Karnataka State Women's University, Vijayapura

BIOTECHNOLOGY

(M.Sc.)

(I to IV Semesters)

2015-16

DEPARTMENT OF BIOTECHNOLOGY

KARNATAKA STATE WOMEN'S UNIVERSITY, VIJAYAPURA

About M. Sc. Biotechnology at Karnataka State Women's University

M. Sc. Biotechnology Program at Karnataka State Women's University, Vijayapura aims to provide an advanced understanding of the core principles and topics of Modern day Biotechnology, and to enable students to acquire a specialized knowledge and understanding of selected aspects by means of a lecture series and a research project. M.Sc. in Biotechnology provides strong fundamentals of biotechnology and its industrial application. This program will allow students to discover in depth knowledge of animal and plant biotechnology, and also broad area of biochemistry, Immunology and molecular biology. It will also provide the students to develop independent learning skills all biochemical and biotechnology studies, which will help students to apply their knowledge and skills in their future professional areas. This course will help in contributing to the education of academics which impart its effect for university to play an active role in other advanced studies.

Programme Outcomes

After successfully completing this course, the student should be able to:

- Understand the basic knowledge and concepts of biotechnology and other related areas.
- Understand the ability to apply their knowledge for practical which they can conduct independently.
- Apply their knowledge in other advanced subject area like medical biotechnology, immunotechnology, and animal and plant biotechnology for the betterment and advancement of their professional career.
- Learn the theoretical and practical exposure to the basic and the advanced fields of biotechnology.

Program Specific Outcome

PSO1. An education in cell biology will impart knowledge to the students to understand origins of cells and the generation of cell diversity, as well as the common features of cellular structure and function – how they obtain energy, synthesize new molecules, communicate, proliferate and survive. It will also emphasis on the fundamental importance of cell biology in modern science, particularly in relation to cell technologies and health. Basic knowledge of structure and functions of major bio-molecules will be taught.

PSO2. Students will understand the importance of microbiology which is an integrated part of Biotechnology. All the genetic manipulation of genes is carried primarily with the help of micro-organisms, hence, understanding the growth kinetics, their physiology and genetics is needed for

better understanding the Molecular biology and genetic engineering. Students will become familiar with the tools and techniques of genetic engineering.

PSO3. Students will imbibe the importance of plant biotechnology regarding basic as well as advance knowledge about the in vitro culture, maintenance and preservation of plant cells, tissues and organs. Molecular Plant Physiology and Developmental Biology course provides an insight for manipulation of vital plants processes to enhance photosynthesis, to overcome photorespiration, improving nutrient use efficiency and nitrogen fixation. The molecular basis of division and differentiation of plant stem cells into different plant organs has also been covered in this course.

PSO4. The main outcome of the course is to provide basic understanding of immunology and immune responses in response to various infectious and non infectious diseases. Immunology is important subject of Biotechnology, which can help us to better understand human health. This paper can also facilitate to clear NET and JRF exam as many questions are being asked on immunology. In fact, immunology and biology of infectious diseases are two core subjects of Medical Microbiology/Biotechnology that provide a scaffold of medical research. By studying 'Diagnostics', the main goal is to provide the basic idea of diagnosis of infectious as well as non-infectious diseases so that early treatment is initiated to avoid unnecessary morbidity and mortality.

PSO5. The major outcome to study the environmental biotechnology is to understand the current applications of biotechnology to environmental quality evaluation, monitoring and remediation of contaminated environments. An education in environmental biotechnology aid the students to identify and implement solutions to these problems and mitigation of human impact on the environment. Interdisciplinary nature of the bioinformatics course offers substantial.

1st SEMESTER

SYLLABUS FOR M.Sc., IN BIOTECHNOLOGY

PAPER – BT: 1.1 CELL BIOLOGY

45 hrs

About Course:

An education in cell biology will impart knowledge to the students to understand origins of cells and the generation of cell diversity, as well as the common features of cellular structure and function – how they obtain energy, synthesize new molecules, communicate, proliferate and survive. It will also emphasis on the fundamental importance of cell biology in modern science, particularly in relation to cell technologies and health. Basic knowledge of structure and functions of major bio-molecules will be taught. Understanding of metabolic pathways (catabolism as well as anabolism), their diversity and how these are specifically regulated and interrelated in different cells.

Course objectives:

The course is aimed to impart knowledge of structural and functional aspects of cells as unit of living systems. To understand functions of various organelles and transport of information and matter across cell membrane and classical genetics comprising Mendelian laws of inheritance and their significance in genetic diseases.

Course Learning Outcomes (CLO):

Students will be able to

1. Acquire knowledge about the organizational and functional aspects of cell and cell organelles
2. Learn about the interactions of the cells with outside environment through exchange of information and transport of molecules.
3. Learn about the classical genetics and transmission of characters from one generation to the next which will make foundation for the advanced genetics.
4. Develop innovative research ideas for curing genetic disorders in humans.

Detail Contents:

1. Diversity of cell size and shape

2 hrs

2. Cell theory.

1 hr

3. Structure of Prokaryotic and Eukaryotic cells – isolation and growth of cells

2 hrs

4. Types of Chromosomes and molecular anatomy of eukaryotic chromosomes –nucleosomes, organization and significance of polytene and lampbrush chromosomes, chromosomal abnormalities and numerical changes in chromosomes.

8 hrs

5. Cellular organelles, plasma membrane, cell wall, their structural organization; Mitochondria; chloroplast; nucleus and other organelles and their organization.

5 hrs

6. Transport of Nutrients, ions and Macromolecules across membranes.

3 hrs

7. Cellular energy transactions – role of Mitochondria and chloroplast.

4 hrs

8. Cell cycle – Molecular events and model systems mechanism of cell division

4 hrs

9. Cellular responses to environmental signals in plant and animals-mechanism of

Signal transduction.

4 hrs

10. Cell motility – cilia, flagella of Eukaryotes and Prokaryotes.

4 hrs

11. Cellular basis of differentiation and development – mitosis gamatogenesis and fertilization. Development in Drosophila and Arabidopsis; spatial and temporal regulation of gene expression. **4 hrs**

12. Cell to cell interactions, cell adhesion and cell transformation.

4 hrs

References*:*

1. "The molecular Biology of cell" – Alberts, et.al, 1983
2. "Cell structure and function" – Ariel G, et al., 1991
3. "Plant molecular biology" – C.H. Shaw (Ed) 1988
4. "The Chromosomes" – Heslop – Harrison, J.S and Flowell, R.B (Ed) Bio scientific publisher, 1993
5. "The membrane of cells" – Yeagle, L. AP. 1983
6. "Oncogenes" – Cooper, M.Jones and Barlett, 1990
7. "Molecular Cell Biology" – Lodish et, all
8. "Reproduction in Eukaryotic cells" - DM Prescott, Academic press
9. "Development Biology'' – S.F.Gilbart, Sinauer associates Inc.
10. "Cell in Development and inheritance" - E.B.Wilson Mac Milan. NY
11. "The coiled spring" - Ethan Bier, cold spring Harbor press
12. "Fertilization" - FT Long, Chapman and Hall
13. "Molecular Biology of steroid and Nuclear Hormone Receptors" - L P Freedman, Birkhuser.

1ST SEMESTER

SYLLABUS FOR M.SC., IN BIOTECHNOLOGY

BT: 1.2: COMPUTATIONAL BIOLOGY

48 Hrs

About course:

The course is designed to aim at imparting a basic level appreciation programme. After completing the course the incumbent is able to the use the computer for basic purposes of preparing his personnel/business letters, viewing information on internet (the web), sending mails etc

Objective of Course

1. To study the process management and scheduling.
2. To understand various issues in Inter Process Communication (IPC) and the role of OS in IPC.
3. To understand the concepts and implementation Memory management policies and virtual memory.
4. To understand the working of an OS as a resource manager, file system manager, process manager, memory manager and I/O manager and methods used to implement the different parts of OS
5. To study the need for special purpose operating system with the advent of new emerging technologies

Course Learning Outcomes (CLO):

Students will be able to

1. Describe the important computer system resources and the role of operating system in their management policies and algorithms.
2. Understand the process management policies and scheduling of processes by CPU
3. Evaluate the requirement for process synchronization and coordination handled by operating system
4. Describe and analyze the memory management and its allocation policies.
5. Identify use and evaluate the storage management policies with respect to different storage management technologies. 6. Identify the need to create the special purpose operating system.

Detail contents:

Computers for Biologists:

1. Computer Organization – Fundamentals of computers – Block diagram of computer (input and output devices) – Generations - Advantages and Limitations of Computers - Basics of operating systems & Windows, Application Softwares. **4 hrs**

2. Network Basics – Communication Technology – Networking – LAN, WAN & MAN, Intranet–Wireless communication – Internet. **3 hrs**

3. Ms-Office – Introduction to M.S. office package - Word – creating a new document – templates and wizards – scientific data representation and basic calculations with EXCEL - Creating Tables and databases using Access – interactive presentations creating using Power Point **15 hrs**

4. Internet Technologies – Web Services – WWW, URL, DNS - Servers-E-mail server, WEB servers, Browsers-IP Addressing **5 hrs**

Mathematics for Biologists:

1. Algebra-Logarithms, Quadratic equations, solutions of a system of linear equations (simple problem) **3 hrs**

2. Matrices: Different types of Matrices-addition, subtraction and multiplication of Matrices- Transpose of a matrix- singular matrix – inverse of a matrix. **5 hrs**

3. Analytical Geometry: straight line-slope of a line- intercepts of a line- equation of a line- intersection of a line- angle between two lines- circle, ellipse and parabola (definition and simple examples).

