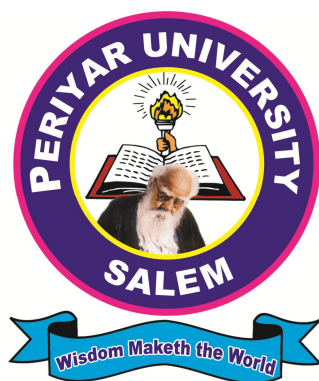


PERIYAR UNIVERSITY
PERIYAR PALKALAI NAGAR
SALEM – 636 001.



DEGREE OF BACHELOR SCIENCE
CHOICE BASED CREDIT SYSTEM
SYLLABUS FOR B. SC BIOTECHNOLOGY

FOR THE STUDENTS ADMITTED FROM THE
ACADEMIC YEAR 2017 – 2018 ONWARDS

Definition:

Programme:

“Programme” means core degrees offered in various disciplines.

Course:

“Course” refers to the courses offered under the degree programme spread over the complete Programme of study asunder.

- Part I** - means “Tamil/other languages” offered under the programme.
- Part II** - means “English” language offered under the programme.
- Part III** - means “the core subjects” related to the programme concerned including practicals.
- Part III Allied** - means “Allied subjects” offered as allied, which is interdisciplinary in nature but related to the programme.
- Part III Electives** - means “Elective subjects” related to the core subjects of the programme concerned.
- Part IV (i)** - “Tamil” means basic orientation in Tamil language for those students who have not studied Tamil upto 12th standard.
- (ii)** - “Advanced Tamil” means, the subject is meant for students who have studied Tamil language upto 12th standard and chosen other languages in college but would like to advance their Tamil language skills.
- (iii)** - “Non-Major Electives” means option is being given to students who do not come under the above two categories (i & ii).
- (iv)** - Skill based subject means the courses offered under the programme related to Advanced Skill acquisition for industrial application for which a separate Diploma will be awarded along with the Degree.
- (iv)** - “Foundation Course” means courses offered as
 - 1) Value Education - Manavalakkali yoga (1st year)

2) Environmental Studies (1st year)

Part V

- “Extension Activities” means all those activities which form part of NSS/NCC/Sports/YRC and other co and extracurricular activities.

A detailed explanation of the above with relevant credits are given under “Scheme of Examination along with Distribution of Marks and Credits”

Duration: Means the stipulated years of study to complete a programme as prescribed by the University time to time. Currently for the undergraduate programme the duration of study is THREE years. These regulations apply to the regular course of study in approved institutions of the University.

Credits: Means the weightage given to each course of study (subjects) attributed by the experts of the Board of Studies concerned.

Credit System: Means, the course of study under this pattern, where weightage of credits are spread over to different semesters during the period of study and the Cumulative Grade Point Average will be awarded based on the credits earned by the students. The following are the total credit points:

For Undergraduate Programme (Three years) : 140

AIM AND SCOPE OF THE COURSE:

- To acquire knowledge in broad area of Biotechnology.
- The topics included in different units of different papers would enable the students to develop technical skills in technology and applied branches.
- Skill based subjects like Biophysics and Bioinstrumentation, Developmental Biology, Nanobiotechnology and Bioinformatics and Proteomics and Genomics have been included in order to provide opportunities in employment and research in Government and Private Organizations.
- There is also scope for self employment for the students.
- Practicals included in the syllabus will improve the skills of the students in plant tissue culture, animal tissue culture, molecular biology, immunology, genetic engineering, bioprocess technology, enzymology and Laboratory techniques.

ELIGIBILITY FOR ADMISSION:

Candidate for admission to the first year of the degree of Bachelor of Science Course shall be required to have passed the Higher secondary examination (Academic or Vocational Stream) conducted by the Government of Tamil Nadu or an Examination accepted by the Syndicate, Subject to such conditions may be prescribed therefore shall be permitted to appear and qualify for B.Sc degree examination in Biotechnology.

DURATION OF THE COURSE:

The course for the degree of Bachelor of Science shall consist of three academic years divided in to six semesters. Each semester consists of 90 working days.

PASSING MINIMUM:

The candidate shall be declared to have passed the examinations if he /she secures not less than 40 marks.

DISTRIBUTION OF MARKS:

THEORY

University examination = 75 marks

Internal assessment = 25 marks

Internal assessment structure:

Test = 15 marks

Assignments = 05 marks

Attendance = 05 marks

Passing minimum for Internal Assessment = 10 marks

Passing minimum for University examinations = 30 marks

PRACTICALS

University examinations = 60 marks
Internal Assessment = 40 marks

Internal assessment structure:

Test = 15 marks
Observation record = 10 marks
Regularity in Practical = 15 marks
Passing minimum for internal assessment = 16 marks
Passing minimum for University examinations = 24 marks

CLASSIFICATION OF SUCCESSFUL CANDIDATES:

- Candidates who secure not less than 60 % of the aggregate marks in the whole examinations shall be declared to have passed the examinations in First class.
- Candidates who secure above 50 % and below 60 % shall be declared to have passed the examinations in Second class.
- Other successful candidates who secure below 50% shall be declared to have passed the examination in Third class.

B.SC BIOTECHNOLOGY

SEM	PAPER CODE	TITLE OF THE PAPER	DURATION HRS	CIA	MARKS	TOTAL MARKS	CREDITS
I		TAMIL I	5	25	75	100	3
		ENGLISH I	5	25	75	100	3
		MAJOR – CELL BIOLOGY	6	25	75	100	4
		ALLIED- BIOCHEMISTRY I	6	25	75	100	4
		LAB IN CELL BIOLOGY	3	40	60	100	3
		MANAVALAKKALAI – YOGA	2	25	75	100	2
II		TAMIL II	5	25	75	100	3
		ENGLISH II	5	25	75	100	3
		MAJOR –GENETICS	5	25	75	100	4
		ALLIED – BIOCHEMISTRY II	5	25	75	100	4
		SBEC- BIOPHYSICS & BIOINSTRUMENTATION	2	25	75	100	2
		ENVIRONMENTAL STUDIES	2	25	75	100	2
		LAB IN GENETICS	3	40	60	100	3
		LAB IN BIOCHEMISTRY	3+3	40	60	100	3
III		TAMIL III	5	25	75	100	3
		ENGLISH III	5	25	75	100	3
		MAJOR – GENERAL MICROBIOLOGY	5	25	75	100	4
		ALLIED-BIOSTATISTICS	5	25	75	100	4
		SBEC- DEVELOPMENTAL BIOLOGY	2	25	75	100	2
		NMEC	2	25	75	100	2
		LAB IN MICROBIOLOGY	3	40	60	100	3
IV		TAMIL IV	5	25	75	100	3
		ENGLISH IV	5	25	75	100	3
		MAJOR – MOLECULAR BIOLOGY	6	25	75	100	4
		ALLIED – COMPUTER APPLICATIONS IN BIOLOGY	6	25	75	100	4
		NMEC	2	25	75	100	2

