DNA transfer – Agrobacterium mediated gene transfer, general features of TI and RI plasmids and their use as vectors,

role of virulence genes; design of expression vectors; use of 35S and other promoters, reporter genes.

Unit III

Animal cell cultures: Culture media – composition and preparation, Balanced salt solution and simple growth medium, chemical, physical and metabolic functions of different constituents of culture medium-Role of CO_2, serum and protein-free defined media and their applications; Culturing and maintenance of different animal cell lines (Primary and established cell lines). Characterization of cultured cell, measurement of viability, cyto-toxicity and growth parameters. Stem cell cultures, embryonic stem cell and their applications, cell culture based vaccines, measurement of cell death, apoptosis, scaling up animals cell cultures.

Unit IV

Transgenic animals: Method of obtaining transgenic animals using fertilized eggs and embryonic blastocyst cell, example, importance of transgenic animals – increased productivity of domestic animals, improved desired characters of domestic animals, production of recombinant gene products and proteins for pharmaceutical use. Animal models for tackling human diseases (Gene knock out in mice models).

Unit V

Transgenic silkworms. Animal cloning : Methods of cloning in animal system – Rat, Sheep, pig; importance of cloning. Gene therapy and cell mediated therapy, RFLP maps, RAPD markers, PCR, antisense technology, terminator gene technology, DNA finger printing.

REFERENCES

1. Plant genetic engineering, Dodds J.H.
2. Plant molecule biology, Grierson and S.V. Convey
3. Molecular biotechnology, Principle and applications of recombinant DNA technology, Bernard R Glick.
4. Plant Biotechnology-Monica Hughes.
5. Animal cell culture – a practical approach, 4^{th} ED., Freshney. John Wiley Pub.
6. Mammalian Cell Biotechnology- A practical approach. ED Butler. Oxford UNI Press.
7. Methods in Cell Biology. VOL 57 Animal methods, ED Mather & Barnes, Academic Press**.**
8. Exploring Genetic mechanisms. ED Singer & Berg.

CORE PAPER: VIII

Subject Title: IMMUNOLOGY

Subject description: This course presents the basic defense mechanism of animals

Goals: To make the student to understood the concept immunology

Objectives: On successful completion of the subject the student should have understood: Immunity, Antigen, Antibody, Cells of immune system and their function and regulations

UNIT I:
Introduction- Historical Development in Immunology. Immunity- Humoral and Cell mediated response, Primary and Secondary immune response. Cells involved in immune response. Innate and Acquired Immunity. Mechanisms of defense.

UNIT II:
Antigen- Types and classifications. Antibody – Structure, Types, properties and their biological functions, poly clonal sera, Monoclonal antibody. Primary and Secondary lymphoid organs – Thymus, Bone marrow, Lymph nodes and Spleen. Lymphocytes traffic and regulation, CD molecules

UNIT III:
Hematopoiesis and development of B and T lymphocytes. Immunoglobulin Gene expression B cell and T cell activation. MHC molecules Response of B cells to antigens. Plasma Cells, Memory Cells.

Unit IV:
Complement – activation and regulation. Cytokines- structure and functions, Interferon and interleukins. Immuno regulation: Tolerance. Suppression, Autoimmunity and hypersensitivity reactions .Primary and secondary Immuno deficiency disorders.

UNIT V:
Transplantation, HLA Typing; Mechanism of Graft rejection. Tumor immunology.Immuno surveillance- mechanisms.
Antigen – Antibody Interactions. Immunodiffussion and Immunoelectrophoresis. Principle and Applications of RIA, ELISA, Fluorescent Antibody techniques. I

REFERENCES:

1. Immunology – Kuby., J - 5th Edition
2. Immunology – Tizard
3. Immunology – Ivan M. Roitt – Third Edition
4. Immunobiology – Janeway and Travers – 5th Edition

CORE PAPER: IX
Subject Title: ENVIRONMENTAL BIOTECHNOLOGY

Subject description: This course presents the Study and the Management of the Environment

Goals: To make the student to understood Ecology and Conservation of the Environment

Objectives: On successful completion of the subject the student should have understood Ecosystem, energy flow and Uses and values of Biodiversity.

