SAURASHTRA UNIVERSITY

RAJKOT

(ACCREDITED GRADE "A" BY NAAC)

FACULTY OF SCIENCE

Syllabus for

M. Sc. (BIOTECHNOLOGY)

Choice Based Credit System

With Effect From: 2016-17

Course Structure and Scheme of Examination

M.Sc. Biotechnology Syllabus

Choice Based Credit System (CBCS)

(Total 96 Credits)

Effective from June 2016

M. Sc. Biotechnology

Program Outcomes (PO)

PO1:

Understand the necessary knowledge and concepts of biotechnology and other related areas.

PO2:

Understand the ability to apply their knowledge for practical which they can conduct independently, employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of experiment.

PO3:

Solve the problem and think methodically, independently and draw a logical conclusion.

PO4:

Use modern techniques, advanced equipment and bioinformatics software's

PO5:

Create an awareness of the impact of biotechnology on the environment, society, and development outside the scientific community

M. Sc. Biotechnology
Program Specific Outcomes (PSO)

PSO1:

Acquire knowledge of biotechnology through theory and practical's

PSO1:

Apply their knowledge in other advanced subject areas like food biotechnology, immune technology, animal, plant biotechnology, and restoration of the degraded environment to provide a sustainable competitive edge to present society, for the betterment and advancement of their professional career.

PSO2:

Learn the theoretical and practical exposure to the basic and advanced fields of biotechnology.

PSO3:

Students will exhibit contemporary knowledge in Biotechnology, and students will be eligible for doing jobs in various sectors of the pharmaceutical and biotechnological industry.

PSO4:

Understand good laboratory practices and safety

PSO5:

Develop research-oriented skill

PSO6:

Make aware and handle sophisticated instrument

Course Structure and Scheme of Examination
For Choice Based Credit System (CBCS)

Semester 1

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage For Internal Examination	Weightage For Semester End Examination	Total Marks	Duration of Semester End Exam in Hrs.
	Core						
BT – 101	Microbiology (Core)	4	4	30	70	100	2.5
BT – 102	Enzyme Technology (Multi/inter)	4	4	30	70	100	2.5
BT – 103	Molecular Biology (Core)	4	4	30	70	100	2.5
	Interdisciplinary						
BT – 104	Biochemistry** (Multidisciplinary/ Interdisciplinary)	4	4	30	70	100	2.5
BT – 105	Combined Practical	8	15		200	200	
Total		24				600	

Semester 2

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage For Internal Examination	Weightage For Semester End Examination	Total Marks	Duration of Semester End Exam in Hrs.
	Core						
BT – 206	Molecular Cell Biology (Core)	4	4	30	70	100	2.5
BT – 207	Immunology (Core)	4	4	30	70	100	2.5
BT – 208	Molecular Biotechnology – I (Core)	4	4	30	70	100	2.5
	Interdisciplinary						
BT – 209	Biostatistics and Analytical techniques** (Multidisciplinary/ Interdisciplinary)	4	4	30	70	100	2.5
BT – 210	Combined Practical	8	15			200	
Total		24				600	

Semester 3

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage For Internal Examination	Weightage For Semester End Examination	Total Marks	Duration of Semester End Exam in Hrs.
	Core						
BT – 311	Fermentation Technology (Core)	4	4	30	70	100	2.5
BT – 312	Molecular Biotechnology (II) (Core)	4	4	30	70	100	2.5
BT-313	Bioinformatics	4	4	30	70	100	2.5
	Elective Course** (any one of the following)						
BT – 314	Environment Biotechnology (Elective-1)	4	4	30	70	100	2.5
BT – 315	Cell culture (Elective-2)	4	4	30	70	100	2.5
BT – 316	Food Biotechnology (Elective-3)	4	4	30	70	100	2.5
BT – 317	Combined Practical	8	15		200	200	
Total		24				600	

Semester 4

Subject Code	Title of the Course	Course Credits	No. of Hrs. Per Week	Weightage For Internal Examination	Weightage For Semester End Examination	Total Marks	Duration of Semester End Exam in Hrs.
	Core						
BT – 418	Molecular Phylogeny and Extremophiles (Core)	4	4	30	70	100	2.5
	Elective Course** (any one of the following)						
BT – 419	Socio Economic aspects & IPR (Elective-1)	4	4	30	70	100	2.5
BT – 420	Pharmaceutical Biotechnology (Elective-2)	4	4	30	70	100	2.5
BT – 421	Agriculture Biotechnology (Elective-3)	4	4	30	70	100	2.5
BT – 422	Dissertation/ Project*	12	21			200	2.5
BT-423	Seminar	2	4			100	
BT – 424	Educational Tour/ Field work*	2	0			100	
Total		24				600	

SEMESTER-1

BT 101: MICROBIOLOGY [CORE]

Objectives:

The objective of this paper is to provide students with a basic understanding of…

- Microbial techniques
- Epidemiology, pathogenicity and virulence
- Microbial genetics
- Basic features of plant and animal viruses
- Antimicrobial agent its class and mode of action

Course Outcome:

CO1: To learn different microbial staining techniques, growth curve of bacteria and understand common nutrient requirement and media for growth of microorganisms.

CO2: To understand pathogenicity, virulence factors of microorganisms get knowledge of medical microbiology

CO3: To learn about recombination gene technology, gene targeting techniques and basic knowledge of different type of mutation

CO4: To identify with classification virus and understand general features of plant and animal virus as well as lytic and lysogeny cycle of virus

CO5: To understand types of antimicrobial agent and classes of antibiotic, antifungal, antiprotozoans antibiotics

Unit 1: Methods in Microbiology

- Sterilization Methods, Pure culture technique, Enrichment techniques
- Preservation & Maintenance of culture
- Staining & fixation, Bacterial morphology
- Growth curve of bacteria, Measurement of microbial growth, The influence of environmental factors in growth ,Synchronous growth, Continuous growth
- Sporulation, Spore germination
- Common Nutrient Requirements, Types of media for growth of microorganisms.

Unit 2: Medical Microbiology and epidemiology

- Pathogenicity and virulence.
- Virulence factors of microorganism.
- Epidemiology

Unit 3: Bacterial Genetics

- Recombination of bacterial genes, gene targeting
- Gene transfer method- Transformation, Conjugation & Transduction

- Mutation:- Types , causes & effects of mutation

Unit 4: Viruses & Prions

- General Characteristics of viruses
- Viruses of Bacteria Lytic & Lysogeny cycle (General features, RNA & DNA viruses)
- Viruses of Plants:-General characteristics and classification, Mechanism of infection by TMV and CMV
- Animal viruses:- Overview of Animal viruses,General features of retroviruses and HIV
- Prions & Molecular basis of their pathogenecity

Unit 5: Antimicrobial agents

- Types of antimicrobial agents
- Classes of antibiotics (β-lactams, tetracyclins, aminoglycosides, macrolids, Polypeptides antibiotics & their mode of action)
- Antiviral, antifungal, antiprotozoan antibiotics
- Development of resistance to antibiotics

REFERENCES

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2. Roger Y.Stanier, 5th Edition General microbiology
3. Powar & Daginawala Vol I & Vol II,General Microbiology
4. Prescott L. M. Microbiology, 6th Edition
5. Atlas R.M. Microbiology
6. Jhonson ,Laboratory Experiments in Microbiology,6th Edition, Pearson Education
7. Harold J.Benson, Microbiological applications, 6th Edition
8. Singleton Sainsbury, Dictionary of Microbiology & Molecular Biology, John Wiley
9. R.C. Dubey& Maheshwari,A Textbook of Microbiology,1st Edn,2005.
10.Medical Microbiology, Anantnarayan
11.Nicklin, Instant Notes in Microbiology,2nd Edn.
12. Stanier,General Microbiology, 5th Edn.
13. Ingraham,Introduction to microbiology,3rd Edn
14.Moat, Microbial Physiology,4th Edn.
15. Ignacimuthu,Methods in Microbiology
16. Black, Microbiology Principle & Exploration,6th Edition.
17. Torotora , Microbiology: An Introduction 8th Edition.
18. Cuppuccino,Microbiology : A Laboratory Manual,8th Edition
19. White, Physiology & Biochemistry of Prokaryotes
20. Alexopoulos, Introductory Mycology
21. Rajvaidya, Applied Microbiology Vol.I to V, APH Pub.