		LAB IN MOLECULAR BIOLOGY	3	40	60	100	4
		LAB IN COMPUTER APPLICATIONS IN BIOLOGY & BIostatistics	3	40	60	100	3
V		PLANT BIOTECHNOLOGY	6	25	75	100	4
		IMMUNOLOGY AND IMMUNOTECHNOLOGY	6	25	75	100	4
		GENETIC ENGINEERING	5	25	75	100	4
		SBEC - NANOBIO TECHNOLOGY AND BIOINFORMATICS	2	25	75	100	2
		ELECTIVE -I	5	25	75	100	4
		LAB IN PLANT BIOTECHNOLOGY	3	40	60	100	4
		LAB IN GENETIC ENGINEERING &IMMUNOLOGY	3	40	60	100	4
VI		ANIMAL BIOTECHNOLOGY	6	25	75	100	4
		PROTEOMICS AND GENOMICS	6	25	75	100	4
		BIOPROCESS & ENZYMOLOGY TECHNOLOGY	5	25	75	100	4
		SBEC- PHARMACEUTICAL BIOTECHNOLOGY	2	25	75	100	2
		ELECTIVE- II	5	25	75	100	4
		LAB IN ANIMAL BIOTECHNOLOGY	3	40	60	100	4
		LAB IN BIOPROCESS TECHNOLOGY & ENZYMOLOGY	3	40	60	100	4

TOTAL 140

SCHEME OF SYLLABUS

SEM	PART	P.CODE	SUBJECT	HOURS		CREDIT	MARKS		
				LECTURE	T/P		CIA	EA	TOTAL
I	I		TAMIL I	5	T	3	25	75	100
	II		ENGLISH I	5	T	3	25	75	100
	III		CELL BIOLOGY	6	T	4	25	75	100
			ALLIED BIOCHEMISTRY I	6	T	4	25	75	100
			CORE PRACTICAL I	3	P	3	40	60	100
		ALLIED PRACTICAL I	3	P	-	-	-	-	
	IV		MANAVALAKALAI YOGA	2	T	2	25	75	100
30				19					
II	I		TAMIL II	5	T	3	25	75	100
	II		ENGLISH II	5	T	3	25	75	100
	III		GENETICS	5	T	4	25	75	100
			ALLIED BIOCHEMISTRY II	5	T	4	25	75	100
			CORE PRACTICAL II	3	P	3	40	60	100
	III		ALLIED PRACTICAL I	3	P	3	40	60	100
	IV		SBEC: BIOPHYSICS AND BIOINSTRUMENTATION	2	T	2	25	75	100
			ENVIRONMENTAL STUDIES	2	T	2	25	75	100
30				24					
III	I		TAMIL III	5	T	3	25	75	100
	II		ENGLISH III	5	T	3	25	75	100

	III		GENERAL MICROBIOLOGY	5	T	4	25	75	100
			ALLIED BIOSTATISTICS	5	T	4	25	75	100
			CORE PRACTICAL III	3	P	3	40	60	100
			ALLIED PRACTICAL II	3	P	-	-	-	-
	IV		SBEC: DEVELOPMENTAL BIOLOGY	2	T	2	25	75	100
			NMEC I: CONCEPTS OF BIOTECHNOLOGY	2	T	2	25	75	100
				30		21			
IV	I		TAMIL IV	5	T	3	25	75	100
	II		ENGLSIH IV	5	T	3	25	75	100
	III		MOLECULAR BIOLOGY	6	T	4	25	75	100
			ALLIED COMPUTER APPLICATIONS IN BIOLOGY	6	T	4	25	75	100
			CORE PRACTICALIV	3	P	4	40	60	100
			ALLIED PRACTICAL II	3	P	3	40	60	100
	IV		NMEC II: BIOTECHNOLOGY FOR SOCIETY	2	T	2	25	75	100
					30		23		
V	III		PLANT BIOTECHNOLOGY	6	T	4	25	75	100
			IMMUNOLOGY AND IMMUNO TECHNOLOGY	6	T	4	25	75	100
			GENETIC ENGINEERING	5	T	4	25	75	100
			ELECTIVE I	5	T	4	25	75	100
			CORE PRACTICAL V	3	P	4	40	60	100
			CORE PRACTICAL VI	3	P	4	40	60	100
	IV		SBEC: NANOBIO TECHNOLOGY AND BIOINFORMATICS	2	T	2	25	75	100

				30		26			
VI	III		ANIMAL BIOTECHNOLOGY	6	T	4	25	75	100
			PROTEOMICS AND GENOMICS	6	T	4	25	75	100
			BIOPROCESS AND ENZYMOLOGY TECHNOLOGY	5	T	4	25	75	100
			ELECTIVE II	5	T	4	25	75	100
			CORE PRACTICAL VII	3	P	4	40	60	100
			CORE PRACTICAL VIII	3	P	4	40	60	100
	IV		SBEC: PHARMACEUTICAL BIOTECHNOLOGY	2	T	2	25	75	100
	V		EXTENSION ACTIVITY			1			
					30		27		

ELECTIVE SUBJECTS

SEM	PART	SUBJECT CODE	SUBJECT
V	III		STEM CELL AND TISSUE ENGINEERING
			CLINICAL BIOTECHNOLOGY

SEM	PART	SUBJECT CODE	SUBJECT
VI	III		FOOD BIOTECHNOLOGY
			ENDOCRINOLOGY

SKILL BASED ELECTIVE COURSES

PART	SEM	SUBJECT CODE	SUBJECT	HRS		CREDITS	MARKS		
				LECT	LAB		CIA	EA	TOTAL
IV	II		BIOPHYSICS AND BIOINSTRUMENTATION	2	-	2	25	75	100
	III		DEVELOPMENTAL BIOLOGY	2	-	2	25	75	100
	V		NANOBIOTECHNOLOGY AND BIOINFORMATICS	2	-	2	25	75	100
	VI		PHARMACEUTICAL BIOTECHNOLOGY	2	-	2	25	75	100

ALLIED PAPERS

I YEAR

PART	SEM	SUBJECT CODE	SUBJECT	HRS		CREDITS	MARKS		
				LECT	LAB		CIA	EA	TOTAL
III	I		BIOCHEMISTRY I	6	-	4	25	75	100
	II		BIOCHEMISTRY II	5	-	4	25	75	100

II YEAR

PART	SEM	SUBJECT CODE	SUBJECT	HRS		CREDITS	MARKS		
				LECT	LAB		CIA	EA	TOTAL
III	III		BIostatISTICS	5	-	4	25	75	100
	IV		COMPUTER APPLICATIONS IN BIOLOGY	6	-	4	25	75	100

NMEC PAPERS

PART	SUBJECT CODE	SUBJECT
IV		CONCEPTS OF BIOTECHNOLOGY
		BIOTECHNOLOGY FOR SOCIETY

PERIYAR UNIVERSITY
QUESTION PAPER PATTERN

SECTION A

I MULTIPLE CHOICE QUESTIONS **(10×1=10)**

II DEFINITION **(10×1=10)**

SECTION B

III ANSWER ALL THE QUESTIONS **(5×5=25)**

Two questions from each unit in either or choice

SECTION C

IV ANSWER ANY THREE QUESTIONS **(3×10=30)**

One question from each unit in open choice pattern

CORE PAPER I

CELL BIOLOGY

UNIT I

Biogenesis theory of origin of life. Cell as a Basic unit; Cell size and shape; Prokaryotic & eukaryotic cell organization. Structural comparison of microbial, plant and animal cells.