UNIT I:
Scope – Branches of ecology – Abiotic factors – water – soil – temperature – light. Biotic factors – Animal relationship – symbiosis – commensalisms – mutalism –Antagonism – Antibiosis – Parasitism – Predation – competition.

UNIT II:
Ecosystem –Definition –structure – pond ecosystem – primary production –secondary production – food chain – food web – trophic levels – energy flow – pyramid of biomass– pyramid of energy. Biogeochemical cycle: Nitrogen and Phosphorous.

UNIT III:
Pollution – types – sources – effects – Air-water – land – Noise – Thermal – Pesticide – Radioactive – green house effect, ozone and its importance – global warming – Acid rain– Bio accumulation – Bio magnification. Biological control. Principles of environment Impact. Assessment and environmental monitoring.

UNIT IV:
Sewage Treatment System – Characteristics, Primary, secondary and tertiary treatment
Industrial waste water treatment system – Tannery and Distillary waste water
Solid waste disposal and solid waste Management.

UNIT V:
Biodiversity –Types of Biodiversity, Hotspots, Values of Biodiversity, Methods of Conservation- insitu and exsitu conservation, speciation, wild life conservation, Uses of bioresources, Loss of Biodiversity, Environmental education.

REFERENCES:

1. Groombridge, B (Ed.) 1992. Global Biodiversity – Status of the Earth's Living Resources. Chapman & Hall, London.
2. UNEP, 1995, Global Biodiversity Assessment, Cambridge Univ. Press, Cambridge.
3. Virchow, D. 1998. Conservation & Genetic Resources, Springer – Verlag, Berlin.
4. Gary K.Meffe & .Ronald Carroll, C.1994. Principles of Conservation Biology, SinauerAssociates, Inc., Massachusetts.
5. Clarke, G.L. 1954, Elements of ecology, John Wiley & sons. N.Y.
6. Kendeigh, S.c. 1961. Animal Ecology. Prentice Hall.
7. Odum, E.P. 1971. Fundamentals of Ecology. W.B.Saunders company,

8. Philadelphia.
9. Rastogi, V.B. and M.S. Jayaraj, 1989. Animal ecology and distribution of
10. Animals, Kedamath Ramnath.
11. Sharma, P.D. 1990. Ecology and environment. Rsatogi publications, Meerut.
12. Southwick, C.H. 1976. Ecology and the quality of environment D.Van.Nostrand Co.,
13. Verma P.S. and V.K. Agarwal. 1996. Principles of Ecology S.Chand. & co., New Delhi.

Core Paper: X
Subject Title: RECOMBINANT DNA TECHNOLOGY

Subject description: This course presents the mechanism of gene manipulation

Goals: To make the student to understood the concept of gene manipulation and gene transfer technologies

Objectives: On successful completion of the subject, the student should have understood: Manipulation of genes, Transfer techniques, Expression systems and methods of selection

UNIT I:
Restriction and Modification systems of Bacteria. Restriction enzyme, DNA Polymerases, RNA polymerase, Taq polymerase, DNA Ligase, methylase, polynucleotide kinase, alkaline phosphatase, reverse transcriptase, DNaseI, S1nuclease, RnaseH, terminal deoxynucleotidyl transferase.

UNIT-II
Plasmids –types of plasmids (F, R and Col), properties of plasmid, plasmid compatibility, copy number control. E.coli vectors- pBR322 and their derivatives, pUC vectors and their derivatives, BAC. Cloning in Bacillus and Streptomyces.

UNIT III
Molecular biology of lambda and Lambda vectors, cosmid, phagemid, M13.
Yeast vectors – YIP, YEP, YRP and YAC. Inducible promoters, selectable markers and expression vectors.

UNIT-IV
Animal vectors- SV40 Vectors, Retero viral and Baculo viral vectors, shuttle vectors.
Plant vectors - Ti plasmid as gene vector, Caulimo viruses, Gemini viruses, Transposable elements as vectors Construction of cDNA and genomic DNA libraries.