8 hrs

4. Calculus: The concept of limit- Derivatives of simple, standard functions- Geometrical application of differentiation- Maxima and minima: definite and indefinite integrals (simple examples)

5 Hrs

Reference:

1. Sherman, J. (2001) "Basic Computer Skills made easy", Butterworth-Heinemann Ltd, USA

2. Balaguruswamy, E. (1985) "Computer Fundamentals and Applications", Second Edition, Tata McGraw-Hill Publishing Co. Ltd., India.

3. Horwitz, E. and Sahni, S. (1978) "Fundamentals of Computers", Second Edition, WH Freeman & Co., USA.

4. Microsoft Office Manual

5. Narayanan,S and Manicavachaagam Pallai, T.S. (1993) " Calculus" , Vol I and II, Vishwanathan Printers and Publishers.

6. Veerarajan, T . (2003) "Engineering Mathematics" III Ed., Tata McGraw Hill Publishing Co Ltd New Delhi.

7. Veerarajan, T . (2003) "Trignometry, Algebra and Calculus" III Ed., Tata McGraw Hill Publishing Co Ltd New Delhi.

8. Sharma,A.K. (2005) "Text book of Integral Calculus" Discovery Publicating House.

9. Grewal, B.S., (2000) "Higher Engineering Mathematics" 37th Ed., Khanna Publishers, New Delhi.

1St SEMESTER

SYLLABUS FOR M.SC., IN BIOTECHNOLOGY

PAPER –BT: 1.3: BIOCHEMISTRY

45 hrs

About Course:

Biochemistry is the application of chemistry to the study of biological processes at the cellular and molecular level. It emerged as a distinct discipline around the beginning of the 20th century when scientists combined chemistry, physiology, and biology to investigate the chemistry of living systems.

Course objective:

The Students will know how the collection of thousands inanimate molecules that constitute living organisms interact to maintain and perpetuate life governed solely by the physical and chemical laws as applicable to the nonliving thing.

Course Learning Outcomes (CLO):

Students will be able to

1. Know the chemical constituents of cells, the basic units of living organisms.
2. Explain various types of weak interactions between the biomolecules.
3. Know how the simple precursors give rise to large biomolecules such as proteins, carbohydrates, lipids, nucleic acids.
4. Correlate the structure-function relationship in various biomolecules
5. Know the role of biomolecules for orderly structures of the cells/tissues.

Detail Contents:

1. Structures of atoms:

Structures of atoms, molecules and bonds, principles of physical chemistry, thermodynamics, kinetics, dissociation and association, constant:, chemical foundations of biology, pH, pK, acids, bases and buffers, Henderson – Hasselbach equation. **4 hrs**

2. Chemical Bonds:

Covalent and non-covalent interactions, Vander –Wall forces, electrostatic and Hydrogen bonding and hydrophobic interactions, **2 hrs**

3. Energy metabolism:

Thermodynamic principles in biology, energy rich bond, weak interactions, coupled reactions and oxidative phosphorylation, group transfer, biological energy transducers, bioenergetics. **2 hrs**

4. Polysaccharides:

Classification, occurrence, isolation, purification, properties and biological reactions. Structural features of homoglycans, heteroglycans and complex carbohydrates. **4 hrs**

5. Proteins:

Amino acids and peptides: Classification, chemical reaction, physical properties. Peptide bond, primary structure of proteins, structural comparisons at secondary and tertiary levels, conformations of proteins and polypeptides, (Secondary, Tertiary, quaternary domain structure) **8 hrs**

6. Lipids:

Classification, Structure and functions: Triglycreides: Phospholipids, steroids and Terpenes, Glycolipids and Lipoprotines- Structure and function. Role of lipids in Biomembranes. **3 hrs**

7. Nucleic acids:

Structure of double stranded DNA (B, A, C, D,T and Z-DNA), the biological significance of double strandedness, sequence dependent variation in the shape of DNA, Physical properties of double stranded DNA. Types of RNAs and their biological significance. DNA Bending, DAN supercoiling. **6 hrs**

8. Enzyme Kinetics:

Regulation of enzymatic activity, Kinetics and thermodynamic analysis, effects of organic solvents on enzyme catalysis and structural consequences. Active sites: coenzymes, activators and inhibitors, isoenzymes, allosteric enzymes; Ribozyme and abzyme: Structure and drug targets (Enzymes and receptors); Prodrug delivery using enzymes; bioluminescence, Denaturation and renaturation of proteins. Lysozyme-structure, enzymatic activity, mechanism of lysozyme action). **8 hrs**

9. Intermediatory metabolism:

Glycolysis and TCA cycle; Glycogen breakdown and synthesis; Gluconogenesis; interconvertion of hexoses and pentoses: co-ordinated control of metabolism; Biosynthesis of purines and pyrimidines; oxidation of lipids; Biosynthesis of fatty acid; Triglycerides, Phospholipids; sterols. **8 hrs**

References:

1. "Principles of Biochemistry" –Smith et al., McGraw –Hill International Book company, 8th Ed

2. "Principles of Biochemistry" -Lehninger, \Nelson, Cox, CBS Publishers.

3. "Fundamentals of Biochemistry" – Voet et al., John Wiley and Sons, Inc.

4. "Biochemistry"- zubay, WCB Publishers.

5. "Harper's Biochemistry" – R.K.Murray, D.K.Granner, P.A.Mayes and V.W.Rodwell, Prentices Hall International.

6. "Biochemistry"- L.Stryer.

1st SEMESTER

SYLLABUS FOR M.Sc., IN BIOTECHNOLOGY

PAPER – BT: 1.4 BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES

45 hrs

About Course:

Biophysics, also known as biological physics, is an interdisciplinary science that applies the principles of physics and chemistry and the methods of mathematical analysis and computer modeling to understand how the mechanisms of biological systems work.

Course Objective:

Introduce the Students to the fundamental concepts of physics applicable in biological systems.

Course Learning Outcomes (CLO):

Students will be able to

1. Concept of electromagnetic radiation, absorption spectrum, Beer's law and Lamberts law
2. Principle, working and applications of spectrophotometer and AAS
3. Concepts of chromatography and concept of partition coefficient
4. Principle, methodology and application of various chromatographic techniques
5. Principle, methodologies and application of electrophoric separation of biomolecules.

Detail contents:

1. Scope of Biophysics, Physical laws, Interaction of living and non-living matters, chemical foundations of Biophysics **2 hrs**

2. Characterization of biological macromolecules, Hydrodynamic properties of biomolecules - Viscosity, Diffusion, Osmosis, Partial specific volume and Donnon effect **3 hrs**

3. Microscopy: Principles of microscopy, Light, Phase-contrast, Fluorescent, X-Ray, UV, Transmission and Scanning electron microscope, Confocal microscopy. **2 hrs**

4. Preparation of specimen for microscopy: Microtome techniques, Fixation, Embedding, Sectioning and staining for light and electron microscopy. **2 hrs**

5. Separation methods- Chromatography – (Principles and Applications) Paper, Thin layer, Column, Gel filtration, Ion-exchange, Affinity, HPCL and GLC. **5 hrs**

6. Centrifugation: Preparative and Analytical Centrifuges, rotors, sedimentation analysis, Rate- Zonal and equilibrium gradient centrifugation, Ultracentrifugation, Sub-Cellular fractionation. **4 hrs**

7. Electrophoresis: Types of electrophoresis, Paper and Gel (Strach, Acrylamide and Agarose) Electrophoresis, Capillary, Disc and Slab, Vertical gel electrophoresis, Isoelectrofocussing, Immunoelectrophoresis, Pulse-field Gel electrophoresis, Blotting of nucleic acids and proteins from gels to solid support. **5 hrs**

8. Concentration of Macromolecules: Salting out, Ammonium sulphate method, Flash evaporation, Lyophyllization, Pressure dialysis, Reverse dialysis, Hollow fiber membrane and Reverse osmosis. **4 hrs**

9. Spectroscopy, Photobiophysics, Electromagnetic spectrum of light, simple theory of absorption of light by biomolecules, Beer-Lambert's law, types of detectors, UV-Visible spectroscopy, Infrared spectroscopy, Raman spectroscopy, Fluorescent spectroscopy, Flame photometry, Atomic absorption, plasma emission mass, ESR and NMR spectroscopy, ORD and CD. X-Ray crystallography, Biological importance of Lasers, Microwaves and Radiations **10 hrs**

10. Radio isotope techniques: Nature of radioactivity, detection and measurement. GM counter and Scintillation counter, Auto radiography, Safety aspects and applications **3 hrs**

11. Automatic analyzers for amino acids, Proteins sequenator, Nucleotide sequencing system, peptide and Poly nucleotide synthesizers. **2 hrs**

12. Methods of detection and quantitative of macromolecules: Detection on gels- staining procedures for proteins, nucleic acids, carbohydrates, pigments etc, Zymograms, Densitometric methods and Transilluminators. **3 hrs**

References:

1. Upadhyay. A., Upadhyaya, K., and Nath , N., 1995, Biophysical chemistry. Himalayan publishing house.

2. Pattabhi, V., and N. Goutham, 1999. Biophysics Narosa publishing house.

3. Friefelder, D., 1990. Physical Biochemistry. 2nd Ed. W.H.

4. Jayaraman, J., 1988. Laboratory manual of Biochemistry. Wiley Eastern limited, New Delhi.

5. Boyer, R.F., 2001 Modern experimental Biochemistry 3rd Ed. Benjamin/Cummins Publications Co.

6. Wilson and Walker, J. 1995 Practical Biochemistry principles and techniques. Cambridge University press.

7. Holde, K.E., Holinson, W.C and Shwig House of Pub. 1998. Principles of physical chemistry. Prentice-Hall Inc. New York.

