

4. Transposable elements – Types & structure.

UNIT-IV: DNA MUTATIONS & REPAIR MECHANISMS

1. Mutations- point mutations, frameshift mutations.
2. Mutagenesis - Spontaneous and induced (Chemical and physical) mutations.
3. Factors affecting DNA damage.
4. Repair Mechanisms - Light induced repair, Excision repair and mismatch repair and SOS repair.

UNIT-V: CELL CYCLE REGULATION, CANCER & SIGNAL PATHWAYS

1. Phases of the eukaryotic cell cycle - Mitosis and Meiosis.
2. Regulation of cell cycle- checkpoints.
3. Basics of Cancer Development (Concept of Angiogenesis and Metastasis) and Cancer causative agents.
4. Proto- oncogenes, oncogenes. Differences between cancer cell and normal cell.
5. Programmed cell death, Introduction to cell signaling.

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1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts and Peter Walter – *Molecular Biology of the Cell* – Garland Science.
2. Geoffrey M. Cooper and Robert E. Hausman – *The Cell: A Molecular Approach* – ASM Press & Sinauer Associates.
3. Gerald Karp – *Cell and Molecular Biology: Concepts and Experiments* – John Wiley & Sons.
4. De Robertis, E.D.P. and De Robertis, E.M.F. – *Cell and Molecular Biology* – Saunders College Publishing.
5. Snustad, D.P. and Simmons, M.J. – *Principles of Genetics* – John Wiley & Sons.
6. Gardner, E.J., Simmons, M.J. and Snustad, D.P. – *Principles of Genetics* – John Wiley & Sons.
7. Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H. and Matsudaira, P. – *Molecular Cell Biology* – W.H. Freeman and Company.

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SYLLABUS

OBJECTIVES: To enable the students to

1. Introduce the structure and properties of nucleic acids and their biological significance.
2. Explain the chemistry and classification of carbohydrates, lipids, porphyrins, heme, and chlorophylls.
3. Provide knowledge on amino acids, protein structure, and conformational analysis.
4. Develop understanding of enzyme classification, kinetics, inhibition, and mechanisms of action.
5. Describe bioenergetics, ATP, and central metabolic pathways including glycolysis, TCA cycle, and oxidative phosphorylation.

COURSE OUTCOMES: Students will

- ☐ **CO1:** Describe the chemical structure and structural variations of nucleic acids.
- ☐ **CO2:** Classify and explain the structures and functions of carbohydrates, lipids, and porphyrins.
- ☐ **CO3:** Explain the properties and structural organization of proteins using the Ramachandran plot.
- ☐ **CO4:** Analyze enzyme kinetics, substrate specificity, and different types of enzyme inhibition.
- ☐ **CO5:** Understand the principles of bioenergetics and summarize major energy-yielding metabolic pathways.

UNIT-I: NUCLEIC ACIDS

1. Chemical structure and base composition of nucleic acids (DNA and RNA). Chargaff's rules.
2. Watson Crick Model (B-DNA), deviations from Watson - Crick Model. Alternative forms of DNA (A-DNA and Z-DNA).
3. Forces stabilizing nucleic acid structures, (hydrogen bonds and hydrophobic associations).

UNIT-II: CARBOHYDRATES & LIPIDS

1. Definition, classification, nomenclature of carbohydrates.
2. Structures of monosaccharides, disaccharides and polysaccharides. Concept and examples of hetero-polysaccharides.
3. **Lipids:** Structure of saturated and unsaturated fatty acids. Triglycerides, phospholipids,
4. Chemistry of Porphyrines, Heme and Chlorophylls.

UNIT III: AMINO ACIDS AND PROTEINS

1. Structure of amino acids occurring in proteins, classification of amino acids (pH based, polarity based and nutrition based).
2. physico-chemical properties of amino acids.
3. Primary, Secondary, Tertiary & Quaternary structure of proteins. Ramachandran Plot.

UNIT-IV: ENZYMES

1. Terminology: Active site, allosteric site, Holoenzyme, apoenzyme, coenzyme, substrate, inhibitor, activator, modulator etc.
2. Classification and nomenclature of enzymes.
3. Substrate Specificity (bond specificity, group specificity, absolute specificity, stereo specificity), lock and key and induced fit models.
4. Enzyme kinetics: Michaelis-Menten equation, effect of substrate concentration, effect of enzyme concentration, effect of pH and temperature, temperature.

5. Enzyme inhibition (reversible inhibition types – competitive, uncompetitive and non-competitive), brief idea of irreversible inhibition.

UNIT-V: BIOENERGETICS

1. Concept of free energy, Entropy, Enthalpy & Redox Potential.
2. Concept of high energy bonds (structure of ATP).
3. Glycolysis, Kreb's cycle, Gluconeogenesis: Bypass reactions.
4. Electron transport chain, Oxidative phosphorylation.

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1. Lehninger, A.L., Nelson, D.L. and Cox, M.M. – *Principles of Biochemistry* – W.H. Freeman and Company.
2. Voet, D. and Voet, J.G. – *Biochemistry* – John Wiley & Sons.
3. Stryer, L. – *Biochemistry* – W.H. Freeman and Company.
4. Satyanarayana, U. and Chakrapani, U. – *Biochemistry* – Elsevier / Books and Allied (Indian edition).
5. Zubay, G. – *Biochemistry* – Wm. C. Brown Publishers.
6. Garrett, R.H. and Grisham, C.M. – *Biochemistry* – Brooks/Cole, Cengage Learning.
7. Conn, E.E. and Stumpf, P.K. – *Outlines of Biochemistry* – John Wiley & Sons.

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UNIT III: MICROBIAL NUTRITION

1. Basic nutritional requirements.
2. Composition of Natural and Synthetic Media. Selective and Differential media, Enriched media, Enrichment media.
3. Factors Affecting Growth of Microbes: pH, Temperature, Salinity.
4. Classification of microorganisms based on nutrition and temperature.

UNIT IV: MICROBIAL GROWTH AND CONTROL

1. Growth rate and generation time, details of growth curve and its phases.
2. Measurement of growth. Pure cultures and cultural characteristics. Maintenance of pure culture.
3. Microbial Control: Sterilization (Physical and chemical methods of sterilization), disinfection, sanitization, germicide, Micro-biostasis, antiseptics and antimicrobials.

UNIT V: VIRUSES

1. Properties and General characteristics of Viruses.
2. Classification of viruses on the basis of nucleic acids composition.
3. Basic Structure of Lamda and M13 DNA Virus.
4. Brief idea of lytic cycle and lysogeny.
5. Viral Transmission: Different modes (dengue, SARS-CoV-2) and their preventive measures.

Reference books:

1. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. – *Microbiology* – Tata McGraw-Hill Publishing Company.
2. Prescott, L.M., Harley, J.P. and Klein, D.A. – *Microbiology* – McGraw-Hill Higher Education.
3. Cappuccino, J.G. and Sherman, N. – *Microbiology: A Laboratory Manual* – Pearson Education.
4. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. – *Prescott's Principles of Microbiology* – McGraw-Hill.
5. Tortora, G.J., Funke, B.R. and Case, C.L. – *Microbiology: An Introduction* – Pearson Education.
6. Powar, C.B. and Dagainawala, H.F. – *General Microbiology* – Himalaya Publishing House.
7. Ananthanarayanan, R. and Paniker, C.K.J. – *Textbook of Microbiology* – Universities Press (for medical aspects).