BT 102: ENZYME TECHNOLOGY

Objectives:

The objective of this course is to provide a guide in the Technology basic and detailed concepts of enzymology and enzyme technology. Enzymes catalyze biological reactions. If one wants to work on production and synthesis of industrially important biological substance it is very essential for him/her to understand the nature of enzymes and type of reactions they catalyze.

Course Outcome

CO1: Introduction, nomenclature and classification of enzymes

CO2: Enzyme kinetics and mechanism of action of enzymes

CO3: Enzyme technology: immobilization of enzymes, commercial production of enzymes, enzyme engineering, design and construction of novel enzymes.

CO4: Application of enzymes in medicine (therapeutic enzymes, enzymes as analytical reagents), drug synthesis and biosensors.

Unit 1: Enzyme – General Account

- Classification of enzymes and enzyme kinetics of single substrate and two
- substrate catalyzed reactions
- Factors affecting rate of enzymatic reactions: temperature pH modulators etc and
- significance of activation energy and free energy in biochemical reactions.

Unit 2: Enzyme Cofactors and Mechanism of Enzyme Catalysis

- Structure and biological function of a variety of enzyme cofactors. Enzymesubstrate complex concept of ES complex binding sites, active site and type of enzyme specificities.
- Acid Base catalysis, Orientation and Proximity, Covalent Catalysis (Electrophilicand Nucleophilic), Strain and Distortion.
- Regulation of enzyme catalysis: Covalent modification, Allosteric regulation
- Abzymes and Isozymes

Unit 3: Enzyme immobilization and Biotransformation

- Methods and principles, Supporting matrix, advantages, and reactor-design for immobilization of enzymes.
- Biotransformation through enzymes and Microbes
- Non-aqueous enzyme technology
- Asymmetric catalysis through enzymes

Unit 4: Enzyme technology for industrial application

- Applications of enzyme technology in environment
- Medical,
- Agricultural,

- Industrial benefits

REFERENCES

1. Enzymes : Biochemistry Biotechnology And Clinical Chemistry by Palmer, T.
2. Fundamentals of Enzymology by Price & Stevens
3. Enzyme kinetics - A modern approach by Marangoni, A. G.
4. Enzyme Kinetics Principles and Methods by Bisswanger, H

BT 103: MOLECULAR BIOLOGY

Objectives:

- To introduce the concepts of molecular biology in a stimulating, elegant, exhaustive and explanatory manner.
- To aware students about history and scope of molecular biology

Course Outcome

After successful completion of the course student will be able to understand

CO1: Central dogma of biology,C-value paradox,multigene families and genomic organization in prokaryotes eukaryotes and Archeabacteria

CO2: Mechanism of replication (synthesis of DNA), Causes and consequences of DNA damage and Mechanism and significance of DNA damage repair

CO3: Mechanism of transcription (synthesis of RNA) ,Control and regulation of gene expression at transcription level

CO4: Mechanism of translation (synthesis of proteins),post translational modifications

CO5: learn about Regulations and gene expression in prokaryotes and eukaryotes using operon concept.

Unit 1: Organization of genetic materials

- Various models to explain the structure of the nucleus and chromosomes, Special type of chromosomes: lamp brush, salivary and B chromosomes.
- Packaging of DNA as nucleosomes in eukaryotes, Chromosomal DNA contents and C-value paradox.
- Structural changes in the chromosomes
- Multigene families in eukaryotes
- Genomic organization in prokaryotes and Archaebacteria

Unit 2: DNA replication and repair

- Enzymes & accessory proteins involved in DNA replication
- Replication process in prokaryotic & Eukaryotic DNA
- Regulations of Eukaryotic replication
- DNA Repair:- Types of DNA Repair, Mechanism of DNA Repair

Unit 3: Transcription

- Importance of DNA binding Proteins, RNA polymerase
- Mechanism of Transcription in prokaryotes & Eukaryotes
- Processing of RNA:- m-RNA processing, 5' capping, 3' polyadenylation, splicing
- r-RNA & t- RNA processing

Unit 4: Translation

- The translation machinery, role of tRNA & ribosome
- Mechanism, of translation
- Post- translational modification of proteins such as phosphorylation, adenylation, acylation and glycosylation

Unit 5: Regulation & gene expression in Prokaryotes & eukaryotes

- Operon concept (lac operon, trp operon, his operon and arabinose operon), Structural basis of DNA-Protein interaction
- Attenuation & termination
- Gene silencing:- DNA methylation,
- Chromatin modification & gene expression. Histone acetylation & deacetylation
- Environmental regulation of gene expression

REFERENCES

1. Garder, Principles of genetics, Wiley Publications, 8th edition
2. Levin, Gene VI to Gene VIII, Oxford Pub.
3. Friefelder, Essentials of Molecular Biology, Panima Pub
4. T. A. Brown ,Genome-2 2nd Edition
5. Old & primrose, Principle of Gene Manipulation, Blackwell Pub.
6. Weaver Molecular Biology, Mc Graw Hill
7. Brown, Gene Cloning and DNA analysis, Blackwell Pub.
8. Winnacker, From genes to clones , Panima Pub.
9. P.C. Tumer, Instant notes in Immunology, Viva books Pub.
10. Griffith, Introduction to genetic analysis, Freeman publication, 8th edition
11. Robert Broker, Genetics, Mc Graw Hill
12. Strickberger, Genetics, Prentice Hall Pub.
13. T. A. Brown, Gene Cloning DNA analysis- Blackwell Pub.
14. Stephen Hunt, Functional Genomics Oxford, Tokyo

BT 104: BIOCHEMISTRY [MULTI / INTER-DISCIPLINARY]

Objectives:

The objective of this paper is to provide students with a basic understanding of

- Structural, chemical biology and three-dimensional construction of macromolecules (carbohydrates, proteins, nucleic acids and lipids)
- Functional properties and importance of carbohydrates, proteins, nucleic acids and lipids.
- To study biochemical pathways involved in intermediary metabolism

Course Outcome

After successful completion of the course student will be able to understand

CO1: Classification and structural properties of carbohydrates and lipids, glycoproteins and glycolipids and proteo glycans their significance in biological systems.

CO2: Structure and Classifications of aminoacids and protein based on different criteria, ramachandran plot and fibrous and globular protein.

CO3: Structure and conformations of nucleic acids, Physical property of DNA,Genomic and organellar DNA in eukaryotes

CO4: Nitrogen acquisition and assimilation, photosynthesis and respiration and electron transport chain .

CO5: Glycolytic pathways, Citric acid cycle, HMP Shunt, glycoxylate pathway, Oxidative deamination, Urea cycle and Oxidation of fatty acids.

Unit 1: Carbohydrates and Lipids

- **CARBOHYDRATES:** Classification, functions, Monosaccharide, Fischer projection formula, hemiketal and hemiacetal formation, furanoses, pyranoses, anomers, epimers, disaccharides-sucrose, lactose, maltose; polysaccharide (homo and heteropolysaccharides), peptidoglycans, glycoproteins, proteoglycans
- **LIPIDS:** Definition, classification & functions of Lipids. Saturated & unsaturated fatty acids, Essential Fatty acids, Prostagladins Fat:-Hydrolysis, Saponification Value, Rancidity of fat, Biological significance Properties & function of Glycerides, Phospholipids, sphingolipids & glycolipids

Unit 2: Proteins

- Structure of all 20 amino acids, Essential & Non essential amino acids
- Classification of Proteins based on Function & Solubility
- Primary, Secondary, tertiary & Quaternary structure of proteins, Ramchandran Plot
- Structure and Function of Fibrous proteins (Keratin, Collagen & Elastin), Globular proteins (Hemoglobins , Myoglobins), Lipoprotein, Metalloproteins & nucleoproteins

Unit 3: Nucleic acids

- Structure of DNA & RNA, Different Conformations of DNA
- Denaturation & annealing of DNA Physical properties of DNA such as bending, super coiling and sequence dependent changes in DNA melting, renaturation properties
- Structure & different types of RNA
- Structure of genomic and organellar DNA in eukaryotes

Unit 4: Photosynthesis & Nitrogen fixation

- Photosynthesis and respiration. Photosynthetic electron transport and respiratory electron transport and their coupling with energetic.
- Biological nitrogen fixation, Biofertilizers, symbiotic and non-symbiotic nitrogenfixation. Mechanism of protection of nitrogenase from molecular oxygen. Nitrate assimilation