8. Hobson, D. and Pick, H. 1998. Analytical 3rd Ed. Addison Wisley Longman, Essentials

9. T.A. Brown Molecular biology.LABFAX. 2nd – TBA.

10. Micklos, D. DNA science – A first course 2nd

PRACTICALS
1st SEMESTER

PRACTICAL BT: 1.1A: CELL BIOLOGY (BASED ON THEORY PAPER BT: 1.1)

1. Separation of cell organelles.

2. Isolation of chloroplast DNA from plant tissue.

3. Study of cell cycle, cell counting and viability test.

4. Chromosomes analysis and Karyotype study.

5. Study of polytene chromosomes.

6. Sub-Cellular fractionation and marker enzymes.

7. Histochemical techniques.

8. Mitosis and Meiosis.

PRACTICAL BT: 1.1B: COMPUTATIONAL BIOLOGY (BASED ON THEORY PAPER BT: 1.2)

1. DOS Commands – Internal Commands: Viewing a directory, Changing Directory, Renaming a Directory – File operations: Creating files, removing a file, renaming files, viewing a file External Commands: Copying a disk, Comparing disks

2. Overview of different versions of windows – working with windows – Desktop Basic Layout, Icons, opening Windows, Window Characteristics, Window Controls, Resize Windows, Arrange Windows, Taskbar.

3. Working with Programs: Basic Program Layout, WordPad Program, Scrolling in Documents, Moving Insertion Point, Delete & Insert Key, Selecting Text, Cut, Copy & Paste, Working with Multiple Programs.

4. Files & Folders: Organization, View Folder Structure, Working with Folders, Search for Files, Organizing Workspace – Personal Desktop, Shortcuts, Start Menu, Start Properties Display as Menu, Taskbar, Quick Launch.

5. Windows Properties – Navigating Control panel, Changing Theme, Desktop Settings, Screen Saver Settings, Appearance Settings, Display Settings and Mouse Settings.

6. Working with Documents: Creating a document, Manage files and folders for documents, working with icons, editing documents – Text formatting and alignment, Indentation.

7. Paragraph formatting – Margins, tabs and page numbering.

8. Working with tables and borders – Printing – Working with images and Text – Find and replace text – Mail merge.

9. Creating and formatting a presentation – Creation of a new Presentation, adding sliders and Text to a Presentation, editing slide text, saving a presentation and running a slide show, Adding tables and charting data – Modifying objects and adding images, prepare to deliver a presentation.

10. Creating and modifying a worksheet – Formatting worksheets – Working with multiple worksheets – Performing calculations.

11. Surfing information using search engines, saving web pages to a disk, composing E-mail and sending E-mail

PRACTICAL BT: 1.2A: BIOCHEMISTRY (BASED ON THEORY PAPER BT: 1.3)

1. Qualitative and quantitative analysis of carbohydrates.

2. Qualitative and quantitative analysis of proteins.

3. Qualitative and quantitative analysis of amino acid.

4. Qualitative analysis of nucleic acids.

Biochemical preparations:

1. Fractionation of egg proteins
2. Disruption of plant/animal/microbial cells by mechanical, Enzymatic, Osmotic methods and extraction of intracellular proteins

PRACTICAL BT: 1.2B BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES (BASED ON THEORY PAPER BT: 1.4)

1. Chromatographic analysis of amino acids, lipids, sugars, nucleotides and plant pigments using – Paper, Thin layer and Column chromatography**.**

2. Electrophoresis techniques
a) Paper electrophoresis
b) Electrophoresis of serum proteins using cellulose acetate films and PAGE.
c) Determination of molecular weight by SDS – PAGE
d) Agarose gel electrophoresis for separation of nucleic acids
e) *In situ* localization of enzymes on PAGE (amylase)

3. Determination of molecular weight of proteins by gel filtration chromatography and PAGE.

4. Estimation of vitamins – thymine / niacin / vitamin C / vitamin A

5. Extraction and estimation of lignin

6. Liposome preparations, sonication, light scattering, uni-lamellar and multi lamellar vesicles

7. Measurement of radio activity GM counter/scintillation counter

8. Demonstration of separation techniques – HPLC, GLC and FPLC.

2nd SEMESTER

PAPER –BT: 2.1: MOLECULAR GENETICS

About Course:
Molecular genetics focuses on DNA, RNA and protein synthesis in cells and is closely related to the fields of cell biology, genetics, genomics, and biochemistry. ... Cells manufacture proteins and are the manifestation of genetic information.

Course Objective:
To understand storage of genetic information and its translation at molecular level in prokaryotic and eukaryotic systems. The course also aims to make Students understand intricate molecular mechanisms of carcinogenesis and apoptosis and their applications.

Course Learning Outcomes (CLO):
Students will be able to
1. The genomic organization or living organisms, study of genes genome, chromosome etc.
2. The mechanism and essential component required for prokaryotic DNA replication.
3. The fundamentals of DNA damage and repair, including types of mutation and repair mechanisms.
4. The Transcription, enzymes involved in transcription and its inhibitors.
5. The concept of operon and its structure and regulation.

Detail contents:

45 hrs

1. Genes and genome: **4 hrs**
Mandelian Laws of Inheritances; Unit of Heredity, Genes, Alleles, Multiple alleles, Cis and Trans test.

2. Genetic material: **4 hrs**
Nucleic acids as genetic material, chemical nature of DNA and RNA; Types of DNA and RNA.

3. DNA Replication: **4 hrs**
Prokaryotic and Eukaryotic DNA replication. Mechanism of DNA replication, enzymes and accessory proteins involved in DNA replication.

4. Mutation: **5 hrs**
DNA Damage, repair and molecular mechanism of recombination.

5. Transcription: **6 hrs**
Central dogma, role of DNA in Protein synthesis, general feature of RNA synthesis, RNA polymerase, mechanism of transcription in Prokaryotic and eukaryotic. Post transcription, modification of RNAs capping and poly adenylation, split gene – Introns, exons and splicing, reverse transcription.

6. Translation: **6 hrs**
Genetic code and its elucidation, Wobble hypothesis, structure and composition, of Prokaryotic and eukaryotic ribosome, structure of mRNA and tRNA. Events of Protein synthesis, (Amino acid activation, initiation, elongation and termination) in Prokaryotic and Eukaryotic. Post -Translation modification of proteins, inhibitors of translation.

7. Regulation of Gene expression: **4 hrs**
The Operon concepts, Lactose Operon,Tryptophan Operon and catabolic repression, steroid induced gene expression.

8. Molecular Mapping of Genome: **6 hrs**

Physical maps, Physical Mapping and map Based cloning, choice of mapping, Population, simple sequence repeat loci, southern and florescence *in situ* hybridization for genome analysis, RFLP, RAPD, AFCP analysis and application.

9. Genome sequencing: 6 hrs

Genome sizes, Organelle genomes, Genomic library, YAC, BAC Libraries, Strategies for sequencing genome-Packaging, transfection and recovery of clones, Application of sequence information for identification of defective genes.

References.

1. Tamarin, R.H, (2000): Principles of genetics, 6th Ed. WMC Brown Publications, London.
2. Snustad,P.D. Simmons,M.J (2000) Principles of genetics, 2nd Ed, John Wiley and Sons. Inc, New York.
3. Fairbanks, D.J. and Andersons, W.R. (1999), Genetics- Continuity' of Life, Books and Cole Publication Company, New York.
4. Lewin, B (2000): GENES Vol VII Oxford University Press, New York
5. W,M. (2000) An Introduction to Genetic Analysis, 7th Ed, W.H.Freeman New York
6. Streips and Yasbin, Modern Molecular Biology. (2001) Niley Limited.
7. Lodish,H.D., Boltimore,A.Berk,B.L., Zipursky,P. Mastsydairs and J,Darnell (2004): Molecular Cell Biology, Scientific American Books Inc, New York.
8. John Ringo (2004), Fundamental Genetics, Cambridge University Press.
9. Klug, W.S. and Cummins: Concepts of Genetics, 7th Ed (2003) Pearson education.
10. Howell, S.H., (1998): Genetics and Plant Development, CAB Cambridge.

11. Winter,P.C, Hickey, G.I and Fletchear,H.I (1999) Instant notes in Genetics Viva Books Private limited, New York.
1**2.** Strickberger,M.W (2000) Genetics Prentice –Hall of India private ltd, New Delhi.
13. Brown,T.A. (1998) Genetics – A molecular approach 3rd Ed, Chapman and Hall, London.
14. Miesfeld,R.L (1999) Applied molecular genetics, John Wiley and sons Inc, New York.

BT: .2.2: MICROBIOLOGY

About Course: **48 hrs**

Microbiology is a broad discipline that involves the study of the biology of bacteria, viruses, protozoa and fungi. The main focus of the course is the pathogenic potential of the organisms that cause disease in man. The course also covers aspects of the biochemistry, physiology and genetics of microorganisms.

Course objective:

To provide fundamental understanding of the microbial world, basic structure and functions of microbes, metabolism, nutrition, their diversity, physiology and relationship to environment and human health. To impart practical skills of isolation and manipulating conditions for their propagation.

Course Learning Outcomes (CLO):

Students will be able to

1. Concept, principle and types of sterilization methods
2. Concept and characteristics of antiseptic, disinfectant and their mode of action
3. Concept of culture and type of culture
4. Cultivation methods of bacteria, yeast, fungi and virus
5. Principle, working and applications of instruments viz, pH meters, spectrophotometer, centrifuge, viscometer, and laminar air flow

Detail contents:

1. SCOPE AND DEVELOPMENT OF MICROBIOLOGY: **3 hrs**

Characteristics and classification of microorganisms, Structure of Prokaryotic and eukaryotic microorganisms.

2. STERILIZATION TECHNIQUES: **2 hrs**

Physical and chemical methods.