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SYLLABUS

OBJECTIVES: To enable the students to

1. Introduce the history and development of microbiology along with contributions of key scientists.
2. Explain the principles and applications of different types of microscopy.
3. Study the structure, morphology, and special features of bacteria, including staining techniques.
4. Provide knowledge on microbial nutrition, growth, cultivation, and methods of microbial control.
5. Introduce viruses, their structure, replication, classification, and transmission with examples of human diseases.

COURSE OUTCOMES: Students will

- **CO 1:** Summarize the historical contributions of Pasteur, Koch, and Jenner in microbiology.
- **CO 2:** Differentiate between light, phase contrast, dark field, fluorescent, and electron microscopy.
- **CO 3:** Describe bacterial morphology, cell structures, plasmids, endospores, and staining methods.
- **CO 4:** Identify nutritional requirements, growth phases, and apply sterilization and disinfection techniques.
- **CO 5:** Explain the structural organization, replication strategies, and transmission of viruses including modern examples.

Practical Course:

1. Cleaning and preparation of glassware
2. Observation of permanent slides using microscope
3. Preparation of nutrient agar medium for bacteria
4. Preparation of PDA medium for fungal culture
5. Sterilization techniques (autoclave, hot air oven, filter)
6. Isolation of bacteria from soil
7. Simple staining technique
8. Differential staining technique
9. Microbial counting by Haemocytometer
10. Identification of different bacteria
11. Motility test by hanging drop
12. Biochemical identification of bacteria
13. Preparation of pure culture by slab, slant, streak culture

Reference books:

1. Pelczar, M.J., Chan, E.C.S. and Krieg, N.R. – *Microbiology* – Tata McGraw-Hill Publishing Company.
2. Prescott, L.M., Harley, J.P. and Klein, D.A. – *Microbiology* – McGraw-Hill Higher Education.
3. Cappuccino, J.G. and Sherman, N. – *Microbiology: A Laboratory Manual* – Pearson Education.
4. Willey, J.M., Sherwood, L.M. and Woolverton, C.J. – *Prescott's Principles of Microbiology* – McGraw-Hill.
5. Tortora, G.J., Funke, B.R. and Case, C.L. – *Microbiology: An Introduction* – Pearson Education.
6. Powar, C.B. and Dagainawala, H.F. – *General Microbiology* – Himalaya Publishing House.
7. Ananthanarayanan, R. and Paniker, C.K.J. – *Textbook of Microbiology* – Universities Press (for medical aspects).

SYLLABUS

OBJECTIVES: To enable the students to

1. Introduce the fundamentals of the immune system, immune cells, and immune organs.
2. Explain the structure, types, and diversity of antibodies and the nature of antigens.
3. Describe mechanisms of humoral and cell-mediated immunity, cytokines, and MHC molecules.
4. Provide knowledge about hypersensitivity, autoimmunity, vaccination, and different types of vaccines.
5. Familiarize students with immunological techniques and applications of monoclonal antibodies.

COURSE OUTCOMES: Students will

- **CO 1:** Explain the organization of the immune system and differentiate innate and acquired immunity.
- **CO 2:** Describe antibody structure, types, and antigenic determinants.
- **CO 3:** Analyze mechanisms of humoral, cell-mediated, and NK cell-mediated immune responses.
- **CO 4:** Differentiate between types of hypersensitivity and explain the principles and applications of vaccination.
- **CO 5:** Apply knowledge of immunological techniques for antigen-antibody interactions and monoclonal antibody production.

UNIT I: INTRODUCTION TO THE IMMUNE SYSTEM

1. Immune System: History and Scope of Immunology.
2. Types of Immunity: Innate and Acquired.
3. Cells of immune system: T cells, B cells.
4. Organs of the Immune system: Bone marrow, spleen, thymus, MALT, lymph node.

UNIT II: ANTIGENS AND ANTIBODIES

1. Antibody and Antigen: Antibodies: Structure and Types of Antibodies (IgG, IgM, IgA, IgE, IgD).
2. Monoclonal and Polyclonal antibodies. Antibody diversity.
3. Antigens: Types of Antigens. Antigenicity (factors affecting antigenicity).
4. Antigenic determinants – adjuvants and haptens, epitopes.

UNIT III: MECHANISMS OF IMMUNE RESPONSES

1. Immunity: Humoral immunity. Cell-mediated immunity – T Cell-mediated immunity, NK cell-mediated immunity, ADCC.
2. Brief description of cytokines and interleukins.
3. Major Histocompatibility Complex (MHC) – Structure and functions of Class I and Class II MHC molecules.

UNIT IV: HYPERSENSITIVITY, AUTOIMMUNITY, AND VACCINATION

1. Hypersensitivity and Vaccination: General features of hypersensitivity, various types of hypersensitivity. Autoimmunity.
2. Vaccination: Discovery, principles, and significance.
3. Types of Vaccines –Live, attenuated, killed, toxoids, recombinant-based (mRNA and Protein).

UNIT V: IMMUNOLOGICAL TECHNIQUES AND MONOCLONAL ANTIBODIES

1. Immunological Techniques: Antigen-antibody reactions: Precipitation, agglutination, complement fixation.
2. Immuno-diffusion –Radial immune diffusion, Ouchterlony double immune diffusion, ELISA, RIA, immune-electrophoresis, Rocket electrophoresis.
3. Hybridoma technology: Monoclonal antibodies and their applications in immunodiagnostics.

Reference books:

1. Kuby, J. – *Immunology* – W.H. Freeman & Company.
2. Abbas, A.K., Lichtman, A.H. and Pillai, S. – *Cellular and Molecular Immunology* – Elsevier.
3. Roitt, I., Brostoff, J. and Male, D. – *Immunology* – Mosby Publications.
4. Ananthanarayanan, R. and Paniker, C.K.J. – *Textbook of Microbiology* – Universities Press (for immunology basics).
5. Kindt, T.J., Goldsby, R.A. and Osborne, B.A. – *Kuby Immunology* – W.H. Freeman.
6. Delves, P.J., Martin, S.J., Burton, D.R. and Roitt, I.M. – *Roitt's Essential Immunology* – Wiley-Blackwell.

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3. Roitt, I., Brostoff, J. and Male, D. – *Immunology* – Mosby Publications.
4. Ananthanarayanan, R. and Paniker, C.K.J. – *Textbook of Microbiology* – Universities Press (for immunology basics).
5. Kindt, T.J., Goldsby, R.A. and Osborne, B.A. – *Kuby Immunology* – W.H. Freeman.
6. Delves, P.J., Martin, S.J., Burton, D.R. and Roitt, I.M. – *Roitt's Essential Immunology* – Wiley-Blackwell.

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SYLLABUS

OBJECTIVES: To enable the students to

1. Acquire knowledge about Plant tissue culture its uses and techniques involved in tissue culture.
2. Be trained in various advanced techniques for production of transgenic plants.
3. Swot about the basic concepts in animal tissue culture techniques.
4. Get insight on advanced applications of animal biotechnology.
5. Acquire knowledge about ethics, bio-safety and patent rights

COURSE OUTCOMES: Students will

- **CO1:** Capable to indentify the economized protocols for both the classical & hybrid Varieties, with the available tissue culture concepts.
- **CO2:** Be abundant in producing transgenic plants
- **CO3:** Able to evaluate animal culture media constituents and their role to manufacture the desired products.
- **CO4:** Be proficient in on health care products.
- **CO5:** Acquire knowledge in generation and protection of patents, copyrights and trade marks.

