

# A .V.C. COLLEGE (AUTONOMOUS)

MANNAMPANDAL, MAYILADUTHURAI

## B.Sc., BIOTECHNOLOGY - Course Structure under CBCS

(For the candidates admitted from the academic year 2018-2019 onwards)

SEM.	TITLE OF THE PAPERS	HRS	CREDITS	EXAM HOURS	TOTAL CREDITS
<b>I</b>	LC -I	6	3	3	20
	ELC -I	6	3	3	
	CC -I - CELL BIOLOGY	5	5	3	
	CC -II - PRACTICAL I	2	2	4	
	AC -I - GENERAL MICROBIOLOGY	7	4	3	
	AC -II - PRACTICAL -I	2	1	3	
	VBC - HUMAN VALUE BASED COURSE	2	2	3	
<b>II</b>	LC -II	6	3	3	20
	ELC -II	6	3	3	
	CC -III - BIOCHEMISTRY	5	5	3	
	CC -IV - PRACTICAL II	2	2	4	
	AC -III - IMMUNOLOGY AND IMMUNOTECHNOLOGY	7	4	3	
	AC -IV - PRACTICAL-II	2	1	3	
	ES - ENVIRONMENTAL STUDIES	2	2	3	
<b>III</b>	LC -III	6	3	3	20
	ELC -III	6	3	3	
	CC -V - MOLECULAR BIOLOGY AND GENETICS	5	5	3	
	CC -VI - PRACTICAL III	2	2	4	
	AC -V - BIOINFORMATICS -I	7	4	3	
	AC -VI - PRACTICAL-III	2	1	3	
	SBC -I - BIOINSTRUMENTATION	2	2	3	
<b>IV</b>	LC -IV	6	3	3	20
	ELC -IV	6	3	3	
	CC -VII - GENETIC ENGINEERING	6	6	3	
	CC -VIII - PRACTICAL IV	2	2	4	
	AC -VII - BIOINFORMATICS -II	7	4	3	
	AC -VIII - PRACTICAL -IV	2	1	3	
	EA -I - GENDER STUDIES	1	1	3	
<b>V</b>	CC -IX - MICROBIAL & BIOPROCESS TECHNOLOGY	5	5	3	30
	CC -X - PLANT BIOTECHNOLOGY	5	5	3	
	CC -XI - ANIMAL BIOTECHNOLOGY	4	4	3	
	CC -XII - PRACTICAL V	5	5	3	
	EC -I - BIOSTATISTICS	5	5	4	
	NMEC-I - MOLECULAR TECHNIQUES	2	2	3	
	SBC -II - BIOPHYSICAL & BIOMEDICAL TECHNIQUES	2	2	3	
	SSD - SOFT SKILL DEVELOPMENT	2	2	3	
<b>VI</b>	CC -XIII - MEDICAL BIOTECHNOLOGY	4	4	3	29
	CC -XIV - ENVIRONMENTAL BIOTECHNOLOGY	4	4	3	
	CC -XV - AGRICULTURAL BIOTECHNOLOGY	4	4	3	
	CC -XVI - PRACTICAL VI	6	5	4	
	EC -II - DIVERSITY OF LIFE FORMS	4	4	3	
	EC -III - BIOPROSPECTING	4	4	3	
	NMEC -II - BIOTECHNOLOGY FOR HUMAN WELFARE	2	2	3	
	SBC -III - MOLECULAR DIAGNOSTICS	2	2	3	
	EA -II	-	1		
<b>Total</b>					<b>140</b>

**A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL**  
**B.Sc., BIOTECHNOLOGY**  
**SEMESTER – I**

**CC – I – CELL BIOLOGY**

**UNIT I Origin of a cell**

Introduction - History and scope of cell biology-cell theory-protoplasm theory- germ plasm theory- Organisational theory- cell biology in the 20<sup>th</sup> century. Cell – size of cell – shape of cell – protoplasm – cytoplasm. Cell as a Basic unit; Classification of cell types; Organization of plant and animals cells; Structural comparison of Microbial, Plant and Animal cells.

**UNIT II Components of a cell**

Ultra structure of cells; structure and function of Cell wall, Cell membrane, Models of Plasma membrane, Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplast, Endosymbiotic theory, Ribosomes, Lysosomes, Peroxisomes, Nucleus Vacuole, Cytosol and Cytoskeletal structures (Microtubules, Microfilaments and Intermediate filaments). Extracellular matrix.

**UNIT III Cytogenetics**

Chromosomes: Discovery, morphology, chemical composition, structural organization of chromatids, centromere, telomere, chromatin, nucleosome organization, euchromatin and heterochromatin, special chromosomes (polytene, lampbrush chromosomes) chromosomal aberrations. Dosage compensation. Genomic imprinting

**UNIT IV Life of a cell**

Cell division and Cell cycle: mitosis and meiosis, interphase, comparison of mitosis and meiosis, cell cycle regulation. Cell differentiation: difference between normal and cancer cells. Tumour suppressor genes. Cell senescence and programmed cell death.

**UNIT V Techniques of Cell Biology**

Cell-Cell adhesion, Cell signaling- mechanism and types. Methods in cell biology: Microscopy - Light microscope, TEM, SEM, Use of radioisotopes; Staining procedures. Karyotyping – Giemsa staining and banding. Chromosome painting.

**Text Book:**

1. Gupta, P.K. 2004. Cell and Molecular Biology. Third Edition. Rastogi Publications.
2. Verma, P.S and Agarwal, V.K. 1993. A Textbook of cytology. S. Chand & Co, New Delhi.

**Reference Books:**

1. A Text Book of Cell Biology- Aminul Islam. Books and Allied (P) Ltd, Kolkatta. First edition.2011.
2. Cell Biology- Powar.C.B, Himalaya publishing house, New Delhi.1983.
3. Cell Biology - - DeRoberties, Blaze publishers & Distributors Pvt.Ltd., NewDelhi.
4. Fundamentals of Cytology – Sharp, Mc Graw Hill Company.
5. Cytology – Wilson & Marrison, reinform Publications.
6. Cell and Molecular biology, concepts and experiments- Gerald Karp; 4 the Edition.

## **CC – II – PRACTICAL - I**

1. Use of Micrometer and calibration, measurement of onion epidermal cells and yeast.
2. Cell division: Mitotic and meiotic studies in grasshopper testes and onion root tips.
3. Identification and Karyotyping of Chromosomes.
4. Identification of cell organelles.
5. Study of cyclosis in cells of suitable plant material.
6. Preparation of smear of anther and identification in meiosis.
7. Examination of electron micrograph of eukaryotic cells with special reference to organelles.
8. Histochemical localization of starch, protein, lipid and lignin.

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**SEMESTER – II**  
**CC- III - BIOCHEMISTRY**

**UNIT I: Structure of atoms and molecules**

Structure of atoms and molecules. Chemical bonds, covalent bonding and hydrophobic interactions. Water- properties. Concepts of pH. Acids, Bases and Buffers: Theory of acids and bases; importance of pH in physiological activities; *In vitro* buffer systems in animals. Biomolecular hierarchy: Macromolecules

**UNIT II: Carbohydrates**

Carbohydrates: Occurrence, Definition, classification & properties of carbohydrates, epimers, anomers Carbohydrate metabolism. Glycogen synthesis and Glycogenolysis, Gluconeogenesis, TCA cycle, Pyruvate oxidation, Electron transport chain, Light and dark reaction.

**UNIT III: Amino acids and peptides**

Amino acids and peptides. Definition, amino acids as ampholytes. Structure and classification of amino acids based on chemical nature, Essential amino acids, Protein- classification, Structure, properties and Urea cycle.

**UNIT IV: Lipids**

Lipids- Structure, classification, chemistry and properties. Fatty acids- Essential fatty acids. Biosynthesis of fatty acids- triglycerides, phospholipids and cholesterol. Structure and classification of Glycolipids and lipoproteins.

**UNIT V: Nucleic Acids and Vitamins**

Nucleic Acids : Purine and pyrimidine bases, Nucleosides, Nucleotides Structure, types of DNA & RNA. double helix: A, B and Z forms. Vitamins: Definition, Classification and sources, Structure and physiological functions; Water soluble vitamins and Fat soluble vitamins.

**TEXT BOOKS**

1. U Satyanarayana. Biochemistry. Elsevier Health Sciences. 2014. 812 pages.
2. J.L. Jain. Fundamentals of Biochemistry. S. Chand Limited, 2005 - 1230 pages

**REFERENCES:**

1. L.Stryer, "**Biochemistry**", Freeman & Co., New York, 1994.
2. A.L.Lehninger, D.L. Nelson & M.M.Cox, "**Principles of Biochemistry**", Worth Publishers, New York, 1993.
3. G.Zubay, "**Biochemistry**", Macmillan publishing Co., New York, 1998.
4. Voet & Voet, "**Fundamentals of Biochemistry**", John Willey & Sons, 2010

## **CC - IV - PRACTICAL II – BIOCHEMISTRY LAB**

1. General guidelines for working in biochemistry lab (theory).
2. Units of volume, weight, density and concentration measurements and their range in biological measurements. (demo)
3. Determination of pH in different acidic and alkaline solutions.
4. Preparation of buffer – titration of a weak acid and a weak base.
5. Qualitative analysis of Carbohydrates by Anthrone Test and Benedict's Test.
6. Qualitative analysis of Amino acids by Ninhydrin Test.
7. Qualitative analysis of Lipids. Solubility Test.
8. Estimation of carbohydrates by Anthrone Test.
9. Estimation of Reducing sugar by DNS method.
10. Estimation of Protein estimation by Lowry's method
11. Estimation of Protein estimation by Bradford method.
12. Separation of amino acids by paper chromatography.
13. Separation of Lipids by Thin Layer chromatography

**CC-V-MOLECULAR BIOLOGY AND GENETICS**

**Unit I : Introduction to molecular biology and genetics**

History and scope of molecular biology- Discovery of Nucleic acids- Experiments for nucleic acid (DNA and RNA )as the genetic material-Griffith's experiment, Avery, Macleod and McCarty Experiment and Hershey and Chase Experiment. Forms of nucleic acids. The genomes of bacteria ,viruses .gene transfer in microorganisms -Conjugation , Transformation and Transduction

**Unit II : Organization of genomes**

Genome Organization – Prokaryote and eukaryote - components of eukaryotic chromatin-chromatin and chromosome structure - DNA – supercoiling - linking number - satellite DNA - possible functions - cot curve - C-value paradox.

**Unit III : DNA replication and repair**

DNA replication- prokaryotic and eukaryotic DNA replication, mechanism of replication. Enzymes and proteins in DNA replication. Inhibitors of DNA replication. DNA damage-Mutation and its types. DNA repair- Mismatch, Base excision, Nucleotide- excision and direct repair. DNA recombination -Homologous ,site specific and DNA transposition

**Unit IV : Transcription Process**

Transcription- prokaryotic and eukaryotic transcription- RNA polymerases-regulatory elements-mechanism of transcription regulation- Transcription termination. Post transcriptional modification-5' cap and 3' polyadenylation - Types of splicing- editing- nuclear export of mRNA. Inhibitors of transcription- Actinomycin D, Rifampicin, A-Amanitin. Operon concept- lac, trp, Ara operons.

**UNIT V: Translation Process**

Translation – Properties of Genetic code- Prokaryotic and Eukaryotic translation- Mechanism of Translational machinery-initiation, Elongation and termination- Regulation of translation. Post-translational modifications and protein processing. Inhibitors of translation-Streptomycin, Erythromycin, Chloramphenicol.

**Textbook:**

1. P.S.Verma, V.K. Agarwal. “**Textbook of Genetics**”. S.Chand Company (P) Ltd, 2009.
2. A. Paul. “**Textbook of Molecular Biology**”. Books and allied (P) Ltd, 2011.

**References**

1. De Robertis, E.D.P. and De Robertis, E.M.F. **Cell and Molecular Biology**. 8<sup>th</sup> ed. B.I. Waverly (P) Ltd, New Delhi, 1995.
2. Edmund W.S, Dunn L. **Principles of genetics**. Tata McGraw Hill publishers 5<sup>th</sup> ed 2002.
3. Karp, G. **Cell and Molecular Biology-Concepts and experiments**. 2<sup>nd</sup> ed. Harris, D (ed.), John Wiley & sons. New York, 1999.
4. Kleinsmith, L.J. & Kish, V.M. **Principles of Cell and Molecular Biology**. 2<sup>nd</sup> ed. Melaughin, S, Trost, K, Mac Elree, E. (Eds.). Harper Collins Publishers. New York, 1995.
5. Alberts B, Bray D, Lewis J, Raff M, Roberts K, Watson J.D. **Molecular Biology of the cell**. 3<sup>rd</sup> ed., IGarland Publishing, Inc., New York, 1994.

**A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL-609305**  
**B.Sc., BIOTECHNOLOGY**  
**SEMESTER – III**  
**CC-VI-PRACTICAL III**

- 1) Equipments use in molecular biology laboratory- General practice and maintenance (Demo only).
- 2) Effect of selected antibiotics on DNA synthesis.
- 3) Effect of selected antibiotics on protein synthesis.
- 4) Total genomic DNA isolation from bacterial source.
- 5) Total genomic DNA isolation from animal tissue
- 6) Total genomic DNA isolation from plant material.
- 7) Effect of physical mutagen on bacterial growth.
- 8) DNA estimation by diphenylamine –colorimetric method
- 9) RNA estimation by Orcinol method
- 10) Total genomic RNA isolation from bacterial source.
- 11) Agarose gel electrophoresis
- 12) Mutagenesis in bacteria : The Ames test.

**Unit - I:**

Acid, Base, Buffers: Definition and theories proposed for acids and bases, titration curves of amino acids, Henderson- Hasselbalch equation and its application, pH meter – Principle and applications.

**Unit – II:**

Microscopy: Basic principle and applications Light- compound -Phase contrast – Dark Field – Fluorescence , Microscope , Electron (Transmission Electron Microscope and Scanning Electron Microscope ) confocal Microscopy.

**Unit- III:**

Centrifugation; basic principle and its types: Preparative centrifugation, Differential and density gradient analytical centrifugation and its applications .

Electrophoresis :basic principles and its types -paper and gel – Agarose and PAGE.

**Unit – IV:**

Chromatography: Basic Principles, types of chromatography - Paper, Thin layer, Column, Gel permeation and its applications. Principle and applications of Ion Exchange chromatography, Affinity Chromatography, High Performance Liquid chromatography, Gas Liquid chromatography.

**Unit – V:**

Radio activity -types of radio isotopes – half life -units of radioactivity -uses of radioisotopes in life sciences and biotechnology – detection and measurement and techniques - liquid scintillation counting – solid state counting Geiger-Muller counter – Radiation hazard and laboratory handling method.

**Text book:**

1. L.Veerakumari. “**Textbook of Bioinstrumentation**”. MJP publishers-1st edition, 2011.
2. M.H.Fulekar, B.Pandey. “**Textbook of Bioinstrumentation**”. IK International pvt Ltd-New Delhi, 2013.