3. MICROBIOLOGICAL MEDIA: **5 hrs**

Definition, components, types and preparation of enrichment and preservative media, Cultivation of microorganisms- culture media, Isolation of microorganisms- serial dilution, streak plate, pour plate and spread plate method. Characterization and identification of colonies, preservation of culture.

4. STAINING TECHNIQUES AND METHODS IN MICROBIOLOGY: **4 hrs**

Staining – simple and differential, fluorescent, negative staining and structural staining – capsule, spore and cell wall and reserve food material.

5. NUTRITION AND GROWTH: **4hrs**

Nutritional requirements, growth and growth curve- counting of bacteria, synchronous growth and continuous culture growth as affected by environment factors.

6. GENERAL CHARACTERS OF MICROORGANISMS: **2 hrs**

General characters of viruses, Prokaryotes (Bacteria, Rickettsia, Mycoplasma and Blue Green Algae) and Eukaryotes (Protozoa, algae and Fungi)

7. BACTERIOLOGY: **4 hrs**

Ultra structure and classification of bacteria Importance of Archaea in Bacteriology (Halophiles, Methanogenes, Hyperthermophillic, Archaea, Thermoplasma).

8. VIRUSES: **4 hrs**

Structure, Classification, cultivation and replication of viruses example of herpes, pox, Adenoviruses, Retroviruses, viriods and prions.

9. FUNGI: **4 hrs**

Structure, Classification of fungi- Typical study of Pencillium and Yeast.

10. MICROBIAL DISEASES: 4 hrs

Diseases reservoirs- Epidemiological terminologies, infectious and disease transmission, Respiratory diseases caused by bacteria and virus- Tuberculosis, sexually transmitted diseases- Gonorrohoea, Syphilis, AIDS. Diseases transmitted by animals- (Rabies, and Plague). Insects and Ticks- Richettsia, lyme diseases and Malaria, food and water borne diseases, Public Health and water quality, pathogenic Fungi.

11. ANTIBIOTICS AND CHEMOTHERAPY: 2 hrs

Antimicrobial Agents- Factors influencing antimicrobial activity and phenol Coefficient test. Definition and classification of antibiotics- Penicillins and Cephalosporins. Broad – spectrum antibiotics, Antifungal antibiotics, mode of action.

12. FOOD MICROBIOLOGY: 4hrs

Microbes in food, food spoiling and toxins.

13. PLANT MICROBE INTERACTION: 2 hrs

Rhizosphere, Phyllosphers and Sphermosphere microbes, Plant growth promoting bacteria (PGPR) Legume spmbiosis, endophytes –VAM.

14. General account of soil, aquatic and atmospheric microbiology. **2 hrs**

References:

1. Pelczar, M.J.Chan, Eosa and Kreig, N.R, 1993, Microbiology Mcgraw Hill Inc, New york.
2. Prescott, L.M. Heviey,J.P. and Klein,D.A., 1996, Microbiology, WMC Brown Publishers, New York.
3. Holt,J.S.Krieg, N.R.Sneath, P.H.S. and Williams,S.T. 1994 Bergey's manual of systematic Bacteriology, 9th Ed Williams and Wilkins, Baltimore.
4. Sullia,S.B., and Shantaram,S. 1998 General Microbiology, Oxford IBH, New Delhi.
5. Microbiology : Fundamentals and Applications. Purohit. Agrobois.
6. Edward Alcamo.I. 1997, Fundamentals of Microbiology 5th Ed, Adelison Wesley Longman. Inc New York.
7. Madigan,M.T., Martinco,J.M. and Parker.J. 1997 Brock Biology of Microorganisms. 8th Ed. Mcgraw Hill Inc, New york.
8. Matthews, R.E.F. 2005 Plant virology.
9. Alexander. 1997. Introduction to soil Microbiology, John Wiley and sons Inc, New York.
10. Frazier, W.C. and Westhaff, D.C.1998 Food Microbiology, TATA Mcgraw Hill, New Dehhi Publications

PAPER-2.3: IMMUNOLOGY AND IMMUNOTECHNOLOGY

About Immunology: **45 hrs**

Immunology as a Medical course manages physical, chemical and physiological characteristics of the components of the immune system. Immunology is the branch of biomedical science that deals with the study of an organism's immune system, in both health and disease.

Course Objective:

The objective of this course is to provide Students with detail understanding of different cells of the immune system and their role in immune protection as well as application of immunological techniques. The course will provide knowledge about role of immune system in pathogenesis of cancer, autoimmune disease, AIDS and different infectious diseases.

Course Learning Outcomes (CLO):

Students will be able to

1. Immunology, immune system, properties of immune system, types of immunity
2. Concept of antigen, antigenic determinants, hapten, factors affecting antigencity
3. Immunoglobulin, structure, types and functions
4. Basic of bioprocess technology, concept and significance of bioprocess technology, concept of bioreactor, designing of fermenter and types of fermentation.
5. Screening of microorganisms, storage and preservation of industrially important microorganisms
6. Culture collection and culture collection centres, national: NCIM, MTCC and international ATCC

1. Introduction: **1 hrs**

The Immune system – innate and adaptive immunity.

2. Cells and organs of immune system: **3 hrs**

Phagocytes, lymphocytes, T-cells, B-cells, Cytotoxic cells, lymphoid organs, thymus of fabricus spleen , lymph nodes, lymphatic system, Mucosa Associated Lymphoid Tissue (MALT) lymphocytes traffic, cytokines, chemokines, interleukins, interferons.

3. Antigen: **3 hrs**

Self and non-self recognition, antigenicity and immunogenecity, epitope mapping, paratopes, nature of B-cell and T-cell epitopes, haptens, carbohydrate antigens, blood group antigens and synthetic peptides as antigens.

4. Immunoglobulin molecule: **4hrs**

Structure, classes and function of Ig molecules, isotypes, antibody diversity, tIg supergene family complement fixing antibiotics and compliment cascade.

5. T-cell activation: **3 hrs**

Development, helper cell, cytotoxic cell, autoreactive T-cells and memory T-cells. Hybridoma

6. Cytokines: **2 hrs**

Structure, receptors and signal transduction, modulation of immune response, cytokine profile of disease.

7. Humoral response: **3 hrs**

Primary and secondary immune response, cell mediated immune response, balance between humoral response complementary system.

8. Antigen – Antibody interaction and immunotechnology: **4 hrs**

Valency of antigen, precipitin, agglutination reactions, Affinity, avidity and cross reactivity. Immuno double – diffusion, Inmmunoelectrophoresis, single radial immunofusion, haemagglutination and complement fixation, direct and indirect immunofluorescence.

9. Hypersensitive reactions: **3 hrs**

Type – I (Ig E), Type – II (Ig mediated), Type – III (Immuno complex mediated), Type – IV (Cell mediated) reaction.

10. Autoimmune response: **2 hrs**

Animal and human models, role of MHC & T-cells, Prevention of autoimmune response

11. Major Histocompatibility complex and Tumor Immunology: 4 hrs

Structure and functions of MHC and the HL – A systems, Gene regulations and Ir – genes. Tumor immunology – tumor specific antigens and Immuno response to tumors. Theory of surveillance, immune diagnosis of tumor, tumor markers – alpha foetal proteins, Carcino embryonic antigen cells etc, genetic control of immune response.

12. Immune responses and transplantation: **4 hrs**

Immunity to bacterial, viral and protozoan infections with suitable examples, HL – A and tissue transplantation. Tissue typing methods for organ and tissue transplantations in humans. Graft versus Host reaction and rejection, autoimmunity, xeno transplantation, immunosuppressive therapy. Autoimmune diseases – Hashimoto's diseases, systemic lupus erythematosis, Multiple sclerosis, Myasthenia gravis and their treatment.

13. Immune regulation: **3 hrs**

Introduction, Immunosuppression, tolerance, immunopotentiation.

14. Immunobiotechnology: **7 hrs**

Hybridoma technology – immunization of animals, Isolation of stimulated spleen cells, myeloma cell lines used and fusion partners, fusion methods, production, detection and applications of monoclonal and polyclonal antibodies, conventional vaccines, viral vaccines, peptide vaccines, genetically engineered vaccines. Production and applications of lymphokines.

References:

1. Abbers, A.K, Lichtman, A.H, Pobers, J.S (1998): Cellular and molecular Immunology. W.B, Sounders company. Philadelphia.
2. Iven Roitt (1993): Essentials of immunology. Black Well scientific Publications, Oxford.
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4. Roitt, Brostoff. Male: Immunology 7th Ed. Panima book distributors, New Delhi.
5. Paul, W.E, (1990) Fundamental Immunology. Raven Press New York.
6. Kuby Immunology 4th Ed.
7. Immunology by Eli Benjamin, Richard Coico, Geoffrey Sunstine. (2000).
8. Klaus D. Elgert (1996). Immunology – Understanding of immune system. Wiley – liss New York.
9. Tizard, I.R (1995) Immunology 4th Ed. Sounders College Publication.
10. a) BIOTOL – Series (1993) Cellular interactions and immunobiology Butterworth- Heinemann.
    b) BIOTOL–Series (1993) Technological applications of immunochemical Butterworth-Heinemann.
    c) BIOTOL – Series (1993) Defense mechanisms. Butterworth - Heinemann.
11. Medical microbiology – Cruick Shank et al.
12. Hand Book of Experimental Immunology – D.M Weir (Ed) Vol 1 – 5.

PAPER –BT: 2.4: BIOINFORMATICS

45 hrs

Course Objective:

The objective of this course is to familiarize Students with basic concepts of sequences, structural alignment, database searching, protein structure prediction and computer-based drug designing. The course will also provide understanding of the fundamentals of statistics, methodology and theory of statistics and their application for solving the problems in the field of life sciences.

