**YOGI VEMANA UNIVERSITY**

***M. Sc.*, Biotechnology**

**SYLLABUS FOR (2012 – 2014 academic year onwards)**

| Course code | Course Title | Marks | |
|---|---|---|---|
| **Semester I** | | EXT | INT |
| 15081 | Cell Biology and Genetics | 75 | 25 |
| 15082 | Biomolecules | 75 | 25 |
| 15083 | Microbiology and Microbial Genetics | 75 | 25 |
| 15084 | Biochemical and Biophysical Techniques | 75 | 25 |
| 15081P | Practical 1: Cell Biology, Genetics and Biomolecules | 100 | |
| 15082P | Practical 2: Microbiology & Microbial Genetics/Biochemical and Biophysical Techniques | 100 | |
| | | | |
| **Semester II** | | | |
| 25081 | Molecular Biology | 75 | 25 |
| 25082 | Computer Applications & Biostatistics | 75 | 25 |
| 25083 | Immunology | 75 | 25 |
| 25084 | Enzymology | 75 | 25 |
| 25081P | Practical 1: Molecular Biology and Computer Applications & Biostatistics | 100 | |
| 25082P | Practical 2: Immunology and Enzymology | 100 | |
| **Semester III** | | | |
| 35081 | Genetic Engineering | 75 | 25 |
| 35082 | Pharmaceutical Biotechnology | 75 | 25 |
| 35083 | Food and Industrial Biotechnology | 75 | 25 |
| 35084 | Bioprocess Technology | 75 | 25 |
| 35081P | Practical 1: Genetic Engineering and Pharmaceutical Biotechnology | 100 | |
| 35082P | Practical 2: Food and Industrial Biotechnology and Bioprocess Technology | 100 | |
| # Industrial Tour during III Semester | | | |
| **Semester 1V** | | | |
| 45081 | Plant Biotechnology | 75 | 25 |
| 45082 | Animal Biotechnology | 75 | 25 |
| 45083 | Functional Genomics | 75 | 25 |
| 45084 | Bioethics and Biosafety | 75 | 25 |
| 45081P | Practical 1: Plant Biotechnology and Animal Biotechnology | 100 | |
| 45082P | Practical 2: Functional Genomics and Bioethics and Biosafety | 100 | |

# Industrial tour is recommended for M. Sc., Biotechnology students during III semester to get industrial experience.

**Programme:** ***M. Sc.*, Biotechnology**
**Course Title:** ***Cell Biology and Genetics***
**Type of Course:** **Core**
**Course No.:** 15081
**Semester:** **I**

**UNIT – I (16hrs)**: Cell Theory and The Cell: Discovery of cell and the cell theory, exceptions to the cell theory. Overview of Prokaryotic *vs.* Eukaryotic Cells. Eukaryotic cell compartmentalization. Cell Membrane: Historical models for structure of plasma membrane. Membrane proteins. Cell adhesion and Cell Junctions, Membrane transport and Vesicular transport. Cytoskeleton: Microtubles, Actin Filaments and Intermediate Filaments and functions. Role of cytoskeleton in intercellular transport

**UNIT – II (16hrs)**: Structure and function of Cell Organelles: Mitochondria, structural organization and biogenesis, Chloroplast (plastids): Polymorphic forms of plastids. Structural organization and functions of chloroplast. Role of mitochondria and chloroplast in cellular energy transactions., Endoplasmic Reticulum (E.R): structure and functions, Ribosomes: prokaryotic and Eukaryotic, Golgi complex, Lysomes and Peroxisomes. The Cell Nucleus: Structure and function of Nuclear Envelope, Nucleolus. Eukaryotic chromosome structure and charactaerstics– chromatin, and heterochromatin. Polytene and lamp brush chromosomes.