**References:**

Brawer, I.M, Perce, A.J. “**Experimental techniques in Biochemistry**”, prentice hall foundation, New York, 1974.

Morris and Morris. “**Separation methods in Biochemistry**”. Pitman London, 1963.

Willard and Merit. “**Instrumental Methods and Analysis**”. John Wiley & Sons, 6<sup>th</sup> edn, 1996.

Ewing GW. “**Instrumental methods of chemical analysis**”. Mc Graw Hill Book Company, 1989.

Braun, H. “**Introduction to chemicals analysis**”. McGraw Hill, 1987.

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**B.Sc., BIOTECHNOLOGY**  
**SEMESTER -IV**

**CC-VII: GENETIC ENGINEERING**

**UNIT I: Molecular tools for gene cloning:**

History, scope and recent development in genetic engineering. Enzymes used in genetic engineering DNA modification enzymes , DNA polymerase ,reverse transcriptase , polynucleotide kinase , DNA ligase , terminal deoxy nucleotidyl transferase , Alkaline phosphatase, DNase and Rnase Restrictions enzymes- endo and exo nucleases, linkers and adaptors.

**UNIT II: Vectors and gene cloning:** Vector ;Basic design and characteristics of cloning vector .Different Kinds of Vectors- Bacteria Plasmids, Phage vectors, Cosmids, , Virus vectors -Animal viral vector SV40, Adeno virus , Baculo virus vectors ; higher plants – caulimoviruses vectors ,gemini viruses vectors, Shuttle vectors and Expression vectors – YAC (*S.cerevisiae* as a model), BAC (*E.coli*).

**UNIT III: Cloning Strategies:** Molecular cloning, Methods of introducing foreign DNA into host - Construction of genomic libraries and cDNA libraries, shotgun cloning selection and screening of recombinant clones ; methods based on nucleic acid hybridization – colony hybridization , plaque lift hybridization Probe construction and labeling .

**UNIT IV: Analysis of gene expression:** Analysis of recombinant DNA,DNA microarray. DNA-sequencing . Mutagenesis: altered expression and engineering genes. Site directed mutagenesis, PCR , types- (real time PCR , reverse transcriptase PCR , multiplex and nested PCR , Analysis of amplified products: Southern blot, Northern blot, Western blot and Southwestern blot, Ligase chain reaction.

**UNIT V: Applications of Genetic engineering:**engineering microbes for the production of therapeutic proteins – insulin and growth hormones . Concept of gene knockout technique. Forensic sciences – RAPD , RFLP , AFLP , SNP and DNA finger printing .

**Text books:**

1. Gene Cloning and DNA Analysis: An Introduction - 6th Edition - T. A. Brown - John Wiley & Sons
2. Principles of Gene Manipulation and Genomics – 7th Edition – Sandy B. Primrose, Richard Twyman – Blackwell Publishing

**REFERENCES:**

1. James D.Watson, Recombinant DNA Technology second edition, scientific American books (2001).
2. Stephen R.Bolsover, Jeremy S.Hyams, Steve jones, Elizabeth A.Shephard, Huge A.White, from Genes to cells, WILEY (1997).
3. P.Joshi, 'Genetic engineering', Agrobios (India) (2002)
4. Molecular Biotechnology: Principles and Applications of Recombinant DNA - 4th Edition - Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten - ASM Press.
5. R.C.Dubey, A text book of biotechnology. S.Chand and co. Ltd, New Delhi.
6. U.Satyanarayana, A text book of biotechnology, Books and allied (P) Ltd(2008).

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**B.SC., BIOTECHNOLOGY**  
**SEMESTER-IV**

**CCVIII MAJOR PARTICAL - IV**

1. Isolation of DNA from plant tissue.
2. Isolation of DNA from animal tissues.
3. Isolation of plasmid DNA from Bacteria.
4. Isolation of RNA from yeast
5. Agarose gel electrophoresis.
6. SDS-PAGE.
7. Transformations of Recombinants in *E.coli* (Preparation of Competent cells).
8. Isolation of antibiotic resistant mutant.
9. PCR (Demonstration).
10. RFLP (Demonstration).
11. RAPD
12. Restriction and digestion
13. Ligation

**A.V.C. COLLEGE (AUTONOMOUS)  
DEPARTMENT OF BIOTECHNOLOGY  
MANNAMPANDAL-609 305, MAYILADUTHURAI  
III-B.SC., SEMESTER-V**

**TITLE OF THE PAPER: CC-IX MICROBIAL AND BIOPROCESS TECHNOLOGY (2018-19 onwards)**

**Subject Code:**

**No. of Hours:**

**No. of Credits:**

**Learning Objectives:**

The course deals with the various aspects of applied and industrial biotechnology thus offers a broad-spectrum exposure to such a rapidly advancing field as biotechnology.

**Programme Specific Outcomes:**

- PSO1: To make our students competent in the field of biotechnology and its allied areas.
- PSO2: To inculcate the capability to work as entrepreneurs .
- PSO3: To equip the students to pursue higher education and research in reputed institutes.
- PSO4: To develop a working knowledge of biotechnology product and processes.

**Course Outcomes:**

- CO1: Select and optimise media for maximum production of microbial metabolites
- CO2: Design bioreactors and control necessary for maximising production
- CO3: Designing of protocols for strain improvement and separation of molecules after fermentation process.
- CO4: Know the principles involving food preservation via fermentation processes.
- CO5: Describe the basic principles and practices in production of various industrial products.

**UNIT: I Overview of Bioprocessing**

Introduction to Bioprocess. History, basic principle, components of fermentation technology, isolation, screening, preservation and maintenance of industrially useful microorganisms. Strain improvement. Media formulation. Types of fermentation– submerged and solidstate fermentation.

**UNIT II: Upstream Bioprocessing**

Sterilization of media and air. Structure and anatomy of fermenter, Fermentor and its types- Batch, Continuous stirred tank reactor(CSTR), Air driven reactors, Fluidized and Packed bed reactors. Physical, Chemical and Biological parameters of Bioprocess and its Measurement.

**UNIT III: Downstream Bioprocessing**

Downstream Processing: Introduction, removal of microbial cells and solid matter, foam separation, precipitation, filtration, centrifugation, cell disruptions, Extraction (solvent, aqueous two-phase, super critical), Purification – Chromatography and Ultrafiltration. Drying .

**UNIT IV: Food Bioprocessing**

Production of milk products- Cheese, Yoghurt, Production of bakery product- Bread. Production of fermented beverages- Beer, Wine and Vinegar. Microbial biomass production: Baker's yeast, SCP production, Mushroom cultivation.

**UNIT V: Industrial Bioprocessing**

Biofuel production – production of methane, alcohol, gasohol and biodiesel. Production of amino acids (Glutamic acid, lysine), organic acids (Citric acid, acetic acid, gluconic acid) and enzymes (Amylase, Protease, Pectinase). Techniques of enzyme immobilization and its applications.

**References**

**Text book:**

1. Kalaichelvan, P. T, and I. Arul Pandi. Bioprocess Technology. 1st ed. Chennai: MJP Pub., 2007.
2. Principle of Fermentation Technology, Stanbury, P.F., and Whitaker, A., Pergammon, Press, Oxford.

**Reference Books:**

1. Manual of industrial microbiology and Biotechnology. Demain, A.L., Solomon, and J.J 1996. ASM Press.
2. Bio chemical Engineering, Alba, S., Humphrey, A.E. and Millis, N.F. Univ. of Tokyo Press, Tokyo.
3. Industrial Microbiology. Reed, C. Prescott and Dann`s. Macmillen Publishers.1982.
4. Microbiology (1961) Alexander.M.,John Wiley & Sons New York.
5. Molecular Biotechnology (2001) Glick BR and Pasteric Jack.J,ASM press London.

**A.V.C. College (Autonomous)**  
**Department of Biotechnology**  
**Mannampandal-609 305, Mayiladuthurai**  
**III-B.Sc., Semester-V**

**Title of the Paper: CC-X **PLANT BIOTECHNOLOGY** (2018-19 onwards)**

**Learning Objectives:**

This course is planned to give basic knowledge about plant tissue culture, transgenesis, genetic modifications in agriculture.

**Programme Specific Outcomes:**

- PSO1: To make our students competent in the field of biotechnology and its allied areas.
- PSO2: To inculcate the capability to work as entrepreneurs .
- PSO3: To equip the students to pursue higher education and research in reputed institutes .
- PSO4: To develop a working knowledge of biotechnology product and processes.

**Course Outcomes:**

- CO1: Determine the factors influencing plant cell differentiation and procedures for the maintenance of sterile condition for plant growth.
- CO2: Be able to describe the gene manipulation methods in plant cells.
- CO3: Be able to describe gene transfer technologies for plants.
- CO4: describe methods for obtaining and application of genetically modified plants.
- CO5: Be able to describe the molecular methods in plant biotechnology.

**Unit I Basics of Plant Tissue culture**

Benefits and History of Plant Tissue Culture, Types of culture, and techniques-Plant Tissue Culture Media. Embryogenesis and Organogenesis, production of haploids, Somaclonal variations and its applications. Micropropagation, Embryo culture and its applications, Cryopreservation.

**Unit II Protoplast – Culture & Genetic Manipulation**

Introduction to protoplast isolation, culture and regeneration, methods of fusing protoplasts, somatic hybridization, cybrids. Manipulation of Protoplast and tissue culture for genetic manipulation in plants.

**Unit III Plant Transgenesis**

Direct gene transfer methods – Vectorless-electroporation, microinjection and particle bombardment, Calcium Phosphate coprecipitation. Agrobacterium mediated gene transfer, Agrobacterium based vectors (Ti plasmids and Ri plasmids), viral vectors (Caulimovirus and Geminivirus) and their applications. Characterization of transgenics, screenable and selectable markers. Marker free methodologies and gene targeting.

**Unit IV Transgenic plants**

Transgenic plants with biotic and abiotic stress tolerance, Transgenic plants as bioreactors. Genetically modified foods – applications, ecological impact of transgenic plants. Genetic modification in food industry– background, history, controversies over risks, application, future applications.

**Unit V Plant Molecular Biology Techniques**

DNA molecular markers :Principle, type and applications: restriction fragment length polymorphism (RFLP), amplified fragment length polymorphism (AFLP), randomly amplified polymorphic DNA sequences (RAPD), Simple Sequence Repeats (SSR), Single Nucleotide Polymorphism (SNP).

**Text Book:**

1. Gupta, P.K. Rastogi and Co. Meerut. 1996. Elements of Biotechnology. 1996.
2. Ramawat K.G and Shaily Goyal. 2009. Comprehensive Biotechnology.

**Reference Books :**

1. Slater A., Scott N.W. and Fowler, M.R. 2008. Plant Biotechnology - The genetic manipulation of plants. Oxford University press, USA.
2. Bernard R Glick. and J.J. Pasternak. 2002. Molecular biotechnology, Principle and Applications of Recombinant DNA. ASM Press, Washington, D.C.
3. Gamborg O.L and Philips, G.C. 1995. Plant Cell, Tissue and organ culture - Fundamental methods. Narosa Publishing House, New Delhi.
4. Hammond J. Mc Garvey, P., and Yusibov, V. (Eds.) 2000. Plant Biotechnology. Springer.
5. Old, R.W and S.B. Primrose. 1996. Principles of Gene Manipulation: An Introduction to Genetic Engineering. Blackwell Scientific Publications, Oxford.

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**MANNAMPANDAL-609 305, MAYILADUTHURAI**  
**III-B.SC., SEMESTER-V**  
**TITLE OF THE PAPER: CC-XI ANIMAL BIOTECHNOLOGY**  
**(2018-19 onwards)**

**Learning Objectives:**

The course deals with the various aspect like embryology, animal cell culture, r-DNA technology in production of transgenic animals and application of molecular markers in disease diagnosis.

**Programme Specific Outcomes:**

PSO1: To make our students competent in the field of biotechnology and its allied areas.

PSO2: To inculcate the capability to work as entrepreneurs .

PSO3: To equip the students to pursue higher education and research in reputed institutes.

PSO4: To develop a working knowledge of biotechnology product and processes.

**Course Outcomes:**

CO1: To learn the basics of embryology and advanced reproductive biology techniques like IVF and embryo transfer.

CO2: To know about media and culture of animal cell lines.

CO3: To get basic idea about genetic manipulation and techniques used for production of transgenic animals.

CO4: Know the applications of transgenics in production of human welfare products and ethical issues in animal cloning.

CO5: To learn the importance of molecular markers in disease diagnosis.

**UNIT I Embryology**

Gametogenesis and fertilization in animals, – Artificial Fertilization methods (IVF, IUF, ICSI) and embryo transfer, Superovulation, Collection and preservation of embryo, culture of embryos, culture of embryonic stem cells and its applications.

**UNIT II: Animal cell culture**

Introduction to animal cell culture. Media preparation for Animal cell culture. Types of cell culture: Primary and secondary cell culture, Biology and characterization of cultured cells , Measurement of growth parameters ,cell viability and cytotoxicity, cell transformation and cell cloning , cell synchronization, senescence and apoptosis.

**UNIT III: Genetic engineering in animals**

Importance of transgenics- Biological vectors – Bacteria- Bacteriophage vectors and viral vectors. Methods of DNA transfer into animal cells. Construction of transgenic animals: Transgenic sheep, goat, chicken, fish, mice and cow.

**UNIT IV: Transgenic animals**

Production and recovery of products from transgenic animals: cytokines, Plasminogen activators, Blood clotting factors, Growth hormones, insulin, Vaccine production, Hybridoma technology. Transgenic animals – Merits and demerits -Ethical issues in animal biotechnology.

**UNIT V: Molecular Methods in Animal Biotechnology**

Mapping of human genome, Human Genome Project (HGP). RFLP, RAPD, SSR, SNP and its applications. Micro array and Gene silencing, DNA finger printing in Forensic Science. Molecular diagnosis of Genetic disorders.

**References:****Text Book**

1. B Singh, SK Gautam and MS Chauhan. 2013. Textbook of Animal Biotechnology. The Energy and Research Institute.
2. M.K. Sateesh. 2010. Biotechnology: V: (Including Animal Cell Biotechnology, Immunology and Plant Biotechnology). 2nd Edition. New Age International Pvt. Ltd. Publishers.

**Reference Books**

1. Freshney, E. D. 2000. Animal Cell Culture: A practical approach. John Wiley Pub. New York.
2. Mather, J.P. and Barnes, D. (Eds.). 1998. Animal Cell Culture Methods (Methods in Cell Biology. Vol. 57). Academic Press, London.
3. Singer, M. and P. Berg. (Ed.). 1997. Exploring Genetic Mechanisms. University Science Books, Sausalito, CA, USA.
4. E.J. Murray (Ed). 1991. Gene Transfer and Expression Protocols – Methods in Molecular Biology Vol.7. Humana Press, Totowa, NJ.