UNIT V
Probes - probe construction and labelling. Introduction of cloned genes into cell – transformation, transduction, particle bombardment, liposome mediation, electroporation, and cocultiovation identification of recombinant DNA. Hybridization techniques-Southern, Western and Northern blotting, Chromosome walking and jumping. DNA sequencing, Microarray.

REFERENCES**:**

1. Ernst.L.Winnacker, (2003) from genes to clones, 2nd edition, Panima publishing corporation, NewDelhi.
2. James.D.Watson(2001) Recombinant DNA technology,2nd edition, WH Freeman and company, New York.
3. Glick and Pasternak,(1996),Molecular biotechnology, Panima publishing corporation.NewDelhi.
4. BrownT.A., (1998) Introduction to gene cloning, 3rd edition, Stanley Thomas Publishing Ltd, London.
5. PrimroseS.B., (2003) Principles of gene manipulation,6th edition, Blackwell Science Ltd, Germany.

PRACTICAL III
LAB IN IMMUNOLOGY AND PLANT TISSUE CULTURE

1. Method of immunization and bleeding
2. Preparation of Anti bodies
3. Antigen-antibody reactions
4. Immuno diffusion (Single radial, double and rocket)
5. Blood grouping
6. Preparation of serum from blood
7. WIDAL, ASO, CRP
8. ELISA- Demonstration
9. Plant Tissue Culture Media Preparation
10. In vitro germination o f seeds
11. Callus induction and differentiation
12. Embryo Culture
13. Somatic embryogenesis.
14. Isolation and fusion of protoplast
15. Artificial seed production
16. Meristem culture
17. Micropropagation
18. Qualitative analysis of alkaloids, flavonoids, safonins, tannins and phenolic compounds

PRACTICAL IV
LAB IN MICROBIAL BIOTECHNOLOGY AND rDNA TECHNOLOGY

1. Fermentor design and working principles – (Demo)
2. Production and assay of extra cellular enzyme –protease – submerged
3. Wine Production
4. Ethanol production and calculate the percentage of alcohol
5. SCP – Production

6. Isolation of genomic DNA – bacteria
7. Isolation of genomic DNA – Plant
8. Isolation of genomic DNA – Animal
9. Agarose Gel Electrophorasis
10. Isolation of Plasmid DNA
11. Restriction digestion
12. Ligation
13. Transformation
14. SDS-PAGE
15. Western blotting – Demo
16. Southern blotting – Demo
17. PCR – Demo

Skill based Subject: 3
Subject Title: DIAGNOSTIC TOOLS

Subject description: This course presents the Diagnostic methods of diseases

Goals: To make the student to understood the concept of Diagnostic methods

Objectives: On successful completion of the subject the student should have understood: Examination of Blood, Urine and CSF.

UNIT I

Blood examination – anticoagulant, hemoglobin, RBC, Packed cell volume, ESR, WBC total, differential normal and abnormal hematopathies – anemia, bone marrow smear, leukemia and myelodysplastic syndromes, diagnostic significance of PB smear, hemorrhagic disorder, L.E. cell phenomenon.

UNIT II

Urine analysis – collection – physical, chemical and microscopic examination of urine – CSF, Parasite analysis

UNIT III

Biochemical analysis of Blood, Blood banking, Transplantation, AIDS, Lab safety, ELISA, RIA, FACS, PCR, Computers in lab. Quality control.

REFERENCES:

1. Handbook of medical lab technology – Ed; V.H.Talib, CBS publication
2. Clinical Chemistry by Willium J.Marshall (Fifth edition, Mosby Publications).
3. An Illustrated color text of Clinical Biochemistry by Allen Gaw, Robert A.Cowan, illustrated by Robert Britton (1999, second edition, Churchill Living stone press).
4. Marks' Basic Medical Biochemistry: A Clinical Approach (2nd Edition), by Colleen M. Smith, Allan D. Marks and Michael A. Lieberman.
5. Medical Microbiology by Jawetz.