**UNIT – III (16hrs)**: Classical genetics – Mendelian Laws of inheritance. Modification of Mendelian ratios, Organellar Inheritance. Linkage and crossing over, cross over frequency, and interference. Genetics of sex chromosomes – sex linked genes, sex determination, and dosage compensation: molecular mechanism of selective chromosomal condensation (Barr body formation). Mutations – Types of mutations and chromosomal mutations. Chromosomal aberrations: deletions, duplications, translocations and inversions. Numerical changes in chromosome number – euploidy, haploidy – their fundamental and practical significance. Polypliody – induction – Aneuploidy – type and genetic significance. Induction of mutations and mutagenesis – types of mutagens. Practical applications of mutations.

**UNIT – IV (18hrs)**: Cell Division: Mitosis: Mechanism of cell division – mitiotic apparatus, cytokinesis, chromosome movement – present concept. Meiotic process – stages, chromosome pairing, chiasma formation molecular mechanisms of recombination, synaptonemal complex. Comparison of mitosis and meiosis. Significance of meiosis. Cell division control in multi cellular animals (regulation of eukaryotic cell cycle).

**REFERENCES**


1. Cell Biology – De Robertes & De Robertes
2. Cell and Molecular Biology –Baltimore.L
3. The Cell – Hooper
4. Cell and Molecular Biology – P.K.Gupta
5. Cell Biology – Verma and Agarwal
6. Cell Biology- Rastogi
7. Cell Biology- twyn
8. Principles of Genetics – Gardner
9. Principles of Genetics – David Suzuki
10. Introduction to Genetics Analysis – Griffth
11. Principles of Genetics – Snustad & Simmons
12. Genetics : A molecular approach. 2nd ed. 1992. T.B. Brown. Panima Publications. PP 496.

**Programme:** ***M. Sc.*****, Biotechnology**
**Course Title:** ***Biomolecules***
**Type of Course:** **Core**
**Course No.:** 15082
**Semester:** **I**

**UNIT – I (16hrs)::** Introduction to Nucleic acids – Types of Nucleic acids, chemistry of Nucleic acids, structure of purines and pyramidines, modified bases nucleosides and nucleotides; structural polymorphism of DNA and RNA types. Identification of DNA and RNA molecules, Ribose Puckering, Melting Temperature ™, DNA binding proteins, structure and forms of DNA (A,B and Z).

**UNIT – II (17hrs)::** Introduction to Biomolecules (Primary metabolites- Carbohydrates, Lipids, Proteins, Nucleic Acids,). Chemical bonds – covalent, coordinate, electrostatic hydrogen, ionic bonds; VanderWal forces; hydrophilic and hydrophobic interactions; functional groups. Chemistry of carbohydrates – Definition and classification of carbohydrates. Outlines of structures of starch, cellulose, lignins, suberins, hemicellulose, amylose, amylopectin. Chemical reactions of sugars and carbohydrates.

**UNIT – II (16hrs)**: Chemistry of proteins – Outline, structure, classification, chemical reactions of proteins and amino acids. Peptide bonding. Composition and sequence of amino acids of proteins. Structural organization of proteins. Outline structures and biological functions of Enzymes, Hormones, Vitamins and Plant Growth Regulators.

**UNIT – IV(18hrs)::** Introduction to Secondary metabolites –. Outline structures and biological functions of pigments, cytochromes, tannins, phenolics, microbial toxins and antibiotics, alkaloids terpenes of biotechnological importance