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**B.Sc., BIOTECHNOLOGY**  
**SEMESTER V**

**CCXII- PRACTICAL –V(Covering CC IX,X,XI) (2018-19 onwards)**

**Microbial and Bioprocess Technology**

1. Isolation of industrially important microorganisms.
2. Ethanol production by yeast .
3. Wine production by yeast .
4. Production of organic acids – citric acid production by solid state fermentation.
5. Test for antibiotic sensitivity of microorganisms.
6. Immobilization of yeast cell by alginate beads .
7. Production of yogurt, butter.
8. Mushroom Cultivation.

**Plant Biotechnology**

9. Tissue culture media preparation: Preparation of stock solutions of Murashige Skoog basal medium and plant growth regulator stocks.
10. Sterilization, inoculation and incubation of explants.
11. Isolation of Protoplasts.
12. Regeneration of plants using callus culture
13. Suspension Culture.

**Animal Biotechnology**

14. Preparation of media for animal cell culture
15. Isolation of Lymphocytes
16. Assay of Cell viability

**A.V.C. College (Autonomous)**  
**Department of Biotechnology**  
**Mannampandal-609 305, Mayiladuthurai**  
**III-B.Sc., Semester-V**

**Title of the Paper: EC I: **BIOSTATISTICS** (2018-19 onwards)**

**Learning Objectives:**

This course provides an introduction to a variety of statistical methods of use in describing and analyzing biological data. It includes a laboratory component in which biological data are analyzed using statistical software.

**Programme Specific Outcomes:**

- PSO1: To make our students competent in the field of biotechnology and its allied areas.
- PSO2: To inculcate the capability to work as entrepreneurs .
- PSO3: To equip the students to pursue higher education and research in reputed institutes.
- PSO4: To develop a working knowledge of biotechnology product and processes.

**Course Outcomes:**

- CO1: Explain the various methods used for data collection
- CO2: Calculate and interpret the measures of central tendency and measures of dispersion of different quantitative data sets
- CO3: Explain the methods of studying correlation and regression analysis.
- CO4: .Know basic concepts of probability and statistics.
- CO5: Identify appropriate tests to perform hypothesis testing, and interpret the outputs adequately

**Unit 1 –Introductory Biostatistics**

Statistics and Biostatistics, Aims and Applications of Biostatistics. Data Collection, Necessity of Sampling, Types of Sampling, Data Processing ,Data Summarization, Classification of Data, Differences between Classification and Tabulation, Formation of Frequency Distribution. Diagrammatic and graphical Representation of Data.

**Unit 2- Measures of Central Tendency, Dispersion**

Average, Objectives of Averages, Characteristics of an Ideal Measure of Central Tendency Types of Averages, Mean, Median, Mode, Measures of Dispersion, Range, Standard Deviation, Standard Error.

**Unit 3- Correlation and Regression**

Correlation, Types of Correlation, Methods of studying correlation, Spearman's Rank correlation coefficient, Merits and demerits of correlation analysis. Regression-Types, Methods of studying Regression, Regression lines, Regression Equations.

**Unit 4- Probability**

Important Terms and Concepts, Sample point, Sample space, Trial and Event; Classical definition of Probability, Rules of Probability (Addition Rule and Multiplication Rule) .Theoretical Distributions-Types, Random variable, Binomial Distribution, Poisson Distribution and Normal Distribution.

**Unit 5- Test of Hypothesis and Tests of Significance**

Test of Significance, Computation of Test of Significance, Test for the mean of a Normal Population, chi-square test, 't' test, F-test and their significance, analysis of variance (ANOVA)-One way and two way methods, SPSS.

**Text books:**

1. Gupta S P Statistical Methods Chand & Co, Delhi.
2. Rama Krishnan P Biostatistics Saras Pub., Nagarcoil.

**Reference books:**

1. Sokal R R & Rohlf F J Biostatistics Freeman, San Francisco
2. Snedecor G W & et al Statistical Methods East-West Press, Delhi.
3. Zar J H Biostatistical Analysis Prentice Hall, London.
4. Shiv Kumar Practical Statistics Chand & Sons, Delhi.

**A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL**  
**B.Sc., BIOTECHNOLOGY**  
**SEMESTER – V**  
**NMEC 1 : MOLECULAR TECHNIQUES (2018-19 onwards)**

**Learning Objectives:**

Students gain knowledge about isolation of genetic material and its hybridization techniques. Students will acquire knowledge on separation techniques and DNA marker technology.

**Programme Specific Outcomes:**

PSO1: To make our students competent in the field of biotechnology and its allied areas.

PSO2: To inculcate the capability to work as entrepreneurs .

PSO3: To equip the students to pursue higher education and research in reputed institutes.

PSO4: To develop a working knowledge of biotechnology product and processes.

**Course Outcomes:**

CO1: To learn the basic techniques for isolation of genomic DNA from different sources and its confirmation by electrophoresis.

CO2: To learn the use of probes in blotting techniques for biomolecules identification.

CO3: To learn different types of chromatography and its advantages and disadvantages.

CO4: To learn different immunodiagnostic methods and its specific applications.

CO5: To understand how the PCR and molecular markers are used in DNA fingerprinting.

**Unit I: Nucleic Acid Isolation and Electrophoresis**

Methods for isolation of plasmid and genomic DNA from bacterial, plant and animal cells. Electrophoresis-Principle, types and applications. Agarose gel electrophoresis, SDS PAGE, Isoelectric focusing and Capillary electrophoresis.

**Unit II : Hybridization Methods**

Introduction to probes, Radioactive probe labelling, Non-radioactive probe labelling, Southern hybridization, Northern hybridization, Western blotting, Dot-blot and Zoo-blot.

**Unit III: Separation Techniques**

Chromatography-Principle and Applications: Adsorption and Partition Chromatography. Ion exchange Chromatography, Gel filtration Chromatography, Affinity Chromatography, HPLC and GLC.

**Unit IV: Immunological Techniques**

Antibody generation, Antibody isolation and purification, Separation of antibodies by Immunoelectrophoresis, Immunoblotting, RIA, ELISA and ELISPOT.

**Unit V: DNA marker Technology**

Principle and Types of PCR Reverse transcription PCR, Long accurate PCR, Nested, Multiplex and Real time PCR. Molecular markers - RFLP, RAPD; DNA fingerprinting-Principle and applications;

**TEXT BOOKS:**

1. Frederick. M.A., Roger. B.R., David. D. M., Seidman. J. G., John A. S., Kevin. S., "Current Protocols in Molecular Biology", John Wiley and Son, Inc. 2003.

2. Daniel. C.L., "Introduction to Proteomics", Humana Press. 2002.

**REFERENCE BOOKS:**

3. Valones et al., Principles and applications of polymerase chain reaction in medical diagnostic fields: a review Braz. J. Microbiol., 40, 1–11, 2009.

4. Shendure. J., Ji. H., Next-generation DNA sequencing, Nature Biotech., 26, 1135 – 1145, 2008.

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DEPARTMENT OF BIOTECHNOLOGY  
MANNAMPANDAL-609 305, MAYILADUTHURAI  
III-B.SC., SEMESTER-V**

**TITLE OF THE PAPER: SBC-II - **BIOPHYSICAL AND BIOMEDICAL TECHNIQUES**  
(2018-19 onwards)**

**Learning Objectives:**

The course aims to provide an advanced understanding of the core principles behind Biophysical and Biomedical techniques and their experimental basis, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a branch lecture series.

**Programme Specific Outcomes:**

- PSO1: To make our students competent in the field of biotechnology and its allied areas.
- PSO2: To inculcate the capability to work as entrepreneurs .
- PSO3: To equip the students to pursue higher education and research in reputed institutes .
- PSO4: To develop a working knowledge of biotechnology product and processes

**Course Outcomes:**

- CO1: Students will be able to learn the biophysical definition and determination of macromolecular structure.
- CO2: Students will Understand and apply the classical spectroscopic techniques in analysis of biomolecules.
- CO3: This course will train the students on how to safely incorporate and image the radioactive chemicals in biological tissues and cells.
- CO4: Students will Understand and explain the applications of Radiotherapy & Nuclear Medicine in healthcare system.
- CO5: This course will impart the versatile advanced imaging techniques, their operating principle, applications & related modalities in healthcare system.

**Unit-I: Levels of Molecular Organization**

Structure of protein at different levels – primary, secondary, tertiary and quaternary; methods of analysis of protein structure. Structure of nucleic acids at different levels – primary, secondary, tertiary, quaternary structures.

**Unit-II: Spectroscopy**

Analysis of biomolecules using UV, Visible spectroscopy. Applications of Spectrophotometry – Fluorescence - Enzyme assay and fluorometers. Structure determination using X-ray diffraction and NMR Spectroscopy, Mass Spectrometry.

**Unit-III: Radiolabelling Techniques**

Atomic and radioactive decay. Detection and measurement of radioisotopes- Isotopes used in medicine. Measurement of beta radiation – GM Counter, Autoradiography, gamma detection. Incorporation of radioisotopes in biological tissue and cells. Molecular imaging (Nuclear medicine) of radioactive material.

**Unit-IV: Basic nuclear medicine techniques**

Diagnostic – In vitro techniques: Principles of Radio immunoassays (RIA) standard curve, data analysis, Quality Control(QC) and applications, Methods of receptor assays, hormones , drugs. Immunoradiometric assay, ELISA, RIA.

**Unit-V: ElectroPhysiological Techniques**

Single Neuron recording , Patch-Clamp Recording, ECG, Brain activity recording, Lesion and Stimulation of brain, Pharmacological testing, X-ray film, Digital radiography, Types of US imaging, PET, MRI, CAT.

**Text Books:**

- 1.R.S.Khandpur“ Handbook of Bio-Medical Instrumentation”,2<sup>nd</sup>Edition,Tata McGraw Hill.
- 2.J.J.Carr&J.M.Brown,” Introduction to Bio-Medical EquipmentTechnology” Pearson Education,Asia.
- 3.Principles and practice of Nuclear Medicine ,Bruce Sodee, Paul J.Early & Sharon Wikepry

**Reference Books:**

- 1.J.Webster, “Bioinstrumentation”, Wiley & Sons
- 2.S.Webb,”The Physics of Medical Imaging”,AdamHolger,Bristol.
3. Sybil M Stockley, “A Manual of Radiographic Equipments”, Churchill Livingstones.

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**DEPARTMENT OF BIOTECHNOLOGY**  
**MANNAMPANDAL-609 305, MAYILADUTHURAI**  
**III-B.SC., SEMESTER-VI**

**Title of the Paper: CC-XIII-MEDICAL BIOTECHNOLOGY (2018-19 onwards)**

**Learning Objectives:**

Students gain knowledge about types of stem cells and their role in medical biotechnology. Students will acquire knowledge on molecular diagnostics, newer therapeutics, vaccines and vaccine technology.

**Programme Specific Outcomes:**

- PSO1: To make our students competent in the field of biotechnology and its allied areas.
- PSO2: To inculcate the capability to work as entrepreneurs .
- PSO3: To equip the students to pursue higher education and research in reputed institutes.
- PSO4: To develop a working knowledge of biotechnology product and processes.

**Course Outcomes:**

- CO1: Students will be able to describe different types of stem cells, how they are derived and the extent of their plasticity.
- CO2: Acquire knowledge base of metabolic pathways occurring inside living cells.
- CO3: They also gain knowledge about molecular basis of cancer.
- CO4: Students learn about the different immunological assay used for diagnosis and treatment of neurogenetic and metabolic disorder.
- CO5: To know the therapeutic approaches for human diseases.

**UNIT I INTRODUCTION TO MEDICAL BIOTECHNOLOGY**

Introduction to Medical Biotechnology: Diseases: bacterial, viral, fungal and parasites. Methods of assaying microbial diseases. Viral vaccines: conventional: killed/attenuated; DNA; peptide; recombinant proteins. Stem cells – potency definitions ; embryonic and adult stem cells ; applications of stem cells – cell based therapies and regenerative medicine.

**UNIT II BIOCHEMICAL AND INHERITED DISORDERS**

Biochemical disorders; Immune, Genetic and Neurological disorders; Chromosomal disorders – Structural chromosomal abnormalities (Deletions, duplications, Translocations), Numerical chromosomal abnormalities (autosomal and allosomal). Single Nucleotide Polymorphisms in common diseases: hypertension (Angiotensin Converting enzyme gene).

**UNIT III CANCER BIOLOGY**

Cancer Biology- Characteristics of tumor cells, cell culture and transformation, characteristics of transformed cells, changes in cell-cell interaction. Etiology of cancer- Agents of transformation –viruses as agents and oncogenes, chemical carcinogenesis and radiation carcinogenesis.. Molecular basis of cancer- apoptotic and tumor suppressor gene. Chemotherapy of cancer and other contemporary therapies.

**UNIT IV DISEASE DIAGNOSIS AND TREATMENT**

PCR, LCR immunological assay. Detection of genetic, Neurogenetic disorders involving Metabolic and movement disorders. Treatment- Products from recombinant and non-recombinant organisms, Interferons, Antisense therapy, cell penetrating peptides, Gene therapy, Types of gene therapy, Immunotherapy, Detection of mutations in neoplastic diseases.

**UNIT V THERAPEUTIC APPROACHES FOR HUMAN DISEASES**

Gene augmentation – ADA deficiency ; Cystic fibrosis & Familial hyper cholesterolemia. Gene delivery methods- Viral delivery, Non-viral delivery. Gene therapy models- Liver diseases, Lung diseases, Hematopoietic diseases, Cancer and autoimmune diseases. Basic concept of Nutrigenomics and pharmacogenomics.

**References :****Textbooks:**

1. Textbook of Pharmaceutical Biotechnology by Chandrakant Kokate, Pramod H.J.SS Jalapure.
2. Textbook of Medical Biotechnology by Judit Pongracz, Mary Keen.

**Reference Books :**

1. Medical Microbiology by David Greenwood, Richard Slack & John Peutherer Churchill Livingstone company.
2. Medical Microbiology by Ananthanarayanan & Panekar Orient Longman Limited.

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**DEPARTMENT OF BIOTECHNOLOGY**  
**MANNAMPANDAL-609 305, MAYILADUTHURAI**  
**III-B.SC., SEMESTER-VI**

**Title of the Paper: CC-XIV-ENVIRONMENTAL BIOTECHNOLOGY**  
**(2018-19 onwards)**

**Learning Objectives:**

The main objectives of environmental biotechnology is the conservation of resources via the recycling of waste materials. The recoveries of more valuable products such as metals, oils, and vitamins are important aspects of this technology.

**Programme Specific Outcomes:**

PSO1: To make our students competent in the field of biotechnology and its allied areas.

PSO2: To inculcate the capability to work as entrepreneurs .

PSO3: To equip the students to pursue higher education and research in reputed institutes.

PSO4: To develop a working knowledge of biotechnology product and processes.