UNIT II

Cell wall and membrane: Plasma membrane-Model of plasma membrane; fluidity of membranes; Membrane proteins and their functions; Transport across the membrane- selective permeability of membrane; Composition of bacterial cell wall; cell adhesion; cell junctions.

Unit III

Structure and function of cell organelle; Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi complex, lysosomes, Ribosomes, Peroxisomes, Vacuoles, Centrioles and Cytosols. Nucleus and molecular organization of chromatin, chromosomes and specialized chromosome

UNIT IV

Cell cycle and cell signaling: Cell Cycle, Mitosis, Meiosis. Cell signaling- types- G Protein receptors, Cell membrane traffic. Cellular Senescence and Apoptosis.

UNIT V

Specialized cells: Motile cells (amoeboid, ciliary, flagellar movements), nerve Cells and nerve impulse conduction, muscle cells and muscle contraction.

REFERENCES:

1. **DeRobertis.**, Cell Biology , Blaze publishers & Distributors Pvt.Ltd., NewDelhi.
2. **Gerald Karp.**, Cell and Molecular biology concepts and experiments-4th Edition.
3. **Wilson & Marrison.**, Cytology , Reinform Publications.
4. **Ajoy Paul.**, 2011. Text Book of Cell and Molecular Biology-. Books and Allied (P) Ltd, Kolkata. Third Edition.
5. **Aminul Islam.**, 2011. A Text Book of Cell Biology-. Books and Allied (P) Ltd, Kolkatta. First edition.
6. **Sharp.**, Fundamentals of Cytology –Mc Graw Hill Company.

PRACTICAL I
LAB IN CELL BIOLOGY

1. Microscopes and its parts.
2. Micrometry - Stage and Ocular Micrometer.
3. Cell Counting - Haemocytometer
4. Mounting epithelium and observing living animal and plant cells using vital staining.
5. Mitosis in Onion root tip squash
6. Meiosis in grasshopper testis / flower buds.
7. Preparation of Permanent Slides – Muscle cells.
8. Observation of Permanent Slides - Cardiac muscle, Sperm cell.
9. Staining of macromolecules – Carbohydrates and Lipids.
10. Microtomy (Demo).

CORE PAPER II

GENETICS

UNIT I

History of Classical and Modern Genetics, Concept and organization of Genetic material in Bacteria, Plant and Animal; Structure, types, forms and functions of DNA and RNA. Genetic model organisms and their significance (*E.coli*, *Arabidopsis thaliana*, *Coenorhabditis elegans*).

UNIT II

Mendelian laws of inheritance; Non-Mendelian inheritance; Chromosomal theory of inheritance. Back cross and Test cross.

UNIT III

Structural and numerical alterations of chromosome- Deletion, inversion, duplication, translocation. Ploidy and their genetic implications. Mutation- (Spontaneous and Induced) mutagen. Biochemical basis of mutation.

UNIT IV

Microbial Genetics: Methods of Gene transfer – Transformation, Transduction, Sexduction, Mapping genes by interrupted Matting, fine structure analysis of genes.

UNIT V

Cytogenetics- Human karyotype, Banding techniques, Human genetic diseases. Pedigree analysis.

REFERENCES:

1. **Robertis et al.**, 1995 Eighth Edition. Cell and Molecular Biology –Waverly publication.
2. **E.J.Gardener, M.J.Simmons and D.P.Snustad**, Principles of Genetics –John Wiley & Sons Publications.
3. Strickberger, **M.W.**, 1997. Fourth Edition.Genetics –Printice Hall, ,
4. **Alberts.**, 2002. Molecular Biology of the Cell –. Garland publication, Fourth Edition.
- 5.**Ajoy Paul.**, 2011. Text Book of Genetics- from Genes to Genomes- Books and Allied (P) Ltd, Kolkata. Third Edition.

SKILL BASED ELECTIVE COURSE

BIOPHYSICS AND BIOINSTRUMENTATION

UNIT-I

Beer Lambert's law - Colorimeter and its applications. Spectrophotometer-Principle and its applications- Types of Spectrophotometer- UV, visible, Infrared Spectrophotometer.

UNIT-II

Electrophoresis - Principle and its applications - Types of electrophoresis- Agarose Gel, SDS-PAGE and 2 D Gel, Blotting –Southern, Northern, Western & Immuno blotting. Gel-Documentation.

UNIT-III

Imaging techniques -EEG, ECG, CT SCAN, MRI SCAN, X-RAY, EMG, NMR, PET.

UNIT-IV

Centrifuge - Principle and its applications - Types of Centrifuge, Chromatography - Principle and its applications, Types- Paper, TLC, Column, Affinity, Ion-exchange, HPLC, GC-MS.

UNIT -V

Biosensors- Principle and its applications- Electrochemical, Thermometric, Potentiometric-Optical, Piezo-electric and Amperometric Biosensors. GM Counter, Scintillation Counter, Autoradiography, Flow Cytometry. Care and Maintenance of Laboratory Instruments – Autoclave, Incubator and Hot air oven.

REFERENCES:

1. **H.V. Volkones.**, General Biophysics, Vol I&II
2. **Upadhyay.**, Biophysical Chemistry-, Himalaya Publication, Edition III
3. **S.Mahesh.**, 2003 Biophysics New Age International Private Ltd.
4. **Ghatak, K.L.**, 2003. Techniques and Methods In Biology. PHI Learning Private Ltd. New Delhi
5. **Zubay.G.L.**, 1993. Biochemistry, 4th Edi. WmC. Brown Publishers.

PRACTICAL II
LAB IN GENETICS

1. Mendel's law of genetics - . Mono and Dihybrid crosses.
2. Rearing morphology of *Drosophila* (mutant eye identification)
3. Observation of Genetic model organisms (*Arabidopsis thaliana* and *Coenorhabditis elegans*)-
Permanent slides
4. Isolation of spontaneous mutant cells.
5. Isolation of petite mutant yeast cell.
6. Identification of Barr body (Buccal epithelium smear)
7. Preparation of polytene chromosomes (Chironomous larvae salivary gland)- squash preparation.

CORE PAPER III
GENERAL MICROBIOLOGY

UNIT I

Definition and Scope of Microbiology. History and Recent developments, Contribution of Leeuwenhoek, Louis Pasteur, Robert Koch, Elie Metchnikoff, Edward Jenner and Alexander Fleming. Spontaneous & Biogenesis of Microbiology.

UNIT II

Microscopy - Simple and compound microscopy, Dark field, Phase contrast, Fluorescence and Electron Microscopy. Stain and staining techniques - Simple, differential and special staining (Endospore, Capsular).

UNIT III

Cellular structures of prokaryotes –Ultra structure and functions of prokaryotic cell wall, Plasma membrane, Flagella, Pili and Capsule. Structure and functions of Cyanobacteria.