CORE PAPER: XI
Subject Title: MICROBIAL BIOTECHNOLOGY

Subject description: This course presents the utility of Microbes
Goals: To make the student to understood the applications of Microbes

Objectives: On successful completion of the subject the student should have understood: Fermentation, Microbial products, Vaccine and antibiotics.

UNIT I:
Microbial Biotechnology: Scope and application-horizons of microbial Technology, public concern about the microbial biotechnology and Economics of microbial biotechnology.

UNIT II:
Microbes: Living factories for macromolecules-Production of proteins in Bacteria and yeast; recombinant and synthetic vaccines; microbial insecticides (*Bacillus.thuringiensis, B.spaerinus, B.papilliae* and Baculo-Viruses); microbial enzymes application in starch processing , textile designing, detergents, cheese making; polysaccharides and polyesters.

UNIT III:
Microorganisms in fermentation-Ethanol from feed stocks to fermentable Sugars, from sugars to alcholos, clostridial fermentation, lactic acid fermentation, acetic acid production and industrial production of various milk products.

UNIT IV:
Metabolites from microorganisms-amino acids; antibiotics-antibacterial agents (□-lactams, tetracyclines, peptides, amino glycosides), antifungal agents, anti-tumor antibodies.

UNIT V:
Application of microbial biotechnology in sewage and wastewater treatment, degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents, production of biofertilizers (nitrogen fixing Bacteria, single cell protein, mycorrizha and phosphate solubilizing Bacteria).

REFERENCES :

1. Glazer, A.N. and Nikaido, H. 1995. Microbial biotechnology. W.H.Freeman & Co.,New York
2. Encyclopedia of Microbiology. 1992. Vols.1-4. Academic Press.
3. Preve et al. 1987. Fundamentals of Biotechnology. VCH Publ.
4. Stanbury, P.F. Whittaker, A, Hall, S.J. 1995. Principles of fermentation technology.Butterworth Heinemann.
5. Prescott, L.M. Harley, J.P. and Klein, D.A. 1999. Microbiology. McGraw Hill Co.
6. Glick, B.R. and Pasternak, J.J. 1998. Molecular Biotechnology. Washington D.C. ASM Press.

7. Stainer, R.Y. Ingraham, J.L., Wheelis, M.L. and Painter, P.R. 1987. General Microbiology. Macmillan Co.
8. Lancini, G. Parenti, F. and Gallo, G.G. 1995. Antibiotics-A multidisciplinary Approach. Plenum Press, New York.
9. Gunasekaran.P. 1995. Laboratory manual in microbiology. New Age International Limited. New Delhi.

Skill based Subject: 4
Subject Title: PHARMACOLOGY

Subject description: This course presents Medicines for different disease

Goals: To make the student to understood the concept therapy.

Objectives: On successful completion of the subject the student should have understood: Drug administration, drug metabolism and allergy.

UNIT I
Pharmacology – origins and antecedents – Pharmacology in the 20^{th} century – Drugs – Sources, dosage forms and routes of administration. Absorption, factors modifying drug absorption, distribution, metabolism – Phase I, II reactions, action of cytochrome P450

UNIT II
Targets for drug action, receptor proteins, ion channel and drug targets, control of receptor expression, assay of drug potency: Chemical, bioassay and immunoassay-Drug tolerance and drug dependence. Principles of basic Pharmacokinetics, Adverse response to drugs, drug intolerance, drug allergy, tachyphylaxis, drug abuse, vaccination against infection, factors modifying drug action and effect.

UNIT III
Mechanism of action of drugs used in therapy of
Respiratory systems – cough, bronchial asthma, pulmonary tuberculosis Cancer chemotherapy
Antimicrobial drugs – sulfonamide, trimethoprim, penicillins, aminoglycosides and bacterial resistance.
Thyroid and anti thyroid drugs, insulin and anti diabetic drugs, anti fertility and ovulation inducing drugs.