**Course Outcomes:**

CO1: To understand the relevance, basic concepts, components and organization of ecosystems.

CO2: Describe the concept of pollution management.

CO3: Acquire knowledge on waste water treatment.

CO4: Discuss the bioremediation of xenobiotics compounds.

CO5: Apply the concepts of biotechnology in environmental management.

**UNIT I ENVIRONMENT – BASIC CONCEPTS AND ISSUES**

Introduction to Environmental, Ecosystem structure and Functions, Abiotic and biotic component, Energy flow, food chain, Food web, Ecological pyramids – Types, Biogeochemical cycles, Ecological succession, Renewable and Non renewable resources. Role of Biotechnology in Environmental protection.

**UNIT II ENVIRONMENT POLLUTION**

An Overview of atmosphere, hydrosphere, lithosphere and anthrosphere. Environmental pollution – Types of Pollution, Sources of pollution, Measurement of pollution, Fate of pollutants in the environment. Bioconcentration, Bio/geomagnification. Global environmental problems – Ozone depletion, UV-B, Greenhouse effect and acid rain due to anthropogenic activities, their impact and biotechnological approaches for management.

**UNIT III WASTE WATER TREATMENT**

Waste water treatment – Aerobic process – Activated sludge, oxidation ponds, trickling filter, towers, rotating discs, rotating drums, oxidation ditch. Anaerobic process – Anaerobic digestion, anaerobic filters, up-flow anaerobic sludge blanket reactors. Treatment of waste water from dairy, distillery, tannery, sugar and antibiotic industries.

**UNIT IV BIOREMEDIATION**

Xenobiotics compounds – organic (chlorinated hydrocarbons, Substituted simple aromatic compounds, polyaromatic hydrocarbons, pesticides, surfactants ) and inorganic (metals, radionuclides, Phosphates, nitrates). Bioremediation of xenobiotics in environment – ecological consideration, decay behavior and degradative plasmids, Molecular techniques in bioremediation. Bioremediation of organic pollutants and odorous compounds. Bioaugmentation. Microphytes in water treatment. Phytoremediation of soil metals.

**UNIT V ALTERNATE SOURCE OF ENERGY**

Biomass as a source of energy, Bioreactors, Biocomposting, Biofertilizers, Vermiculture, Biomineralization, Biofilm, Bioplastics, Biofuels, Biopesticides, Bioleaching, Biomining, Biosensors, Bioethanol, Solid waste management, Role of immobilized cells/enzymes in treatment of toxic compounds.

## **References**

### **Textbook**

1. Evans & Furlong. Environmental Biotechnology.Theory& Applications. 2<sup>nd</sup>ed 2011. Wiley-Blackwell.
2. Scragg A. Environmental Microbiology Oxford Univ Press. 2005.

### **Reference Books**

- 1.Environmental chemistry , AK. De Wiley Eastern Ltd, NewDelhi.
- 2.Environmental molecular Biology , Paul. A, Rochelle, 2001. Horizon Press.
- 3.Bioremediation , Baaker, KH and Herson D.S., 1994 Mc. Grawhill Inc, Newyork.

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**III-B.SC., SEMESTER-VI**

**Title of the Paper: CC-XV-AGRICULTURAL BIOTECHNOLOGY**  
**(2018-2019 onwards)**

**Learning Objectives:**

Agricultural Biotechnology graduates will acquire knowledge about the range of approaches to manipulate and improve plants, animals and microorganisms .

**Programme Specific Outcomes:**

PSO1: To make our students competent in the field of biotechnology and its allied areas.

PSO2: To inculcate the capability to work as entrepreneurs .

PSO3: To equip the students to pursue higher education and research in reputed institutes.

PSO4: To develop a working knowledge of biotechnology product and processes.

**Course Outcomes:**

CO1: Introduction to soil and its relevance in agriculture.

CO2: To understand the structure and characteristic features of different biofertilizers.

CO3: To get knowledge about biopesticides and its advantage over chemical pesticides.

CO4: To apply vermicomposting technology to improve crop yield.

CO5: Discuss about organic farming and get knowledge about stable farming systems.

**UNIT -I INTRODUCTION TO SOIL**

Soil and its components; Soil morphological, physical, chemical and biological properties; Acidic, saline and alkali soils and their reclamation; Essential plant nutrients: Functions and deficiency symptoms; Soil micro-organisms; Rhizosphere and its domain in soil; Organic manures and inorganic fertilizers.

**UNIT-II INTRODUCTION TO BIOFERTILIZERS**

Structure and characteristic features of biofertilizer organisms: Bacteria:Azospirillum, Azotobacter,Bacillus,Rhizobium.Cyanobacteria:Anabaena,Nostoc.Fungi:Glomus,Gigaspora. Biogeochemical Cycles.Biological Nitrogen Fixation.C/N ratio and their importance. BIS quality norms for biofertilizer production

**UNIT – III: BIOPESTICIDES**

*Bacillus thuringensis*, Genetic Engineering of Bt toxin, Baculovirus – Mode of Action, Mass production.Fungal Biopesticides-Entomopathogenic Fungi.Viral Insecticides. Advantages of Biopesticides over chemical pesticides. Interaction among Microbial population: Interaction within a single microbial population – positive and negative interaction.

**UNIT – IV: CONCEPT OF COMPOST**

Green manure-importance,crops for green manure;Organic manure-Cow dung,Livestock wastes. Microbes involving in compost preparation. Vermicompost – advantages, pre digested food preparation, Methods of vermicomposting, Selection of earth worms, nutrient composition of vermicompost, Vermiwash.

**UNIT V ORGANIC FARMING**

Basic concept, Principle and components of Organic Farming, Integrated Plant Nutrient Supply Management, Integrated Insect Pest and Disease Management, Integrated Soil and Water Management.Sustainable Agriculture and its key indicators.Stable farming Systems.

**Text books:**

1. Satyanarayana U. (2007) - Biotechnology, Books and Allied Pvt.Ltd.Kolkata.
2. Microbial Biotechnology –Fundamentals of applied Microbiology. Glazer and Nikaido (1995) W.H. Freeman Publication company.
3. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.

**Reference books:**

1. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New \_Delhi.
2. Agricultural Microbiology: G.Rangaswamy and D.J. Bagyaraj 1993, 2nd Edition, Prentice Hall of India Private Limited, New Delhi.
3. Schmauder Hans Peter (1997) - Methods in Biotechnology, Taylor and Francis, London.
4. Schuler M. A. and Zielinski R. E. (1989) - Methods in Plant Molecular Biology.

**A.V.C. COLLEGE (AUTONOMOUS)**  
**DEPARTMENT OF BIOTECHNOLOGY**  
**MANNAMPANDAL-609305, MAYILADUTHURAI**  
**III B.Sc., SEMESTER- VI**

**Title of the Paper: CCXVI – PRACTICAL VI ( COVERING CC-XIII,XIV,XV)**  
**(2018-19 onwards)**

**Medical Biotechnology**

1. Preparation of selective and differential media used in diagnostic microbiology.
2. Laboratory examination of sputum by differential staining.
3. Identification and characterization of selected medically important pathogens –  
*Escherichia coli, Streptococcus pneumoniae*.
4. ELISA Test
5. PCR (Demo)

**Environmental Biotechnology**

1. Isolation of microorganisms from soil/Industrial effluents.
2. Determination of Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of a sewage sample.
3. Production of Ethanol from waste by products.
4. Calculation of Total Dissolved Solids (TDS) of water sample.
5. Isolation of Xenobiotics degrading bacteria by selective enrichment technique.
6. Production of Biogas(Demo)

**Agricultural Biotechnology**

1. Isolation of Plant Genomic DNA (Pea Shoot tip – CTAB , Cauliflower ).
2. Preparation of Complex Nutrient Medium.
3. Isolation and culture of protoplasts from leaf.
4. Initiation and Maintenance of callus.
5. Organogenesis from callus.

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**DEPARTMENT OF BIOTECHNOLOGY**  
**MANNAMPANDAL-609 305, MAYILADUTHURAI**  
**III B.Sc., SEMESTER – VI**  
**Title of the Paper: EC II – DIVERSITY OF LIFE FORMS**  
**(2018-19 onwards)**

**Learning Objectives:**

This course makes the students to understand the basic evolutionary relationship among different taxa.

**Programme Specific Outcomes:**

- PSO1: To make our students competent in the field of biotechnology and its allied areas.
- PSO2: To inculcate the capability to work as entrepreneurs .
- PSO3: To equip the students to pursue higher education and research in reputed institutes.
- PSO4: To develop a working knowledge of biotechnology product and processes.

**Course Outcomes:**

- CO1: To understand the basic concepts of taxonomy of living organisms.
- CO2: To learn the structural organization of life forms at different levels.
- CO3: To know the range of biological taxa, and its classification.
- CO4: To understand the habitat of species and seasonal variations of climatic conditions.
- CO5: To learn why conservation biology is important for biodiversity management.

**Unit I : Principles and methods of taxonomy**

Concepts of species and hierarchical taxa Biological nomenclature Classical and quantitative methods of taxonomy of plants, animals and microorganisms.

**Unit II : Levels of structural organization**

Unicellular ,Colonial, Multicellular forms, Levels of organization of Tissues. Organs, Systems, comparative anatomy.

**Unit III : Outline classification of plants, animals and microorganisms**

Important criteria used for classification in each taxon , Classification of Plants, Animals and Microorganisms, Evolutionary relationships among taxa.

**Unit IV : Natural History of Indian subcontinent**

Major habitat types of the subcontinent, geographic origins and migrations of species, Common Indian mammals and birds,Seasonality and phenology of the subcontinent.

**Unit V: Organisms of health and agricultural importance**

Common parasites and pathogens of Humans, Domestic animals and Crops major drivers of biodiversity change; biodiversity management approaches. Conservation biology.

**Text Books:**

- 1.UGC/CSIR NET/SET Life Sciences-Ashish Nagesh,Prashant Kmar,Arihant Publications.
2. M.A. Singara Charya & S. Girisham S.M. Reddy,Microbial Diversity Exploration And Bioprospecting , Scientific Publishers (India) (2016)

**Reference Books:**

1. The Diversity of Life by E.O. Wilson (1992),
2. The Diversity of Life – Principles of Biology-Pressbooks
3. Perspectives on Biodiversity, National Research Council.
4. Microbial Biodiversity and Bioprospecting, Alan T. Bull, American Society for Microbiology; 1 edition (1 December 2003)

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**DEPARTMENT OF BIOTECHNOLOGY**  
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**III-B.SC., SEMESTER-VI**  
**TITLE OF THE PAPER: ECIII – BIOPROSPECTING (2018-19 onwards)**

**Learning Objectives:**

This course will cover identification of the sources of natural products, the relevance of bioprospecting in natural product development, application, bioassay guided fractionation and characterization of compounds in drug development, the role of national and international conventions, agreements and regulations in Bioprospecting.

**Programme Specific Outcomes:**

PSO1: To make our students competent in the field of biotechnology and its allied areas.

PSO2: To inculcate the capability to work as entrepreneurs .

PSO3: To equip the students to pursue higher education and research in reputed institutes .

PSO4: To develop a working knowledge of biotechnology product and processes

**Course Outcomes:**

CO1: Students will be able to discuss the relevance of Bioprospecting in natural products research and regulations in Bioprospecting.

CO2: Students will understand the bioprospecting of plants for novel medicines and learn procedures for screening and isolation of pure compounds.

CO3: The students will be able gain knowledge on the discovery of novel compounds from marine organisms.

CO4: Students will be able to perform procedures for the isolation and assay of bioactive compounds from microbes.

CO5: This course will update the students on the biodiversity in different agro ecological regions and bioprospecting from forest resources.

**Unit-I: Bioprospecting**

Definition, Introduction, Current practices in Bioprospecting for conservation of Biodiversity and Genetic resources. Bioprospecting Act: Introduction, Phases of Bioprospecting, Exemption to Act. Fields of Bioprospecting.

**Unit-II: Pharmaceutical Bioprospecting**

Bioprospecting for new drugs, assays in Bioprospecting. Antioxidant assay – NO free radical scavenging assay, Antigenotoxicity assay – MTT assay, Antiviral activities of plants – SRB assay.

**Unit-III: Marine Bioprospecting**

Sources of marine planktons and their bioprospecting, Isolation and cultivation of marine bioresources, Isolation of marine yeast and its industrial applications, bioactive chemicals from Seaweeds and their applications.

**Unit-IV: Microbial Bioprospecting:**

Isolation of Microbial metabolites and their bio-activity. Endophytic microbial products as Antibiotics. Role of microbes in the sustainable development of various industrial products.

**Unit-V: Forest Bioprospecting**

Origin, evolution, botany, cultivation and uses of Food, Fodder, Fibers, Oil yielding crops, wood and timber, Non-wood forest products(NWFPS): Bamboos, Gums, Dyes, Resins, Fruits etc. Preservation of plants and plants products.

**Text Books:**

1. Swaminathan, M.S. and Kocchar, S.L. (Es.) (1989). Plants and Society, MacMillan Publication Ltd.,
2. Microbial Biodiversity and Bioprospecting, Alan T. Bull, American Society for Microbiology; 1 edition (1 December 2003)

**Reference Books:**

1. M.A. Singara Charya & S. Girisham S.M. Reddy, Microbial Diversity Exploration And Bioprospecting ,Scientific Publishers (India) (2016)
2. Thakur, R.S., Puri, H.S. and Husain, A. (1969). Major medicinal plants of India, Central Institute of medicinal and aromatic plants, Lucknow.

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**III-B.SC., SEMESTER-VI**  
**TITLE OF THE PAPER: SBC-III-MOLECULAR DIAGNOSTICS**  
**(2018-19 onwards)**

**Learning Objectives:**

This course makes the students familiar to the procedures and techniques used in a laboratory of molecular diagnostics.

**Programme Specific Outcomes:**

- PSO1: To make our students competent in the field of biotechnology and its allied areas.
- PSO2: To inculcate the capability to work as entrepreneurs .
- PSO3: To equip the students to pursue higher education and research in reputed institutes.
- PSO4: To develop a working knowledge of biotechnology product and processes.

**Course outcome:**

- CO1: To learn the overview of scope, significance and history of molecular diagnostics.
- CO2: To learn how the biomarkers methods are applied in disease diagnosis.
- CO3: To evaluate the disease at genetic level by using advanced techniques and learn its advantages and disadvantages.
- CO4: To learn different immunodiagnostic methods and its specific applications.
- CO5: To understand how the omics (proteomic and metabolomic profiles) datas used as diagnostic marker.

**Unit – I Introduction to Molecular Diagnostics**

History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario.

**Unit – II Biomarkers in Disease Diagnostics**

FDA definition of disease markers, Role of markers in disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis.

**Unit – III Chromosomes and Cytogenetic analysis**

Nomenclature and functional significances of chromosome bands. GC and AT rich isochores. X-chromosome dosage compensation and inactivation mechanism. Sex determination and Y chromosome; Uniparental disomy, Genomic Imprinting . FISH, CGH, Flow cytometry techniques and clinical diagnostics.