UNIT IV

Sterilization - Physical and chemical methods. Growth of bacteria-multiplication –nutritional requirements –factors affecting growth -growth curve –Determination of growth. Media and its types. Culture techniques –Pure culture, anaerobic culture - preservation of cultures.

UNIT V

Antimicrobial chemotherapy –Antibiotics –mode of actions –antimicrobial resistance -tests for sensitivity to antimicrobial agents.

REFERENCES:

1. **A Text book of Microbiology.** Dubey, RC and Maheswari DK (2005). S. Chand & Company Ltd., New Delhi.
2. **College Microbiology.** Sundara Rajan S (2003).Volume 1 7 2. Revised Edition, Vardhana Publications, Bangalore.
3. **Microbiology-Pelczar** Tr. MJ, Chan ECS & Kreig NR (2006). 5th Edition, Tata McGraw-Hill companies Ltd.
4. **Microbiology** - Prescott LM, JP Harley and DA Klein (2005). 6th international Edition, McGraw Hill companies Ltd.

5. **General Microbiology** - Robert F Boyd(1984). Times Mirror / Mosby College publishers.

SKILL BASED ELECTIVE COURSE

DEVELOPMENTAL BIOLOGY

UNIT I

Spermatogenesis and Oogenesis in mammals, Menstrual cycle, Monitoring of estrus cycle, Sperm Banking. Hormones involved in reproduction.

UNIT II

Activation of sperm and egg– interaction of sperm and egg – Sequence of events in sperm entry – Egg surface changes. Post–fertilization changes. Embryo development.

UNIT III

Cell cleavage – pattern of cleavage – Chemical changes- Distribution of cytoplasmic substances in the egg –Metamorphosis (Insects and amphibians) –Hormone control of metamorphosis.

UNIT IV

Development of Microsporangium and Megasporangium, Pollination, Embryo-Embryo sac development and double fertilization in plants, seed formation and germination. Out line of experimental embryology.

UNIT V

Organization of shoot and root apical meristem, and development. Leaf development and Phyllotaxy.

REFERENCES:

1. **Gilbert, Scott's**. 10th edition (2014). Developmental biology. Sinauer Association, Inc., Publishers.
2. **Chattopadhyay.S.** 2016. An Introduction to Developmental Biology, Books and Allied (P) Ltd, Kolkata. First Edition.
2. **Bruce M Carlson**, Patten's Foundation of Embryology,. Tata McGraw HillCo.
3. **Balinsky, B.I.**, 1981. 5th edition. An Introduction to Embryology, W. B. Saunders Co., Philadelphia
4. **Verma , P.S., Agarwal, V.K., and Tyagi.**, 1995. Chordate embryology, S. Chand & Co., New Delhi.
5. **Berril, N.T., Karp, G.**, 1988. Development. Tata McGraw Hill Co., New York

PRACTICAL III

LAB IN MICROBIOLOGY

1. Sterilization Techniques & sterilization of Media, Glass wares.
2. Media Preparation (solid & liquid).
3. Isolation & Enumeration of Microorganism from water and Soil.
4. Types of culture method Streak plate, Pour plate, Stab & Slant preparation.
5. Measurement of Growth rate of bacteria - Turbidometric method.
6. Staining Techniques–Gram’s staining, Spore Staining, Acid fast, Lacto phenol Cotton Blue Staining.
7. Hanging drop technique.
8. Characterization of microorganisms -IMVIC tests.
8. Microscopic slide preparation –Fungi & Bacteria.
9. Antibiotic sensitivity Test - Kirby Bauer method.

CORE PAPER IV
MOLECULAR BIOLOGY

UNIT I

Central dogma: DNA as a genetic material. Modern concept of gene organization. DNA replication in prokaryotes and Eukaryotes, Enzymes and proteins involved in replication. DNA repair mechanisms –Light and Dark.

UNIT II

Transcription & transcriptional control: (Prokaryotes and eukaryotes), Initiation, elongation, termination, promoter sequences, TATA box, Hogness box, CAAT box, Enhancers, upstream activating sequences. Post transcriptional modifications, splicing, spliceosomes. Editing, Nuclear export of mRNA.

UNIT III

Translation: Prokaryotic and eukaryotic translation, Initiation, elongation and termination, Co and post translational modifications of proteins. Import into nucleus, mitochondria and chloroplast. Genetic code: Codon, Anti-codon,

UNIT IV

Control of gene expression at transcription and translation level: regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, Regulation of gene expression-Operon concepts (*lac&trp*). Gene silencing . Recombination – Homologous and Non – homologous recombination.

UNIT V

Biology & Genetics of cancer: Genetic rearrangements in progenitor cells, oncogenes, tumor suppressor genes (P^{53} and PRB genes), virus-induced cancer, metastasis, interaction of cancer cells with normal cells. Molecular techniques; DNA finger printing, DNA Microarray, Gene Mapping, Protein Micro array.

REFERENCE:

- **T.A. Brown.**, Molecular Biology, Labfax, Bioscientific publishers Ltd, Oxford.
- **J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steltz & A.N. Weiner.** Molecular Biology of gene (4th edition) The Benjamin/Cummings publications C Inc. California.

- **K.G.Ramavatt & Shaily Goel.** 2010. Molecular Biology & Biotechnology 1st edition. S.Chand Company, New Delhi.
- **J.Darnell, H. Lodish & D.Baltimore,** 1994. Molecular Cell Biology. 2nd edition, Scientific American Book, USA,
- **B.Aberts, D.Bray, J.Lewis, M.Raff, K.Roberts & J.D.Watson,** 1994. Molecular Biology of the Cell (2nd Edition) Garland Publishing, Inc.New York,.
- **Ajoy Paul** , Textbook of Cell & Molecular biology .

PRACTICAL IV

LAB IN MOLECULAR BIOLOGY

1. Isolation of genomic DNA from bacteria.
2. Bacterial transformation.
3. Conjugation.
4. Estimation of DNA (DPA method).
5. Estimation of RNA (Orcinol method).
6. Estimation of Protein (Lowry's method).
7. Separation of DNA by AGE.
8. Isolation and purification of protein (Dialysis).
9. Separation of protein by SDS PAGE.
10. Isolation of antibiotic resistant mutant.

CORE PAPER V

PLANT BIOTECHNOLOGY

UNIT I

History of PTC, Concept of Cellular Totipotency. Laboratory Organization, Sterilization Techniques, Media Preparation. Types of media – MS, Nitsh, Gamborgs. Plant growth regulators. Cytoplasmic Male Sterility.

UNIT II:

Protoplast Isolation, Fusion & Culture Regeneration – Somatic Hybrids & Cybrids. Establishment & Maintenance of Callus & Suspension Culture. Somatic embryogenesis, Synthetic seeds, Plant Micropropagation, Micrografting.

UNIT III:

Shoot tip Culture (Virus Free Plants), Haploid Plant Production, Anther & Microspore Culture, Embryo Culture & Rescue, Invitro Pollination & Fertilization, Secondary Metabolites, Cryopreservation & Germplasm conservation, Role of tissue culture in agriculture & Forestry.