UNIT-I: Plant Tissue Culture Techniques & Secondary Metabolites Production

1. Plant tissue culture: Totipotency, media preparation – nutrients and plant growth regulators
2. Sterilization techniques.
3. Establishment of cultures – callus culture, cell suspension culture, protoplast culture and anther culture.
4. Applications of tissue culture-micro propagation, somatic hybridization, Somatic embryogenesis; synthetic seed production. Cryopreservation.
5. Plant secondary metabolites- concept and their importance.

UNIT – II: Transgenesis and Molecular markers

1. Plant transformation technology-- *Agrobacterium* mediated Gene transfer (Ti plasmid), hairy root features of Ri-plasmid.
2. Transgenic plants as bioreactors. Herbicide resistance – glyphosphate, Insect resistance- Bt-cotton.
3. Molecular markers -RAPD, RFLP and DNA fingerprinting-principles and applications.

UNIT – III: Animal Tissue Culture Techniques

1. Animal cell culture: cell culture media and reagents; Culture of mammalian cells, tissues and organs; primary culture, secondary culture, cell lines, stem cell cultures.
2. Tests: cell viability and cytotoxicity.

3. Trans-fection methods (calcium phosphate precipitation, electroporation, Microinjection) and applications.

UNIT – IV: Transgenic Animals & Gene Therapy

1. Production of vaccines, diagnostics, hormones and other recombinant DNA products in medicine (insulin, somatostatin, vaccines)
2. IVF (*In-vitro* Fertilization)
3. Concept of Gene therapy.
4. Concept of transgenic animals – Merits and demerits -ethical issues in animal biotechnology

UNIT V: Bioethics, Bio-Safety and IPR

1. Bioethics in cloning and stem cell research, Human and animal experimentation, animal rights/welfare.
2. Bio-safety-introduction to biological safety cabinets; primary containment for biohazards; bio-safety levels; GLP, GMP.
3. Introduction to IP-Types of IP: patents, trademarks & copyright

REFERENCES

1. Introduction to Plant Tissue Culture..M.K. Razdan ,2003,Science Publishers
 2. Plant Tissue Culture, kalyan Kumar De,199 M7,New Central Book Agency
 3. Plant Tissue Culture : Theory and Practice By S.S. Bhojwani and A. Razdan,1998
 4. Biotechnology – By U. Satyanarayana ;1997
 5. Plant Cell, Tissue and Organ Culture, Applied and Fundamental Aspects By Y.P.S. Bajaj and A. Reinhard ,2001
 6. Introduction to Plant Tissue Culture,M. K. Razdan, 2003,Science Publishers
 7. A Textbook of Biotechnology,R C Dubey,S. 2014,Chand Publishing
 8. Elements of Biotechnology,P. K. Gupta, 1994,Rastogi Publications
 9. R. Ian Freshney, “Culture of animal cells –A manual of basic techniques” 4thedition, John Wiley & Sons, 2000 ,Inc, publication, New York
 10. Daniel R. Marshak, Richard L. Gardner, David Gottlieb “Stem cell Biology” edited by Daniel 2001,Cold Spring Harbour Laboratory press, New York
 11. M.M. Ranga, Animal Biotechnology; Agrobios (India) ,2006.
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PRACTICAL SYLLABUS

OBJECTIVES: To enable the students to –

1. Acquire the techniques and inoculation methods in plant tissue culture.
2. Gain the basic idea about the animal tissue culture
3. Familiarize on quantitative estimation of both antigens of HIV

COURSE OUTCOMES: Students will

- **CO1:** Attain Be expertise in formulating the concentrations of tissue culture media constituents
- **CO2:** Be proficient Capable to identify the economized protocols for both the classical & hybrid varieties, with the available tissue culture concepts.
- **CO3:** Be Able to breed the haploid cultivars and enhance vegetative propagation, virus free stocks, flexible to current agriculture practice
- **CO4:** Be expertise in analyzing the clinical samples through immunodiagnostic methods.

I. COURSE:

1. Plant culture media and composition of MS media
2. Raising of aseptic seedlings
3. Induction of callus from different explants
4. Plant propagation through Tissue culture (shoot tip and Nodal culture)
5. Establishing a plant cell culture (both in solid and liquid media)
6. suspension cell culture
7. Cell count by hemocytometer.
8. Establishing primary cell culture of chicken embryo fibroblasts.
9. Animal tissue culture –maintenance of established cell lines.
10. Animal tissue culture –virus cultivation.
11. Estimation of cell viability by dye exclusion (Trypan blue).
12. ELISA –Demonstration

II. REFERENCES

1. Introduction to Plant Tissue Culture..M.K. Razdan ,2003,Science Publishers
2. Plant Tissue Culture, kalyan Kumar De,199 M7,New Central Book Agency
3. Plant Tissue Culture : Theory and Practice By S.S. Bhojwani and A. Razdan,1998
4. Biotechnology – By U. Satyanarayana ;1997
5. Plant Cell, Tissue and Organ Culture, Applied and Fundamental Aspects By Y.P.S. Bajaj and A. Reinhard ,2001
6. Introduction to Plant Tissue Culture,M. K. Razdan, 2003,Science Publishers
7. A Textbook of Biotechnology,R C Dubey,S. 2014,Chand Publishing
8. Elements of Biotechnology,P. K. Gupta, 1994,Rastogi Publications
9. R. Ian Freshney, “Culture of animal cells –A manual of basic techniques” 4thedition, John Wiley & Sons, 2000 ,Inc, publication, New York
10. Daniel R. Marshak, Richard L. Gardner, David Gottlieb “Stem cell Biology” edited by Daniel 2001,Cold Spring Harbour Laboratory press, New York
11. M.M. Ranga, Animal Biotechnology; Agrobios (India) ,2006.

III. CO-Curricular Activities

a) Suggested Co-Curricular Activities

1. Assignments
 2. Seminars, Group Discussions on related topics
 3. Charts on different medias
 4. Visit to plant tissue culture lab
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SYLLABUS

OBJECTIVES: To enable the students to

1. Acquire knowledge about structure and organization of genetic material.
2. Swot about the basic mechanism in DNA replication.
3. Get an insight on transcription in both prokaryotes and eukaryotes.
4. Gain the basic concepts in gene expression and regulation.
5. Acquire knowledge about genetic code and protein synthesis.

COURSE OUTCOMES: Students will

- **CO1:** Capable to identify the genome structure and organization in both prokaryotes and eukaryotes.
- **CO2:** Be abundant in mechanism and enzymes of DNA replication.
- **CO3:** Able to learn about enzymatic synthesis and features of transcription.
- **CO4:** Be proficient in Lac operon and expression of clustered & mRNA genes.
- **CO5:** Acquire knowledge on determination of protein.

UNIT-I: Genome Structure

1. Watson and Crick model of DNA.
2. Genome organization with specific reference to prokaryotic and eukaryotic genomes; Genome size.
3. Concepts of Genetic Material, Gene, Chromosome and Genome.
4. Experiments to prove DNA as genetic material (Griffith experiment, Hershey-Chase experiment).

UNIT – II: DNA Replication

1. Enzymology of replication: (DNA polymerase-I, Pol-II and Pol-III, helicases, topoisomerases, single strand binding proteins (SSB's), DNA melting proteins, primase & DNA Ligase.
2. Proof of semi-conservative replication, Replication origins (Ori-C).
3. Rolling circle replication of DNA.