Course Learning Outcomes (CLO):

Students will be able to

1. Perform alignment of sequences and construct the matrix for alignment based on dynamic programming
2. Construct the phylogenetics of different sequences.
3. Analyze sequence and structure of bio-macromolecule data
4. Edit the three dimensional structure of protein using structural bioinformatics tools
5. Classify various types of data and apply basic statistical concepts such as measures of central tendencies, measures of dispersion and sampling.
6. Use concepts of probability, probability laws, probability distributions and apply them in solving biological problems and statistical analysis

Detail contents:

1. BIOLOGICAL SEQUENCE DATABASES: 8 hrs

Overview of various primary and secondary databases that deal with protein and nucleic acid sequences. Databases to be covered in detail are GenBank, EMBL, DDBJ, SwissPort, PIR, and MIPS for primary sequences. Various specialized databases like TIGR, Hovergen, TAIR, PlasmoDB, ECDC etc., will be discussed. Preliminary ideas of query and analysis of sequence information.

2. SEQUANCE MCOMPARISON METHODS: 8 hrs

Method for the comparison of two sequences viz., Dot matrix plots, Needleman-Wusch and smith –Waterman algorithms. Analysis of computational complexities and the relative merits and demerits of each method. Theory of scoring matrices and their use of sequence comparison.

3. DATABASE SEARCH ALGORITHMS: 5 hrs

Methods for searching sequence database like FASTA and BLASTA algorithms. Statistical analysis and evaluation of BLASTA results.

4. PATTERNS RECOGNITION METHODS IN SEQUANCE ANALYSIS: 9 hrs

Concepts of a sequence pattern, regular expression based patterns. The use of pattern database like PROSITE and PRINTS. Concept of position specific weight matrices and their use in the sequence analysis. Theory of profile and their uses with special reference to PSI-BLAst. Markov chain and Markov models and their use in gene finding. Concept of HMMS, the forward and backward and the Viterbi algorithm. The baum-Welch algorithm fore training a HMM. Use of profile HMM for protein family classification.

BIOSTATISTICS:

1. Organization, description, and graphical presentation of data.
2. Summary measures of – central tendency, description, correlation and regression.
3. Z, T, F and X2 (Chi-Square) Tests.

References:

1. A.Malcolm Campbell, Laurie, J. Heyer., (2004): Discovery Genomics, Proteomics, and Bioinformatics: Pearson Education (Singapore) Pte. Ltd.,
2. Arthur, M. Lesk: (2003) Introduction to Bioinformatics: Oxford University Press
3. S.C.Rastogi, N.Mendiratta, P.Rastogi: (2005)- Bioinformatics –Methods and Application: Prentices Hall of India Pvt. Ltd –New Delhi.
4. T.K.Attwood., D.J.Parry-Smith., Samiron Phukan; (2007) – Introduction to Bioinformatics- Pearson Education.
4. Bishop, O.N 1996: Statistics for Biology, Longmans, Green Co., London.
5. H, Frank., S.C, Althoen (1994) Statistics – concepts and applications" Ambridge University Press.
6. Bland, M. (1989) – An Introduction to Medical Statistics. London: ELBS.
7. Dixon, W.J., and Massey, F.J., (1969) Introduction to Statistical Analysis. New York: McGraw –Hill.
8. Ingelfinger, T.A. (1983) Biostatistics in clinical Medicin. New York Macmillan.
9. Mathews, D.E., (1998): Using the Understanding Medical Statistics- New Delhi: Karger.
10. Mood, A.M and Graybill, F.A., (1974): Introduction to Theory of Statistics, New York: McGraw –Hill.
11. Rohatgi, V.K. (1985)/: An introduction to Probability Theory and Mathematical Statistics, New Delhi: Wiley Eastern.
12. Seal, H.L (1968) Multivariate Statistical Analysis for Biologists, London, Methuen.

PRACTICALS

2nd SEMESTER

PRACTICAL BT: 2.1A MOLECULAR GENETICS (BASED ON THEORY PAPER BT: 2.1)

1. Single Cell Isolation
2. Isolation of Auxotrophs
3. Isolation of Antibiotic resistant organisms
4. Study of growth curve
5. Isolation of DNA
6. Denaturation of DNA
7. Renaturation of DNA
8. Amines test
9. Enzyme induction of beta-galactosidase synthesis in E.coli
10. Estimation of DNA
11. Estimation of RNA

PRACTICAL BT: 2.1B MICROBIOLOGY (BASED ON THEORY PAPER BT: 2.2)

1. Safety measures in microbiology laboratory and aseptic techniques.
2. Study of Instruments – Autoclave, Hot Air Oven, Laminar air Flow, Incubator, pH meter etc.,
3. Cleaning and sterilization of glass wares.
4. Preparation of nutrient broth and nutrient agar slant and sterilization.
5. Culture of microorganisms using various methods.
6. Study of colony characters.

7. Simple and differential staining procedure – staining of Endospore, Flagella, cell wall, capsule and negative staining.
8. Biochemical Tests used for identification of bacteria, fermentation of sugars, starch hydrolysis, gelatin liquefaction, catalase test, IMVIC and oxidase test.
9. Isolation of microorganisms from soil sample and determination of numbers of colony forming units.
10. Study growth curve of *E.coli* cells.
11. Effect of antibiotics and bacterial growth – paper disc and cup plate method.
12. Effect of pH on growth of microorganisms.

PRACTICAL BT: 2.2A IMMUNOLOGY AND IMMUNOTECHNOLOGY (BASED ON THEORY PAPER BT: 2.3)

1. Study of cells / organs of Immune system
2. WBC and RBC count
3. Preparation of different types of antigens
    a) Whole cell antigens
    b) Purified proteins
4. Demonstration of antigen administration to animals Mice / Rat
    a) Intra muscular
    b) Intra venial
    c) Intra peritoneal
    d) Intradermal
5. Production of polyclonal antiserum
6. Determination of Bleeding Time (BT) and Clotting Time (CT)
7. Separation of serum / plasma from whole blood
8. Blood film preparation and identification of cells.
9. Estimation of Hemoglobin
10. Determination of Blood groups and Rh factor
11. Electrophoretic separation of serum proteins
12. Determination of antibody titer of the serum
13. Precipitation of Immunoglobulins from serum by ammonium sulphate precipitation
14. Partial purification of ammonium sulphate precipitated Immunoglobulins by dialyzing against phosphate buffered saline
15. Electrophoresis of Immunoglobulin preparation
16. Purification of IgG from serum
17. Agglutination tests
    a) Haemagglutination
    b) Bacterial agglutination
    c) Latex agglutination
18. Immunoprecipitation tests – Radial Immunodiffusion test / Ochterlony double diffusion test
19. Immunoelectrophoresis – Rocket Immunoelectrophoresis Immunochromatography
20.
21. Western blot.

PRACTICAL BT: 2.2B BIOINFORMATICS (BASED ON THEORY PAPER BT: 2.4)

1. Entrez and Literature searches
    a) PubMed
    b) PubMed central
    c) OMIM / OMIA
    d) Citation matcher
2. SRS of Biological Databases
    a) Nucleotide / Genome Databases
    b) Protein Sequence Databases
    c) Structure databases
3. File Format conversion
    a) FmtSeq
    b) ReadSeq
    c) Sequence manipulation suite
4. Sequence Analysis
    a) Dot Plot
    b) Pairwise alignment
    c) Multiple Sequence Alignment
5. Phylogenetic analysis using PHYLIP, Phylodraw, PAUP, Treeview, Jalview
6. Software's

a) BioEdit
b) GeneDoc
c) ClustalW / X, MEGA, MEME

7. Visualization Tool

a) RasMol
b) Cn3D c) MolMol

3rd SEMESTER

SYLLABUS FOR M.SC., IN BIOTECHNOLOGY

PAPER –BT: 3.1 GENETIC ENGINEERING

About Course: **50hrs**

Genetic Engineering course essentially comprising the study of the deliberate modification of an organism's basic characteristics by manipulating its genetic material. Such postgraduates are hired in capacities such as Scientific/ Medical Writer etc.

Course Objective:

This course would familiarize Students with facile molecular techniques involved in isolation and manipulation of genetic material for achieving the desired goal.

Course Learning Outcomes (CLO):

Students will be able to

1. Apply landmark discoveries in developing a number of facile molecular techniques used in rDNA technology.
2. Learn how to select the suitable hosts for the individual vectors for different purposes.
3. Know the extraordinary power of restriction and other enzymes in molecular cloning and genetic manipulations.
4. Perform application of PCR in rDNA technology.

Detail contents:

UNIT-1:Foundations of recombinant DNA technology **5Hrs**
Introduction, tools of genetic engineering, recombinant DNA experiment and the safety issues.

UNIT-2:Plasmid Biology **10Hrs**
Plasmid vectors and atheir feature, common plasmids, plasmids of Gram-negative bucteria, PBR 322, PUC 18, Col El, RI, PT 181, PSC 101. Plasmids of Gram-positive bacteria-PIJ 101, SLP and SCP. Plasmids from Bacteiophage fambda, Phage, M 13. Cosmids, Plasmids from animal viruses-SV40, Adenoviruses, retroviruese, Vaeacinia viruses and Baculoviruses. Plasmids fsrom Yeast and special rectors.

UNIT-3: Gene Libraries **8Hrs**
Establishing a gene library, sceening the gene library, The cDNA library. Applicatios of genetic engineering in Medical, Agricultural, Environmental and other fields.