Unit 5: Carbohydrate, Protein and Lipid metabolism

- Carbohydrate metabolism: Glycolysis, TCA cycle, HMP shunt, Glyoxylate pathway and Gluconeogenesis
- Protein metabolism: Oxidative deamination and Urea cycle
- Lipid metabolism: Oxidation of fatty acids

REFERENCES

1. Lenhinger. Principles of Biochemistry, Nelson & Cox, 4th Edition.
2. Stryer – Biochemistry. W.H.Freeman & Co.
3. Plumner. An introduction to practical Biochemistry,3rd Edition
4. J.Jayraman. Lab Manual in Biochemistry.
5. Cohn and Stumph. Outline of Biochemistry. Wiley eastern.
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7. Switzer and Garrity. Experimental Biochemistry WH Freeman.2nd Edition
8. Voet & Voet Donald. 3rd Edition. Fundamentals of Biochemistry, J/W.
9. Hames and Hooper. 2000. Instant notes in Biochemistry. BIOS Sci. Publ.
10. Smith G. 1996. Biotechnology. Cambeidge Univ. Press.
11. Geoffrey Cooper. 2000. The cell with CD- Rom. Sinauer Asso. Incorp.
12. Elliott & Elliot.3rd Edition Biochemistry and molecular bilogy.
13. Seidman and Moore. 2000. Basic laboratory methods for biotechnology. Longman
14. Boyer. 1999. Concepts in biochemistry. Thomson
15. Das and Mookerijee. Outline of biology.
16. Biotechnology, Demystifying the concepts. By David Bourgaize. Alp 2000
17. Wilson, & Walker. 1995. Principles and techniques of practical Biochemistry.
18. Boyer. 2001. Concepts in Biochemistry. 2nd Edition
19. Hames, Instant Notes in biochemistry, 2nd Edition.
20. Garrett, Biochemistry,2nd Edition.
21. Price & Steven, Fundamentals of Enzymology,3rd Edition
22. Creigntion, proteins: Structure & Molecular Properties, Freeman Pub.+
23. Stephen Neidle, Nucleic acid Structure and Recognition, Oxford University Press
24. Rob Reed , David Holmes, Practical Skills in Bimolecular Sciences, LONGMAN Pub.

M.Sc. Biotechnology (PRACTICALS)

Semester I

MODULE I: Microbiology

1. Isolation & maintenance of organism by plating, streaking & serial isolation methods slants & stab culture, storage of microorganism
2. Microscopic observation - Gram staining, Capsule & Spore Staining
3. Growth cure – Diauxic
4. Effect of Physicochemical Factors on Growth of Bacteria: Salt, Temp, pH
5. Viable count of bacteria from soil sample (Dilution Plating Method)
6. Biochemical characterization of selected Microbes
7. Isolation of bacteriophages from sewage sample
8. Enrichment and Isolation of:

a) Halophiles b) Acidophiles c) Phenol Degraders

d) Nitrogen Fixers e) Antibiotic Producers f) Kojic Acid Producers

9. Effect of Antibiotics on various Gram Positive and Gram Negative bacteria (Antibiotic sensitivity of bacteria)

10. Determination of Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of various Antibiotics on different Organisms

11. Isolation of auxotrophic mutant by 5 BrU mutagenesis
12. Bacterial Conjunction
13. Physical mapping with interrupted conjugation techniques (By Problem solving approach)
14. Bacterial Transformation

MODULE II: Enzymology

1. Enzyme assay: Amylase/Protease/Xylanase/Cellulase
2. Enzyme Kinetics: Determination of Km &Vmax,
3. Effect of Physical parameters on enzyme: pH, Temperature on Amylase/Alkaline phosphatase /protease/cellulose
4. Effect of chemicals on enzyme: Inhibitors, Chelators, Solvents on Amylase/Alkaline phosphatase/protease/cellulose.
5. Alkaline Phosphatase i.e, a) Competitive Inhibition (NaH, PNP) b) Uncompetitive Inhibition (L – Phenylalanine)

MODULE III: **Molecular Biology**

1. Isolation of Genomic DNA from bacterial cell / plant cell
2. Isolation of RNA from Yeast cells
3. Isolation of Plasmid DNA
4. Determination of Tm values of DNA
5. Blotting techniques: Western and Southern

6.Plasmid Curing by Acridine Orange (Shift to sem I)

MODULE IV: Biochemistry

1. Method of Protein Estimation

i) Estimation of Protein by Biuret methods

ii) Estimation of Protein by Folin Lowry methods

iii) Estimation of Protein by Bradford method

iv) Estimation of Protein by UV Absorption.

2. Method of Carbohydrate Estimation

i) Estimation of reducing sugar by DNSA method.

ii) Estimation of Carbohydrate by Nelson-somogys method
iii) Estimation of Carbohydrate by GOD/POD method.
iv) Estimation of Carbohydrate by Phenol Sulphuric acid method.
v) Estimation of Carbohydrate by Anthrone's method
3. Nucleic acid Estimation
i) Estimation of DNA by DPA method
ii) Estimation of RNA by orcinol method /modified orcinol
iii) Estimation of Nucleic acid by UV Absorption method
iv)Estimation of total lipids in seeds
4. Analysis of oils, iodine numbers, saponification value, acid number
5. Separation of plant pigments by paper chromatography (Shift in Sem II parcticals)
6. Separation of Amino acids by thin layer chromatography (Shift in Sem II parcticals)

SEMESTER 2

BT 206: MOLECULAR CELL BIOLOGY

Objectives:

- Aspect of cell cycle its components and its control
- Phenomenon of cell death and factors regulating cell death.
- To introduce the fascinating mechanism of cell signaling along with brief overview on developmental biology and molecular biology of cancer

Course Outcome

After successful completion of the course student will be able to understand…..

CO1: Overview of cell cycle, it's components, control, check points, also learn about cell signaling and molecular basis of signal transduction.

CO2: Mechanisms of apoptosis and necrosis and regulating factors

CO3: Structure of microtubules, cilia, flagella and intermediate filaments, also learn about cell behavior.

CO4: Fertilization, Post fertilization, In vitro fertilization and role of different protein in fertilization.

CO5: Genetic basis of cancer, Oncogene , Viral oncogene , techniques used in cancer research and cancer treatment.

Unit 1: Cell cycle & Cell signaling

- Overview of cell cycle & It's control

- Components of Cell Cycle control systems
- Role of Protein kinase in cell cycle
- Check points in Cell Cycle regulation
- Molecular basis of signal transduction
- Signaling through G-Proteins linked cell surface receptors, Signalling through Enzyme linked cell surface receptors

Unit 2: Apoptosis

- Phenomena of apoptosis,
- Factors regulating apoptotic death in normal cells and tumorous cells
- Necrosis

Unit 3: Cytoskeleton

- Microtubules, cilia, flagella & centrioles, roles of microtubule dynamics in cell division
- Microfilaments &cell motility
- Intermediate filaments
- Actin & Myosin, Functional role of actins filaments and motor proteins.
- The cytoskeleton & cell behaviour

Unit 4: Developmental Biology and Cell Differentiation

- Establishing multicellularity, formation of blastula, embryonic germ layer, tracking of migrating cells
- Aggregation behaviour in embryonic cells and possible understanding in the positional information in developing organs.
- Events during fertilization, post fertilization, early embryonic development and invitro fertilization.
- Roles of different proteins in fertilization

Unit 5: Molecular Biology of Cancer

- Characteristics of cancer cells
- The genetic basis of cancer, Proto-oncogenes & its regulation
- Oncogenes & cancer, Viral oncogenes (Viruses & Cancer)
- Techniques used in cancer research (From genomics to proteomics)
- Cancer treatment present & future
- Regulation of gene expression and signal translocation on cancerous cells vs. normal cells

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4. R.S.Singh , Oxford Pub. Prin. Of Plant Pathology, Oxford Pub.
5. S.Ignacimuthu, Plant Biotechnology, Plant Biotechnology
6. R.S.Singh, Prin. of Plant Pathology, Oxford Pub
7. H.N.Verma, Basics Plant Virology, Oxford Pub
8. M.K.Rajdan, Plant Tissue Culture, Oxford Pub
9. Buchanan, Wilhelm Gruissem ,Biochemistry & Molecular Biology of Plants, Wiley

10. Peter Westhoff, Molecular Plant Development, Oxford Tokyo
11. Freshney, R. Ian, Culture of Animal Cells: a manual of basic technology, 5th Ed,John Wiley & Sons
12. Ranga, M. M. Animal Biotechnology, 2nd ed. Student Edition
13. Masters, John R. W., Animal Cell culture: a practical approach, 3rd Ed.,Oxford University Press
14. Yadav, P. R.; Tyagi, Rajiv, Biotechnology of Animal Culture, Discovery Publishing House
15.Periera-Raja, Florence, Animal Biotechnology,Dominant Publishers & Distributors

BT 207: IMMUNOLOGY

Objectives:

- In-depth knowledge and understanding of major cellular and molecular mechanisms underlying immunological processes in health and diseases
- To acquire a knowledge of immunochemical techniques in qualitative and quantitative analysis of antibodies and antigens.
- An understanding of the factors that determine the effectiveness of immune responses to microorganisms (bacteria, viruses, parasites) and tumours and how protective immunity can be elicited by vaccination

Course Outcome

After successful completion of the course student will be able to understand…..