UNIT – III: Transcription

1. Enzymatic synthesis of RNA: Basic features of transcription, the structure of prokaryotic RNA polymerase (core enzyme and holo enzyme, sigma factor).
2. Concept of promoter (Pribnow box, -10 and -35 sequences).
3. Four steps of transcription (promoter binding and activation, RNA chain initiation, chain elongation, termination and release).
4. Differences between prokaryotic and eukaryotic transcription.
5. Reverse transcription.

UNIT – IV: Gene Expression and Regulation

1. Regulation of gene expression; Clustered genes.
2. The concept of Regulon & Operon – Negative & Positive control of the Lac-Operon, Trp-Operon.
3. Control of gene expression.
4. Poly and Mono Cistronic m-RNA.

UNIT V: Genetic Code and Protein Synthesis

1. Genetic code: Features of genetic code, Structure of mRNA & tRNA.
2. The adaptor hypothesis, attachment of amino acids to tRNA.
3. Codon – Anticodon interaction: The Wobble hypothesis.
4. Initiation, elongation & termination of Protein synthesis.
5. Differences between prokaryotic and eukaryotic translation.

REFERENCES

1. Cell and Molecular Biology, 8th edition. De Robertis, E.D.P. and De Robertis, E.M.F. 2006; Lippincott Williams and Wilkins, Philadelphia.
 2. Cell Biology, (2017), De Robertis & De Roberis, Blaze Publishers & Distributors Pvt. Ltd.
 3. The Cell: A Molecular Approach. 5th edition. Cooper, G.M. and Hausman, R.E. 2009. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
 4. The World of the Cell, 7th edition, Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 Pearson Benjamin Cummings Publishing, San Francisco.
 5. David A. Thompson. 2011. Cell and Molecular Biology Lab. Manual.
 6. P.Gunasekaran. 2007. Laboratory Manual in Microbiology. New Age International.
 7. D O Hall, S E Hawkins. 1974. Laboratory Manual of Cell Biology. British Society for Cell Biology, Published by Crane, Russia.
 8. Mary L. Ledbetter. 1993. Cell Biology: Laboratory Manual. Edition: 2. Published by Ron Jon Publishing. Incorporated.
 9. Gunasekaran, P. 2009. Laboratory Manual in Microbiology. 1st Edition. New Age International Publishers.
 10. Dr. T. Sundararaj. Microbiology Laboratory Manual. 2005. Dr.A.L. MPGIBMS, University of Madras, Taramani, Chennai –600 113.
 11. James G. Cappuccino and Natalie Sherman. 2013. Microbiology: A Laboratory Manual. 10th Edition. Benjamin Cummings.
 12. Dr. David A Thompson. 2011. Cell and Molecular Biology Lab Manual.
 13. George M. Malacinski. 2013. Freifeder's Essentials of Molecular Biology. Narosa Publishing House.
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PRACTICAL SYLLABUS

OBJECTIVES: To enable the students to –

1. Gain the knowledge on quantitative estimation of Nucleic acids.
2. Be trained in isolation of DNA from the different sources.
3. Familiarize on purity analysis of nucleic acids.

COURSE OUTCOMES: Students will

- **CO1:** Be proficient in determination of growth kinetics through UV radiations.
- **CO2:** Attain expertise in quantitative estimation of Nucleic acids.
- **CO3:** Be Able to isolate DNA from different plant resources.
- **CO4:** Be expertise in analyzing the purity of DNA.

I. COURSE:

1. Effect of UV radiations on the growth of microorganisms.
2. Determination of absorption maxima of DNA and RNA and their quantification
3. Quantitative estimation of RNA
4. Quantitative estimation of DNA
5. Isolation of plasmid DNA from bacteria
6. Isolation of genomic DNA from *E.coli*
7. Isolation of DNA from sheep liver
8. Isolation of DNA from plant leaves (Rice or Tobacco or any other plant)
9. Separation of DNA by Agarose gel Electrophoresis
10. Purity analysis of the Nucleic acids

II. REFERENCES

1. Cell and Molecular Biology, 8th edition. De Robertis, E.D.P. and De Robertis, E.M.F. 2006; Lippincott Williams and Wilkins, Philadelphia.
2. Cell Biology, (2017), De Robertis & De Roberis, Blaze Publishers & Distributors Pvt. Ltd.
3. The Cell: A Molecular Approach. 5th edition. Cooper, G.M. and Hausman, R.E. 2009. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. The World of the Cell, 7th edition, Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 Pearson Benjamin Cummings Publishing, San Francisco.
5. David A. Thompson. 2011. Cell and Molecular Biology Lab. Manual.
6. P.Gunasekaran. 2007. Laboratory Manual in Microbiology. New Age International.
7. D O Hall, S E Hawkins. 1974. Laboratory Manual of Cell Biology. British Society for Cell Biology, Published by Crane, Russia.
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11. James G. Cappuccino and Natalie Sherman. 2013. Microbiology: A Laboratory Manual. 10th Edition. Benjamin Cummings.
12. Dr. David A Thompson. 2011. Cell and Molecular Biology Lab Manual.
13. George M. Malacinski. 2013. Freifeder's Essentials of Molecular Biology. Narosa Publishing House.

III. CO-Curricular Activities

a) Suggested Co-Curricular Activities

1. Assignments
 2. Seminars, Group Discussions on related topics
 3. Charts on Replication, Transcription and Translation.
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SYLLABUS

OBJECTIVES: To enable the students to

1. Acquire knowledge about the history and tools of genetic engineering.
2. Comprehend the usage of cloning vectors.
3. Swot the advanced genetic hybridization techniques.
4. Gain the basic concepts in construction of gene libraries & expressions.
5. Acquire knowledge about gene engineering, mutagenesis & sequencing.

COURSE OUTCOMES: Students will

- **CO1:** Accustomed with the tools & techniques of genetic engineering and molecular cloning.
- **CO2:** Be comprehend about different cloning vectors.
- **CO3:** Acquire insights in probes and PCR reactions.
- **CO4:** Be proficient at DNA library construction & vector screening techniques.
- **CO5:** Acquire knowledge on gene editing, mutagenesis & sequencing.

UNIT-I: Recombinant DNA Technology – 1

1. Basics, history, scope, and recent developments in Genetic Engineering; guidelines; strategies in plant and animal genetic engineering.
2. Molecular tools in genetic engineering – Restriction enzymes: Endo & Exo nucleases. Enzymes used in rDNA Technology: Polymerases, ligases, phosphatases, methylases, Kinases and nucleases.
3. Ligation (cohesive & blunt end ligation) – linkers & adaptor.

UNIT – II: Recombinant DNA Technology – 2

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

UNIT – III: Techniques in Genetic Engineering

1. Hybridization techniques: Probes (radioactive & non-radioactive), detection.
2. Polymerase Chain Reaction (PCR) – Principle, Applications and types of PCR
3. Labeling of DNA-Nick translation, Random priming method & labeling by primer extension.

UNIT – IV: Gene Libraries and Expression patterns

1. Construction of genomic & c DNA libraries.
2. Vector engineering & codon optimization (Change in mRNA constitution), strategies of gene delivery, *in-vitro* translation
3. Expression in bacteria, yeast, insects, plant & mammalian cells

UNIT V: Gene editing and DNA Sequencing

1. Chromosome engineering, targeted gene replacement.
2. Gene editing, gene regulation & silencing.
3. Site-directed mutagenesis.
4. DNA sequencing – Maxam Gilbert (chemical) & Sanger's, Nicolson sequencing, Pyro-sequencing. Human Genome Project.