REFERENCES:
1. Pharmacology – 5^{th} edition – H.P.Rang, M.M.Dale, J.M.Ritter, P.K.Moore
2. The Pharmacology, Volume I and II – Goodman and Gillman
3. Basic Pharmacology – Foxter Cox. Butterworth's 1980
4. Pharmacology and Pharmacotherapeutics – R.S.Satoskar, S.D. Bhandhakam and S.S. Alinapure
5. Principles of Medicinal Chemistry – William O.Foye – B.I. Waverks. Pvt. Ltd, New Delhi

ELECTIVE - I (A)
Subject Title: AGRICULTURAL BIOTECHNOLOGY

UNIT-1

Biotechnology in agriculture, growth and historical perspective of agricultural biotechnology. Agriculture biotechnology – Risks and applications. Transgenic plants resistance to biotic and abiotic stress. Transgenic plants in crop improvement. Advantages and applications of transgenic plants.

UNIT II

Transgenic plants in quality modifications – Starch, Oil, Protein, Golden Rice, Suppression of endogenous gene, Male sterilization. Plants derived vaccines, flower modification and colour.Targetting transgenic product to chloroplast and mitochondria.

UNIT III

Importance of Biofertilizers in agriculture (Rhizobium,Azotobacter, Mycorrhiza, Actinorhiza) advantages and current status,vermiculture, composting, current practices and production of biofertilizers.

REFERENCES:

1. Biotechnology fundamental and application (4^{th} edition) - S.S.Purohit.
2. Plant Biotechnology – B.D.Singh
3. Plants, Genes and agriculture by Maartein, J.Christpeels, David E.Sdava.
4. Crop Biotechnology by P.R.Yadav, Rajiv Tyagi.
5. Plant Biotechnology by Chawla. Gendel,
6. Steven M. et al (eds.) Agricultural Bioethics: Implications of Agricultural Biotechnology. Ames:

ELECTIVE - I (B)
Subject Title: BIOREMEDIATION

UNIT I

Bioremediation: Definition - constraints and priorities of bioremediation. Bioaugmentation; bioreactors for remedial processes, types of bioremediation- in situ, ex situ, **Bioremediation of heavy metals**: Microorganisms for ore concentration and leaching. Reclamation of mine sweepings - Biosorption and bioleaching. Heavy metal elimination from sewage water and effluents – Biotechnological approaches.

UNIT II

Phytoremediation –Definition, various phytoremediation processes, example of phytoextractrion from soil, hyper accumulators and biotic interaction. Mycoremediation: Definition, Rhizofiltration, Mycorrhizal associations, Mycofiltration.

UNIT III

Xenobiotic compounds: Recalcitrance – hazardous wastes – disposal of radioactive wastes. Biodegradation of xenobiotics - Biological detoxification; Biodegradation of

DDT, BHC and malathion in soil, plants and insects. Biotechnological methods for hazardous waste management. Biotechniques for **air pollution** abatement and odor control: Deodorization process, application.

REFERENCES:

1. Environmental Science & Technology- Stanley E. Manahan
2. Introduction to Environmental Biotechnology- A K Chatterjii
3. Environmental Biotechnology- S N Jogdand

ELECTIVE - I (C)
Subject Title: INTRODUCTION TO BIOINFORMATICS

UNIT I

Introduction and history of bioinformatics – Internet, World Wide Web, Web browser, EMBnet, NCBI. File transfer protocol. Database browsers and search engines. Introduction to MS access, making queries, Designing forms, Report design

UNIT II

Database- Definition, DBMS, Biological Databases – FASTA, Blast, Genbank, DNA sequence databases, Protein databases. Entry formats, carbohydrate databases, Enzyme databases, Pathway databases. Relational database model. Theory on RDBMS. SQL.

UNIT III

Application aspects – gene precdiction, target searchings – drug designing – E- cell, phylogenetic analysis, PERL, Chemoinformatics.

REFERENCES:

1. Introduction to Bioinformatics T.K.Altwood, D.J.Parry-smith (2004) Pearson Education
2. Bioinformatics for the beginners K.Mani & N.vijayaraj
3. Proteomics- Pennigton & Dunn (2002) Viva books publishers, New Delhi
4. Bioinformatics- A practical guide to the analysis of genes & protein 2nd ED Andreas, Baxevanis and Francis Ouellette.
5. The internet (1999) Christian Crumlish. BPB publications.