CO1: Introduction, history and scope of Immunology ,Cells, organs and molecules of immune system

CO2: Nature and biology of antigens. Structure and function of antibodies. Kinetics of antigen and antibody interaction and immunological techniques.

CO3: B lymphocyte AND Tlymphocyte development and activation , also learn about generation of immunological diversity.

CO4: MHC molecules its gene and organization , MHC restriction and tolerance.

CO5: Immunity to infectious agents, autoimmunity, hypersensitivity, transplantation, tumor immunology, vaccination ,Hybridoma technology and production of monoclonal antibody

Unit 1: Molecular cells & organs of Immune system

- Historical perspective, Innate Immunity:- Skin, Mucosal Surface, Physiological barrier,Inflammation, Adaptive Immunity
- Molecules of innate & Acquired immune system:- Complement, Interferon, other molecules

- Cells of Innate & Acquired Immune system
- Organs of the immune system:- Primary Lymphoid organs, Secondary Lymphoid organs, Lymphatic etc.

Unit 2: Antigens, Antibody & Ag-Ab Interaction

- Antigens: - Immunogenicity vs Antigenicity, Factors influencing Immunogenicity, Adjuvant, Epitopes & Haptens, super antigens, auto antigens
- Antibody:- Structure, classes & functions, Allotypes & Idiotypes
- Basic principles of Antigen-Antibody Interaction
- Immunological techniques: Principles & Applications:Precipitation & agglutination, Radio Immunoassay, Enzyme linked Immunosorbent Assay etc.

Unit 3: Mechanism of Immune response

- Generation of Immunological diversity
- Antigen recognition
- Lymphocyte development &activation
- Lymphocyte interaction, cytokines & lymphoid system

Unit 4: MHC & Transplantation Immunology

- MHC:- General organization, MHC molecules & genes
- Cell recognition of self & nonself
- MHC restriction
- Tolerance:- Central Peripheral & acquired tolerance
- HLA typing methods using serological and molecular techniques.

Unit 5: The Immune system in Health & Disease

- AIDS & other Immunodeficiencies
- Autoimmunity & autoimmune diseases
- Hypersensitivity
- Vaccines:- Principle & types of vaccines, Recent advances in vaccination
- Monoclonal & Recombinant antibodies

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2. Ivan Roitt, Essential Immunology, 9th Edn.
3. Ananthnarayan , Medical microbiology,
4. Mary S. Leffell,& Noel R. Rose, Handbook of Human Immunology, CRC press
5. Tizzard, Immunology
6. Elgert Immunology
7. Lidyard, Instant notes in Immunology, 2nd Edition.
8. Darla J wise, Immunology-A comprehensive review : A Blackwell science Pub.
9. Todd & Spickett, Immunology
10. Delves & Roitte Encyclopedia of Immunology- Vol-1 to Vol.-4, 2nd Edition

BT 208: MOLECULAR BIOTECHNOLOGY-I

Objectives:

- To introduce the concepts of recombinant DNA technology in a stimulating, elegant, exhaustive and explanatory manner.
- To understand the technique of gene manipulation and gene cloning

Course Outcome

After successful completion of the course student will be able to understand…..

CO1: recombinant DNA technology, Dna modifying enzyme and restriction mapping

CO2: Various gene cloning vectors like plasmid,cosmid,BAC, YAC,Shuttle vector, Expression vector

CO3: Genomic libraries preaparations, probe preparations , in vitrophage packaging, positional cloning and chromosomal walking.

CO4: Various screening techniques to analyzed recombinant and also learn about Microarray techniques

CO5: Nucleic acid synthesis and sequencing, methods of gene regulations, DNA markers and applications of genetic engineering.

Unit 1: Molecular Tools used in Genetic Engineering

- Restriction Endonuclease and Restriction mapping
- DNA modifying enzymes:- Nuclease, Polymerase, Enzymes that modify the ends of DNA molecules, DNA ligase- joining DNA Molecules
- Adaptors, Linkers, Homopolymer tailing

Unit 2: Gene cloning vectors

- Plasmids, Cosmids, Bacteriophage
- Phagemids, BAC,YAC
- Shuttle vector, Expression Vector & other Advanced vectors

Unit 3: Cloning Strategies

- Genomic libraries, Preparation of DNA fragments for cloning
- Positional cloning, chromosome walking, Jumping.
- C-DNA Synthesis & cloning
- *In-vitro* phage packaging
- Probe preparation (Radiolabelled & non-radiolabelled)

Unit 4: Selection, Screening & analysis of recombinant

- Genetic selection of screening methods:- Use of chromatographic substrate, Insertional inactivation, Complementation of defined mutation

- Methods based on nucleic acid homology (Southern, Northern, Western Blotting, Subtractive, colony & plaque hybridization, chromosomal walk
- *In-situ* chromosomal hybridization
- Immunological screening for expressed genome
- Microarray Technique

Unit 5: Advanced Techniques.

- Nucleic acid Synthesis & Sequencing, Chemical & automated method
- Methods of gene regulation in Eukaryotes (Antisense RNA, PNA & RNAi)
- Polymerase Chain Reaction
- DNA markers:- RFLP, micro-minisatellites, SNPs, RAPDs,AFLP, Linkage analysis, genotyping & DNA fingerprinting
- Applications of genetic engineering

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1. Nicholl, An Introduction to Genetic Engg. - 2 ed, Cambridge
2. Primrose, Principles of Gene Manipulation - 6 ed, Blackwell
3. Winnacker, From Genes to Clones, Panima
4. Primrose, Principle of Gene Manipulation, Blackwell
5. Griffiths, Intro. to Genetic Analysis - 8 ed, Freeman Pub.
6. Maxine singer-berg, Genes – Genomes, Uni. Sci. Book
7. T.A.Brown, Gene Clonning - DNA Analysis, Blackwell
8. John Witkowski, Recombinant DNA, Scientific American
9. Piramal, Molecular Biotechnology, Dominant Pub.
10. Maxine singer & Paul Berg, Exploring Genetic Mechanism, Uni.science Books
11. Bruce K. Patterson, Techniques in Quantification and Localization of Gene Expression, Birkhaus Pub.
12. Reed , Holmes,Jonathan Weyers, Practical Skills in Bimolecular Sciences
13. Anthony, Griffiths,William M, Modern Genetic Analysis :Integrating Genes & Genomes,W.H.Freeman And Company

BT 209: BIOSTATISTICS & ANALYTICAL TECHNIQUES

Objectives:

- Understanding the concept of statistics is necessary for researchers to test their hypothesis and to analyse their experimental data to make firm conclusions
- to provide detailed knowledge of techniques used in biological research and industries. Understanding biotechniques is essential to strengthen the knowledge of the candidate desired to work in the field of biotechnological research, development and manufacturing. Learning biotechniques is important for students of all fields of life sciences

Course Outcome

After successful completion of the course student will be able to understand…..

CO1: Diagrammatic, graphical and tabular representations of data ,Measures of central tendency, dispersion, Regression and correlation ,Basic concepts of hypothesis testing, Level of significance

CO2: Radio isotops, it's properties and applications, also learn about light and electron microscopy.

CO3: Various types of spectroscopy and its applications

CO4: Various types of chromatography, centrifugation, Gel electrophoresis .