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1. Textbook of Biotechnology - 2007, By H.K. Das (Wiley Publications)
2. Principles of Gene Manipulation - 7th edition, 2006, By R.W. Old & S.B. Primrose, Publ: Blackwell
3. Molecular Biology & Biotechnology- 1996, By H.D. Kumar, Publ: Vikas
4. Molecular Biotechnology - 4th edition, 2010, G.R. Click and J.J. Pasternak, Publ: Panima
5. Genes and Genomes – 1991, By Maxine Singer and Paul Berg
6. Genes VII- 2000, By B. Lewin - Oxford Univ. Press
7. Molecular Biology - 4th Edition, 2008, By D. Freifelder, Publ: Narosa Publishing house New York, Delhi
8. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
9. Clark DP and Pazdernik NJ. (2009). Biotechnology-Appling the Genetic Revolution. Elsevier Academic Press, USA.
10. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology-Principles and Applications of recombinant DNA. ASM Press, Washington
11. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
12. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

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PRACTICAL SYLLABUS

OBJECTIVES: To enable the students to –

1. Improve the awareness on genetic engineering problems.
2. Be trained in restriction digestion of DNA.
3. Observe the nucleases action on DNA/RNA.
4. Be proficient in isolation of Plasmid DNA

COURSE OUTCOMES: Students will

- **CO1:** Be proficient in transformation in bacteria.
- **CO2:** Attain expertise in restriction digestion and its evaluation.
- **CO3:** Be Able to evaluate the kinetics of nucleases activity.
- **CO4:** Be expertise in isolation of Plasmid DNA.

I. COURSE:

1. Problem in Genetic engineering.
2. Transformation in Bacteria using plasmid
3. Restriction digestion of DNA and its electrophoretic separation.
4. Ligation of DNA molecules and their testing using electrophoresis.
5. Activity of DNAase and RNAse on DNA and RNA.
6. Isolation of Plasmid DNA
7. Demonstration of PCR

II. REFERENCES

1. Textbook of Biotechnology - 2007, By H.K. Das (Wiley Publications)
2. Principles of Gene Manipulation - 7th edition, 2006, By R.W. Old & S.B. Primrose,
Publ: Blackwell
3. Molecular Biology & Biotechnology- 1996, By H.D. Kumar, Publ: Vikas
4. Molecular Biotechnology - 4th edition, 2010, G.R. Click and J.J. Pasternak, Publ:
Panima
5. Genes and Genomes – 1991, By Maxine Singer and Paul Berg
6. Genes VII- 2000, By B. Lewin - Oxford Univ. Press
7. Molecular Biology - 4th Edition, 2008, By D. Freifelder, Publ: Narosa Publishing
house New York, Delhi

8. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.
9. Clark DP and Pazdernik NJ. (2009). Biotechnology-Appling the Genetic Revolution. Elsevier Academic Press, USA.
10. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology-Principles and Applications of recombinant DNA. ASM Press, Washington
11. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
12. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.

III. CO-Curricular Activities

a) Suggested Co-Curricular Activities

1. Assignments
 2. Seminars, Group Discussions on related topics
 3. Visit to instrumentation labs.
-

UNIT V: Enzyme Kinetics

1. Michaelis–Menten equation, Factors affecting enzyme activity: substrate concentration, enzyme concentration, pH and temperature.
2. Enzyme inhibition kinetics – competitive, uncompetitive, and non-competitive.
3. Immobilized enzymes and their applications.

REFERENCES

1. Understanding enzymes: Palmer T., Ellis Harwood ltd., 2001.
 2. Enzyme structure and mechanism. Alan Fersht, Freeman & Co. 1997
 3. Principles of enzymology for food sciences: Whitaker Marc Dekker 1972.
 4. Principles of Biochemistry, White. A, Handler, P and Smith.
 5. Biochemistry, Lehninger A.L.
 6. Biochemistry, Lubert Stryer.
 7. Review of physiological chemistry, Harold A. Harper.
 8. Text of Biochemistry, West and Todd.
 9. Metabolic pathways – Greenberg.
-

PRACTICAL SYLLABUS

OBJECTIVES: To enable the students to

1. Learn the basic concepts in immobilization and evaluate the factors.
2. Comprehend various specific enzyme assays.
3. Evaluate the amount of starch from vegetables.
4. Expertise in qualitative determination of carbohydrates and proteins.

COURSE OUTCOMES: Students will

- **CO1:** Familiarized with immobilization & entrapment of enzymes with gels.
- **CO2:** Determine the specific enzyme assays.
- **CO3:** Acquaint with isolation protocols for starch.
- **CO4:** Be proficient in determining the concentrations of carbohydrates and proteins.

I. COURSE:

1. Immobilization of enzymes /cells by entrapment in alginate gel-19. Effect of temperature/pH on enzyme activity.
2. Assay of protease activity.
3. Assay of alkaline phosphatase.
4. Preparation of starch from Potato and its hydrolysis by salivary amylase.
5. Isolation of urease and demonstration of its activity
6. Estimation of amino acids by ninhydrin method
7. Estimation of protein by Biuret method
8. Estimation of glucose by DNS method
9. Estimation of glucose by Benedicts titrimetric method
10. Estimation of total carbohydrates by anthrone method

II. REFERENCES

1. Understanding enzymes: Palmer T., Ellis Harwood ltd., 2001.
2. Enzyme structure and mechanism. Alan Fersht, Freeman & Co. 1997
3. Principles of enzymology for food sciences: Whitaker Marc Dekker 1972.
4. Principles of Biochemistry, White. A, Handler, P and Smith.
5. Biochemistry, Lehninger A.L.
6. Biochemistry, Lubert Stryer.
7. Review of physiological chemistry, Harold A. Harper.

8. Text of Biochemistry, West and Todd.
9. Metabolic pathways – Greenberg.

III. CO-Curricular Activities

a) Suggested Co-Curricular Activities

1. Assignments
 2. Seminars, Group Discussions on related topics
 3. Charts on cycles – Carbohydrate, lipid and amino acid metabolism.
-

2. Hybridoma technology: Monoclonal antibodies and their applications in immuno diagnosis.
3. ELISA, RIA, immuno electrophoretic, Rocket electrophoresis.

REFERENCES

1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY
2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India
3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.
4. Immuno diagnostics, 1996, By S.C. Rastogi, Publ: New Age
5. Introduction to Immunology- 2002, C. V. Rao- Narosa Publishing House



PRACTICAL SYLLABUS

OBJECTIVES: To enable the students to –

1. Identify the basic reactions between antigen and antibody.
2. Gain the basic idea about various immunodiagnostics.
3. Familiarize on quantitative estimation of both antigens of HIV

COURSE OUTCOMES: Students will

- **CO1:** Be expertise in evaluating the concentrations of antigen and antibody in blood.
- **CO2:** Be proficient in determination of HCG concentration in urine.
- **CO3:** Be Able to determine the quantity of both antigen and antibody.
- **CO4:** Be expertise in analysing the clinical samples through immunodiagnostic methods.

I. COURSE:

1. Antigen – antibody reaction – determination of Blood group, Cross reactivity
2. Pregnancy test
3. Widal test
4. Ouchterloney immuno diffusion
5. Radial immuno diffusion
6. ELISA
7. Isolation of casein by isoelectric precipitation
8. Production of antibodies and their titration

II. REFERENCES

1. Kuby immunology, Judy Owen, Jenni Punt, Sharon Stranford., 7th edition (2012), Freeman and Co., NY
2. Textbook of basic and clinical immunology, 1st edition (2013), Sudha Gangal and Shubhangi Sontakke, University Press, India
3. Immunology, 7th edition (2006), David Male, Jonathan Brostoff, David Roth, Ivan Roitt, Mosby, USA.