UNIT-4: **DNA analysis and diagnosis** **8Hrs**
Methods of DNA analysis-DNA, RNA and cDNA probes.PCR implication. DNA chips, RFLP analysis. Diagnosis of infectious diseases:- AIDS Tuberculosis and other diseases. Identifying genetic diseases, Hybridization techniques:- Sourthern, Northern and Western blotting Immunodiagnostic probes.

UNIT-5: DNA finger printing **8Hrs**
DNA matching teachniques-DNA figner printing, genetic identification and microbial identification.

UNIT-6: DNA sequencing **9Hrs**
Maxam and Gilbert's methods, Sanger and Nicholoson's methods, the primer, template, the didecoxynucleotide, terminates, and deoxynuclcotides, and polymerases. Messing shot gun method. DNA sequencing homology-using computers. Application in plant. Animal and microbes.

PRACTICALS;

01. Isolation of DNA from bacteria, polant and animal tissue.
02. Isolation of plasmid DNA from bacteria
03. Transformation.
04. Conjjgation.
05. Sourthern bloting.
06. SDS-PAGE and Western blotting.
07. PCR.
08. Restriction mapping.

REFERENCE BOOKS;

1. Molecular Biology of the Cell:- Alberts etal., 1983.
2. Molecular Biology of the Gene:- J.D. Watson.
3. Molecular Cell Biology:- Darncil etal.,
4. The Gene:- Benjamin Levine.
5. Bacteial Plasmids:- P.Breda.
6. Genetic Engineering Vol I-IV Willamson (Ed).
7. Gene Cloning:- Glover, 1984.
8. Recombinant DNA:- Watson etal., 1983.
9. Vectors:- Rodrignes and Denhardt, 1987.
10. Experiments with gene fusion:- Sil Havy etal.,
11. Tailoring enes for Crop improvement:- an Agricultural propective Bresenting G, Haads, J. Kosuge, T. Hollasender, A.
12. DNA technology:- Edward Alccuno. J. 1990.
13. Commerical Biotechnology:- OTA, 1984.
14. DNA Science:- Michols, D.A. 1990.
15. DNA Finger printing:- Krawizak, M and Schmidtke.J. Bcos 1984.
16. Gene expression technology:- Hgoeddel, A.IP. 1991.
17. Genetically Engineered Organisms:- Fenmchanm. J.R. S. 1991.

B.T:3.2 INDUSTRIAL BIOTECHNOLOGY

About Course:

50 Hrs

Industrial biotechnology aims to provide fundamental insights to exploit enzymes and microbes for the manufacturing of products which have a huge industrial significance. It uniquely blends the science and engineering with various biochemical processes to obtain products of diverse fields such as chemicals, food, bioenergy etc.

Course Objective:

1. To understand the basics of traditional and modern industrial fermentation process.
2. To gain the knowledge about the primary and secondary microbial metabolites.
3. To learn about the production process of pharmaceutically important bioproducts

Course Learning Outcomes (CLO):

Students will be able to:

1. Understand the basics of fermentation process which helps to develop new microbial product.
2. Gain the knowledge about the steps and operations involved in microbial primary metabolites production. Illustrate the secondary metabolites production with flow-sheeting.
3. Acquire knowledge about the industrially relevant microbial strains and processes for production of enzyme, biopolymer and food products.
4. Learn about the use of recombinant technology in pharmaceutically important microbial bioproducts production.

Detail contents:

UNIT-1: Scope of food and industrial biotechnology. 3Hrs

UNIT-2: Microbiological examination of food, principles of food preservation (Sterilization, pasteurization, canning and packing). Importance of microorganisms in food production. **6Hrs**

UNIT-3: Factors affecting the growth and survival of micro-organisms in food: Microbial growth, intrinsic and extrinsic factors and productive food microbiology. **4Hrs**

UNIT-4: Microbiology of food: Cereal products, brewing, fermented food products, protein products, food additives and ingsredients, fsruits, vegetables, meat and sausage product, large scale cultivation of edible mushrooms. **6Hrs.**

UNIT-5: Fermentation of mild products and its analysis. **4Hrs.**

UNIT-6: Biological nitrogen fixation: mass lproduction and field application of biofertilisers: Rhizobium. Azotobacter, Azospicillam. Cynabacyteria, Azolla, Vesicular and Arbuscular Mycorrhiza (VAM). **4Hrs.**

UNIT-7: Microbiological assays: Microbiological assay of vitamins, antibiotics and aminoacids. Advantages and disadvantages of microbiological assays. **4Hrs.**

UNIT-8:Bacterial agents of food born illness: Salmonella, Clostridium, Vibrio, Shigella and E.Coli. **4Hrs.**

UNIT-9: Non bacterial agents of food born illness: Protozoa, algae, fungi, helminthes, nematodesandviruses. **4Hrs.**

UNIT-10: Energy biotechnology:Biomass solar energy technology, photosynthesis, Agriculture and forestry, conversion to fuels, cell free system, use of micro organisms in mineral, beneficiation and iol recovery. Immoabilization of microbes. **6Hrs.**

UNIT-11: Patents and seacret processes: Patent concept, composition of of patent, characteristics of patent, protection of rights of inventor and cost patent. **3Hrs**.

REFERENCES

01. Ananth, N. 2000: A Text Book of Microbiology-Vol. IV, Surabhi Books, Ssrinagar, Bangalore.
02. Singh, B.D 2001, Biotechnology, Kalyani Publishers, Ludhiana.
03. Wulf, Crueger and Annelies, Biotechnology-A Textbook of Industrial Microbiology Cuger-Panima Publishing Corporation. New Delhi.
04. Malik, V.S and Sridhar, P. 1992: Industrial Biotechnology.
05. Frazier, W.C and Westhaff, D.C. 1998: Food Microbiology Tata McGraw Hill, Delhi.
06. Patil. A.H. 1984. Industrial Microbiology.
07. Casida, L.E. 1968. Industrial Microbiology.
08. Jay James. M. 1996. Modern Food Microbiology CBS Publishers, New Delhi.
09. Prophet, S.S., Mathur 1996 Biotechnology-Fundamentals and applications, Agro botanical Publishers, New Delhi.
10. Bains and Williams 1998. Biotechnology From A to Z, Oxford University Press, New-York.

PRACTICAL: 3.1 B, Based on Paper B.T:3.2

B.T:3.3 MEDICAL BIOTECHNOLOGY

About course **50Hrs**

In medicine Biotechnology has genetic engineering that motivated expectations for drugs, therapeutic proteins, and various biological organisms. It includes engineering yeasts, pesticides, seeds and also modified human cells. The modified cells are used to treat multiple genetic diseases.

Course Learning Outcomes (CLO):

1. Hands-on training and mandatory research projects will help our students by providing knowledge and technical experience of problem-solving in a research environment.
2. Students after completing this course can become entrepreneurs in the most demanding sector of medical biotechnology such as diagnostics, drug designing, stem cell biology etc.
3. Students will develop an ability to identify, organize and answer problems in Medical Biotechnology
4. Students will develop an ability to use skills and modern technological tools necessary for medical biotechnological practice.
5. Perfrom independent as well as team work to accomplish lab based tasks.
6. Become a part of mission-Skill India- to develop researcher and scientists to uncover advance biology problems.

Detail contents:

UNIT-1: Medical Biotechnology:Scope and Importance. **2Hrs**

UNIT-2: Cancer Biology: Types of tumors, pre disposing factors, cellular changes involved in tumor formation. Genes associated with cancer (Oncogenes and Tumor suppressivegenes). Methods of tumor detection, tumor markers, treatment of cancer chemotherapy, radio therapy, immunotherapy and agene therapy. **7Hrs**

UNIT-3: Microbial diseases in humans: Mode of infection, symptoms, epidemiology and control measures of diseases casued by Viruses(AIDS, Hepatits-B, Rabies, HSV-1)
Vacterial (Typhoid, STD, TB, Plague), Fungi (ASpergillosis, Histoplasmosis, Cryptococcosis), Protozoa (Malaria, Amoebiasis). **8Hrs.**

UNIT-4: Diagnostics: Applications of immunological and molecular diagnostic methods(RIA,ELISA, PCR, and DNA finger printing) in forensic science and disease diagnosis. **6Hrs.**

UNIT-5: Stem cells: Types, sources,, properties, and applications of stem cells in tissue repair, tissue engineering and regenerative medicine. **5Hrs.**

UNIT-6: Human genome project and its applications: Example of genes identified with various human diseases, molecular detection of pre symportmatic genetic diseases, Importance in health care, pre-natal diagnosis, genetic manipulation and ethical implications. **5Hrs.**

UNIT-7: Gene therapy: Human diseases targeted for gene therapy, vectors and other delivery systems for gene therapy. Ex vivo and in vivo gene therapy, tissue of choice for gene therapy. In-vitro gene therapy and gene therapy of genetic diseases. Eg. Neurological, Metabolic disorders and Cystic fibrosis, gene therapy for Acquired diseases (ADA gene in SCID), Cardiovascular, Cancer etc. Importance of humanized antibodies and lplasminogen activating factor in treating thrombosis. **5Hrs.**

UNIT-8: Nan biotechnology: Intoruction, types and synthesis of nonmaterial. Nano biosensors, drug and gene delivery, disease diagnostics and cancer therapy Risk potential of nonmaterial. **4Hrs.**

UNIT-9: Pharmacobiotechnology: Role of biotechnology in the production of pharmaceutical products. **3Hrs.**

UNIT-10: Ethical issues involved in stem cell research: Use of cell cultures as alternative for animal model for research, testing of drugs on human volunteers, use of animals for research and testing. Animal cloning, human cloning, ethical and social issues, organ transplantation and xeno transplantation. **5Hrs.**

REFERENCES:

01. Strokes, J., et al,1993, Clinical miacrobiology-7th Edn.,
02. Colle, J.G., 1989, Practical Medical microbiology, Churchill living stone.
03. Anthnarayana, R. and C.K. Jayaram paniker, 1997. Text Book of Microbiology, Orient Longman.
04. Jawetz, E., Melonick, J.L., Adelberg, E.A. Review of Medical microbiology, Prentice Hall, 1987.
05. Mackie, and McCarthy 1996. Medical microbiology, Vol-I, Microbial infection Vol-II, Practical Medical microbiology, churchil living storn.
06. Nester, Roberts, Pearsall, Anderson. 1998. Microbiology-a human perspective, 2nd Edn., McGraw-Hill.
07. Warren, Levinson. 2000. Medical microbiology and immunology. Examination and Board review, 8th Edn., McGraw Hill.
08. Credric, A. Mims 2004. Medical microbiology-3rd Moshy Inc.
09. Leslic collier, john oxford 2000. Human virology: A Text book of students of medicine, dentistry and microbiology 2nd Ed., Oxbord university Press.
10. Topley and Wilson. Principles of Bacyteriology, Virology and Immunity, Edward Arnold.
11. Hoghl and Mottet. Clinical microbiology, J.B Lippincott company.
12. Kenneth, J.R. Medical Microbiology- introduction to infectious diseases, printice Hall Int.