Unit 1: Biostatistical Concepts

- Scope of Biostatistics, Samples & population & Sampling techniques, Kinds of variable, Graphical & diagrammatic representation
- Theory of errors, measure of precision, Probable errors of function, rejection of observation
- Mean (Arithmetic, Harmonic, & Geometric), Median & Mode.
- Measure of dispersion, standard deviation & standard errors
- Probability distribution:- Binomial, Poisson & normal distribution
- Regression:- Linear, Bivariate & Polynomial regression analysis
- Level of significance: F test, T test, chi square & goodness of fit, ANOVA

Unit 2: Radioisotope Techniques and Microscopy

- Radioisotopes & half life of isotopes, Units & measurement of radiation, Autoradiography, Application of radioisotopes in biological study, Interaction of radiation with matter
- Light Microscopy: - Bright field, Dark field, Fluorescent Microscopy, Phase contrast Microscopy
- Electron Microscopy :- Transmission, EM & Scanning EM, Flow Cytometry, Atomic force microcopy

Unit 3: Spectroscopy

- Spectroscopic techniques:- Beer Lambert's law, Extinction coefficient, Principles & applications of visible & U.V. spectroscopic technique
- Electromagnetic spectrum, interaction of EM radiation with matter, Physical phenomenon:- Absorption, Emission, Refraction, Diffraction, Transmission
- Absorption & Emission Spectroscopy
- X-ray diffraction & crystallization
- CD, ORD, IR & NMR, MALDI-TOF Mass spectroscopy (Matric Assisted Laser Desorption Ionization Time of Flight Mass Spectrometry

Unit 4: Chromatography, Centrifugation and Electrophoresis

- Chromatography Theory & Principles
- Key terms:- Stationary phase, mobile phase, Retention time, column efficiency, Peak shape,Rate theory
- Types of chromatography, partition, adsorption, Ion exchange, size exclusion, affinity, Paper chromatography, Hydrophobic chromatography, GC,GLC, HPLC

- Centrifugation: - Sedimentation, Relative centrifugal force, preparative and analytical centrifuge.
- Basic Principles of electrophoresis, Agarose electrophoresis, PAGE, SDS PAGE, 2D PAGE, Isoelectric focusing

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1. Biotol, Analysis of Amino Acids, Proteins and Nucleic Acids,B.H.Edn.
2. Biotol, Techniques used in Bioproduct Analysis,B.H.Edn.
3. Daniel, Basic Biophysics. Student Edn.
4. Singh, Biophysics, Freeman Pub.
5. Patania,Analytical Chromatography, Campus Publisher.
6. Siuzdak,Mass Spectroscopy for Biotechnology
7. Richard F. Ven, Principles and Practices in Bioanalysis, Taylor & Francis Inc.
8. Wilson & Walker, Practical Biochemistry, Cambridge Edn.
9. Chang, Physical chemistry with application to Biological system, MacMillan Pub.
10. S. Mahesh, Biotechnology-3, Molecular Biology & Biophysics, New age Int.Pub.
11. Thomas, Analytical Biochemistry,1st Edn.
12. Switzer & Garrity, Experimental Biochemistry,3rd Edition.
13. Shamauder, Methods in Biotechnology.
14. Willard,Instrumental Method of analysis, CBS Pub.7th Edn
15. Jerrold H Zar, Biostatistical analysis, 4th Edition, Pearson Education
16. P.S.S.Sundar Rao, An Introduction to Biostatistics, Eastern Economy Edn.
17. N.Gurumani,An Introduction to Biostatistics,2nd Edition,MJP Publisher.
18. Jiang, Xu & Zhang,Current topics in Computational Molecular Biology,Ane Books
19. Gary B.Fogel & David Corne , Evolutionary Computation In Bioinformatics Morgan Kaufmann Publishers

SEMESTER-II (Practical)

MODULE V: Molecular Cell Biology

1. NESTROF (Naked Eye Single Tube Red Cell Osmotic Fragility Test) - Screening Test For β-Thalassemia Trait
2. Study of various stages of mitosis from onion root tip cells.
3. Effect of colchicines on the DNA content of cell.
4. Study of different stages of meiosis in flower bud of *Tradenscantia sp.*
5. Localization of protein by mercuric bromophenol blue.
6. Localization of lipid by Sudan black B.
7. Study of Karyotyping.
8. Study of permanent slides of the chick embryo.
9. Staining of Golgi appartus using Neutral Red stain.
10. Staining of mitochondria in human cheek epithelial cells.

MODULE VI: Immunology

1. Total count of RBC & WBC differential count & Blood grouping
2. Western Blotting
3. Single Radial Immunology Diffusion

4. Octerlony Double diffusion
5. WIDAL test
6. VDRL test
7. ELISA
8. Generation of primary antibody by using mice as model organism.

MODULE VII: Metagenomics and Molecular Phylogeny

1. Isolation of soil metagenome
2. Restriction Digestion of λ DNA using three Restriction Endonuclease enzymes:
a) EcoR V b) Hind III c) BamH I
3. Accessing population diversity by 16S rDNA analysis
4. Isolation of Lambda phage DNA
5. PCR:
   - Basic PCR
   - Nested PCR
   - Multiplex PCR
   - RAPD
   - RFLP

SEMESTER 3

BT 311: FERMENTATION TECHNOLOGY [CORE-I]

Objectives:

To provide knowledge of basic principles of fermentation processes.

To provide insight into design, development, and operation of fermentation processes at lab as well as Large scales. And the techniques used.

To Provide fundamental knowledge of already established fermentation processes used in production of various products.

Course Outcome

CO1: Students will get knowledge of basic techniques like media formulation, sterilization, strain isolation and improvement, which are mandates of development of any fermentation process.

CO2: Students will gain knowledge of parameters related to fermenter designs, and the accessories used in the design of a fermenter, to troubleshoot problems associated with various fermentation processes.

CO3: students will get acquainted to the fermentation economics and how to design processes accordingly.

CO4: students will attain information on already well-established fermentation processes in the industry and the current approaches for the improvisation in them.

CO5: students will also have insight in the fundamentals of food processing and the advancements in that industry. In addition to that they too have been exposed to the modern approaches of the food and nutraceuticals.

Unit 1: Basics of Industrial fermentation and Sterilization of air, media &equipment's

- Medium formation & Raw material
- Isolation and screening of industrially useful microorganisms
- Strain Improvement
- Methods of measuring process variation
- Control system
- Computer application in fermentation technology

Unit 2: Design of fermenter

- Various Design and types of fermentors & Bioreactor
- Aeration and agitation, oxygen transfer rate, heat control
- Batch, fed-batch and continuous culture operations
- Starter culture, its importance and preparation
- Mass transfer bioprocess
- Scale up bioprocess

Unit 3: Product Recovery & Purification (Downstream Processing)

- Extraction and separation techniques; Cell disruption – disintegration, Flocculation & Floatation, Filtration, Centrifugation, Distillation
- Enrichment of product by: Thermal process, Membrane filtration and dialysis, Freeze concentration, Chromatographic methods, Purification: Crystallization and drying
- Bioassay and fermentation economics

Unit 4: Industrial production of chemicals

- Alcohol Fermentation
- Organic acids (Gluconic acid & Citric acid)
- Vitamins (Vit. B12)
- Amino acids (Lysine & Glutamic acid)
- Single cell protein

- Antibiotics (Penicillin & streptomycin)
- Enzyme (Amylase, Protease & lipase)

Unit 5: Food Technology

- Food Spoilage & Preservation
- Methods of Food Processing
- Designer Foods, Nutraceuticals & Genetically Modified Foods

References:

1. Biochemical Engineering, Aiba, S., Humphrey,A.E. and Millis, N.F. Univ. of Tokyo Press.

2. Process engineering in Biotechnology, Jackson, A. T. Prentice Hall, Engelwood Cliffs.

3. Biochemical Reactors, Atkinson, B., Pion Ltd, London.

4. Fermentation Microbiology & Biotechnology, E L - Mansi and Bryce, Taylor & Francis, 1999.

5. Industrial Microbiology, Prescott & Dunn, Fourth Edition.

6. Industrial Microbiology by Casida. LE, New age International (P) Limited, Publishers.

7. Industrial Microbiology by Prescott & Dunns, AVI Publishing Company Inc.

8. Industrial Microbiology by A.H. Patel.

9. Principles of Fermentation Technology by P.F. Stanbury, A. Whitaker and S.J. Hall, Butterworth Heineman, Aditya Books (P) Ltd.