UNIT IV:

Molecular biology of N₂ fixation (plants & cyanophytes, Nif gene). Plant Gene Expression Cassettes – Selectable Marker, Reporter Genes, Promoters in Plant Vectors. Transposons in plants, Somaclonal & Gametoclonal Variations in Plants.

UNIT V:

Genetic engineering of plants – Insect Resistance, Virus Resistance, Herbicide Resistance, Bacterial Resistance, Stress (Biotic & Abiotic) Resistance. Delayed Fruit Ripening, Edible Vaccines & Plantibodies. Terminator seed concepts.

REFERENCES:

1. **Chawla**, 2003. Introduction to Plant Biotechnology (2nd edn) Oxford and IBH Publishers
2. **R.C. Dubey**, A Text Book of Biotechnology. S.Chand & Co Ltd, New Delhi.

3. **Chrispeel M.J, Sadava D.E**, 1994. 2nd Revised edition, Plants, Genes and Agriculture, Jones and Barlett Publication, Boston.
4. **Satyanarayana . U**, 2008, Biotechnology, Books and Allied (p) Ltd.
5. **R. Keshava Chandran and K.V. Peter**. Plant Biotechnology. First edition. University Press (India) Pvt Ltd, Hyderabad.
6. **Ramawath** , 2003. Plant biotechnology, S. Chand and Co, edition 2.

COER PAPER VI
IMMUNOLOGY AND IMMUNOTECHNOLOGY

UNIT I

History of the immune system, Innate and Acquired immunity. Haematopoiesis. Cells and organs of the immune system.

UNIT II

Nature & biology of Antigen & super antigens. Haptens, Mitogens, Adjuvants. Humoral response – B cell activation and proliferation. Cell mediated immunity – T cell receptors and its activation.

UNIT III

Immunoglobulins – Structure and functions. Antigen – Antibody reactions – Agglutination, precipitation, RIA, ELISA, FACS and Immunopanning. Hybridoma technology & CCA. Organization and expression of immunoglobulin genes. Antibody Engineering & Finger Printing.

UNIT IV

Cytokines: Types and function, Complement- Properties and activation pathways, Classical, Lectin & Alternative pathway. Major Histocompatibility Complex. Immunological tolerance. Immunity to infectious agents (intra cellular parasites, helminthes viruses).

UNIT V

Transplantation immunology. Hypersensitivity and its types. Autoimmunity, Immune senescence, Cancer immunology, Vaccines. Immunotherapeutics. Immuno enhancing technology.

REFERENCES:

1. **Kubey, J.** 1993. Immunology Freeman and company.
2. **Janeway, C.A.,** Immuno-biology Paul Travers 1994.
3. **Seemi Farhat Basir.,** Text Book of Immunology by. First edition. PHI Learning Pvt Ltd, New Delhi.
4. **Madhavee Latha, P.,** A Text Book of Immunology, First Edition. S.Chand & Company Ltd, New Delhi.
5. **Ajoy Paul.,** Textbook of Immunology
6. **Rajasekara pandian M and Senthil kumar B.,** 2007. Immunology and Immunotechnology. (2007), Panima publishing corporation , New Delhi.

CORE PAPER VII

GENETIC ENGINEERING

UNIT-I

Basics, history, scope and recent developments in Genetic Engineering; guidelines; strategies in plant and animal genetic engineering. Molecular tools in genetic engineering- Restriction enzymes: Endo & Exonucleases. Modifying enzymes- DNA & RNA polymerase, reverse transcriptase, terminal transferase; nucleases (DNases, RNases, S1) T4 polynucleotide kinase, Alkaline Phosphatase and ligase (*E.coli* & T4). Ligation (cohesive & blunt end ligation) – linkers & adaptor.

UNIT-II

Cloning vectors: plasmid - definition, properties and types. pUC19 & pBR322- phage vectors (λ & M13), Cosmid vectors, Shuttle and expression vectors; YAC(*S.cerevisiae* as a model)& BAC (*E.coli*); Screening and selection of recombinants; Gene transfer methods

UNIT-III

Hybridization techniques: Probes(radio active & non radio active), detection. PCR - Principle, Types and applications; Labeling of DNA- Nick translation, Random priming method & labelling by primer extension.

UNIT-IV

Construction of genomic & c DNA libraries. Vector engineering & codon optimization, strategies of gene delivery, invitro translation, Expression in bacteria, yeast, insects, plant & mammalian cells

UNIT-V

Chromosomes engineering, targetted gene replacement, gene editing, gene regulation & silencing. Site directed mutagenesis. DNA sequencing – Maxam Gilbert (chemical) & Sanger's, Nicolson sequencing, Pyrosequencing. Gene therapy, Human Genome Project.

References:

1. **Primrose, S.B. and Twyman, R.M.**, 2006. Principles of Gene Manipulation and Genomics - 7th Edition. Blackwell Publishing Company.
2. **Dubey. R.C.** A Text Book of Biotechnology. S. Chand & Co Ltd, New Delhi.
3. **Brown T.A.**, 2008. Genomes. 3rd Edition. New York: Garland Publishing Co. New York: Garland Science.
4. **Tvan R.S.**, 1997. Recombinant gene expression protocols. Human Press Inc., Tokowa
5. **Satyanarayana. U**, 2008. Biotechnology, Books and Allied (p) Ltd.

SKILL BASED ELECTIVE COURSE
NANOTECHNOLOGY AND BIOINFORMATICS

UNIT I:

Nanobiology – concepts, definitions, prospects; nanoparticles – size, shape, properties. Bionanoparticles – nanostarch, nano composites – dendrimers. Hot – Dot nanoparticles. Types of biomaterials. Biodegradable polymers.

UNIT II:

Methods of nanobiotechnology – Analysis of bimolecular nanostructures by Atomic Force Microscopy, Scanning Probe Electron Microscopy. Nanofabrication - lithography. Drug nanoparticles - structure and preparation ,Liposomes, Cubosomes and hexosomes. Lipid based nanoparticles-liquid nano dispersion, solid liquid nanoparticles

UNIT III:

Nanotubes, Nanorods, Nanofibers and Fullerenes for nanoscale drug . Bio nanoelectronics. Applications of nanobiotechnology in medicine, drug designing and cancer treatment. Medical, social and ethical considerations of nanobiotechnology.

UNIT IV:

Bioinformatics - definition, introduction, history and scope. Databanks – Gen Bank, PDB. Literature DataBanks – PubMed. Biological databases including both proteins and nucleic acids – sequence – EMBL, DDBJ. Structural databases – CATH, SCOP. Specialized database – genome data base, EST.

UNIT V:

Sequence Alignment based on Matrices (BLOSUM and PAM), tools for sequence alignment – BLAST, FASTA. Clustal W. Phylogenetic analysis– WPGMA, UPGMA methods.

REFERENCES:

- 1. Buddy D. Ratner, Allan S. Hoffman, Frederick J. Schoen and Jack E. Lemons.** Biomaterials Sciences: An Introduction to Materials in Medicine 2nd Edition.
- 2. David L. Nelson and Michael M. Cox, 2006** Lehninger's Principles of Biochemistry, 4th Edition.
- 3. M. Niemayer, Chad A. Mirkin, 2004. Nanobiotechnology:** Concepts, applications and perspectives, Wiley VCH publishers.
- 4. David. S. Goodsell., 2006.** Bionanotechnology: Lessons from Nature, John Wiley.
- 5. K.K. Jain, Nanobiotechnology:** Molecular Diagnosis, Taylor L. Francis Group.