**REFERENCES**


1. Biochemical techniques : Theory and Practical. 1987. J.P. Robft and B.J. White, Waveland Press, Inc. Prospect heights, IL, pp. 407.
2. Biochemistry. 1992. R.H. Abeles, Panima Publication. PP 894.
3. Principles of Biochemistry. 2nd ed. 1993. A.L. Lehninger, D.L.Nelson.M.Cox. Paniama Publications. PP. 1090.
4. Harper's biochemistry. 1988. R.K. Murray. D.K. Granner, P.A. Mayes. Printice Hall International.
5. Biochemistry. 1988. 2nd ed. Zubay. Addision-Sesley Publication.
6. Biochemistry. 1988. 3rd ed. Luber Stryer. Freeman International.
7. Biochemistry of the Nucleic acids. 1992. 11th ed. R.L.P. Adams, J.T. Knowler, D.P. Leader, Chapman and Hall.
8. Proteins: Structure, function and evolution. Dickerson & Geis, 2nd Edn.Banjamin/Cummings, Meulo park, Calif 1983.
9. The Proteins: Neurath and Hill, 3rd Edn. Academic New York.
10. Biochemistry, A problem approach, 2nd ed. Wood, W.B., Addison Wesley, 1981.
11. Biological Chemistry, Mahler & Cordes.
12. Text book of Biochemistry West, W.S. Todd, Mason & Vanbruggen, Macmillian & Co.
13. Principles of Biochemistry – White –A, Handler, P and Smith E.L.Mc.Graw-Hill.
14. Biochemistry – Cantrow, A. Sehepartz. B. Sunders – Japan.
15. The Carbohydrates: Pigman & Hartman Vol.II – A & II-B.
16. Biochemistry Voet & Voet.
17. Comprehensive biochemistry – Florkin & Storz, Academic Press.

**Programme:** ***M. Sc.*****, Biotechnology**
**Course Title:** ***Microbiology and Microbial Genetics***
**Type of Course:** **Core**
**Course No.:** 15083
**Semester:** **I**

**UNIT – I (17hrs)**: History and scope of microbiology- Discovery of microorganisms, Theory of spontaneous generation, germ theory of diseases, Major contribution and events, scope and relevance, systematic diversity, Carl wooes 3 domain system, five kingdom systems, major characteristics used in taxonomy-morphological, physiological, ecological, genetic and molecular. Nutritional requirements to microorganisms – mode of nutrition – phototrophy, chemotrophy – methylotrophy organotrophy, mixotrophy, saprophytic, symbiotic and parasitic, Interaction of microbes. Outlines of characterization and identification of common bacteria, fungi, alga and protozoa.

**UNIT -11** (**(17hrs)**: Isolation, enumeration. Approaches for obtaining pure cultures from different samples, cultivation of aerobic and anaerobic microorganisms, (continuos, batch, synchronous and stock cultures), maintenance and preservation of microbial cultures, methods of identification and characterization of microorganisms by staining techniques, Control of microorganisms – principles, physical and chemical agents, assay of antimicrobial action. Batch and continuous sterilization of media and air.Microorganisms and disease

**UNIT – 111 (16 hrs):** Ultra structure of nucleus and nuclear envelop. Organization of prokaryotic and Eukaryotic chromosomes – structure of nucleosome and extent of chromatic condensation, c-value, paradox, cell cycle overview, regulation, cell growth and extra cellular signals, regulations of cell cycle progressions, unit of genes, establishments of cistrons, recons and mutons, complementation, modern concept of gene, mutagenesis, mutation screening, AMES test.

**UNIT IV(17hrs)**: Gene transfer mechanisms in bacterial and viruses: Plasmids : types, properties, detection, transfer. Transposable elements and insertion sequences – types of transposons and transposition. Bacterial transformation – biology, molecular mechanisms, Bacterial conjugation – Hfr transfer, Rec proteins. Bacteriophages T4 and Lamba – Genome organization, replication, lytic and lysogenic cascades, recombination, generalized and specialized transduction, co-transduction. Eukaryotic viruses – recombination, assortment, transduction of genes.

**REFERENCES**


1. Microbiology: concepts and Applications. Michael J. Pelczar, Jr., E.C.S., Chan, Noel R. Krieg, 1993. Mc. Graw Hill, Inc.
2. Introductory Microbiology. 1995, by Trevor Gross.
3. Fundamentals of Microbiology. 4th ed. 1994. I.E. Alcamo. Scientific Publication.
4. Microbiology, 1990. 4th Ed.B.D. Davis, R. Dulbeco, H.N. Eisen and H.S. Ginsberg and J.B. Lippincott Company.
5. Fundamental Principles of Bacteriology. 1994. A.J. Sake. Tata McGraw Hill.
6. Laboratory Experiments in Microbiology. 3rd ed. Brief Version. 1992. T.R. Johnson and C.L. Case. Addision Wesley International Publications. PP 350.
7. Microbiological Applications : A Laboratory Manual in General Microbiology. 5th ed. 1990. H.J. Benson. Panima Publications. PP 459.