BT 312: MOLECULAR BIOTECHNOLOGY-II [CORE-II]

Objectives:

This subject deals with the various techniques used to extract, purify, and manipulate the biological macromolecules like DNA and Protein. Specially focused more on the Proteins.

Students will be familiarized to the techniques used to study the DNA-Protein and Protein-Protein Interactions, to know the significance of the molecule of interest. And will learn about the molecular markers and approaches used in the detection based on them.

To make students learn about the strategies of protein folding in vivo and in vitro, so as to expand their knowledge in the field of protein engineering and drug designing.

Course Outcome

CO1: Students will get information regarding the methods used in gene detection and detection of expressed gene products; as well as they will get knowledge of protein sequencing approaches.

CO2: Students will attain the knowledge of modern approaches used to study DNA-Protein interactions and Protein-Protein interactions and the advancements in them.

CO3: Students will gain knowledge about various Reporter/Marker genes and their use in expression studies of gene of interest.

CO4: Students will be familiarized to the protein folding strategies used to get the information on the correct protein folding in Vivo. And the approaches used to attain the same in Vitro.

CO5: exposure to the strategies and concepts of protein engineering, Drug targeting and Drug designing using various case studies.

UNIT – 1: Proteomics techniques

- Techniques used in gene detection and expression studies: Southern hybridization, Northern hybridization, western hybridization, PCR and RT-PCR
- Peptide sequencing and synthesis: principles and strategies for protein sequencing. Design of primers from ammo acids sequences.

UNIT – 2: DNA- protein interaction techniques

- Gel mobility shift assay, DNA-protein cross-linking assay, Dnase I foot printing and Sl nuclease mapping.
- Protein- protein interactions: chemical cross-linking. Yeast-2-hybid, Yeast-3- hybid and their various versions. Principles and applications.

UNIT – 3: Reporter genes

- Chloramphenicol acetyl transferase (cat), neomycin phosphoryl transferase II (nptII), Luciferase, β- galactosidese etc. and their applications in expression kinetics and promoter probing studies.

UNIT – 4: Protein folding

- Protein folding and the roles of Molecular chaperones

- Mechanism and relevance to biotechnology
- Assisted protein folding , In-vitro protein folding

UNIT – 5: Protein engineering and drugs design

- Rational of protein engineering,
- Methods and approaches: directed Evolution and gene shuffling, random mutagenesis and selection of engineered proteins, gene modification at specific sites, synthesis of complete gene. Engineering by gene fusion.
- Drug design and various approaches: by blocking enzyme activity, Inhibitor for Dihydroxyfolate reducase (DHFR), Renin. HIV reverse transcriptase etc Drug design by blocking hormone receptors, propanolol for norepinephrine and epinephrine etc, and drug design by inhibiting nucleic acid synthesis using antisense RNA technology.

References:

1. Goodwin, W. (2007). JD WatsonA. A. CaudyR. M. MyersJ. A. WitkowskiRecombinant DNA: Genes and Genomes—A Short Course3rd Edition2007W. H. Freeman and CompanyNew York0-7167-2866-4474 pp. Science & Justice, 47(4), 172.

2. Hardin, C., Pinczes, J., Riell, A., Presutti, D., Miller, W., & Robertson, D. (2001). Cloning, gene expression, and protein purification (pp. 196-384). Oxford: Oxford University Press.

3. Malke, H. (1990). J. SAMBROCK, EF FRITSCH and T. MANIATIS, Molecular Cloning, A Laboratory Manual , Volumes 1, 2 and 3. 1625 S., zahlreiche Abb. und Tab. Cold Spring Harbor 1989. Cold Spring Harbor Laboratory Press. Journal of Basic Microbiology, 30(8), 623-623.

4. Glover, D. M., & Hames, B. D. (1995). DNA cloning 3: a practical approach. IRL Press Ltd.

5. Walker, M. R., & Rapley, R. (1997). Route Maps in Gene Technology. Blackwell Science Ltd., Oxford.

6. Kingsman, S. M., & Kingsman, A. J. (1988). Genetic engineering: an introduction to gene analysis and exploitation in eukaryotes. Blackwell Scientific Publications.

7. Glick, B. R., & Pasternak, J. J. (1998). Principles and applications of recombinant DNA. ASM, Washington DC, 683.

8. Primrose, S. B., & Twyman, R. (2013). Principles of gene manipulation and genomics. John Wiley & Sons.

BT 313: BIOINFORMATICS [CORE-III]

Objectives:

To deals with fundamentals of computer science and computational biology.

To aid students in understanding the pipeline of dry lab approach like databases, data analysis and interpretation; and the approaches of computer science used to design them.

To make students familiarize with various primary and secondary databases and the tools associated or independent of them for the data processing and interpretations.

To expose students to the modern "Omics"-branches and modern computational approaches of gene and protein prediction and manipulations.

Course Outcomes:

CO1: Students will be exposed to the fundamentals to make them used to with the terms of computer science and to develop computational approach in them. Further leading them to the emergence of the Bioinformatics and the recent status of the same.

CO2: students will get used to with the biological databases, types of databases, organization, Data retrieval systems used by various databases and searching the correct database to obtain the desired results. Students will also learn about the tools and algorithms used to furnish the retrieved data to extract the useful information from them and to interpret.

CO3: Students will be exposed to the modern day "Omics" approaches and the relevant terminologies

Unit 1: Computational approach

- Introduction to operating system and Basics of computer.
- Use of computer networking - LAN, WAN, MODEM, Fibre Optics Network.
- Introduction to Internet. WWW, NICNET, ERNET VSNL. ISDN ETC.
- Introduction to artificial intelligence and neural networks.
- Current perspective & Emergence of Bioinformatics
- Commercial use of Bioinformatics

Unit 2: Biological databases

- Primary & secondary database

- Database searching
- Database Management:- Sequence Retrieval system (SRS)

Unit 3: Data mining and Sequence Alignment (Primer Designing)

- Data mining & Data warehouse, Machine Learning methods, Data mining tools & techniques,
- Pair wise sequence Alignments, Global & Local Alignments, Multiple Sequence Alignments, Gaps & scoring matrices, Homology, orthology, Analogy & Paralogy
- Primer designing

Unit 4: Gene Prediction & Genome analysis

- Reliability of ORF Prediction
- Methods for Gene prediction in microbial genomics & in eukaryotes
- Evaluation of gene prediction
- Comparative genomics
- Functional Genomics
- Microarray methods & its applications in genome analysis

Unit 5: Protein structure prediction

- Terms used for classifying protein structure & sequences
- Alignment of protein structures
- Structural prediction and its evaluation
- Structural modelling

References

1. Bioinformatics: Principles and Applications Book by Bibekanand Mallick and Zhumur Ghosh

2. Introduction to Bioinformatics, Fifth Edition by Arthur Lesk

3. Bioinformatics: Basics, Algorithms and Applications Ruchi Singh, Richa Sharma

BT 314: ENVIRONMENTAL BIOTECHNOLOGY [ELECTIVE I]

Objectives:

To study usefulness of biotechnology in the field of bioremediation and biodegradation.

To study biotechnological and microbial approaches used in environmental sustainability, agriculture, and various other fields.

To understand biodiversity, so as to develop better methodologies and formulations to be used at local level

Course outcomes:

CO1: Students will learn to count on the biological/ renewable resources and sustainable approaches in various fields like agriculture, energy production and recycling of the waste material.

CO2: Approach will be developed to conserve the non-renewable resources and the environment, and to think about more and more use of biological/renewable, non-hazardous resources.

CO3: Students will be exposed to the approaches of the production and post-production processing using the biological material so as to lessen the burden of the pollutants generated by the industrial processes.

Unit 1: Environmental impact and Biosensors

- Reducing environmental impact of industrial effluents Toxic site reclamation, removal of spilled oil and grease deposits. Microbial degradation of textile dyes, timber petroleum products, leather plastics and food product
- Biosensors, recent approaches and applications

Unit 2: Bio fertilizers

- Use of mycorrhizae in reforestation and aforestation
- Biofertilizers and biopesticides
- Role of Dienococcus sp. in bioremediation of radioactive waste. Molecular mechanisms of radiation resistant

Unit 3: Environment and energy

- Renewable source of energy: Biomass production and Biogas production. Generation of energy and fuel using microorganisms (Hydrogen production and Methane production)

- Brief account of alternative energy source: Biofuel etc.
- Conservation of energy: Global Warming and carbon credit
- Heavy metals and its effect on microbes and higher organisms

Unit 4: Biodiversity

- Biodiversity & species concept
- Benefits from Biodiversity
- Factors threatening Biodiversity
- Endangered species management & Biodiversity protection

References:

1. Alexander, M. Biodegradation and Bioremediation, Academic Press, 1994.

2. Arceivala, S.J. and Asolekar, S.R., Wastewater treatment for Pollution Control and Reuse, 3rd edition, Tata McGraw Hill, 2007.