4. Immuno diagnostics, 1996, By S.C. Rastogi, Publ: New Age
5. Introduction to Immunology- 2002, C. V. Rao- Narosa Publishing House

III. CO-Curricular Activities

a) Suggested Co-Curricular Activities

1. Assignments
 2. Seminars, Group Discussions on related topics
 3. Charts on cell mediated immunity.
 4. Models on antibodies.
-

SYLLABUS

OBJECTIVES: To enable the students to

1. Familiar about the concept and areas of bioinformatics.
2. Understand various biological databases.
3. Find the relationships among the species.
4. Awake the basic principles in statistics.
5. Understand the population studies though various statistical methods.

COURSE OUTCOMES: Students will

- **CO1:** Analyse gene annotation and analysis tools in bioinformatics.
- **CO2:** Comprehend Biological databases and retrieve data
- **CO3:** Acquaint in sequence alignments and identify similarities between nucleic acid sequences.
- **CO4:** Be proficient in measurement of central tendency.
- **CO5:** Acquire various test hypothesis.

UNIT-I: History and Scope of Bioinformatics

1. Scope of computers in biological research.
2. Introduction to Bioinformatics: Definition, nature and scope of bioinformatics.
3. Bioinformatics versus computational biology.
4. Branches of bioinformatics. Basic concepts in bioinformatics.

UNIT – II: Biological data bases and Omics

1. Basic concepts of system biology. Protein Data Bases -visualization of proteins using database
2. Overview of computer-aided drug design.
3. Searching sequence database using BLAST.
4. Concept of genomics and proteomics

UNIT – III: Software and Tools

1. Computational phylogenetics –various applications.
2. Phylip software. Microarray,
3. Bio informatics –Experimental design & Over view of data analysis.

UNIT – IV: Basic principles of Statistics

1. Measurement of central tendency (mean, mode and range)
2. Dispersion (standard error and standard deviation).
3. Probability and distribution. Poisson and binomial distributions. Normal distribution

UNIT V: Statistical methods

1. Population and sampling test of significance. Test hypothesis.
2. Student t-test for small samples. ANOVA, Chi2 test for analysis, correlation and regression.
3. Computer applications in Biotechnology

REFERENCES

1. Fowler, J., Cohen, L. and Jarvis, P. (1998). Practical Statistics for Field Biology. John Wiley and Sons, 2nd ed.
2. Bland, M. (2006). An Introduction to Medical Statistics. Oxford University Press, 3rd ed.
3. Finney, D.J. (1980). Statistics for Biologists. Chapman and Hall Ltd.
4. Wayne, W, Daniel (1999). Biostatistics: A Foundation for Analysis in Health Sciences. John Wiley and Sons, 7th ed.



PRACTICAL SYLLABUS

OBJECTIVES: To enable the students to –

1. Learn and solve the various problems in statistics.
2. Gain the basic idea about various test hypotheses.
3. Familiarize in sequence retrieval from various databases.

COURSE OUTCOMES: Students will

- **CO1:** Be expertise in evaluating the problems in mean, mode and median.
- **CO2:** Be proficient in test hypothesis.
- **CO3:** Be Able to determine the sequence retrieval from NCBI & PDB.

I. COURSE:

1. Mean, Median, Mode
2. Standard deviation, variance and coefficient of variation
3. Testing of hypotheses regarding population mean
4. Testing of hypotheses about the difference between population means
5. Chi-square test
6. Testing of Correlation Coefficient
7. Fitting of simple linear regression
8. Sequence retrieval (protein and gene) from NCBI, Structure download (protein and DNA) from PDB

II. REFERENCES

1. Fowler, J., Cohen, L. and Jarvis, P. (1998). Practical Statistics for Field Biology. John Wiley and Sons, 2nd ed.
2. Bland, M. (2006). An Introduction to Medical Statistics. Oxford University Press, 3rd ed.
3. Finney, D.J. (1980). Statistics for Biologists. Chapman and Hall Ltd.
4. Wayne, W, Daniel (1999). Biostatistics: A Foundation for Analysis in Health

III. CO-Curricular Activities

a) Suggested Co-Curricular Activities

1. Assignments
 2. Seminars, Group Discussions on related topics
 3. Charts on data bases.
-

SYLLABUS

OBJECTIVES: To enable the students to

1. Identify the diseases caused by microbial sources.
2. Understand the general bacteriology of common diseases.
3. Ascertain the fungal, viral and protozoan diseases.
4. Awake the basic principles of gene therapy.
5. Understand the concept of drug discovery and therapeutic applications.

COURSE OUTCOMES: Students will

- **CO1:** Analyse various diseases caused by microbial source.
- **CO2:** Comprehend epidemiology, pathogenicity, disease diagnosis, prevention and control of bacterial diseases.
- **CO3:** Acquaint in mycosis, subcutaneous; pneumonia, mumps, AIDS & malaria.
- **CO4:** Be proficient about gene therapy and viral vectors in gene therapy.
- **CO5:** Acquire knowledge on various neurological disorders.

UNIT-I:

1. Diseases, introduction, types : genetic, chromosomal aberrations, numerical and structural autoimmune disorders
2. Disease caused by microbial sources. mechanism of pathogenicity, pathogenic islands, molecular basis of diseases
3. Antimicrobial compounds and their mode of action

UNIT – II:

1. Characteristics of infectious diseases, herd immunity
2. Disease cycle (source of disease , reservoir, carries) , transmission of pathogens (air borne, contact transmission, and vector transmission)
3. Bacterial diseases –epidemiology, pathogenicity, laboratory, diagnosis, prevention and control of the following diseases –tuberculosis, typhoid, tetanus, leprosy

UNIT – III:

1. General account of fungal diseases : mycosis, subcutaneous and deep
2. General account of viral and protozoan diseases-pneumonia, mumps, AIDS, malaria
3. Brief account of sexually transmitted diseases

UNIT – IV:

1. Gene therapy –*Ex-vivo*, *In-vivo*, *In-situ* gene therapy
2. Strategies of gene therapy, gene augmentation
3. Vectors used in gene therapy, biological vectors –retrovirus, adeno virus, herpes. Synthetic vectors -liposomes, receptor mediate gene transfer

UNIT V:

1. Introduction to drug discovery. Stem cell based drug discovery , drug screening and toxicology
2. Therapeutic applications –neurological disorders -Parkinson’s diseases, Alzheimer’s disease.
3. Antiviral therapy for AIDS, DNA/RNA based diagnosis, hepatitis.

REFERENCES

1. Text book of microbiology R. Ananthanarayana and C.K. Jayaram Paniker, Orient longman 1997
2. Medical microbiology, vol 1 microbial infections: Mackie and Ma Carty, Churchill Livingstone 1996
3. Bailey and Scotts Diagnostic microbiology : Baron EJ Peterson LR and Finegold SM Mosby 1990
4. Broude A.I (1981) Medical microbiology and infectious diseases , W.B Saunders &Co Philadelphia



PRACTICAL SYLLABUS

OBJECTIVES: To enable the students to –

1. Learn the general laboratory guidelines.
2. Be expertise in staining protocols.
3. Familiarize in cultivation of microbes and their characterization.
4. Learn about serological analysis of diseases.