**Programme:** ***M. Sc.*****, Biotechnology**
**Course Title:** ***Biochemical and Biophysical Technique***
**Type of Course:** **Core**
**Course No.:** 15084
**Semester:** **I**

**UNIT – I(15Hrs):**

Principles and applications of light, phase contrast, fluorescent, electron microscopy (SEM and TEM). Preparation of specimen for microscopy
Centrifugation –principles of sedimentation, preparative and analytical centrifuges, rotors, sedimentation analysis, density gradient centrifugation.

**UNIT –II(18Hrs):**

Chromatography – general principles. paper, thin layer, gas-liquid, ion exchange, HPLC, molecular sieve and affinity chromatography techniques. Electrophoresis – types of electrophoresis, paper and gel electrophoresis. Native and SDS PAGE,

**UNIT – III(18Hrs):**

Spectroscopy – Electromagnetic spectrum of light Beer-Lambert law. UV-visible spectrophotomety fluorescence spectroscopy, Atomic Absorption spectroscopy, NMR spectrophotometry. Mass spectroscopy, MALDI-TOF. X-ray diffraction and X-ray crystallography.

**UNIT – IV(18Hrs):**

Radioisotope tracer techniques – Nature and types of radioactivity, decay units, preparation of labeled biological compounds, detection and measurement of radioactivity (GM counter, scintillation counter auto radiography, Biological uses of radioisotopes, safety measures in handling radio-isotopes.

REFERENCE:


1. Biochemical techniques : Theory and Practical. 1987. J.F. Robft and B.J. White, Waveland Press, Inc. Prospect Heights, IL, PP 407.
2. Principles and Techniques of Practical Biochemistry, 1994. 4th ed. Eds. K. Wilson and J. Walker.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology. 2nd ed. David Freifelder. W.H. Freeman and Company, New York.
4. Affinity Chromatography: Bio selective adsorption on insert matrices. 1992. W.H. Scouten, John Wiley & Sons, New York, PP 348.
5. Applications of HPLC in Biochemistry : Laboratory Techniques in Biochemistry and Molecular Biology. 1987. A. Fallon, R.F.G. Booth and L.D. Bell, eds. Elsevier Science Publishers, Amsterdam, the Netherlands. PP 338.
6. Electron microscopy: Principles and Techniques for biologists. 1992. J.J. Bozola and L.D. Rusel, Jones and Bartlett Publishers, Boston, M.A. PP 542.
7. Electrophoresis : Theory, techniques and biochemical applications. 2nd ed. 1986. A.T. Andrews, Oxford University Press, Oxford. PP 452.
8. Enzymatic analysis : A practical guide. 1993. Janet. V. Passonneau and Oliver. H. Lowry, Humana Press, Totowa, N.J. PP 400.
9. Enzyme assay : A Practical Approach. 1992. R. Eisenthal and M.J. Danson, Eds. IRL Press. PP. 351.
10. Flow Cytometry: A practical approach. 1990. M.G. Ormerod. Ed. IRL Press. PP 279.