ELECTIVE - II (A)
Subject Title: MEDICAL BIOTECHNOLOGY

UNIT I

Tools of Medical Biotechnology – Biotechnological revolutions-Genomics,combinatorial chemistry, insight into basic biology-Areas of application, Diagnosis and prediction of disorders ,Limits and approaches.

UNIT II

Role of biotechnology in healthcare. World wide market and work in medical biotechnology. Vaccine production-New developments. Biosensors in clinical diagnosis,chiral technology, monoclonal antibodies for immunotherapy.

UNIT III

Recent developments in medical biotechnology –Pharming for human proteins and neutraceuticals .Tissue engineering and therapeutic cloning, Application of nanotechnology in biomedical sciences- Green nanaosubstances, gene delivery, drug delivery. Nanotechnology in replacing defective cells.

REFERENCES:

1. Fundamentals of medical biotechnology by Aparna Rajagopalan,Ukaaz publications.
2. Medical biotechnology by S.N.Jogdand, Himalaya publications.
3. Medical Microbiology- Mackie and Mc Cartney

ELECTIVE - II (B)

Subject Title: BIOTECHNOLOGICAL APPROACH FOR WASTE WATER TREATMENT

UNIT I

Historical introduction to water and waste water environment. Domestic and industrial waste water flow rate and characteristics. Design of waste water network, waste water treatment process.

Waste water pretreatment – screenings, grit channels, filtration and equalization, primary treatment- chemically enhanced primary sedimentation, sludge quantity from primary settlings.

UNIT II

Secondary Treatment – Biological treatment of waste water, secondary treatment systems, filtration, sludge settlement parameters. Nitrification and denitrification. Activated sludge systems – Complete mix, plug flow reactors, attached growth systems. Nutrient removal – Biological nutrient removal. Nitrification combined biological phosphorus and nitrogen removal.

UNIT III

Secondary classification, advanced treatment process – Granular media filtration, Absorption, Chemical treatment, Air stripping and ammonia removal. Waste water disinfectant. Diffuses from waste water – plume flow, design.
Treatment of waste water in Food processing, Paper, Sugar and Leather industry.

REFERENCES:

1. Enviromental Engineering by Gernard hily.
2. Text book of environmental biotechnology by Pradeep Kumar Mohaptra.
3. Environmental Biotechnology by Alan.Scragg.
4. Industry Microbiology by Patel.
5. Biotechnology fundamentals and application by S.S.Purohit1.Waste Water Engineering Treatment and Disposal and Reuse by Metcalf and Eddy.
6. Water Pollution management hand book by Lepathak
7. Waste Water management by Arceivala
8. Environmental biotechnology by C.F forster and D.A. J. waste

ELECTIVE - II (C)
Subject Title: GENOMICS

UNIT I:

Introduction to genome databases - database search - Algorithms issues in databases search - sequence database search - FASTA - BLAST – Types of genomic databases and uses: Polymorphic markers, Cytogenic Maps, LINE, SINE- Amino acid substitution matrices PAM and BLOSUM.

UNIT II:

Gene Therapy: Concept and Principles of Gene Therapy. Principles of gene Expression - Genome Mapping –physical and genetic mapping techniques, Human Genome Project - Genomes of other organisms. Shotgun DNA sequencing - Sequence assembly - Gene predictions - Molecular prediction with DNA strings.

UNIT III:

Genomic resources, Gene structure and DNA sequences. EST comparison, gene hunting. Expression analysis- SAGE, cDNA library, ORF prediction, Microarray – DNA sequencing and sequence alignment: RFLP, SNP, RAPD, Application of Comparative Genomics.

REFERENCES:

1. Introduction to bioinformatics by Dr. Mani and Dr. Vijayaraj.
2. Bioinformatics by Parry and Smith.
3. Bioinformatics by David Mount.
4. Genomes 3 by T. A. Brown.

ELECTIVE - III (A)
Subject Title: INDUSTRIAL BIOTECHNOLOGY

UNIT I

Fermenter- batch and continuous fermenter, general design of a stirred tank fermenter, sterilization and maintenance of sterile conditions, preparation of inoculum.