PRACTICAL: 3.2 A Based on Paper B.T:3.3

B.T:3.4 PLANT BIOTECHNOLOGY

About Course: **50 Hrs.**

Plant biotechnology is a set of techniques used to adapt plants for specific needs or opportunities. Plant biotechnologies that assist in developing new varieties and traits include genetics and genomics, marker-assisted selection (MAS), and transgenic (genetic engineered) crops.

Course Objective:

The Students will learn the fundamentals of culturing plant cells and tissues, culture environment, cell proliferation, differentiation, and media formulation. The Students will acquire knowledge on various recombinant DNA techniques to produce genetically modified organisms with novel traits.

Course Learning Outcomes (CLO):

Students will be able to:

1. Acquire the knowledge about the techniques of Plant Tissue Culture, Lab. organization & measures adopted for aseptic manipulation and nutritional requirements of cultured tissues.
2. Learn the techniques of culturing tissues, single cells, protoplasts & anther culture, germplasm conservation and cryobiology
3. Learn the large scale clonal propagation of plants through various micropropagation techniques, Production of secondary metabolites under in vitro conditions
4. A good understanding of r-DNA technology, methods of gene transfer, molecular markers and marker assisted selection
5. Develop transgenics resistant to biotic & abiotic stresses & quality characteristics and their role in crop improvement.

Detail contents:

UNIT-1: Plant tissue culture: Introduction to cell and Tissue culture. Tissue culture as a technique to produce novel plants and hybrids. **02 Hrs.**

UNIT-2: Tissue culture media (Composition and preparation) **01Hrs.**

UNIT-3: Initiation, maintenanace of callus and suspension culture and single cell clones. **02Hrs.**

UNIT-4: Organogenesis: Somatic embryogenesis, transfer and establishment of wholel lplants in soil. **02Hrs.**

UNIT-5: Shoot tip culture: rapid clonal prolpagation and production of virus free plants. **02Hrs.**

UNIT-6: Embryo culture and Embryo rescuer. **01Hrs.**

UNIT-7: Protoplast isolation and fusion. Selection of hybrids cells and regeneration of hybrid plants. Symmetric and asymmetric hybrids, and hybrids. **02Hrs.**

UNIT-8: Anther, pollen and ovary culture for production of haploid plants and homozygous lines. **02Hrs.**

UNIT-9: Cry preservation, slow growth and DNA banking for germ plasma conservation. **01Hrs.**

UNIT-10: Basic techniques in r-DNA technology: Biolistics (Paricle bombardment) Elecroration, microinjection and Agrobacyterium mediated gene transfer. T-plasmid derived vector systems, structure and restriction site. The mechanism of T-DNA transfer from Agro bacterium to plant cells Marker and reporter genes used in plant system Manipulation of gene expression in plants. Isolation and uses of different promoters, production of marker free transgenic plants. **07Hrs**.

UNIT-11: Plants transformation Technology: Basis of tumor formation, hairy root, features of Ti and Ri Plasmids, mechanisms of DNA Transfer, role of virulence genes, use of Ti and Ri as vectors, Binary vectors, use of 355 and other promoters. Genetic markers, use of reporter gene with interns, luse of scaffold attachment regions, methods of nuclear transformation, viral vetors and their applications, Multiple gene transfers, vector-less of direct DNA transfer. Transformation of monocots, trans gene stability and gene silencing. **06 Hrs.**

UNIT-12: Application of plant transformation in plant productivity and performanance: Herbicide resistance, Phosphoinothricin, Glyph sate, sulfoyurea urea, atrazine, insect resistance/Bt genes, Non Bt like protease inhibitors, alpha amylase inhibitor, virus resistance coat protein mediated, nucleo capsid gene disease resistance, 1-3 B gluconase, RJP antifungal proteins, thoinins, PF Proteins, nematode resistance Aabioticstress, post harvest losses, long self life of fruits and flowers use of ACC synthase, polygalactourancase, and ACC oxidase, Male sterile lines, bar and barnase systems. Carbohydrate composition and storage ADP glucose pyrophosphates. **05Hrs.**

UNIT-13: Molecular marker aided breeding: RELP mapa linkage analysis, RAPD markers. STS micro satellites SCAR(sequence Characterized Amplified Regions)SSCP (Single strand conformational polymorphism) AFLP, QTL, Map based cloning, molecular markers. **04Hrs.**

UNIT-14: Plant genomics: Arabidopsis thaliana (Mad-Box gene) as a model for plant genomics and Plant proteomics, Rice genome project. Genetic diversity and phyllogenetic studies**.** **02Hrs**

UNIT-16: Metabolic Engineering and Industrial products: Plant secondary metabolites, control mechanisms and manipulation of phenylpropaniod pathway. Alkaloids, industrial enzymes, biodegradable plastics, Polyhydroxy butyrate, therapentic proteins, lysosomal enzymes, antibodies, edible vaccines, purification strateies. Oleosin lpaartitioning. **04Hrs.**

REFERENCES:

01. Bhojwant, S.S., and Razdan, M.K. 1996. Plant Tissue culture. Theory and practice. Elsevier Publishers. Amsterdam.
02. Bhan 1998. Tissue culture, Mittal Publications, New delhi.
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PRACTICAL: 3.2B Based on Paper B.T:3.4

4th SEMESTER

B.T:4.1 Animal Bioteachnology

About Course:

This course deals with the details on animal biotechnology the applications of tools of molecular biology and biotechnology for the improved production and protection of animals, animal products. At the introduction of the course, the definitions of biotechnology, animal biotechnology and various branches of animal biotechnology have been explained.

Course Objective: **50 Hrs**

The objective of this course is to enable Students to develop basic skills for vertebrate cell culture, maintenance of cell lines and in vitro application of cell and molecular techniques and also to understand the principles of animal cloning and its applications.

Course Learning Outcomes (CLO):

Students will be able to

1. Understand the fundamental scientific principles that underlie cell culture
2. Acquire knowledge for isolation, maintenance and growth of cells.
3. Develop proficiency in establishing and maintaining of cell lines.
4. Acquire knowledge in animal cloning and its applications.

Unit:1 **06 Hrs.**

Animal cell, tissue and organ culture: Historical perspectives, development and scope. Requirements for animal cell, tissue and organ culture-Equipments and materials for aminal ceel culture technology, advantages and limitations of tissue culture, aseptic handling facilities, required media and cell lines.

Unit:2 **03 Hrs.**

Initiation of cell culture: Cultivation of animal cell in mass in Bioreactors, Biology of cell culture, evaluation of culture dynamics and maintenance of cell lines.

Unit:3 **03 Hrs.**

Primary culture: Isolation of mouse and chick embryos, human biopsies, methods for primary culture, nomenclature of cell lines, sub culture and propagation, immortalization of cell lines, cell line designation, selection of cell line and routine maintenance.

Unite:4 **03 Hrs**.

Cell separation and characterization: Density based, magnetic and fluorescence based cell sorting. Characterization of cells based on morphology, chromosome analysis, DNA content, RNA and protein, enzyme activity, antigenic markers, cytotoxicity assays, Cell quanta ion and Cell culture contamination, monitoring and eradication, Cryo preservation.

Unit:5 **03 Hrs**.

Culturing of specialized cells: Epithelial, mesenchymal, neuron, ectodermic, hematopoietice, gonad and tumor cells, Lymphocyte preparation, culture of amniocytes, fish cells and confocal microscopy, Stem cell culture and its applications.

Unit:6 **03 Hrs**.

Organ and embryo culture: Choice of models, organ culture, and histolytic culture Filter-well inserts, neuronal aggregates, whole embryo culture eggs, chick and mammalian embryos.

Unit:7 **04 Hrs.**

Cell and tissue engineering: Growth factors for in situ tissue regeneration, biomaterials in tissue engineering, approaches for tissue engineering of skin, boen grafts, nerve grafts, Hemoglobin based blood substitutes, bio artificial or biohybrid organs, Limitations and possibilities of tissue engineering.

Unit:8 **03 Hrs.**

Serum and protein free defined media and their applications. Measurement of viability and cyutotoxicity cell synchronization, cell soloing, micromanipulation, cell transformation and applications of animal cell culture.

Unit:9 **02 Hrs.**

Hybridism technology and production of monoclonal antibodies

Unit:10 **07 Hrs**.

Animal reproductive system with reference to insects and mammals: Organization, function, hormonal regulation of growth and reproduction in insects and mammals. Hormonal regulation of estrous cycle, menstrual cycle and pregnancy. IVF-embryo transfer technology in human and livestock Mechanism of protein and steroid hormone action and importance of hormones as a biotechnological product.