11. Introduction to Biophysical methods for protein and Nucleic acid research. (1995). J.A. Glasel; and Murray P. Deutscher. Academic Press. PP 505.
12. Special Analytical techniques in Nutritional Biochemistry. 1991. Gopalakrishna and S.K. Ranjhan. Kalyani Publishers.
13. Methods in Non-radioactive deteraction, 1993. Gary C Howard. Ed. Appleton & Lange Earwalk. CT. PP. 342.
14. Preparative centrifugation : A Practical approach. 1992. D. Rickwood. Ed.IRL Press, PP 400.
15. Principles of Laboratory Instruments. 1993. L.E. Schoeff, R.H. Williams, Mosby Year-book Inc. Pp 473.
16. Radioisotopes in Biology : A Practical approach. 1990. R.J. Slater, Ed., IRL Press, PP 307.
17. Physical Chemistry. 1986. P.W. Atkins, W.H. Freeman. Sanfrancisco Pub.
18. Principles and techniques of Practical biochemistry, 1994 (4th ed. ) by K. Wilson and J. Walker (eds).

**Programme:** ***M. Sc*., Biotechnology**
**Course Title:** ***Molecular Biology***
**Type of Course:** **Core**
**Course No.:** 25081
**Semester:** **II**

**UNIT – I (16hrs):** Identification of genetic material as DNA or RNA, Central dogma theory and flow of genetic information. Molecular organization of genetic material in prokaryotes and eukaryotes - DNA and histone proteins. Role of Histone proteins in genome organizationReplication of DNA- Semi conservative replication of DNA, rolling circle model of replication, enzymology of replication – Helicases, topoisomerases, SSB, DNA ligases, primases. DNA polymerase – *E.coli* DNA polymerase I, II and III and Eukaryotic DNA polymerases. Mechanism of DNA repair – Photoreactivation, excision, recombinational repair and SOS response.

**UNIT – II (17hrs):** Transcription – RNA polymerases – nature of prokaryotic and eukaryotic RNA polymerase. Mechanism of transcription in prokaryotes and eukaryotes – Initiation, elongation and termination of RNA synthesis. Polycistronic and monocistronic RNAs, Post transcriptional modifications of eukaryotic transcripts – capping, polyadenylation and RNA splicing. Types of introns and splicing mechanisms – group I and group II. Alternate splicing and mechanism of RNA Editing.

**UNIT – III (18hrs):** Translation - genetic code and its elucidation, experimental studies of Nurenburg and Khorana. Codon degeneracy, Wobble hypothesis, structure and composition of prokaryotic and eukaryotic ribosomes, structures of mRNA and tRNA. Events of protein synthesis - amino acid activation, initiation, elongation and termination in prokaryotes and eukaryotes, Inhibitors of protein synthesis – antibiotics and other inhibitors. Mechanism of inhibition. Post-translational modification of proteins – Protein sorting and targeting, molecular chaperons, Protein folding and protein degradation.

**UNIT – IV (16hrs):**
Regulation of gene expression- Terminology – Operon, operator, promoter, attenuater, repressor, co-repressor, inducer, apoinducer, gratituous inducer, induction, repression. Organization of Prokaryotic genes- Operons and their regulation, Lac operon, Trp operon, negative regulation, positive regulation. Organization of eukaryotic genes and their regulation – Transcriptional factors, activators, and enhancers – Eukaryotes – Yeast: gal operon. Hormones and environmental factors affecting gene expression.

**REFERENCES**

1. Molecular Biology. 2nd ed. 1994. D. Freifelder. Springer.
2. Molecular Biology by G. Padmanabhan, K. Sivaram Sastry, C. Subramanyam, 1995, Mac Millan.
3. Molecular Biology and Biotechnology 2nd ed. J.M. Walker and E.B. Gingold. Panima Publications. PP 434.
4. Dictionary of microbiology and molecular biology. 2nd ed. 1994. Sigleton. P. and Sainsbury, D. Sciential Publication.

5. Molecular Biology of the Gene, 1987. 4th Ed. J.D. Watson, N.H. Hopkins, J.W. Roberts, J.A. Steitz and A.M. Weiner, 2 Vol. Benjmin/Cummings.
6. Biochemistry of the Nucleic acids. 1992. 11th ed. R.L.P. Adams, J.T. Knowler, D.P. Leader. Chapman and Hall.