**Unit IV :Immunodiagnostic techniques**

Radioactive isotopes, DNA reporters, fluorogenic reporters, electro-chemiluminescent tags & label free immunoassays – precipitation, agglutination hemagglutination, RIA,ELISA, RIA, MELISA and specific applications. Quantum dots. Immunohistochemistry – principle and techniques.

**Unit V : Omics in diagnostics**

Role of genomic,transcriptomic, proteomic and metabolomic profiles as a diagnostic marker. Pedigree analysis with genetic markers. FDA regulations for clinical use of DNA tests.

**Text books:**

1. Molecular biology of the cell. Bruce Alberts, 6th Edition
2. Molecular Cell Biology: Darnell J, Lodish H and Baltimore D

**Reference books:**

1. Cell and Molecular Biology: De Robertis EDP and De Robertis EMF
2. Principles of Immunology and Immunodiagnostics, Ralph Michael Aloisi. Lippincott Williams and Wilkins
3. Valones et al., Principles and applications of polymerase chain reaction in medical diagnostic fields: a review Braz. J. Microbiol., 40, 1–11, 2009.
4. Daniel. C.L., “Introduction to Proteomics”, Humana Press. 2002.

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III-B.SC., SEMESTER-VI**

**TITLE OF THE PAPER: NMECII : BIOTECHNOLOGY FOR HUMAN WELFARE  
(2018-19 onwards)**

**Learning Objectives:**

This course provides an introduction to understand the application of biotechnological products produced by advanced methods and techniques.

**Programme Specific Outcomes:**

PSO1: To make our students competent in the field of biotechnology and its allied areas.

PSO2: To inculcate the capability to work as entrepreneurs .

PSO3: To equip the students to pursue higher education and research in reputed institutes.

PSO4: To develop a working knowledge of biotechnology product and processes.

**Course Outcomes:**

CO1: To learn the basic concepts of fermentation and their application in industries.

CO2: To understand the plant –microbe interaction and its application in agricultural production.

CO3: Student will learn about environmental pollution and its biodegradation by microbes.

CO4: Students will know how DNA based methods used in forensic science laboratory.

CO5: Students will know how to develop non-toxic therapeutic agents, recombinant live vaccines, monoclonal antibodies and understand the concept of gene therapy.

**UNIT I Industrial Biotechnology**

Introduction to Bioprocess - Bioreactor Design, parts and their functions. Types of reactor, types of fermentation. Isolation and screening of industrially important microorganisms. Microbial biomass production- Baker's yeast, SCP and Mushroom Cultivation

**UNIT II Agricultural Biotechnology**

Biofertilizers: Mass production , Field Application of *Rhizobium* , *Azotobacter*, *Azospirillum* and VAM. Biopesticide : *Bacillus thuringiensis*, Genetic Engineering of Bt toxin, Baculovirus – Mode of Action, Mass production.

**UNIT III Environmental Biotechnology**

Bioremediation – *In-situ*, and *Ex-situ* – Use of genetically engineered bacterial strains – Bioremediation of dyes – Bioremediation in paper and pulp industry. Bioremediation of heavy metals: Mechanism of metal removal – Bioremediation of xenobiotics .

**UNIT IV Biotechnology in Forensic science**

Introduction to, Forensic Biotechnology, DNA fingerprinting; Restriction fragment length polymorphism (RFLP); Random amplified polymorphic DNA (RAPD); Amplified fragment length polymorphism (AFLP); Microsatellites; PCR amplifications; Single nucleotide polymorphism (SNPs).

**UNIT V Biotechnology in Medicine**

Recombinant DNA proteins and their uses: i) Interferon, ii) Interleukin and iii) Tissue plasminogen activator –. Diagnostics of genetic disorders using DNA probes and antibodies. Gene therapy, Human Genome Project.

**Text books:**

1. Patnaik, "Textbooks of Biotechnology", McGraw Hill Education (India) Private Limited. 2012.
2. Satyanarayana, U, "A Textbooks of Biotechnology", Books and Allied (p) Limited, 2013.

**Reference Books**

1. B.C. Bhattacharyya and Rintu Banerjee. 2007. Environmental Biotechnology. Oxford Higher Education Publication.
2. D. Balasubramanian, C. F. A. Bryce, K. Dharmalingham, J. Green and K. Jayaraman. 1996. Concepts in Biotechnology. Universities Press.
3. Ashok K. Chauhan. 2009. A Textbook of Molecular Biotechnology. I.K. International Publishing house Pvt. Ltd.

# A.V.C. COLLEGE (AUTONOMOUS)

MANNAMPANDAL, MAYILADUTHURAI

## M.Sc., BIOTECHNOLOGY - Course Structure under CBCS

(For the candidates admitted from the academic year 2018-2019 onwards)

SEM.	COURSE	INST HOURS/ WEEK	CREDITS	EXAM HOURS	TOTAL CREDITS
I	CC I Cell and Molecular Biology	5	4	3	23
	CC II Biochemistry	5	4	3	
	CC-III Microbiology	5	4	3	
	CC-IV Immunology and Immunotechnology N	5	4	3	
	CC- V Practical covering CC I - IV	6	3	4	
	EC- I Physiology	4	4	3	
II	CC VI Recombinant DNA technology	4	4	3	25
	CC VII Medical biotechnology	4	4	3	
	CC VIII Plant biotechnology	4	4	3	
	CC-IX Animal biotechnology	4	4	3	
	CC X Practical covering CC VI - IX	6	3	4	
	EDC-I Fundamentals of Bioinformatics	4	2	3	
	EC-II Molecular Breeding and Genomics	4	4	3	
III	CC XI Bioprocess technology	4	4	3	25
	CC XII Bioinstrumentation	4	4	3	
	CC XIII Bioinformatics	4	4	3	
	CC-XIV Research methodology	4	4	3	
	CC XV Practical covering CC XI - XIV	6	3	4	
	EDC-II Applied and Industrial Biotechnology	4	2	3	
	EC-III Aquaculture Biotechnology	4	4	3	
IV	Project		17		17
<b>TOTAL</b>					<b>90</b>

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**M.Sc. BIOTECHNOLOGY**

**SEMESTER- I**

**CC-I- Cell and Molecular Biology**

**Unit – I Foundation of Cell biology and its origin**

Molecules of life- Cellular evolution-assembly of macromolecules and Origin of life. The discovery of cell, development of the cell theory. The molecular evolution of cell. General structure of prokaryotic and eukaryotic cell.

**Unit – II Cell organelles and cell architecture**

Cell wall of plants and bacteria. Endoplasmic reticulum, golgi complex - exocytosis; Micro bodies - phagocytosis and endocytosis. Plant cell vacuoles. Endosymbiotic theory. Structure of mitochondria and organization of respiratory chain; Structure of chloroplast and photophosphorylation; Structure of nucleus and nucleolus.

Cytoskeletons - structure and motility function. Extracellular matrix. Role of tight junctions and gap junctions. Molecular aspects of cell division and cell cycle, Regulation of cell cycle events, apoptosis, necrosis.

**Unit – III Cell membrane, transport and cell signaling**

Plasma membrane – structure and function. Transport across the membranes. Role of clatherin coated vesicles. Nuclear membrane - transport across nuclear membrane. Gibbs-Donnan membrane equilibrium. Membrane electrical properties.

Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis.

**Unit – IV Central Dogma of Molecular Biology - I**

Operon, unique and repetitive DNA, interrupted genes, gene families, structure of chromatin and chromosomes, heterochromatin, euchromatin, transposons. DNA-supercoiling -linking number- satellite DNA-possible functions- Cot curve- C- value paradox.

Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms, homologous and site-specific recombination.

**Unit – V Central Dogma of Molecular Biology - II**

Transcription factors and machinery, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

Genetic code. Prokaryotic and eukaryotic translation- translational machinery. aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors. Post translational modification. Regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, role of chromatin in gene expression and gene silencing.

**Text Books**

1. N. Arumugam. Cell Biology. ISBN : 9789382459613 Size : Demy, Octova 384pp.
2. P.S. Verma Cell Biology,Genetics,Molecular Biology, Evolution and Ecology. S Chand Ltd. 2004. 350pp

**References**

1. Darnell, Lodish and Baltimore. Molecular Cell Biology, Scientific American Pub Inc, 2000
2. Bruce Alberts, Molecular biology of the Cell. 4 th ed. Garland publishing Inc, 2002
3. Benjamin Lewin. Gene VII. Oxford University Press, Nelson Cox

## SEMESTER- I

### CC-II - Biochemistry

#### Unit – I The Molecular Design of Life

Biochemical Evolution. Chemical Bonds in Biochemistry. Biomolecular structural stability - intra and intermolecular forces; Basic thermodynamics - Laws of thermodynamics. Concepts of  $\Delta G$ ,  $\Delta H$  and  $\Delta S$ . Physical properties of water and their role in biology. Concepts of pH, ionic strength and buffers. Henderson Hasselbalch equation.

#### Unit – II Carbohydrates

Chemistry and Metabolism of Carbohydrates - Structure and function of monosaccharides, Oligosaccharides and Polysaccharides. Metabolism of carbohydrates Glycolysis, Citric acid cycle, HMP pathway, Cori cycle;. Gluconeogenesis, Glycogenesis and Glycogenolysis.

#### Unit – III Lipids

Classification and chemistry of Lipids: Structure and functions of triglycerides, phospholipids, glycolipids, waxes, prostaglandins; Significance of PUFA, Cholesterol and its derivatives. Cholesterol synthesis; Lipoprotein systems; Oxidation and synthesis of fatty acids; Acetic acid as a central precursor for biosynthesis of lipids. endogenous synthesis of triacylglycerols, phospholipids cerebrosides, gangliosides, cholesterol.

#### Unit – IV Proteins and Enzymes

Classification of Proteins and their biological functions: Essential and non-essential Aminoacids. Structure and properties of amino acids, sequencing of aminoacids, general degradation of amino acids - transamination, oxidative deamination, decarboxylation, disposal of ammonia Urea cycle. Oxidative degradation of one carbon units. Biosynthesis of amino acids.

Biocatalysts: Enzymes classification and its kinetics. Mechanism of action / allosteric enzymes / Isoenzymes / Coenzymes and cofactors.

#### Unit – V Nucleic acids and Vitamins

Nucleic acids: Structure and function of DNA and RNA. Purine and Pyrimidine bases structure, degradation and synthesis, inborn errors of nucleotide metabolism.

Vitamins - Introduction, structures, sources, RDA, functions, deficiency diseases of fat soluble and water soluble vitamins. Dietary minerals. Metabolism of iron. Chemistry and mechanism of Hormonal action; BMR – Determination of BMR, Nitrogen balance, Protein malnutrition

#### Text Books

1. U Satyanarayana. Biochemistry. Elsevier Health Sciences. 2014. 812 pages.
2. J.L. Jain. Fundamentals of Biochemistry. S. Chand Limited, 2005 - 1230 pages

#### Reference

1. Nelson.D.L, Cox. M. M. Lehninger's. Principle of Biochemistry. 6th ed. Freeman, 2012.
2. Murray. R.K, Granner.D.K, Mayes. P. A, Rodwell. V. W. Harper's Biochemistry. 27th ed. McGraw Hill, 2006.
3. Jeremy M. Berg, Lubert Stryer, Biochemistry. Macmillan Learning, 2015. 8th ed.1120 pages

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M.Sc. BIOTECHNOLOGY

SEMESTER- I

## **CC-III MICROBIOLOGY**

### **Unit – I Introduction to microbiology and its diversity**

Discovery and Origin of microbial world, Theories- spontaneous generation. Germ theory of diseases. Diversity and distribution of microbes. Criteria for classification; Classification of Bacteria according to Bergey's manual. Classification of fungi. Molecular classification of microbial kingdom (rRNA phylogeny). General characteristics of virus, life cycle and classification of viruses.

### **Unit – II Microbial growth and culture**

Microbial Growth; The definition of growth, Mathematical expression of growth curve, measurement of growth and its yields, Synchronous growth, Continuous culture, Growth influenced by environmental factors like temperature, acidity, alkalinity, water availability, osmotic pressure, hydrostatic pressure and oxygen. Culture collection and maintenance of cultures. Media Formulation; Sterilization and its methods - Physical and Chemical sterilization.

### **Unit – III Microbial genetics and nutrition**

Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes. Operon concept (lac and trp).

Nutritional types of microbes, Enrichment culture technique. Role of microbes in Biogeochemical cycles. Transformation of elements: Carbon, Nitrogen, Phosphorous and Sulphur.

### **Unit – IV Applied Microbiology**

Food production by microbes – Microbial cell as food (SCP), Fermented products - Cheese, Yoghurt, kumiss, kefir. Sauerkraut, pickles and sausage. Fermented alcohol beverages – Beer and Wine. Production of organic acids

### **Unit – V Microbes and Environment**

Role of microorganisms in natural system and artificial system; Influence of Microbes on the Earth's Environment and Inhabitants; Ecological impacts of microbes; Symbiosis (Nitrogen fixation and ruminant symbiosis); Microbes and Nutrient cycles; Microbial communication system; Quorum sensing; Microbial fuel cells; Prebiotics and Probiotics; Vaccines

### **Text Books:**

1. Pelczar. Microbiology. Tata McGraw-Hill Education, 1998. 900 pages.
2. D.K.Maheshwari. A Textbook of Microbiology. S. Chand Publishing, Revised edition 2013. 912pp.

### **References:**

1. Prescott's Microbiology. 10<sup>th</sup> Edn. McGraw-Hill Education, 2016. 1104 pages.
2. Ananthanarayan and Paniker's Textbook of Microbiology. Orient Blackswan, 7<sup>th</sup> Edn. 2005. 657pp.
3. Jeffrey C. Pommerville Alcamo's Fundamentals of Microbiology 9<sup>th</sup> edition Jones & Bartlett Publishers, 2010 860 pages
4. Benjamin Pierce. Genetics: A Conceptual Approach. 5<sup>th</sup> Edition. WH Freeman.

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**M.Sc. BIOTECHNOLOGY**

**SEMESTER- I**

**CC - IV IMMUNOLOGY AND IMMUNOTECHNOLOGY**

## **Unit I Immunology- fundamental concepts and anatomy of the immune system**

Components of innate and acquired immunity; Phagocytosis; Complement and Inflammatory responses; Haematopoiesis; Organs and cells of the immune system- primary and secondary lymphoid organs; Lymphatic system; Lymphocyte circulation; Lymphocyte homing; Mucosal and Cutaneous associated Lymphoid tissue.(MALT&CALT); Mucosal Immunity; Antigens - immunogens, haptens; Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility, HLA typing

## **Unit II Immune responses generated by B and T lymphocytes**

Immunoglobulins-basic structure, classes and subclasses of immunoglobulins, Principles of cell signalling; Immunological basis of self – non-self discrimination; memory; B cell maturation, activation and differentiation; Generation of antibody diversity; T-cell maturation, activation and differentiation and T-cell receptors; Functional T Cell Subsets; Cell- mediated immune responses, ADCC; Cytokines-properties, receptors and therapeutic uses; Antigen processing and presentation- endogenous antigens, exogenous antigens, non-peptide bacterial antigens and super-antigens; Cell-cell co-operation, Hapten-carrier system

## **Unit III Antigen-antibody interactions**

Precipitation, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, Western blotting, ELISPOT assay, immunofluorescence, flow cytometry and immunoelectron microscopy; Surface Plasmon resonance, Biosensor assays for assessing ligand –receptor interaction, CMI techniques- lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays, Apoptosis.