COURSE OUTCOMES: Students will

- **CO1:** Be expertise in evaluating the Laboratory safety regulations.
- **CO2:** Be proficient in various staining techniques.
- **CO3:** Be Able to cultivate and characterize specific bacteria.
- **CO4:** Adopt the serological analysis for sexually transmitted diseases.

I. COURSE:

1. Laboratory Safety Regulations
2. Culture media & isolation of pure culture
3. Smear Preparation & Simple stain
4. Gram stain
5. Culture of bacteria and its cultural characteristics
6. C Reactive protein test
7. Widal test
8. Serological diagnosis of tuberculosis
9. Serological diagnosis of HIV

II. REFERENCES

1. Text book of microbiology R. Ananthanarayana and C.K. Jayaram Paniker, Orient longman 1997
2. Medical microbiology , vol 1 microbial infections : Mackie and MaCarty, Churchill Livingstone 1996

3. Bailey and Scotts Diagnostic microbiology : Baron EJ Peterson LR and Finegold SM
Mosby 1990
4. Broude A.I (1981) Medical microbiology and infectious diseases , W.B Saunders & Co
Philadelphia.

III. CO-Curricular Activities

a) Suggested Co-Curricular Activities

1. Assignments
 2. Seminars, Group Discussions on related topics
 3. Charts/models on bacterial/fungal/viral/protozoan diseases.
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UNIT – V:

1. Amino Acid Production
2. Vitamin Production- Vitamin B12
3. Production Of Recombinant Proteins Having Therapeutic And Diagnostic Applications (Insulin, Growth Hormone, Recombinant Vaccines, Monoclonal Antibody).

REFERENCES

1. Industrial Microbiology by A.H.Patel,2009
2. Prescott & Dum (2002) Industrial Microbiology, Agrabiros (India) ,2005,Publishers
3. Creueger W. & Crueger A.A Text of Industrial Microbiology,2000, 2nd Edition, Panima Publishers corp.

PRACTICAL SYLLABUS

OBJECTIVES: To enable the students to –

1. Isolate and identify industrially significant microorganism.
2. Study the production of industrial enzymes and metabolites
3. Evaluate and apply quantitative analytical methods
4. Understand and compare different fermentation methods

COURSE OUTCOMES: Students will

- **CO1:** Isolate, screen, and identify industrially important microorganisms from soil for the production of enzymes and metabolites.
- **CO2:** Demonstrate the ability to carry out microbial fermentation processes such as amylase, alcohol, and citric acid production under laboratory conditions.
- **CO3:** Analyze and quantify fermentation products (alcohol and citric acid) using titrimetric and colorimetric techniques.
- **CO4:** Compare different fermentation techniques (shake flask and submerged) and assess their effectiveness in product yield.
- **CO5:** Apply knowledge of industrial microbiology to design small-scale experiments for microbial production and estimation of bioproducts, linking theory with industrial applications

I. COURSE:

1. Isolation of industrially important microorganisms from soil.
2. Isolation of amylase producing organisms from soil.
3. Production of α – amylase from *Bacillus Spp.* by shake flask culture.
4. Production of alcohol or wine using different substrates.
5. Estimation of alcohol by titrimetry.
6. Estimation of alcohol by calorimetric method.
7. Production of citric acid.
8. Citric acid production by submerged fermentation.
9. Estimation of citric acid by titrimetry.

II. REFERENCES

1. Industrial Microbiology by A.H.Patel,2009
2. Prescott & Dum (2002) Industrial Microbiology, Agrabiros (India) ,2005,Publishers
3. Creueger W. & Crueger A.A Text of Industrial Microbiology,2000, 2nd Edition,
4. Panima Publishers corp.

III. CO-Curricular Activities

a) Suggested Co-Curricular Activities

1. Assignments
 2. Seminars, Group Discussions on related topics
 3. Industrial visit to nearby industries.
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SYLLABUS

OBJECTIVES: To enable the students to

1. Provide fundamental knowledge of food preservation principles, methods, and their applications.
2. Develop an understanding of food processing techniques, cooking methods, packaging, and their nutritional implications.
3. Introduce students to the microbiology of food, milk, milk products, and preservation of animal and sea foods.
4. Explain the role of macronutrients (carbohydrates, proteins, fats), vitamins, and minerals in human health and nutrition.
5. Create awareness about nutritional disorders, dietary requirements, and the importance of balanced diet across different life stages.

COURSE OUTCOMES: Students will

- **CO1:** Explain the principles and techniques of food preservation and their impact on food safety and shelf life.
- **CO2:** Differentiate between various cooking methods, food additives, and evaluate their effects on nutritional quality.
- **CO3:** Analyze the microbiological aspects of milk, milk products, animal, and sea foods, and apply preservation methods.
- **CO4:** Identify and discuss the causes, symptoms, and preventive measures of nutritional deficiencies and related disorders.
- **CO5:** Evaluate and apply concepts of dietary allowances, calorific values, BMI, and nutritional requirements for special groups like infants, pregnant and lactating women.

UNIT I

1. Principles of food preservation. Microorganisms associated with foods.
2. Infection, food intoxication, definition of self-life, perishable foods. Food preservation by freezing, refrigeration.
3. Storage at high temperature: sterilization, pasteurization, blanching, drying, dehydration, evaporation and irradiation.

UNIT II

1. Food packing, methods of cooking –dry, moist, frying and microwave cooking.
2. Advantages, disadvantages and effects of various cooking methods of food.
3. Canning, fermentations, pasteurization and adulteration. Food additives..

UNIT III

1. Animal and sea foods -their importance, nutritional values, and preservation methods
2. Microbiology of milk, milk products –cheese, yoghurt, butter, ice –cream, milk powder and their preparation.

3. Food preservation by salting, smoking, curing and crystallization

UNIT IV

1. Components of food: Carbohydrates, Fats, Proteins and their importance in daily diet.
2. Deficiency disorders: Protein deficiency disorders, Calorie maintenance diet, Malnutrition, Kwashiorkor, Marasmus, Starvation.
3. Vitamins: types of vitamins, sources of various vitamins. Essential vitamins and their biological role in metabolisms. Vitamin deficiency disorders

UNIT V

1. Basal Metabolic Rate (BMR) and its determination. Calorific values of foods, Atherosclerosis and obesity. Body Mass Index (BMI).
2. Recommended dietary allowances, Food allergy and its importance in health, Controlling measures
3. Essential minerals: Ca, Mg, Fe, I, Co, Mo, Zn, Se & F. Their role and deficiency disorders. Nutrition for pregnant, lactating women and for infants

REFERENCES

1. "Food Biotechnology" by Elsayed Abdel-Aal and Andy Khatwa (2019)
2. "Introduction to Food Biotechnology" by Perry Johnson-Green (2016)
3. "Food Biotechnology" by Kalidas Shetty and Gopinadhan Paliyath (2005)
4. "Food Biotechnology, Second Edition" by Klaus Buchholz and Volker Kasche (2013)
5. "Nutritional Biochemistry and Metabolism: With Clinical Applications" by Maria Luz Fernandez and Jose M. Ordovas (2014)
6. "Biotechnology in Functional Foods and Nutraceuticals" edited by Debasis Bagchi and Francis C. Lau (2010)

PRACTICAL SYLLABUS

OBJECTIVES: To enable the students to –

1. Familiarize students with quantitative & qualitative techniques.
2. Develop technical skills in isolation & preparation.
3. Enhance understanding of food quality parameters.
4. Introduce various food preservation & fermentation techniques.