3. Atlas, R.M. and Bartha, R. Microbial Ecology, 4th edition, Pearson Education, 2009.

BT 315: CELL CULTURE [ELECTIVE II]

Objectives:

To study culturing techniques, types of cultures, media formulation and sterilization methods used in plant and animal cell cultures

To study stem cell technology, stem cell characters and their usefulness in modern therapeutics

To study the methods and consequences of gene transfer in eukaryotic cells and usefulness of transgenic plants and animals and the products associated to them.

Course Outcomes:

CO1: students will learn about plant and animal cell culturing methods, and the techniques to get improvised cell lines of the eukaryotes and their maintenance.

CO2: Students will have insight in the field of modern therapeutics using the stem cell lines in treatment of various diseases, and the potential of stem cells and gene therapy

CO3: Students will have the knowledge regarding the recombinant products produced by the genetically manipulated eukaryotic organisms to benefit the human health

Unit 1: Plant Biotechnology

- Culture media: - constituents and concepts of sterilization, Preparation, isolation and selection of explant, Concepts of totipotency.
- Suspension cell culture, Callus culture, Protoplast Isolation, culture & fusion.
- Anther & pollen culture for production, Somatic embryogenesis, Synthetic seeds.
- Germplasm Conservation: Improvement, exploitation and conservation of plant genetic resources.

Unit 2: Animal Biotechnology

- Equipments & media used for Animal cell culture technology, Primary & established cell line culture and culture media
- Applications of animal cell cultures
- Serum protein media viability and cytotoxicity, Basic techniques of mammalian cell culture
- Cryopreservation and trans shipment of animal tissue and cell line

Unit 3: Stem cells

- Erythrogenesis, Chondrogenesis,. Cell cycle analysis, cells synchronization, cells separation, cells transformation in vitro, cells locomotion and cell cloning
- Different types of stem cell Characteristics of stem cells. The methods for stem cells differentiations. Potential of stem cell research in treatment of different genetic, infectious diseases and drug targeting
- Gene therapy and its application

Unit 4: Transgenics

- Objectives of transgenics
- Methods of gene transfer in plants and animals
- Expression of transgene in higher plants and animals for producing value based products
- Application of transgenic plants and animals: Recombinant product produced through transgene viz. Edible Vaccine, Recombinant proteins, Hormone production etc.

References:

1. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, Sixth Edition by R. Ian Freshney
2. Animal Cell Culture and Technology By Michael Butler
3. Atlas of Plant Cell Structure by Noguchi, T., Kawano, S., Tsukaya, H., Matsunaga, S., Sakai, A., Karahara, I., Hayashi, Y.

BT 316: FOOD BIOTECHNOLOGY [Elective-III]

Objective

to study the scope of food microbiology and food safety

to obtain the knowledge about important genera of microorganisms associated with food and their characteristics

to gain the knowledge and applications of various techniques for preserving food (ancient to modern)

to understand the role of different microorganisms in food spoilage, food fermentation and food-borne diseases

to comprehend the microbiological quality control and food-borne illnesses investigation procedures for ensuring food safety and hygiene and to understand current national and international food safety rules and regulations

Course Outcome:

The student will have knowledge on the role of various microorganisms associated with different foods.

The student will have knowledge on the presence of pathogenic and spoilage microorganisms associated with different foods.

The student will have specific knowledge on microorganisms in different raw materials and the health risk of food borne infections and intoxications.

The student will understand how microorganisms grow, and can be used in a positive manner and also controlled in foods.

The student will understand how to use qualitative and quantitative analysis of microorganisms based on theory as well as practical work. The student will have knowledge on physical, chemical and microbiological methods to control both quality and health risks in foods.

Unit 1

- Starter cultures and their biochemical activities; production of alcoholic beverages; production of Single cell protein and Baker's yeast; Mushroom cultivation
- Food and dairy products: Cheese, bread and yogurt.
- Fermented vegetables – Saurkraut; Fermented Meat – Sausages

Unit 2

- Novel microorganisms eg. LAB (Probiotics), Cyanobacteria, methylotrophs enzyme biotransformations
- Role of Plant tissue culture for improvement of food additives; color and flavor
- Genetic modifications of microorganisms; detection and rapid diagnosis
- Genetically modified foods and crop

Unit 3

- Food borne infections and intoxications; with examples of infective and toxic types – Clostridium, Salmonella, Staphylococcus
- Mycotoxins in food with reference to Aspergillus species
- Food preservation: canning, dehydration, ultrafiltration, sterilization, irradiation
- Chemical and naturally occurring antimicrobials; Biosensors in food industry

Unit 4

- Quality assurance: Microbiological quality standards of food
- Intellectual property rights and animal welfare
- Government regulatory practices and policies. FDA, EPA, HACCP, ISI
- Risk analysis; consumer and industry perceptions

References

1. Encyclopedia of Food Microbiology ,2nd Edition 2014, Carl A. Batt

2. Modern Food Microbiology By Jay, James M., Loessner, Martin J., Golden, David A.

3. Food Safety Culture Creating a Behavior-Based Food Safety Management System By Yiannas, Frank

4. Handbook of Foodborne Diseases By Dongyou Liu

BT 317 Combined Practicals

MODULE VIII: Fermentation technology

1. Primary screening of amylase, protease, lipase and cellulase producing microorganisms.

2. To study the submerged fermentation for enzyme production (lab scale).

3. To study alcohol tolerance of given culture of yeast.

4. To study sugar tolerance of given culture of yeast.

5. To demonstrate the production of alcohol by yeast and the quantification of alcohol produced in the fermentation broth

6. Comparative studies of ethanol production using different substrates

7. To estimate alcohol present in the given sample by potassium dichromate (K2Cr2O7) method.

8. To estimate the potency of antibiotic streptomycin in the given sample by bioassay technique

9. To carry out fermentation of Ca-gluconate using Aspergillusniger.

10. To prepare a standard curve of Ca-gluconate

MODULE IX: Food Biotechnology

1. Milk analysis: Methylene blue reduction test (MBRT), Resazurin reduction test (RRT), Acid fast staining

2. Food analysis: Standard Plate Count (SPC)

3. Water analysis: IMViC test

4. Isolation of probiotics organisms from various samples

MODULE X: Protein Purification

1. Protein Purification of different proteins/enzymes:

Gel Filtration Chromatography,

Ion Exchange Chromatography

2. SDS PAGE

3. Native PAGE

4. Silver staining technique

5. Induction of Protein synthesis in E.coli cells.

6. Protein Folding Studies.

MODULE XI: Bioinformatics

1. Use of NCBI Bioinformatics tools

(a) Pubmed (b) OMIM (c) Taxonomy (d) Protein analysis (e) Genes and Diseases

2. Use of Expasy tools

3. FASTA and sequence formats

4. BLAST

5. Alingments- pair wise and global

6. Construction of dendogram

7. Prediction of ORF/Gene prediction

8. Protein visualization (RASMOL, SPDB VIEWER, PROTEIN EXPLORER)

9. Protein modeling- Homology modeling and Acvitve site prediction

10. Primer Designing

Semester IV

BT 418: MOLECULAR PHYLOGENY AND EXTREMOPHILES [CORE]

Objectives:

To study evolution from the molecular point of view

To study methods to measure the evolution within and between species by cultivable and non-cultivable approaches

To study various extremophiles and their adaptations to the environment they are living in.

To study the approaches of use of various biological products produced by extremophiles.

Course Outcomes

describe evolutionary process at the molecular level, apply molecular methods to study genetic variation within and between species, and explain and justify different models of sequence evolution

discriminate between Pros and Cons of the cultivable and non-cultivable approaches to study the microorganisms and establishment of the concept of actual evolutionary relationship of the microbes

understanding the extreme environments and the adaptation s in the organisms and the usefulness of such products in day to day human life.