## **Unit IV Vaccinology**

Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvant, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries.

## **Unit V Clinical Immunology**

Hypersensitivity – Type I-IV; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; Transplantation – Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy; Tumour immunology – Tumour antigens; Immune response to tumours and tumour evasion of the immune system, Cancer immunotherapy; Immunodeficiency-Primary immunodeficiency, Acquired or secondary immunodeficiency.

### **TEXT BOOKS**

1. J. Kuby, 2013, Immunology 7<sup>th</sup> edition, W.H. Freeman and Company, Newyork.
2. I.Roitt, 2017, Essential Immunology 13<sup>th</sup> edition, Blackwell Science, Singapore.

### **REFERENCES**

1. I.R.Tizard, 1995, Immunology: An Introduction, 4th edition, Saunders College Publishers, New York.

2. A. Bul and K. Abbas, 1994, Cellular and Molecular immunology, W.D. Saunders and Co, Philadelphia
3. Playfair J. H. L. 2001. Immunology at a Glance. 7<sup>th</sup> edition. Blackwell Publishing Company.
4. Introduction to Medical immunology by Gabriel Virellce, Marcel Dekker.1993.
5. Lydyard P. (2011). BIOS Instant notes Immunology 3<sup>rd</sup> edition. Garland Science , Taylor & Francis Group, LLC

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**M.Sc. BIOTECHNOLOGY**

## SEMESTER- I

### CC V Practical covering CC I – IV

#### **Cell and molecular biology:**

Principle and functioning of commonly used biotechnological instruments in the laboratory.

Cell division in onion root tip/ insect gonad cells.

Isolation and purification of genomic DNA from prokaryotes, eukaryotes and its observation by Agarose gel electrophoresis.

Extraction, purification of proteins and its separation by SDS PAGE.

#### **Biochemistry**

Preparation of solutions (Molar, Normal, Percentage, Stock, Working) and buffers (PBS, Tris and Acetate buffer)

Qualitative tests for carbohydrates, lipids and proteins.

Quantitative tests for carbohydrates, lipids, DNA, aminoacids and proteins.

Separation of Amino acids by paper chromatography.

#### **Microbiology**

Isolation of microorganisms from air, soil & water - spread plate, pour plate, streak plate techniques

Staining methods – simple, negative, differential, & capsular

Identification - Macroscopic, microscopic & biochemical level.

Antibiotic sensitivity test – Kirby - Bauer method.

#### **Immunology and Immunotechnology**

Basics - Bleeding, separation of serum, plasma.

Total (WBC, RBC) & differential count of human blood cells.

Precipitation techniques – Agar gel diffusion, counter immuno-elektrophoresis, single radial immuno-diffusion, rocket immuno-electrophoresis.

Agglutination techniques-Blood grouping and Rh factor; Latex agglutination; Heme agglutination.

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**M.Sc. BIOTECHNOLOGY SEMESTER- I**

#### **EC-I Physiology**

#### **Unit – I Cell and Microbial Physiology**

Principals of Homeostasis. Fluid compartments of the body. Comparative physiology across the three domains (Eubacteria, Archaea, Eukaryotes (microeukaryotes)) Growth yield and

characteristics - Energy generation, Strategies of cell division – Biomass changes, stress response - Uptake, growth, and survival in response to external change. Physiological adoption and life style of Prokaryotes; Unicellular Eukaryotes and the Extremophiles (with classical example from each group)

#### **Unit – II Animal Digestion and Renal Physiology**

Digestion- digestive processes at various regions of digestive system, regulation of gastric secretion and motility- intestinal secretion and motility-role of gastrointestinal hormones.

Renal physiology- structure of nephron- glomerular filtration- tubular reabsorption and secretion- formations of urine- regulation of water and mineral excretion- counter current multiplier and exchanger- renal role in acid base balance.

#### **Unit –III Animal Cardio and Respiratory Physiology**

Cardiophysiology- functional anatomy of heart- genesis and spread of cardiac impulses- cardiac cycle- heart sound- cardiac output- cardiovascular regulatory mechanisms- basic E.C.G.

Respiratory physiology- functional anatomy of air-passages and lung- respiratory muscles- mechanism of respiration- lung volumes and capacities- gas exchange in the lungs- regulation of respiration.

#### **Unit – IV Animal Nerve, Muscle and Applied Physiology**

Nerve physiology-Structure of neuron and synapse- excitability- action potential- conduction of nerve impulse-synaptic transmission- neurotransmitter systems.

Muscle physiology- skeletal and smooth muscle- electrical properties and ionic properties- types of muscle contraction- Neuromuscular transmission.

#### **Unit – V Plant and Applied Physiology**

Photoprotective mechanisms; CO<sub>2</sub> fixation-C<sub>3</sub>, C<sub>4</sub> and CAM pathways. Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates. Mechanisms of action of phytochromes. Photoperiodism and biological clocks.

Physiological basis of transfusion medicine. Introduction to environmental physiology

#### **Text Books**

Lincoln Taiz, Eduardo Zeiger. Plant Physiology. Sinauer Associates, 2010 5<sup>th</sup> Edn. 782 pp.

G. N. Cohen. Microbial Biochemistry. Springer, 2014. 3<sup>rd</sup> Edn. 611 pp.

Roger TannerThies. Physiology - An Illustrated Review. Thieme, 2011. 352pp.

#### **Reference**

Guyton and Hall Textbook of Medical Physiology. Elsevier Health Sci., 13<sup>th</sup> Edn. 2016, 1145pp

Linda S. Costanzo. Physiology. Elsevier Health Sciences, 2009. 4<sup>th</sup> Edn. 512pp.

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**M.Sc. BIOTECHNOLOGY**

**SEMESTER- II**

**CC-VI RECOMBINANT DNA TECHNOLOGY**

**UNIT –I Basics Concepts**

Introduction to r-DNA technology, Molecular cloning Tools: Restriction modification systems: Types, Mode of action, nomenclature, applications of Type II restriction enzymes in genetic engineering, DNA modifying enzymes and their applications: DNA polymerases, Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases- cohesive and blunt end ligation , Nucleases , Klenow Enzyme.

#### **UNIT –II Cloning Vectors**

Plasmids, bacteriophages, M13 mp vectors, PUC19 and blue script vectors. Phagemids, lambda phage vectors, insertion and replacement vectors, EMBL, cosmids, artificial chromosome vectors (YAC, BAC), animal virus derived vectors - SV40, vaccinia/baculo and retroviral vectors. Expression vectors – pMal, GST and pET based vectors. Protein purification. his-tag, GST-tag, MBP- tag etc., intein-based vectors, inclusion bodies, methodologies to reduce formation of inclusion bodies, baculovirus and pichia vectors system, plant based vectors, Ti and Ri as vectors, yeast vectors and shuttle vectors.

#### **UNIT –III Cloning strategies**

DNA sequencing methods, Probe- construction. Isolation of mRNA and total RNA. cDNA libraries, genomic libraries, Chromosome Walking and Jumping strategies. cDNA and genomic cloning, expression cloning and protein-protein interactive cloning. Yeast two hybrid system, phage display and principles in maximizing gene expression. Selection and screening strategies.

#### **UNIT –IV Advances in transgenic technology**

Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two). Labeling of DNA - nick translation, random priming, radioactive and non radioactive probes. Colony hybridization, fluorescence in- situ hybridization, chromatin, DNA - protein interactions, electromobility shift assay, DNeI foot printing and methyl interference assay.

#### **UNIT -V Methods in Molecular Cloning**

Transformation of DNA: Chemical method, Electroporation; Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral-mediated delivery, Agrobacterium - mediated delivery; DNA, RNA and Protein analysis: Southern - and Northern – blotting techniques, dot blot, DNA microarray analysis, SDS-PAGE and Western blotting. Problems with genetically modified organisms and safety concerns.

#### **TEXT BOOKS:**

3. S.B. Primrose, R.M. Twyman and R.W.Old. 2001. Principles of Gene Manipulation. 6 th Edition. S.B.University Press.
4. T.A.Brown, “Gene cloning and DNA analysis”, Blackwell science, 4<sup>th</sup> edn, 2001.

#### **REFERENCE BOOKS:**

6. James D.Watson, “Recombinant DNA Technology:, Scientific American books 2<sup>nd</sup> edn, 2001.
7. Sivramiah Shantharam,”Biotechnology, Biosafety and Biodiversity”, Oxford&IBH Publishing co. pvt LTD, 1999.
8. Stephen R.Bolsover, Jeremy S.Hyams, Steve Jones, Elizabeth A.Shephard, Huge A. White, “From Genes to cells”, WILEY, 1997.

9. P.Joshi, "Genetic engineering", Agro bios (India), 2002.
10. Helen Kreuzer, "Recombinant DNA and Biotechnology", American society Microbiology press, 2<sup>nd</sup> edn.
11. Bernard R.Glick, "Molecular Biotechnology", ASM press, Washington, 2<sup>nd</sup> edn, 2001.
12. Sambrook J, Russell D (2001) Molecular Cloning: A Laboratory Manual, 3rd edn. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

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**M.Sc. BIOTECHNOLOGY**  
**SEMESTER- II**

**CC – VII - MEDICAL BIOTECHNOLOGY**

**UNIT I: Genetics in Medical Practice**

Genetic Principles and their application in medical practice; Molecular pathology of monogenic diseases; Genetics of diseases due to Inborn an errors of metabolism;

Genetics of Neurogenetic disorders; Genetic basis of muscle disorders; Genetic disorders of Haemopoietic systems. Genetic basis of eye disorders; Genetics of skeleton & skin disorders; Genetics of Syndromes & Genomic Imprinting; Genetics of Cancers and cancer-prone syndromes.

#### **UNIT II: Syndromes, disorders and infections**

Definition and their genetic basis; Complex polygenic syndromes; Mitochondrial syndromes; Management of genetic disorder; Infections of the Gastrointestinal Tract; Infections of the Respiratory system, Pyrexial Illness; Infections of the Nervous System, Sexually Transmitted Diseases and Congenital Infections; Host pathogen interactions in disease process.

#### **UNIT III: DNA based diagnosis**

Biochemical disorders; Immune, Genetic and Neurological disorders; Molecular techniques for analysis of these disorders; Assays for the Diagnosis of inherited diseases; DNA sequencing and diagnosis; PCR and Array based techniques in diagnosis; Single nucleotide polymorphism and disease association; Two dimensional gene scanning.

#### **UNIT IV: Protein based diagnosis**

Antibody based diagnosis: Monoclonal antibodies as diagnostic reagents; Production of monoclonal antibodies with potential for diagnosis; Diagnosis of bacterial, viral and parasitic diseases by using; ELISA and Western blot. Proteomics based diagnosis: Protein profiling for disease diagnosis; 2D analysis of isolated proteins associated with disease by sequencing individual spots by Mass Spectrometry; Protein Micro array.

#### **UNIT V: Therapies**

Gene therapy, Cellular therapy (Stem cells), Recombinant therapy, Immunotherapy, Gene silencing technology: Antisense therapy, siRNA; Tissue transplantation; Cloning: Ethical issues and organ; Human disease genes; Pharmacogenomics and pharamacogenetics and drug development; Toxicogenomics; Metagenomics.

#### **TEXT BOOK:**

1. Medical Biotechnology- 2nd Edition by V. V. Rao P. Nallari, Oxford publishers, 2010

#### **REFERENCE BOOKS:**

5. Medical Biotechnology- 1st Edition by Judit Pongracz, Mary Keen, Elsevier Health Sciences, 2009
6. Medical Biotechnology- 1st Edition by Bernard R. Glick, Cheryl L. Patten, Terry L. Delovitch, ASM Press, 2014
7. The Gale Encyclopedia of Medicine- second edition by Jacqueline L. Longe, Deirdres. Blanchfield, Gale group, 2002
8. DNA Pharmaceuticals: Formulation and Delivery in Gene Therapy, DNA Vaccination and Immunotherapy- by Martin Schleaf, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim 2005
9. Industrial Pharmaceutical Biotechnology. Heinrich Klefenz, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim 2002.



**UNIT-I Plant Tissue Culture**

Introduction. Totipotency. Laboratory organization, sterilization techniques. Tissue culture media (composition and preparation), Callus and suspension culture; Somaclonal variation; Micropropagation; Organogenesis; Somatic embryogenesis; Embryo culture. Artificial seeds. Protoplast fusion and somatic hybridization; cybrids;

**UNIT-II Plant micro propagation**

Micro grafting –*invitro* clonal multiplication, *in vitro* genetic conservation, Anther, pollen and ovary culture for production of haploid plants. Basic concepts, principles and scope of forest biotechnology. Nursery Technology. Cryopreservation and DNA banking for germplasm conservation.

**UNIT-III Plant Genetic Transformation**

Gene transfer methods in plants: direct and indirect DNA transfer (Binary vectors, *Agrobacterium* mediated gene transfer, *Agrobacterium rhizogens* hairy root culture). Chloroplast transformation and its advantages. Transgene stability and gene silencing. RNAi technology. Transgenics for delayed ripening.

**UNIT-IV Genetic engineering for quality improvement**

Genetic engineering for biotic stress tolerance: Insects, fungi, bacteria, viruses, weeds. Genetic engineering for abiotic stress: drought, salt and temperature.

**Plants as Bioreactor:** Plantibody production – plants as tool for recombinant protein production – vaccine product in plants – Bio – farming. Industrial enzymes, biodegradable plastics, polyhydroxybutyrate, therapeutic proteins, lysosomal enzymes, antibodies, edible vaccines, Phytoremediation.

**UNIT-V Molecular Breeding**

Molecular markers- (RAPD, RFLP, AFLP & Microsatellite markers), Constructing molecular maps - Molecular tagging of genes/traits - Marker-assisted selection of qualitative and quantitative traits. Introduction to Plant genomics (Arabidopsis genome project).

**Text book:**

10. P.K.Gupta, Rastogi Publications, 2005. Plant Breeding Plant Propagation and Biotechnology.

**Reference books:**

13. Adrian Slater, Nigel W. Scott, Mark R. Fowler, Oxford University Press, 2008. Plant biotechnology: the genetic manipulation of plants.