COURSE OUTCOMES: Students will

- **CO1:** Perform accurate quantitative analysis of food components (moisture, ash, iron, calcium) using standard protocols.
- **CO2:** Isolate and characterize biochemical substances (e.g., glycogen, chloroplasts, carotenoids) from food or biological tissues.
- **CO3:** Apply analytical techniques to assess food quality, including pH measurement and microbial contamination detection.
- **CO4:** Demonstrate knowledge and practical understanding of food preservation techniques and fermentation processes (e.g., yoghurt preparation).
- **CO5:** Interpret and create nutritional labels in accordance with regulatory guidelines, reflecting a clear understanding of nutritional standards.

COURSE:

1. Quantitative analysis of food for a) Moisture b) ash c) Iron d) Calcium
2. Isolation of Glycogen from sheep liver
3. Preparation of chloroplast from green leaves / carotenes from carrots.
4. Determination of pH of different foods using pH meter.
5. Study of food preservation methods
6. Nutritional labeling of food
7. Preparation of yoghurt
8. Isolation and identification food spoiling microorganisms.

I. REFERENCES

1. "Food Biotechnology" by Elsayed Abdel-Aal and Andy Khatwa (2019)
2. "Introduction to Food Biotechnology" by Perry Johnson-Green (2016)
3. "Food Biotechnology" by Kalidas Shetty and Gopinadhan Paliyath (2005)
4. "Food Biotechnology, Second Edition" by Klaus Buchholz and Volker Kasche (2013)
5. "Nutritional Biochemistry and Metabolism: With Clinical Applications" by Maria Luz Fernandez and Jose M. Ordovas (2014)
6. "Biotechnology in Functional Foods and Nutraceuticals" edited by Debasis Bagchi and Francis C. Lau (2010)

II. CO-Curricular Activities

a) Suggested Co-Curricular Activities

1. Assignments
 2. Seminars, Group Discussions on related topics
 3. Charts on deficiency disorders.
-

UNIT V

1. Basics of Mass Spectroscopy- MALDI-TOF
2. ESI and their applications in proteomics.
3. Tandem MS/MS spectrometry , De novo sequencing using mass spectrometric data

REFERENCES

1. Discovering Genomics, Proteomics, & Bioinformatics (2003). Campbell & Heyer Pearson Education,
2. Bioinformatics, Methods of Biochemical Analysis (2001), Series Vol. 43, Baxevanis & Ouellette, John Wiley & Sons,
3. Computational Molecular Biology. Pevzner, P.A. (2000) MIT Press
4. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins(2004). Andreas D. Baxevanis & B. F. Francis Ouellette. 3rd Edition. Wiley & Sons,

PRACTICAL SYLLABUS

OBJECTIVES: To enable the students to –

1. Introduce tools & databases for genome and proteome analysis.
2. Understand microarray techniques & their application.
3. Perform protein structure prediction, validation & analysis.
4. Explore protein functional analysis (structural motifs, networks & pathway mapping).

COURSE OUTCOMES: Students will

- **CO1:** Use genome & proteome browsers.
- **CO2:** Analyze & interpret microarray data.
- **CO3:** Predict and validate protein structures.
- **CO4:** Identify structural and functional motifs in protein.

COURSE:

1. Genome Viewers, SNP Analysis
2. Microarray Analysis
3. Protein Structure Prediction
4. Proteome Analysis
5. Network & Pathway Analysis
6. Calculation of phi and psi angles in proteins.
7. Structure validation and Protein Data Bank
8. Structural and functional motifs in proteins

I. REFERENCES

1. Discovering Genomics, Proteomics, & Bioinformatics (2003). Campbell & Heyer Pearson Education,
2. Bioinformatics, Methods of Biochemical Analysis (2001), Series Vol. 43, Baxevanis & Ouellette, John Wiley & Sons,
3. Computational Molecular Biology. Pevzner, P.A. (2000) MIT Press
4. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins(2004). Andreas D. Baxevanis & B. F. Francis Ouellette. 3rd Edition. Wiley & Sons.

II. CO-Curricular Activities

a) Suggested Co-Curricular Activities

1. Assignments
 2. Seminars, Group Discussions on related topics
 3. Charts on molecular markers.
-

SYLLABUS

OBJECTIVES: To enable the students to

1. Introduce the fundamental concepts of nanobiology.
2. Provide knowledge on tools and methods in nano-biotechnology.
3. Explore various nanostructures & their applications in drug delivery & medicine.
4. Understand the principles of pharmacology, drug classification, pharmacokinetics etc.
5. Evaluate the production of therapeutic agents & advances in tissue engineering and synthetic therapies.

COURSE OUTCOMES: Students will

- **CO1:** Describe the principles & applications of nanobiology.
- **CO2:** Apply nanobiotechnological methods.
- **CO3:** Evaluate the use of nanostructures in therapeutics.
- **CO4:** Understand the basics of pharmacology.
- **CO5:** Demonstrate knowledge of therapeutic molecule production.

UNIT I:

1. Nanobiology – concepts, definitions, prospects; nanoparticles – size, shape, properties.
2. Bio nanoparticles – nano starch, nano composites – dendrimers.
3. Hot – Dot nanoparticles. Types of biomaterials. Biodegradable polymers.

UNIT II:

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

UNIT III:

1. Nanotubes, Nanorods, Nanofibers and Fullerenes for nanoscale drug.
2. Bio nano electronics. Applications of nano biotechnology in medicine, drug designing and cancer treatment.
3. Medical, social and ethical considerations of nano biotechnology.

UNIT-IV:

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

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

UNIT-V:

1. Production of biological – Human insulin, HGH, Erythropoietin's, IFN, TNF, IL, Clotting factor VIII
2. Synthetic therapy: Synthetic DNA, therapeutic ribozymes, synthetic drugs.
3. Tissue Engineering: Skin, Liver, Pancreas. Recombinant vaccines, Cell adhesion based therapy: Integrins, Inflammation

REFERENCES

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

PRACTICAL SYLLABUS

OBJECTIVES: To enable the students to –

1. Provide hands-on experience in the biological and chemical estimation of antibiotics..
2. Perform antimicrobial activity assays & determine MIC values.
3. Develop skills in sterility testing methods for pharmaceuticals & injectables.
4. Understand the principles: drug shelf life, microbial spoilage & effects of sterilents on microbial growth.

COURSE OUTCOMES: Students will

- **CO1:** Perform and compare biological & chemical assays.
- **CO2:** Evaluate the antimicrobial potency of various drugs.
- **CO3:** Conduct sterility testing of pharmaceutical products.
- **CO4:** Assess the stability & safety of antibiotics.

COURSE:

1. Estimation of penicillin/streptomycin by biological assay.
2. Estimation of penicillin/streptomycin by chemical assay.
3. Assay of antimicrobial activity of Penicillin, Chloramphenicol, streptomycin
4. Determination of Minimum Inhibitory Concentration (MIC) of Antibiotic
5. Determination of shelf life of antibiotics (Expired drugs)
6. Sterility testing of commercial pharmaceuticals.
7. Study of microbial spoilage of pharmaceuticals.
8. Sterility testing of injectable as per IP.
9. Effect of chemical disinfectant on growth of bacteria

I. REFERENCES

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

II. CO-Curricular Activities

a) Suggested Co-Curricular Activities

1. Assignments
 2. Seminars, Group Discussions on related topics
 3. Charts on drug action, chemotherapeutic drugs.
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