Types of fermentation- solid state fermentation- tray and drum, and submerged fermentation- batch and fed batch

Media used for industrial fermentation.

UNIT II

Microbial production and product recovery- Alcoholic beverage- wine and beer

Production of vinegar from alcohol, production of vitamin-B 12, production of organic acid- lactic acid and glutamate.

UNIT III

Fermented diary products- microorganisms involved in fermentation, yogurt, curds, sour cream, cheese paneer, pickles, idly, single cell protein.

REFERENCES:

1. Industrial Microbiology, Prescot and Dunn,
2. Biochemical Engineering and Biotechnology Handbook, Atkinson, B and Marituna, F., The Nature Press, Macmillan Publ. Ltd.
3. Biochemical Engineering Fundamentals, Bailey & Olis. MGH.
4. Text book of Biotechnology – Plant Biotechnology and industrial biotechnology by S.B. Sullia, G. Siva Kumar Swami, P.A. Sastry- United publishers

ELECTIVE - III (B)
Subject Title: BIOETHICS AND BIOSAFETY

Unit I

Definition of ethics and Bioethics, Ethics in Biotechnology(positive and negative effects with classical examples – Rice with Vitamin A, No-till Agriculture, cotton without insecticide, reduced need for fertilizer, biological pest control , slow ripening fruits and controlled ripening, fast growing trees and fishes.

Awareness education on genetically engineered organism.-Transgene instability, gene flow, resistance/ tolerance of target organism, increase weedlessness, risks and uncertainity associated with Biotechnology.

UNIT II

Containment levels and their impact on Environment- Containment- definition, types of containment, summary of recommended Biosafety levels for infectious agents, detail checklist – premises and lab equipment, Animal facilities, environment. Gene technology laboratory.

GLP and Bioethics- introduction, national Good Laboratory Practices (GLP), the GLP authority functions, Good Laboratory Practices- necessity, aspiration and responsibility.

UNIT III

Ethics in clinical trials and Good Clinical Practices (GCP) – Definition of clinical trials and GCP, general information about clinical trials, need to conduct clinical trials, faces of clinical trials, institutional set ups for conducting clinical trials, ethics in clinical Biotechnology and

REFERENCES:

1. Safety Assessment by Thomas, J.A., Fuch, R.L. (2002), Academic Press.
2. Biological safety Principles and practices) by Fleming, D.A., Hunt, D.L., (2000). ASM Press.
3. Biotechnology - A comprehensive treatise. Legal economic and ethical dimensions VCH.
4. Bioethics by Ben Mepham, Oxford University Press, 2005.
5. Bioethics & Biosafety by R Rallapalli & Geetha Bali, APH Publication, 2007
6. Bioethics & Biosaftey By Sateesh Mk (2008), Ik Publishers
7. Biosafety And Bioethics Rajmohan Joshi Publishers

ELECTIVE - III (C)
Subject Title: PROTEOMICS

UNIT-I

Protein databases: CATH, SCOP, FSSP, SARF, MMDB. Protein structure and comparison, Blocks, Class, Domain, Fold, Profile, Motif, and PSSM.

UNIT-II

Structural Proteomics: Experimental Techniques for Protein Structure Elucidation, X-ray Crystallography, 2-D Electrophoresis- Sample preparation, pH gradient- MALDI-TOF, Electro plot, Protein Microarrays and Bioseparation.

UNIT-III

Metabolomics: Understooding the Metabolic Pathways of Microbes, metabolic pathway databases-KEGG. Structure prediction, active site determination, neural networks. Protein –protein interaction, protein – DNA interaction. Enzyme – Substrate interaction. Applications of Proteomics: Plant breeding and Biomedical.

REFERENCES:

1. Proteomics- Pennigton & Dunn (2002) Viva books publishers, New Delhi
2. Bioinformatics- A practical guide to the analysis of Genes & Protein 2nd ED Andreas, Baxevanis and Francis Ouellette.
3. Bioinformatics by David Mount.