Unit 1: Microbial evolution and phylogeny

- Molecular basis of microbial classification,
- Chronometers and chronological distances,
- Paradox in establishing Evolutionary distances.

Unit 2: Non-cultivable microbes

- Cultivable vs. non-cultivable microbes, Genetic heterogeneity among noncultivable, Metabolic potential of non-cultivable microbes, Evolutionary and biotechnological significance of non-cultivable microbes
- Molecular methods for studying non-cultivable microbes: Isolation of nucleic acids and analyses of microbial diversity, In-situ hybridization, Methods of 16S rRNA analysis

Unit 3: Archaebacteria:

- Archaebacteria - distinguishing features, Phylogenetic groups of Archaebacteria, Ecology and habitats of Archaebacteria, Physiology of Archaebacteria

Unit 4: Life at Extremities:

- Life at hyper-extremities: hyperthermophilic Archaebacteria and bacteria, Life at hyper salinity, other forms of extremophiles
- Gene expression in hyperthermophilic bacteria and archaea, Genome analysis from extremophiles
- Protein stability in hyper-extremophiles

Unit 5: Biotechnology and Extremophiles:

- Hyper-extremophiles and their novel metabolic machinery and biomolecules - future unique applications

References:

1. Extremophiles: Sustainable Resources and Biotechnological Implications By Om V. Singh

2. Extremophiles Handbook by Koki Horikoshi

3. Extremophiles: Microbial Life in Extreme Environments (Wiley Series in Ecological and Applied Microbiology) 1st Edition by Koki Horikoshi, William D. Grant

BT – 419: SOCIO-ECONOMIC ASPECTS & IPR [ELECTIVE-1]

Objectives

To create awareness in the students about the economic, social and cultural benefits of IPRs in the field of biology

To study values of IPRs and generating wealth for IPRs through commercialization

To study and strengthen the IPR laws

Course outcome:

Awareness about conservation of the biological diversity and the global efforts made for the same

Impact of genetically engineered products on biodiversity, ecosystems and on human life

Social concern about the use of GMOs and awareness towards the biosafety laws.

Awareness toward the IPR laws

Awareness about Rights of patenting the biological material.

UNIT – 1:

- Steps to preserve biodiversity. In situ and Ex Situ conservation - Gene banks, Insitu and Ex situ conservation. Ex situ conservation efforts at international level, Ex-situ conservation by G-15 countries, Europe, India.
- Conservation efforts by private sectors, management of germplasm collection. Species conservations

UNIT – 2:

- Biosafety and Societal Concern: Public debate and concern on Genetically modified microorganisms, plants and animals, scientific analyses of the concern, Biosafety regulation and guidelines on developing and using the Genetically modified organisms, radiation safety.

UNIT – 3:

- Intellectual property, Intellectual property rights (IPR) (Patents, trade secret, copy right, trade marks), Choice of intellectual property protection (IPP). IPR and plant genetic resources (PGR).

UNIT – 4:

- Patenting of Biological Materials: International conventions. International cooperation obligations with patent applications, implications of patenting, current issues: Can live form be patented-? with special reference to Factor VIII, Erythropoitin, tissue plasminogen, activator, hybridoma technology etc.
- Patenting of higher plants and animals: Transgenic organisms and isolated genes. Patenting of genes and DNA sequences, plant breeder's rights and farmer's right.

References

1. INTELLECTUAL PROPERTY RIGHTS by KHUSHDEEP DHARNI and NEERAJ PANDEY

2. Intellectual Property: The Law of Copyrights, Patents, and by John R. Thomas and Roger E. Schechter

BT 420: PHARMACEUTICAL BIOTECHNOLOGY [Elective II]

Objectives

To study the emerging fields of Molecular Biotechnology, particularly in its aspect applied to medicines and human health

To study the current methodologies employed in the field of Pharmaceutical Biotechnology

To study effect of genetic construction on pharmacology

To study molecular diagnostics and vaccines

Course outcomes

Students will understand the various techniques used in modern biotechnology.

Students can able to provide examples of current applications of biotechnology and advances in the different areas like medical science

Students can explain the concept and application of monoclonal antibody technology

Students can demonstrate and Provide examples on how to use microbes and mammalian cells for the production of pharmaceutical products

Unit 1: Structural and functional genomics

- Structural and functional organization of the human genome.
- Physical mapping and linkage analysis, Identification of the disease linked genes and markers, positional cloning, isolation of the disease responsible genes and their characterization.
- Global genome functional variations: assessment by microarrays (cDNA and Oligo microarrays), 2D protein gel electrophorosis, MALDI.
- Functional analysis of human genome for studying the diseases and drug functionality and drug side effects (by microarray and 2D gel electrophoresis).

Unit 2: AIDS

- History of HIV, types, Life cycle to the HIV
- Genome variations among the HIV strains
- Key aspects for the drug designing targets.

Unit 3: Pharmacogenomics and molecular diagnostics

- Importance and types of drug metabolizing enzymes
- Variations in the drug metabolizing genes their effects, Individualized medicine and their application in the drug dosage and treatment in cancer.
- Principles and application of the molecular diagnosis via protein, DNA and other biomolecular detections.

Unit 4: Antibiotics and Pharmacokinetics

- Antimicrobial agents
- Vaccines
- Modern approaches in Vaccination

References

1. Pharmaceutical Biotechnology by Vyas S. P

2. Health and Pharmaceutical Biotechnology Book by Chetan D. M. and Dinesh K. P

3. Pharmaceutical Biotechnology: Concepts and Applications Book by Gary Walsh

BT – 421: AGRICULTURE BIOTECHNOLOGY [Elective – III]

Objective:

To study classification system of plants and their characteristics

To study plant adaptations in context of stressed environment and associated genetics and molecular biology

To study genetic transformation in plants (natural and artificial system)

To study transgenic plants with improved metabolic ability and products of human use

Course outcome:

Recall the basic concepts of Biotechnology and explain fundamental cellular events during the process of plant cell culture development

Determine the factors influencing plant cell differentiation and thereby execute proper techniques/ procedures for the maintenance of sterile condition and proper plant growth

Translate the concepts in future studies and debate on the issue related to GMOs and evaluate its significances

describe methods for obtaining and application of genetically modified plants

explain the application of plants as bioreactors for the production of vaccines and therapeutic proteins

demonstrate critical knowledge in problem solving within an interdisciplinary context of biotechnological production of secondary metabolites and recombinant proteins using plant cell technology

UNIT – 1: Taxonomy and physiology

- Classification of plant kingdom (Bentham and Hooker)
- Absorption of water, mineral nutrition, transpiration, phytohormones

UNIT – 2: Molecular Biology of Stress Tolerance in Plants

Basic plant physiology and regulation

- Water Stress, salt stress, High Temperature Stress, Freezing Stress, Systems Biology to Study Cold Tolerance, Nutrient Stress, Heavy Metal Stress

UNIT – 3: Genetic Transformation of Plants

- Agrobacterium mediated and biolistics-basic principles and applications, Ti plasmids, binary vectors, transformation hosts, Selection markers, Reporter genes, promoters
- Mechanism of transformation
- Screening of the transgenic plants and heterologous gene expression

UNIT – 4: Molecular farming: (Reported examples)

- Transgenic crop with Heat shock proteins, Ion/proton transporters, Reactive oxygen scavenger, Transcription and factors
- Transgenetic plants with pathogenetic resistance protein
- Plant-derived recombinant therapeutic protein, plant-derived recombinant antibody, vaccine candidate –hepatitis B virus surface antigen in tobacco, plant-derived industrial enzyme, amylase in tobacco, Secretory IgA produced in tobacco.

References

1. Plant biotechnology – J Hammond, et. al., Springer Verlag.
2. Plant cell and tissue culture for production of food ingredients – T J Fu, G Singh, et. al.
3. Biotechnology in crop improvement – H S Chawla.
4. Practical application of plant molecular biology – R J Henry, Chapman & Hall.
5. Elements of biotechnology – P K Gupta.
6. An introduction to plant tissue culture – M K Razdan.
7. Plant tissue and cell culture – H E Street, Blackwell Scientific.
8. Plant cell culture technology – M M Yeoman.

BT 422 Dissertation/ Project

Dissertation research work is offered to students of Semester IV to carry out research according to the provision of objectives and teacher guide. Students are allowed to apply in other national

and international level research institutes, Universities and industries of high repute to pursue six month dissertation research project for the partial fulfillment of M.Sc. Biochemistry degree.