PRACTICAL V

LAB IN PLANT BIOTECHNOLOGY

1. MS media preparation.
2. Establishment of shoot tip culture using MS medium
3. Isolation of protoplasts using enzymatic method.
4. Establishment and maintenance of callus culture.
5. Establishment and maintenance of suspension culture.
6. Establishment and maintenance of somatic embryogenesis (Demo).
7. Synthetic seeds (Entrapment method).
8. Isolation of genomic DNA from plant.
9. Extraction & Separation of Chlorophyll A & B using Column Chromatography.

PRACTICAL VI

LAB IN GENETIC ENGINEERING AND IMMUNOLOGY

I IMMUNOLOGY

1. Preparation of plasma and serum.
2. Blood cell analysis – total count, differential count.
3. Agglutination tests:
 - a. ABO Blood grouping.
 - b. WIDAL test.
 - c. ASO test.
 - d. Pregnancy test.
 - e. RPR test.
4. Precipitations:
 - a. Radial immunodiffusion.
 - b. Double immnodiffusion.
 - c. Counter Current immune electrophoresis.
5. ELISA

II GENETIC ENGINEERING

6. Isolation of plasmid DNA and size analysis
7. Restriction digestion.
8. Ligation.
9. Transformations of recombinants in *E.coli* (Preparation of competent cells).
10. Selection & screening of rDNA antibiotic resistance, blue – white colony.
11. PCR amplification (demo).

CORE PAPER VIII
ANIMAL BIOTECHNOLOGY

Unit I

History and Scope of Animal tissue culture. Design & layout of ATC laboratory. Requirements for Animal cell culture. Types of media, ingredients of media. Foetal Bovine Serum. Metabolic profiling of Animal cell culture.

Unit II

Basic Techniques of mammalian cell culture; Disaggregation of animal tissue. Primary culture & secondary culture. Evolution of cell line & continuous cell line, characterization of cell lines. Monolayer, suspension culture. Organ culture, Embryo culture. Maintenance of cell culture. Common cell culture contaminants.

Unit III

Sericulture, Commercial production of silk, Baculoviruses as animal viral vector. Silkworm as a bioreactor. Biotechnology of aquaculture, apiculture.

Unit IV

Embryo Technology and Animal Breeding: In vitro fertilization, Embryo transfer, ICSI, Embryo splitting, Fertility control & regulation, test tube babies. Cell cloning methods.

Unit V

Applications of animal tissue culture for in vitro testing of drugs. Production of transgenic animals & molecular pharming, animal cloning techniques. Cell culture based vaccines. Ethical values in animal biotechnology.

REFERENCES:

1. **R.C. Dubey.**, A Text Book of Biotechnology. S. Chand & Co Ltd, New Delhi.
2. **Sudha Gangal**, Animal Tissue culture. Second edition. University Press (India) Pvt Ltd. Hyderabad.

3. **Sverdrup H.V.**, Oceans & their Physics, Chemistry & Biology –Johns & R.H. Fleming, Prentice Hall Inc.
4. **M. Ranga**, 2006. Animal Biotechnology, Studam publishers.
5. **R.Sasidhara**, 2006. Animal Biotechnology, MJP Publishers.
6. **U.Satyanarayana**, 2008. Biotechnology, Books and Allied (p)Ltd

CORE PAPER X
BIOPROCESS & ENZYME TECHNOLOGY

UNIT I

Historical developments in Fermentation. Screening of industrially important microbes. Strain improvement. Inoculum development. Media formulation, Sterilization, Types of fermentation. Enzymes & cell immobilization techniques. Preservation of microbes.

UNIT II

Stoichiometry of cell growth and kinetics. Batch and continuous culture. Immobilization of Cells & Enzymes. Bioreactor- Design, parts and their function. Types of bioreactors- CSTR, Air lift, Bubble column, Packed bed, Tower. Overview of Down stream processing – Extra & Intra cellular products.

UNIT III

Monitoring and control of process variables (Temperature, pH and DO, mass transfer, heat transfer & O₂ transfer mechanism). Computational control of fermentors.

UNIT IV

Biofertilizers – Azola, Azospirillum, Rhizobium, VAM. Biopesticides, Production of microbial products: Enzymes- Amylase, Organic acid- Citric acid, Amino acid- Glutamic acid, Antibiotics- Penicillin, Solvent- Ethanol, Vitamins- Riboflavin and SCP.

Mushroom technology, Vermitechnology, Petro corps. Quorum sensing in bioprocess. Biodyes.

UNIT V

Industrial Enzymes: Thermophilic enzymes, Lipases, Proteolytic enzymes in meat, leather & detergent industries, Enzymes in Fermentation process, cellulose & metal degrading enzymes.

REFERENCES:

1. **Alexandar N. Glazer & Hiroshi Nikaido** Microbial Biotechnology (Fundamental of Applied Microbiology) –
2. **El – Mans, E.M.T., and Bryce, C.F.A.** 2002. Fermentation Microbiology and Biotechnology. Taylor & Francis group.
3. **A.H. Patel,** 2005. Industrial Microbiology –MacMillan Publishers.
4. **Satyanarayana.** U, 2008. Biotechnology, , Books and Allied (p) Ltd
5. **P.Ponmurugan, Nithya Ramasubramanian and Fredimoses.** 2012. Experimental Procedures in Bioprocess technology and Down stream processing. Anjana Book House, Chennai.

CORE PAPER X
PROTEOMICS AND GENOMICS

UNIT I

Studying the Genome: Genetic Mapping-Markers for Genetic Mapping; RFLP, SSLP - VNTR's, STR's, SNP's; Physical Mapping - In situ hybridization, Sequence Tagged Sites Mapping. DNA data bases.

UNIT II

Determination of nucleotide sequence: Chemical degradation method, Sanger's dideoxynucleotide synthetic method. Direct DNA sequencing using PCR, Sequencing by conventional shotgun method, Whole genome shot gun method, Clone contig method.

UNIT III

ORF scanning – Codon bias, Exon-Intron boundaries - Exon trapping, CpG island, Gene location – Southern and Northern blotting hybridization, Zoo blotting. Studying a transcriptome – Microarray or chip analysis, SAGE.

UNIT IV

Proteomics - ID-SDS-PAGE, 2D-PAGE. Detection and quantitation of proteins in gels. Protein staining techniques. Affinity purification of proteins.

UNIT V

Basics of Mass Spectroscopy- MALDI-TOF and ESI and their applications in proteomics. Tandem MS/MS spectrometry.

REFERENCES:

1. **Ajoy Paul.**, 2011. Text Book of Genetics- from Genes to Genomes- Books and Allied (P) Ltd, Kolkata. Third Edition,.