Unit:11 **04 Hrs.**

Transgenic aminals Methods of obtaining transgenic animals and their importance. Production of useful proteins in transgenic animals, regulatory proteins, blood products and vaccines.

Unit:12 **03 Hrs.**

Seri biotechnology and Aqua culture biotechnology.

Unit:13 **03 Hrs.**

Gene therapy: Types and genetic diseases targeted for gene therapy. Human genome project and its applications.

Unit:14 **03 Hrs.**

The legal and socio-economic impact ob ioteachnology at national and international levels, public awareness. Biosafety regulations, guidelines for research in transgenic animals, public awareness of the processes of production transgenic organisms.

References:

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Practical 4.1 A Based on Paper B.T:4.1

B.T: 4.2 Environmental Biotechnology and Biodiversity

About Course: **50Hrs**

The Environmental Biotechnology course aims to introduce and elaborate the **fundamental concepts and applications of biotechnology** in all aspects of environment including its protection, restoration and sustainability.

Course Objectives:

The exposure to this course would facilitate the Students in understanding the terms, definitions and scope of environmental and energy issues pertaining to current global scenario; understanding the value of regional and global natural and energy resources; and emphasize on need for conservation of energy and environment.

Course Learning Outcomes (CLO):

1. Conduct basic laboratory experiments and employ standard observational strategies for treating biological waste water.
2. Develop requisite skills to work in water quality testing, environmental pollution control labs, textile industries etc

Unit:1 **02 Hrs.**

Meaning, Scope and concept of Environment and Environmental pollution

Unit:2 **06 Hrs.**

Aerobiology: Air sampling Techniques, Identification of airborne Bioparticles, Sources and characteristics of air pollutants, health hazards due to air pollution. Air borne diseases and controlling measures of air pollution.

Unit3 **08 Hrs**.

Soil Biology: Classification of soil based on physical and chemical characteristics, Microorganisms in various soil types. Soil pollution-sources and characteristics of soil pollutants, health hazards due to soil pollution, control measures of soil pollution. Interaction among soil microbes-mutualism, commensalisms, amensalism, parasitism, predation, competition, antibiosis and their significance. Interrelationship between microbes, plant and soil. Brief account on rhizosphere, Phyllosphere and Sphermoshere, Symbiotic and non-symbiotic association with higher plants, role or enzymes of microbial origin in the release of plant nutrients.

Unit:4 **08 Hrs**.

Water ecosystem: Fresh water and marine water ecosystems, Zonation of water ecosystem, water pollustion-sources, characteristics of water polluation, health hazards due to water pollution, eutrophications, Indicators of water pollution-chemical, Micropbiological and Biotechnological indicators. Water purifications Brief account on water born diseases and control measures.

Unit:5 **09 Hrs.**

Waste Treatment: Solid and Liquids wastes and their characterization. Physical, Chemical, and biological methods of solid waste treatment. Saccharification, Gasification, Composting and waste water recycling-chlorination. Ozanization, radiation, filitrations, reverse osmosis. Effluent treatment-(Dairy, Distillery, Tannery, Textile, Paper and sugar industries) Physical, chemical and biological sewage treatment-Tricking filters, oxidation pond ditch and activated sludge treatment. Advanced waste water treatment-Rotating Biological Contractors (RBC), submerged aerobic filters, fluidized bet reactors, biological aerated flooded system, and combination of anaerobic, denitrification and aerobic treatment of water water. Advanced activated sludge process.

Unit:6 **09 Hrs**.

Bioremediation: Concepts and principoes, Insitu and Exsitu Bioremediation and Phytoremediation. Biodegradation of pesticides and Xenobiotics(Halocarbons, C-1 Compounds, aliphatic Hydrocarbons, acyclic hydrocarbons, Aromatic hydrocarbons, polycyclic hydrocarbons, Halogenated compounds) in soil and their influence on soil micro flora. Biodegradation of natural polymers-Cellulose, Lignin, Pectin, Chitin Detergents, soaps and plastics. Biodeterioration of paper, Leather, Wood, Textiles, Mode of Deterioration and organisms involved. Bioleaching and Bioniming, production of Oils and fuels from wood wastes, Biofuels, Biodeisel and byproducts of sugar industries.

Unit:7 **02 Hrs**.

Environmental Education: Global Warming, Ozone depletion, Gree house effect, acid rain their impact and biotechnological approaches in the environment.

Unit:8 **04 Hrs.**

Biodiversity and its conservation: Current levels of biodiversity, extinction and endangered species, reasons of concern for loss of biodiversity, steps to preserve biodiversity, Insitu and Exsitu conservation, gene banks, convention of biological diversity, species conservation.

Unit:9 **02 Hrs.**

Biological control and Integrated Pest Management(IPM)

References:

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Practical 4.1 B. Based on Paper B.T:4.2

B.T:4.3 Bioprocess engineering and Technology

50 Hrs.

About Course:

The course is focused on the development of processes for the sustainable production of organic bulk chemicals and the generation of energy from organic raw materials, residuals, and waste products.

Course Objectives: **50Hrs**

1. State the enzyme kinetics, various factors regulating catalysis, different models for analyzing the enzyme kinetics, Immobilization and large-scale production of enzyme;
2. Extend comprehensive knowledge about media constituents, formulations and microbial growth as well as measurement of cell biomass and analysis of mass balance, different methods of sterilization, agitation, oxygen transfer rate and operation of bioreactor;
3. To demonstrate about concept and criteria of scale up of laboratory process, Instrumentation and process control-offline and online,
4. Gain knowledge about the design of production of bioproducts under aerobic and anaerobic states, process economic and preparation of flow sheet of production process

Course Learning Outcomes (CLO):

1. Explain the kinetics of enzyme catalysed reaction in free and immobilized states. They will also able to organise the production of microbial enzymes and operate variables affecting the production process.
2. Design medium for microbial growth, solve the mass balance of production process, propose and use the sterilizers for removal of microbial contaminants, state the significance of aeration and agitation for synthesis of bioproducts and modes of operation of Fermenter.
3. Collect the proficient knowledge of translation of lab data to pilot level, they will be able to solve features involved in the scale up process, process monitoring and control.

Unit:1 **03 Hrs**.

Introduction of Bioprocess engineering: Isolation screening, selection, preservation and maintenance of industrial microorganisms. Strain improvement, Inoculums development for bacterial and fungal processes, spore inoculums or vegetative mycelia inoculums methods for fungi.

Unit:2 **04 Hrs.**

Fermentation media: Natural media, synthetic media, and typical media. Media formulation strategies, sources of Carbon, Nitrogen, Vitamins and minerals. Role of buffers, precursors, inhibitors, inducers and antifoam agents. Solid state fermentation.

Unit:3 **03 Hrs**.

Sterilization process in fermentation industry: Media sterilization, methods of batch styerilization and the Design of continuous sterilization process, sterilization of fermentor, feeds air, and filter design.

Unit:4 **06 Hrs.**

Bioreactors: Design of ferementors, basic function of a ferementors, body construction, aeration and agitation. The achievement and maintenance of aseptic conditions, sterilization of ferementors air supply. Addition of incoculum and nutrients, sampling various types of valves. Types of bioreactors, Specialized bioreactors- Tubular bioreactors, membrane bioreactors fluidized bet reactor, packed bed reactor and photo bioreactors.

Unit:5 **04 Hrs.**

Fermentation Technology: Types of fermentation process, Analysis of batch, fed batch and continuous bio-reactions. Stability of microbial reactors. Analysis of mixed microbial population. Measurement and control of bio-process parameters.

Unit:6 **05 Hrs.**

Down stream processing: Introduction, objectives and criteria. Removal of microbial cells and solid matter-Foam precipitation, filtration, centrifugation, cell disruptions, liquid extraction, chromatography, membrane process. Drying, crystallization, packaging and quality assurance, Effluent treatment, DOC, COD and disposal of effluents.

Unit:7 **03 Hrs**.

Immobilization: Definition and concepts of immobilization, enzyme and whole cell immobilization, immobilization techniques-Adsorption, cross-linking, ionic bonding, entrapment, and encapsulation. Advantages and industrial applications of immobilized enzymes and cells.

Unit:8 **12 Hrs.**

Industrial production of Agar-Agar, Alginate, Alcohol(Ethanol), Organic acids(Citric, Acetic, Lactic and Gluconic acid), Solvents (Glycerol Acetone, Butanol), Antibiotics (Penicillin, Streptomycin, tetracycline), Amino acids(Lysine, Glutamic acid, Single Cell Proteins (SCP), Vitamins (Riboflavin), Enzymes (Amylase, Lactase, Protease), Hydrocarbons- Biodegradable Plastic or Polyhydroxy alkanoates (Butyrate, Propoinate etc)., and reacombinant protein (hepatitis-B vaccine)

Unit:9 **04 Hrs.**

Food processing: Food spoilage-by bacteia, fungi and yeast. Food preservation-principles and general methods, elementary idea of canning and packing sterilization and pasteurization of food products. Food fermentation technology-Sausages, olives, bread, Idli and acidphilus milk. Hazard analysis and critical control point (HACCP) concepts.

Unit:10 **02 Hrs**.

Bioprocess development: An Inter disciplinary challenges.

Unit:11 **04 Hrs.**

Entrepreneurship: Potential entreneurship activities in biotechnology. Product development, marketing, research and training unit, Industrial licensing, and venture capital. Biotech parks, biotechnology industries in India, the potential job opportunities and Intellectual property rights(IPRs)

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Practical 4.2 A Based on Paper B.T:4.3

B.T: 4.4 Project

Practical 4.2 B: Based on Project