14. Evans et al., 1983 and 1986. Hand book of plant cell culture. Vol. I to Vol. IV.

15. Sharp et al., 1984. Hand book of plant cell culture. Vol.2.

16. Amiratao et al., 1984. Hand book of plant cell culture Vol.3.

17. Dixon, R.AZ.1989. Plant cell culture – A practical approach.

18. Vasil, I.K.1984 to 1988. Cell culture and somatic cell genetics of plants Vol.1 to Vol.5.

19. Bhojwani and Razdan, 1989. Plant tissue culture: Theory and practice.

**M.Sc. BIOTECHNOLOGY  
SEMESTER- II**

**CC - IX ANIMAL BIOTECHNOLOGY**

**UNIT I: Animal Cell, Tissue and Organ Culture**

History – Definitions – steps for preparation of cell culture room, culture Environment (Substrate and Media) – Techniques for establishing of cell lines –insect cell culture – organ and embryo culture–cryopreservation–valuable products. Artificial insemination (IUI, ICSI)–Embryo transfer – cloning. Nuclear transplantation, in-vitro fertilization technology.

**UNIT II: Genetic Engineering in animals**

Transformation of animal cells – Cloning vectors, expression vectors, animal viral vectors and yeast vectors. Transgenic Animals - development and uses - mice, cattle, goat, fish and sheep and transgenic pets. Tendered meat production. Transgenic breeding strategies – Molecular farming (products with strategic importance). Insulin production using GMO. Embryonic stem cell preservation and its uses in endangered animals.

**UNIT III: Pest and Animal Management**

Pest management using Juvenile hormone analogues – pheromones and genetic manipulation. Biotechnology of silkworms. Transgenic silk production – Baculo viruses vector and foreign gene expression- micro array, SAGE, FISH. Biotechnological approach to the production of live feed. Animal management: cat, dog, pig, horse using appealing pheromones and their products.

**UNIT IV: Molecular Markers**

Use of nucleic acid probes and antibodies in clinical diagnosis and tissue typing. Mapping of human genome – HGP (Human genome project). Genetic engineering approaches for the correction of genetic disorders. Human cloning, Gene silencing. Animal right activities Blue cross in India – Society for prevention of cruelty against animals. Ethical limits of Animal use –Human Rights and Responsibilities.

**UNIT V: Application of animal biotechnology**

Animal cell culture based vaccines, production of useful protein in transgenic animal, blood products and hormones, Xenograft and organ culture. Transgenic disease model- Cancer, Alzheimer's, HIV. Regulating DNA technology – DNA barcoding. Regulating food and food ingredients. Patenting Biotechnology inventions – patenting multi-cellular organisms – patenting of fundamental research. Indian and USA patents.

**Text Book:**

1. Singh. B, S.K. Gautam, M.S.Chauhan, and S.K.Singala, 2015, Textbook of Animal Biotechnology, TERI, New Delhi
2. Sasidhara R, MJP Publishers, 2006 Animal Biotechnology

**Reference:**

1. Sateesh. M.K 2010. Biotechnology: V: (Including Animal Cell Biotechnology, Immunology and Plant Biotechnology). 2 nd Edition. New Age International Pvt. Ltd. Publishers.
2. Bernard B. Glick, Jack J. Pastunak. 2009. Molecular Biotechnology principles and application of Recombinant – DNA
3. R. Ian Freshney. 2010. Culture of Animal cells & Manual of basic technique. 6 th Edition. Wiley – Blakwell publication.
4. Ramawat K.G, Shaily Goyal 4<sup>th</sup> Edition 2009 Comprehensive Biotechnology S.Chand Publishers

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**M.Sc. BIOTECHNOLOGY**

**SEMESTER- II**

**CC X Practical covering CC VI - IX**

**Recombinant DNA technology**

11. Isolation and purification of plasmid DNA.
12. Restriction digestion and ligation.
13. Preparation of competent E.coli cells & transformation of E.coli with recombinant DNA.
14. Selection methods (Blue white selection, insertional inactivation).

**Medical biotechnology**

15. Analysis of blood / urine samples for sugars / urea / bile pigments.
16. P.C.R. amplification of DNA: Visualisation by gel electrophoresis.
17. Different types of ELISA.
18. Southern and Western blotting.

**Plant biotechnology**

19. Tissue culture media preparation: Preparation of stock solutions of Murashige Skoog, basal medium and plant growth regulator stocks
20. Selections, Prune, sterilizes and prepare an explants for culture.
21. Isolation of protoplast and culture
22. Micro propagation

**Animal biotechnology**

23. Preparation of Hanks Balanced salt solution
24. Preparation of Minimal Essential Growth medium
25. Cell viability test
26. Chick embryo fibroblast

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**BIOTECHNOLOGY SEMESTER- II**  
**EC-II-Molecular Breeding and Genomics**

**Unit-I Principles of plant and animal breeding**

Breeding for self and cross pollinated crops. Heterosis breeding limitations of conventional breeding. Animal breeding, out breeding and inbreeding, open nucleus breeding systems. Conservation of germplasm, breeding of laboratory animals

**Unit-II Molecular markers**

Genome organization of plants and animals. Restriction based and PCR based molecular markers. DNA profiling using different assays- RFLP, RAPD, AFLP, ISSR, SNP etc. Development of SCAR and SSR markers. Development of ESTs. Molecular markers for genotyping and germplasm analysis

**Unit-III Gene flow in plants and animals**

Development of mapping population - Marker Assisted Selection (MAS), screening and validation; Trait related markers and characterization of genes involved; Mapping genes on specific chromosomes; QTL mapping; Gene pyramiding.

**Unit-IV Molecular breeding strategies**

Marker Assisted Breeding for various traits, Foreground and background selection, gene introgression and pyramiding, Non-gel based techniques for plant genotyping. Genetic fidelity analysis; Settling IPR issues in molecular breeding.

**Unit V Genomic tools and applications**

Structural and Functional genomics, Epigenomics, Nutrigenomics and Metagenomics. NGS analysis for molecular breeding – GBS and RAD sequencing

**Text Books**

1. Hasan Khatib. John Wiley & Sons, 2015. Molecular and Quantitative Animal Genetics. 313 pp.
2. Ashok K. Chauhan, Ajit Varma. A Textbook of Molecular Biotechnology. I. K. International Pvt Ltd, 2009. 1352 pp.
3. Manjit S. Kang. Quantitative Genetics, Genomics, and Plant Breeding. CABI, 2002, 432pp.

**References**

1. Bernard R. Glick, Cheryl L. Patten. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press, 2017. 5<sup>th</sup> Edn. 850pp.
2. J. C. Avise. Molecular Markers, Natural History and Evolution. Springer Science & Business Media, 2012. 511 pp.
3. Joel Weller. Genomic Selection in Animals. John Wiley & Sons, 2016. 192pp.

**A.V.C.COLLEGE (AUTONOMOUS), MANNAMPANDAL - 609 305**  
**M.SC. BIOINFORMATICS**

**EDC-I: FUNDAMENTALS OF BIOINFORMATICS**

**Unit I:** Prokaryotic and Eukaryotic Cells- Structure of Eukaryotic and bacterial chromosomes-General organization of Nuclear and Mitochondrial genomes– Gene structure and function s. DNA as genetic material- DNA structure – Stereochemistry- Repetitive and Satellite DNA; Types of RNA- structure and functions.  
Gene Concept- – Cistron, muton, recon, exon, intron. Gene paradox -Split genes- Pseudogenes; Operon concept. Control of Gene expression- Epigenetics.  
Definition, objectives and overview of Bio informatics; Carriers in Bioinformatics, Bioinformatics in Pharmaceutical Industries- Bioinformatics orientation in IT Industries.

**Unit II:** Protein Structure Primary-secondary- Tertiary-Quaternary- Protein folding and functions-purification and characterization of proteins- Ramachandran plot - Protein secondary structure prediction methods: GOR, Chou-Fasman - Protein Tertiary structure prediction methods: Homology Modeling-Molecular Docking of Protein.  
Structural features of RNA: Primary, Secondary, Tertiary.  
Introduction to RNA Secondary structure prediction - Methods for RNA Secondary structure prediction, Limitations of RNA Secondary structure prediction.

**Unit III:** Understanding and using biological databases: Types of databases, Networks and data bases, Nucleic acid databases (NCBI, DDBJ, and EMBL) - Protein databases (Primary, Composite, and Secondary) - Specialized Genome databases: (SGD, TIGR, and ACeDB) - Structural databases (PDB, MMDB, CATH, SCOP) - Metabolic pathway database (KEGG pathway database) - Concept of metabolome and metabolomics.

**Unit IV:** Sequence analysis of biological data, and model of sequence analysis and their biological motivation, methods of alignment. Pairwise Sequence alignment (BLAST and FASTA Algorithm) and multiple sequence alignment (Clustal W algorithm) - Methods for presenting large quantities of biological data: sequence viewers (Artemis, SeqVISTA) -3D structure viewers (Rasmol, SPDBv, Chime, Cn3D, PyMol), Anatomical visualization. Quantitative Structure Activity Relationship (2D & 3D). High throughput screening, virtual screening, Lipinski's rule of five.

**Unit V:**

Genomics: Genome Annotation, Genome Assembly, Structural and Functional Genomics.

Computer Aided Drug Design (CADD) – Drug Design Approaches – Target based, Structure based and *De novo* Approaches –ADME –Tox Property Prediction and Models.  
Phylogenetic Analysis: Molecular phylogenetics and Evolution. Gene Evolution, Concept of trees, Phylogenetic trees and multiple alignments, Distance matrix methods, characters based methods, steps on constructing alignments and phylogenies. .

**Text Books:**

1. Lesk, A.M. 2007. Introduction to Bioinformatics (Second edition). Oxford University press, New Delhi.
2. Murthy.C.S.V. 2004. Bioinformatics. Himalaya Publishing House. Delhi.

**Reference Books:**

1. Attwood, T.K., Parry-Smith, D.J. Phukan, S. 2014 (Ninth Impression). Introduction to Bioinformatics. Pearson Education, Delhi.
2. Bal, H.P. 2007. Bioinformatics Principle and applications. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
3. Campbell, A.M and Heyer, L.J. 2004. Discovering Genomics, Proteomics and Bioinformatics. Pearson Education, Delhi.
4. Gladis HelenHepsyba, S. and Hemalatha, C.R. 2009. Basic Bioinformatics, MJP Publishers, Chennai.
5. Krane, D.E and Raymer, M.L. 2006. Fundamental Concepts of Bioinformatics. Pearson Education, USA.
  
6. Kumerasan, V. 2009. Biotechnology (Revised Edition), Saras Publications, Kanyakumari.U
7. Lohar, P.S. 2009. Bioinformatics, MJP Publishers, Chennai.
8. Ramawat, K.G. and Goyal, S. 2009. (Fourth Revised Edition). Comprehensive Biotechnology, S.Chand and Company Ltd, New Delhi.
9. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2011 (Third Edition). Bioinformatics Methods and Applications: Genomics, Proteomics and Drug Discovery. PHI Learning Private Limited, New Delhi.
10. Sharma, V., Munjal, A. and Shanker, A. 2011-2012. A Text Book of Bioinformatics. Rastogi Publications.

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**M.Sc., BIOTECHNOLOGY**  
**III SEMESTER**

**CCXI- BIOPROCESS TECHNOLOGY**

**Course outcomes:**

1. Comprehend and apply the inoculum development and strain improvement techniques for a desired fermentation process.
2. Select a fermenter and formulate suitable media for a desired fermentation process.
3. Apply techniques and processes for batch and continuous sterilization and solve related problems.
4. Apply various downstream techniques for product isolation, separation and purification.
5. Conduct experiments for production, isolation and recovery of bio-products.

**Unit-I Introduction to fermentation technology:**

Introduction to fermentation process. Microbial cultures-types; Growth curve and kinetics. Isolation, Screening and selection of industrially useful microorganisms. Strain improvement. Preservation and maintenance of microbial strains. Types of fermentation: Solid substrate fermentation and submerged fermentation

**Unit-II Media formulation:**

Fermentation media: Nutritional requirements, media preparation and optimization. Types of media: Natural and synthetic media. Sterilization: concept and methods. Types of Sterilization: Batch sterilization and Continuous heat sterilization of liquids, Sterilization of air.

**Unit-III Design and construction of fermentors:**

Structure of fermentor, Types of bioreactor: Fluidized bed bioreactors, packed bed bioreactors, tower bioreactors, bubble column bioreactors, Air-lift bioreactors and photo bioreactors . Parameters for measurement and control of bioreactors: Temperature, pH, dissolved oxygen, pressure and foam. Manual control system, Role of physical, chemical & biological sensors, Advanced control strategies viz. PID controllers, Fuzzy logic based controllers.

**Unit-IV Upstream and Downstream processing:**

Upstream Processing: Ideal Reactor Operation: Batch, Fed Batch & Continuous operation of bioreactors. Scale up of Bioreactors: Laboratory, pilot and industrial scale.

Downstream Processing: Biomass separation by centrifugation; filtration; flocculation and other methods; Cell disintegration: Physical; chemical and enzymatic methods; Separation of solid and liquid phases; isolation and purification techniques for end products based on different physico-chemical properties.

**Unit- V Applications of Bioprocess technology:**

Production of antibiotics, enzymes, vaccines and biofuels. Production of milk products- Cheese, Yoghurt, Production of bakery product- Bread, Production of fermented beverages- Beer, Wine & Vinegar, Microbial biomass production: baker's yeast, SCP production. Immobilized cells/enzymes. Bioremediation and waste water treatment: Activated sludge process.

**References**

**Text book:**

1. Kalaichelvan, P. T, and I. Arul Pandi. Bioprocess Technology. 1st ed. Chennai: MJP Pub., 2007.
2. Principles of fermentation technology by P F Stanbury and A Whitaker, Pergamon press.

**Reference Books:**

1. Manual of industrial microbiology and Biotechnology. Demain, A.L., Solomon, and JJ 1996. ASM Press.
2. Principle of Fermentation Technology, Stanbury, P.F., and Whitaker, A., Pergamon, Press, Oxford.
3. Bio chemical Engineering, Alba, S., Humphrey, A.E. and Millis, N.F. Univ. of Tokyo Press, Tokyo.
4. Industrial Microbiology. Reed, C. Prescott and Dann`s. Macmillen Publishers.1982.
5. Microbiology (1961) Alexander.M.,John Wiley & Sons New York.

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**M.Sc. BIOTECHNOLOGY (2018 onwards)**  
**SEMESTER- III**

**CCXII- BIOINSTRUMENTATION**

**Course Objectives:** The objective of this course is to introduce student to basic biomedical engineering technology and to introduce different biological signals, their acquisition, measurements and related constraints.

**UNIT I**

Acid, Base, Buffers; Definition and theories proposed for acids and bases. Titration curves of amino acids, Henderson-Hasselbalch equation and its application, pH meter-principle and applications.

**UNIT II**

Colorimetry; Beer and Lambert's principle, Description of the instrument and techniques. Spectrophotometry – principle, types, Description of the Instrument.