2. **Keith Wilson and John Walker**, 2010. Principles and techniques of practical biochemistry-, Cambridge University Press, 7th edition.
3. **U.Sathayanarayana**, Biotechnology, Books and allied (p) ltd., India, 2008.
4. **Hubert Rehn**, 2006 Protein Biochemistry and Proteomics – Academic press.
5. **Liebler, Humana W.**, 2002. Introduction to proteomics: Tools for new Biology CBS pub.

SKILL BASED ELECTIVE COURSE
PHARMACEUTICAL BIOTECHNOLOGY

UNIT I:

History & principle of pharmacology. Drug names & classification systems. General principle of drug action – Pharmacokinetics, Pharmacodynamics. Measurement of drug action.

UNIT II:

Chemotherapeutic drugs – Protein Synthesis Inhibitors, Anti-Inflammatory, Antibacterial, Antifungal, Antiviral, Anthelmintic, Anticancer Drugs.

UNIT III:

Production of biological – Human insulin, HGH, Erythropoietins, IFN, TNF, IL, Clotting factor VIII.

Synthetic therapy: Synthetic DNA, therapeutic ribozymes, synthetic drugs.

UNIT IV:

Prenatal diagnosis: Invasive Techniques- Amniocentesis, Fetoscopy, Chronic Villi sampling (CVS), Non Invasive Techniques – Ultra Sonography. Diagnosis using protein & enzymes markers, DNA/RNA based diagnostics.

UNIT V:

Tissue Engineering: Skin, Liver, Pancreas. Recombinant vaccines, Cell adhesion based therapy: Integrins, Inflammation.

REFERENCE

1. **S.S. Purohit, Kaknani, Saleja** Pharmaceutical Biotechnology.
2. **Mary J. Myuk, Richard A. Hoarey, Pamala Lippinwitt Williams** Pharmacology edition.
3. **H.P. Rang, M.M. Pale, J.M. Moore** , Churchill Livingston. Pharmacology.
4. **Page, Curtis, Sulter, Walker, Halfman** Integrated pharmacology. Mosby Publishing co.
5. **N. Murugesh**, A concise Text Book of Pharmacology. Sixth edition. Sathya Publishers, Madurai.
6. **R.C. Dubey**, A Text Book of Biotechnology. S.Chand & Co Ltd, New Delhi.

PRACTICAL VIII

LAB IN ANIMAL BIOTECHNOLOGY

1. Preparation of animal cell culture media.
2. Preparation & sterilization of balanced salt solution and DBSS.
3. Disaggregation of tissues – trypsinization.
4. Culture of chick embryo fibroblast (monolayer).
5. Single cell suspension culture.
6. Viability test and cell counting.
7. Inoculation of virus and observation.
8. Applications of CO_2 incubator & inverted microscope.
9. Membrane filter.
10. Isolation of genetic DNA from animal tissue.

PRACTICAL IX

LAB IN BIOPROCESS TECHNOLOGY AND ENZYMOLOGY

1. Enumeration of Microorganisms from bread.
2. Determination of TDT & TDP.
3. Analysis of Aflatoxin by TLC.
4. Qualitative analysis of milk.
5. Isolation of industrially important microorganism.
6. Production & estimation of biomass (SCP), dry weight & Wet weight methods.
7. Production of wine.
8. Immobilization of yeast cells & enzymes.
9. Alcohol production & estimation.
10. Production & estimation of citric acid.

ELECTIVE I

STEM CELL BIOLOGY AND TISSUE ENGINEERING

Unit I

Introduction to stem cell, definition, classification and source. Development stage, property of stem cell- pluripotency, totipotency. Types of stem cell-embryonic and adult stem cell

Unit II

Germ line stem cells Prostate and Mammary SCs, Induced pluripotent Stem cells, Muscle and Cardiac stem cells, Neuro stem cells, Telomeres in stem cell biology. Stem cell plasticity.

Unit III

Stem cell Techniques- Blastomere extraction, Nuclear transfer, Therapeutic cloning, Reprogramming of stem cells, Transplantation, Stem cell therapy, Stem cell politics and ethics. Stem cell bank.

Unit IV

Principles of tissue engineering, cell matrix and cell-cell interactions. Biomaterials in tissue engineering. Tissue microfabrication.

Unit V

Cells and tissue characterization, Musculo-skeletal tissue engineering, Cardiovascular tissue engineering, Neural tissue engineering and its Clinical applications.

Additional resources and recommended reading:

1. **Lodish** et al., 2008. Molecular Cell Biology 6th Ed., W.H. Freeman & Co..
2. Christopher Thomas Scott. Stem Cell Now.
3. Cell Information Home Page. In Stem Cell Information [World Wide Web site]. Bethesda.
4. MD: National Institutes of Health, U.S. Department of Health and Human Services. Available at <http://stemcells.nih.gov/index>.
5. New Scientist, article 'Instant Expert: Stem Cells': <http://www.newscientist.com/article/dn9982-instant-expert-stem-cells.html.page=1>
6. Kursadtarksen. 2002. Embryonic stem cell protocol. 2 edition. humana press.
7. Potten, C.S., 2006 stem cell elseiever

ELECTIVE I
CLINICAL BIOTECHNOLOGY

UNIT I

Classification of genetic diseases. Chromosomal disorders-numerical disorders e.g. trisomers and monosomes, structural disorders e.g. deletions, duplications, translocations and inversions, chromosomal instability syndromes.

UNIT II

Gene controlled diseases-autosomal and X-linked disorder, mitochondrial disorders, Fragile X syndrome, myotonic dystrophy. Mitochondrial diseases. Microarray technology application in diseases.

UNIT III

Huntington's disease- sickle cell diseases, AAT (alpha-1 antitrypsin deficiency), Alzheimers disease, cystic fibrosis, infection of nervous system.

UNIT IV

Clinical management & metabolic manipulation – PKU, Familial hyper cholesterolemia, Rickets, ADA, Congenital hypothyroidism.

UNIT V

Clinical Enzymes: Enzymes as thrombolytic agents, anti inflammatory agents, Streptokinase & Asparaginase. Catalytic antibodies. Enzyme Engineering- Designer enzymes.

REFERENCE

1. **Betty Forbes, Danial SAHM Alics Weinfeld, Bailey** 2007. Scott's diagnostic microbiology, 12th edition Mosby.
2. **Gerald collee, J, Andrew G. Fraser, Barri P Marmion, Mackie and McCartney's** Pratical medical microbiology, elesiver 2006.
3. **Elmer W Koneman et al., Koneman's** 2005. Color Atlas and Textbook of diagnostic microbiology, 6th edition. Lippincott Williams and Wilkins

ELECTIVE II

ENDOCRINOLOGY

UNIT I:

Hormones: definition, classification, biosynthesis and degradation. Mechanism of hormone action, class I and II hormone receptors, steroids. Feedback regulation of hormones.

UNIT II:

Hypothalamus and pituitary hormones: Hypothalamic releasing factors vasopressin, oxytocin; biosynthesis, secretion, transport, regulation and biological effects of growth hormones. FSH, LH, TSH, ACTH and prolactin.

UNIT III:

Thyroid hormones: biosynthesis, secretion, transport, regulation and biological actions. Hypo and hyper thyroidism, antithyroid agents, role of parathyroid hormones, calcitriol, calcium and phosphorous homeostasis. Hypo and hyperparathyroidism.

UNIT IV:

Pancreatic hormones: Islets of Langerhans, cell types. Insulin and glucagon: biosynthesis, mechanism of action and biological effects. Hormonal action of somatostatin and pancreatic polypeptide.

Adrenal hormones: biosynthesis, secretion, transport, mechanism of action and excretion of glucocorticoids, mineralocorticoids, adrenal medullary hormones – epinephrine and nor epinephrine, steroid hormones – androgens and estrogens.

UNIT V:

Structure and function of the brain, central nervous system, peripheral and autonomic nervous system. Cells of nervous system: Neurons, Glial cells, Oligoendocytes and Schwann cells. Neurotransmitters – synthesis, storage, release, uptake, degradation and action of neurotransmitters. Acetyl choline, GABA serotonin, dopamine, glutamate, aspartate, nitrous oxide. Mechanism of action of anesthetics, analgesics, hallucinogens, depressants, stimulants and toxins on the nervous system, addiction and drug abuse.

REFERENCE

1. **Donald Voet , Judith G. Voet , Charlott W. Pratt.** Fundamentals of Biochemistry, upgrade edition. John Willey & Sons. Inc,

2. **Edward Staunton West , Wilbert R. Todd , Howard S. Mason , John T. Van Bruggen**,1996.Textbook of Biochemistry, 4 th edition , Oxford & IBH publishing Co.Pvt.Ltd.,
3. **J.L. Jain**, 2004. Fundamentals of Biochemistry, S. Chand publications.
4. **Agarwal**, 1999. Biochemistry, GOBL publications.
5. **David L. Nelson , Michael M.Cox, Lehninger** Principles of Biochemistry, 4th edition, W.H. Freeman and company.
6. **Lubert Stryer**, 1995. Biochemistry, 4th edition, W.H. Freeman & Co.,
7. Concepts in Experimental Biochemistry , 1999, Brooks / Cole Publishing company.
8. **White Handler Smith**, Mammalian Biochemistry .
9. **Francis Sreenspan, Gordon J. Strewler Prentice**, 1997. Basic & Clinical Endocrinology – Hall International Inc. 5.th ed.

ELECTIVE II
FOOD BIOTECHNOLOGY

UNIT I

Microorganisms associated with food - bacteria, fungi & yeast. Enzymes in food preparation. Food contaminations. Food preservation. Food carcinogens & mutagen (N – nitrosamines, Acrylamide & their mode of action)

UNIT II

Food borne diseases. Food Allergens. Antioxidants. Food colors (natural & artificial food colourants). Food flavoring agents. Properties & function of Emulsifiers & Stabilizers in food. Food Sweeteners – Saccharine, Acesulfane, Aspartame & Sucrolose).

UNIT III:

General principle, plant design, construction, functionality of building, Plant layout. Pest proofing / fumigation methods. Water supply to food processing unit.

UNIT IV:

Food engineering operations: Characteristics of food raw materials, preparative operations in food industry, cleaning of food raw materials, sorting of foods, grading of foods. Sensory evaluation of food quality, quality factors for consumer safety. FSSA, HACCP FDA.

UNIT V:

Cleaning and sanitation of process plants. Classification & Characterization of waste from food industry. Treatment methods for solid & liquid waste. Genetically Modified Food – Bovine somatotropin, alpha lactalbumin & lactoferrin in milk, Edible vaccine (Cholera vaccine –potatoes & Hepatitis B vaccine - maize).

REFERENCES:

- 1. B.Siva** 2011. Food Processing & Preservation –PHI Learning Pvt Ltd.
- 2. D.G. Rao**, 2010. Fundamentals of Food Engineering –PHI Learning Pvt Ltd.
- 3. Narang**, Food Microbiology
- 4. Michael P. Doyle, Larry. R.** Food Microbiology – Fundamentals & Frontiers
- 5. Frazier**, Food Microbiology
- 6. Yiu Hui & G. Khachatourians**, Food Biotechnology
- 7. Bibek, Laramie & Bhunia**, Fundamentals of Food Microbiology, CRC Press.

NON MAJOR ELECTIVE COURSE I
CONCEPTS OF BIOTECHNOLOGY

UNIT I

Scope of Biotechnology. History of Biotechnology: Conventional and Modern Biotechnology – Biotech industries. Biotechnology Tree. Strategies of gene cloning.

UNIT II

Tools used in gene cloning – Restriction endonucleases – Types – Features. Ligases – Linkers, adaptors and homopolymer tails. Modifying enzymes.

UNIT III

Vectors – Properties of good Vector .Constructed plasmids- pBR322. Cosmid vectors, Animal vectors- SV40. Plant vectors- Ti derivatives.

UNIT IV

Introduction of genes – Vector mode – transformation and transfection. Vector less mode – Biolistics, Electroporation, Microinjection.

UNIT V

Selection of recombinants. Marker techniques- PCR, RFLP, RAPD and blotting techniques

REFERENCES:

1. **Principles of Gene Manipulation Old & Primrose**, (1989), 3rd edition
 2. **Biotechnology**, Satyanarayana. U, (2008), Books and Allied (p) Ltd
 3. **Biotechnology and Genomics**, Gupta P.K: (2004) Rastogi publication.
 4. **Gene cloning and DNA analysis** Brown, T.A (1996),. Blackwell science, Osney Mead, Oxford.
 5. **A text book of Biotechnology**, Dubey, R. C. (2007), S.Chand & Company Ltd. New Delhi.
 6. **Biotechnology**, Singh, B. D (2004). Kalyani Publishers, New Delhi
- Note: This paper is offered for other major students.

NON MAJOR ELECTIVE- II
BIOTECHNOLOGY FOR SOCIETY

UNIT I

Sericulture. Aquaculture, Apiculture. Vermiculture. Mushroom technology.

UNIT II

Biofertilizers. Biopesticides. Biorepellants. Pest control and management. Biomass (SCP). Bioplastics. Bioweapons.

UNIT III

Bio dyes, Bio fuels – Biodiesel & Biogas. Bioindicators. Biodegradation- Role of GMO's.

UNIT IV

Production of Penicillin, Recombinant Vaccines (HBV). Recombinant Insulin. Plantibodies. Vaccines in animal cells, Gene therapy.

UNIT V

Transgenic animals and their applications- Mice, Sheep and Fish. Transgenic plants and their applications- BT Cotton, Flavr-Savr tomato and Golden rice.

REFERENCES:

1. **Animal Biotechnology** ,M .M. Ranga, (2000) , Agrobios (India),
2. **Introduction to Plant Biotechnology** Chawla,(2003) (2nd edn) Oxford and IBH publishers
3. **Biotechnology**, Satyanarayana. U, (2008), Books and Allied (p) Ltd.
4. **Industrial Microbiology** – A.H. Patel, MacMillan Publishers, 2005
5. **A text book of Biotechnology**, R. C. Dubey, (2001), Rajendra Printer. New Delhi.
6. **Environmental Biotechnology**. A.K.Chatterji. Third edition. PHI Learning Pvt Ltd. New Delhi.