**UNIT III**

Centrifugation; Principle, Type of centrifugation, Description of the analytical and ultracentrifuge, Determination of Molecular weight by sedimentation velocity method, Separation of cell organelles.

**UNIT IV**

Chromatography; Basic principles, Types of chromatography and its applications, Principles of adsorption and partition, Paper chromatography, Adsorption chromatography Ion- exchange chromatography Gel filtration, Affinity chromatography HPLC and GLC.

**UNIT V**

Electrophoresis; Basic principles, Types of electrophoresis and its applications, AGE, SDS-PAGE, Capillary, immuno electrophoresis including isoelectric focusing, PFGE & OFGE. Blotting techniques- Southern blotting, Northern blotting, Western blotting principle and its applications. PCR.-Principle and its types-RT PCR, qRT-PCR, nested PCR. Microarray

**Text books :**

1. Wilson.K and Walker.J Principle and Techniques of Biochemistry and Molecular Biology Cambridge University press 2010
2. Morris and Morris, “**Separation methods in Biochemistry**”, Pitman London , 1963.

**References:**

1. Brawer.I.M, Perce.A.J, “**Experimental techniques in Biochemistry**”, prentice hall foundation, New York, 1974.
- 2 Willard and Merit, “**Instrumental Methods and Analysis**”, John Wiley & Sons, 6<sup>th</sup> edn, 1996.
3. Ewing GW, “**Instrumental methods of chemical analysis**”, McGraw Hill Book Company, 1989.
4. Braun. H, “**Introduction to chemicals analysis**”, McGraw Hill, 1987.

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**M.Sc., BIOTECHNOLOGY**  
**III SEMESTER**

**CCXIII – BIOINFORMATICS**

**Course outcomes**

1. Describe various bioinformatics resources and classify biological databases and their file formats.
2. Construct sequence alignment, analyze and interpret the data.
3. Perform phylogenetic analysis and interpret the data.
4. Perform sequence analysis, restriction site mapping, primer designing and visualization of protein structures.
5. Comprehend and apply the in silico tools towards drug discovery.

**UNIT - 1 BIOLOGICAL DATABASES** – Nucleic acid sequence data bases: NCBI, EMBL, DDBJ. Protein sequence databases- PIR, SWISSPROT, Tr EMBL. Structure databases: PDB, MMDB, MSD. Structure classification databases: SCOP and CATH. Organisms specific databases: OMIM, Fly base, Ecocyc, Arabidopsis. Metabolic pathway databases: KEGG, BRENDA. Open access bibliographic resources and literature databases: PubMed. PMC, BMC.

**UNIT - 2: SEQUENCE ALIGNMENT** – Algorithms in Global Vs local alignment, Dot matrix – Scoring matrices: PAM and BLOSUM Substitution matrices – Alignment scores and gap penalties – Pairwise Sequence Alignments using LALIGN – Database searching tools– BLAST and FASTA algorithms – basic versions. Multiple sequence alignments and analysis – CLUSTALW and TCOFEE - Phylogeny: Concept of dendrograms and its interpretation – Phylogenetic analysis – Maximum Parsimony and UPGMA methods – Phylogenetic trees – Rooted and unrooted trees – Phylogeny programs: PHYLIP, PAUP, MEGA

**UNIT - 3: GENOME ANALYSIS** –Sequence assembly and finishing methods - Sequence assemblers – finishing and visualization programmes - Gene expression analysis - Geo2R - Data collection - Image processing - Measures of expression - Finding significant genes- ORF, Genscan - Clustering approaches – SNP – Types - SNP discovery methods - databases and browsers - Applications of Bioinformatics in Gene Therapy.

**UNIT - 4: PROTEIN STRUCTURE PREDICTION** – Conformational Analysis of proteins – Forces that determine protein structure – polypeptide chain geometries – Ramachandran Map – potential energy calculations – observed values for rotation angles. Protein Structure Visualization Tools: RasMol, Swiss PDB Viewer. Secondary structure prediction methods - GOR, Chou - fasman, Tertiary structure prediction methods –Homology Modeling, Fold Recognition, *Ab - initio* methods – Rosetta – CASP

**UNIT - 5: DRUG DESIGN** – An *in silico* approach: Drug design and discovery an overview – Drug targets - identification and validation Structure and ligand based drug design - virtual screening, Docking – principles, methods and tools – Schrodinger, Discovery studio, Auto Dock. Prediction of ADMET properties .

**Text Books:**

1. S.Ignacimuthu. 2004. Basic Bioinformatics, Alpha Science International Ltd.
2. Baxevanis D and Ouellette BFF, Bioinformatics: A practical guide to the analysis of genes and proteins (3rd Ed), John Wiley & Sons, Inc., 2005.

**Reference Books:**

1. Teresa K. Attwood, David J. Parry –Smith. 2001. Introduction to bioinformatics. 4<sup>th</sup> edition. Pearson Education.
2. Zhumur Ghosh and Bibekanand Mallick, Bioinformatics – Principles and Applications, Oxford University Press, New Delhi, 2008.
3. N.C. Jones and P.A. Pevzner, An Introduction to Bioinformatics Algorithms, Ane Books, New Delhi, 2005.
4. R. Durbin, S.R. Eddy, A. Krogh and G. Mitchison, Biological Sequence Analysis, Cambridge Univ. Press, Cambridge, UK (1998).

**A.V.C. COLLEGE (AUTONOMOUS), MANNAMPANDAL –609 305.**  
**M.sc., BIOTECHNOLOGY**  
**SEMESTER - III**

**CCXIV- RESEARCH METHODOLOGY**

**Unit-I**

**Introduction to research methodology:** Meaning of research, Objectives of research, Research and Scientific methods, Research process, Criteria of research, Defining research problems, Research design, Hypothesis setting, Basic principles of experimental design, Developing research plan, Sample design and its types, Characteristics of sampling procedure.

**Unit II**

**Methods of data collection: Data sources-**Narrative, phenomenological, grounded theory, ethnographic, case study, Journals, Interviews, Focus groups, observations, Periodicals and web sources. Approaches to analysis of data – coding, content analysis. Tools- Questionnaire, Interview, Schedule, Rating scale-qualitative and quantitative measures.

**Unit- III**

**Data processing and analysis:** Frequency distribution, Diagrammatic representation, Probability distribution, Binomial distribution, Poisson distribution, Distribution of data: Normal, Skewness and Kurtosis; Measure of central tendency (arithmetic mean, median, mode, geometrical and harmonic mean), Measure of dispersion (range, mean deviation, variance, standard deviation, coefficient of variation), Central limit theorem.

**Unit- IV**

**Principles and practice of statistical methods in biotechnological research:**

Tests of hypothesis: one-tailed versus two-tailed tests, p-value, type-I and type-II errors, student t-test, paired t-test; Chi-square test: 2x2 contingency table, Goodness of fit test; ANOVA: One-way AND Two-way analysis of variance. Relationships between two variables- correlation and regression, Scatter diagram, Pearson's correlation coefficient, Regression analysis-Linear and Multiple regression; Applications of computer software- MS Excel, SPSS in biostatistics and data management.

**Unit- V**

**Interpretation, Scientific writing and Publications:**

Interpretation-meaning, techniques and precautions in interpretation, Report writing and presentation - Types of research reports-thesis, manuscript and research proposals, guidelines for report writing and formats, appendices, referencing. Publications; h-index, impact factor, SCI, Research grants and fellowships, funding agencies.

**Textbook:**

1. **Research methodology for biological sciences**, Gurumani, 2012.
2. **Research Methodology, Methods and Techniques**, Kothari, C.R. (Vishwa Prakashan, New Delhi, 1985)

**Reference Books:**

1. **Research methodology**, P.Saravanel, Kitab Mahal Publisher, 2009.

2. **Fundamentals of Research Methodology and statistics**, Yogesh Kumar Singh, New Age International Publisher, 2018.
3. **Research Methodology**, Ranjith Kumar, (SAGE Publications, 2014)
4. **Research Methods for the Biosciences**. Holmes, Moody & Dine. Oxford University Press.
5. **Research Methodology**, P.Ravlochanan, Margham Publications, 2012.

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**SEMESTER - III**

**CCXV-PRACTICAL COVERING CC XI-XIV**

**Bioprocess Technology:**

1. Production of citric acid by fungi
2. Production of ethyl alcohol
3. Quantification of ethyl alcohol
4. Immobilization of cells and Enzymes
5. Wine production
6. Production of amylase enzyme
7. Isolation of industrial important microorganism for microbial process
8. Determination of thermal death point and thermal death time

**Bioinstrumentation and Research Methodology:**

1. Estimation of Nucleic acids
2. Cell counting by Hemocytometer
3. Chromatography-Ion exchange, Adsorption and Gel filtration
4. Electrophoresis -Agarose gel, SDS-PAGE
5. Polymerase chain reaction

**Bioinformatics:**

1. Pair wise Sequence Alignments - BLAST
2. Multiple Sequence Alignments - Clustal W.
3. Phylogenetic analysis – Phylodraw.
4. Protein Primary structure analysis – PROTPARAM
5. Secondary Structure Prediction –SOPMA
6. Homology modeling – SWISS Model, CPH
7. Structure Visualization – Rasmol and SPDBV
8. Structure Validation – SAVS.

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**M.sc., BIOTECHNOLOGY**

**SEMESTER - III**

**EC III- AQUACULTURE BIOTECHNOLOGY**

**Objectives:** This course is planned to give basic idea about aqua culture so that one can think of establishing aqua culture as a means for their future.

**Outcome:**

1. Understand the pharmaceutical and biotechnological applications of marine resources.
2. Comprehends the marine biodiversity, threats and conservation policies and conventions.
3. Realize the methods of ecosystem monitoring.
4. Understand the techniques and applications of fisheries and aquaculture

**Unit 1: Marine ecosystem:** Microorganisms-Marine viruses, Bacteria and their significance: unculturable bacteria: occurrence, characteristics and exploitation, Macroorganisms: Hydrothermal vents and marine extremophiles: barophilic halophilic, thermophilic organisms. Marine biodiversity and conservation of endangered species - captive breeding, habitat fragmentation, ecosystem restoration and rehabilitation. Threats to marine biodiversity .

**Unit 2: Biotechnology in Aquaculture:** Culture of shrimp, crab, edible mollusc, oysters and pearl oysters, culture of milkfish, mullets and eel. Culture of livefeed organisms-brine shrimp, rotifers, marine algae. Culture systems and hatchery techniques-Importance of coastal aquaculture; aqua farms; design and construction; criteria for selecting cultivable species; culture types -extensive, semi extensive and intensive culture practices.

**Unit 3: Potent marine resources:** Bioactive compounds from marine organisms (Microorganisms, Sponges, Corals, Bryozoans and Tunicates). Seaweeds as a source of polysaccharides. Biological uses of Omega-3 polyunsaturated fatty acids and production of DHA and EPA from microalgae. Marine hydrocolloids, Marine enzymes, Marine lipids, marine flavourants. Bioconversion of organic materials and fish ensilage.

**Unit 4: diagnostic methods in aquaculture:** GFP characteristics and applications. diseases of cultured shrimp, fish. Probiotics bacteria . Vaccines for aquaculture. PCR and western blot technique for identification of bacterial and viral pathogen in aquaculture. Pharmaceuticals from marine realms, Chromosomal manipulation and sex reversal in fish.

**Unit 5: Marine Process and bioremediation:** Transgenic fish technology- Transgenic fishes with growth hormone (GH) and antifreeze genes, Cloning and expression of GnRH. Quorum sensing. Seafood processing. Marine bioremediation-super bug, removal of heavy metal pollutants, halophiles. Global CO<sub>2</sub> levels and reduction by ocean farming.

**Text book:**

1. **Recent Advances in Marine Biotechnology**, Volume-4, Fingerman.M and Nagabhusanam. R, Science publishers, 2000.
2. **Advances in Marine Biotechnology**, Ninawe.A.S, Joseph selvin and Seghal Kiran.G, LAP Lambert Academic Publication, 2013.

**Reference Books:**

1. **Applied Fisheries** , Q.J.Shammi and S.Bhatnagar, Agrobios Publisher, 2002.
2. **“Frontiers in Marine Biotechnology”**, Proksch and Muller, First Edition Taylor and Francis Publications, 2006.
3. **“New Developments in Marine Biotechnology”**, Le Gal.Y. and Halvorson.H.O, Springer Publisher, 2010.

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**M.Sc. BIOTECHNOLOGY**

**EDC-II APPLIED AND INDUSTRIAL BIOTECHNOLOGY**

**Unit-I**

Bioreactor Design, parts and their functions. Types of reactor. Upscaling of the fermentation process. Regulation of fermentation process. Genetic modification of industrial microorganism. Metabolites from micro-organisms- amino acids and antibiotics, microbial polysaccharides- SCP production and advantages.

**Unit-II**

Agricultural Biotechnology- Genetically modified organisms- phytoremediation. Fertilizers: *Azospirillum*, *Azolla*, *Rhizobium*, *Frankia*, VAM. Petrocrops, Single cell proteins (SCP), Genetic engineering of plant for virus, pest and herbicide resistance, Biopesticide and Biofertilizers.

**Unit-III**

Recombinant DNA proteins and their uses: i) Interferon, ii) Interleukin, iii) Factor VIII, iv) Urokinase and v) Tissue plasminogen activator – Recombinant Medical application of r-DNA technology, human disorders associated with defects in protein/enzyme biosynthesis. DNA probes and their application in diagnostics of genetic and other disorders. Detection of HIV, Hepatitis virus in human.

**Unit-IV**

Environmental Biotechnology – Bioremediation – *In-situ*, and *Ex-situ*. Bioremediation – Use of genetically engineered bacterial strains – Bioremediation of dyes – Bioremediation in paper and pulp industry. Immobilized culture – Bioremediation of heavy metals: Mechanism of metal removal – Bioremediation of coal waste through VAM fungi – Bioremediation of xenobiotics – Recycling of waste water through Microbes.

**Unit-V**

Patenting in different countries. Patenting procedures, Copyrights, Trade secrets, Trade Mark, GATT and TRIPS. Patenting crops, patenting DNA material and patenting fundamental research. GMOs, Laboratory Biosafety level criteria-the four levels.

**Text Book:**

1. **Biotechnology**, R.C.Dubey, S.Chand Publisher, 2017
2. **Biotechnology**, B.D.Singh, Kalyani Publisher, 2018

**Reference:**

1. **Principles of Gene manipulation** (1994) Old R.N. and Primrose S.B.
2. **Industrial Microbiology**. Reed, C. Prescott and Dann's. Macmillan Publishers.1982.
3. **Basic and Agricultural Biotechnology** (1993) Purohit and Mathur.
4. **Biotechnology and patent protection**-oxford and IBH Publishing Co. New Delhi. Beier.F.K., Crespi,P.S and straus.J 1982.
5. **Food Microbiology** (IV Edition) William C. Frazier, Dennis C. We4sthoff