**Programme:** ***M. Sc.*****, Biotechnology**
**Course Title:** **Computer Applications & Biostatistics**
**Type of Course:** **Core**
**Course No.:** 25082
**Semester:** **II**

**UNIT – I :** Introduction to computers, Definition, block diagram, Components such as CPU etc. Storage devises, concept of hardware and software, Organization and working of computers operating systems: basics of operating systems and types – DOS, Windows. Classification of computers based on technology, usage and working principle,

**UNIT –II:** Bioinformatics- Overview, History, Scope, Importance, Objectives of Bioinformatics, Kind of Data used, Major Bioinformatic Data Bases and search tools: NCBI, EMBL, DDBJ. Data integration and Data Analysis,
Sequence analysis: Concepts, importance and alignment methods, comparative and multiple alignments and scoring methods. Applications of Bioinformatics: Ab initio methods for determining protein structure, Insilico analysis drug designing and modeling.

**UNIT –III: Biostatistics-** Introduction and scope of biostatistics – variables and attribution, diagrammatic representation of biological data. Measures of location and dispersion and skewness, Raw data, group data, construction of frequency distribution,

**UNIT IV:**, Mean, Standard deviation and coefficient of variation, Correlation and regression concept,Tests of significance: Null hypotheis,T test
Analysis of variance (ANOVA)-one-way and two-way classification. Elements of statistical quality control. Elements of Statistical packages and uses.
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**REFERENCES**

1. Computing supplement to Models in Biology: Mathematics, Statistics and Computing. 1994. B. Brown and P. Rothery. Sciential Publication.
2. Meical informatics: Computer applications in Health care. 1990. E. H. Shortliffe, L.E. Pereault, G. Wiederhold and L.M. Fagan. Addision-Wesly International Publications. PP 714.
3. Computing for Biologists. 1985. A Fielding Addison-Wesley Publishers.
4. Microcomputers in Biology: A Practical approach. 1985. C. R. Ireland and S.P. Long. IRL Press.
5. Subhas Mehta, “Dos made simple”, Golgotia Publications, New Delhi.
6. Taxali R.K., “Wordstat 4.0”, Tata Mc. Graw-Hill Publishing Company Ltd., New Delhi.
7. Statistical methods in Agriculture and Experimental biology. 2nd ed. 1993. R. Mead, R.N. Curnow, A.H. Hasted, Panima Publication, PP 415.
8. Introduction to Biostatistics. 1995. R.N. Forthafter and E.S. Lee. Academic Press. PP 656.
9. Statistics with application to the biological and health sciences. 1985. R.D. Remington and M.A. Schork, Prentice-Hall.
10. Biostatistics an introductory text, Goldstein, Avrom, New York, The Mac Millian Company, 1971.

**Programme:** ***M. Sc.*****, Biotechnology**
**Course Title:** ***Immunology***
**Type of Course:** **Core**
**Course No.:** 25083
**Semester:** **II**

**UNIT – I (16hrs):** History of immunology : Immunity – natural and acquired; specific and non-specific; local and general. Primary and Secondary organ of immune system – thymus, spleen, lymph nodes, bursa fabricus, other types of lymphoid tissue. Cells of the immune system; B and T lymphocytes, neutrophils, macrophages, plasma cells, eosinophils and basophils. Natural body defense. Virulence factors in microbes – host relationships. Blood groups and isohaemagglutins.

**UNIT–II (17hrs):** Antigen – definition, properties, specificity, cross reactivity, immunogenicity, antigenic determinants and haptens. Antibody: nature and formation, classification of immunoglobulings, types, diversity and production of antibody – primary and secondary responses, valency and avidity production of polyclonal antibodies: animals, additives, adjuvants, route, dose, collection and preservation of antisera. Monoclonal antibodies – principles, production, advantages and disadvantages over polyclonal antibodies. Mechanism of antigen – antibody interaction.

**UNIT – III (17hrs):** *In vitro* serological tests : Principles and applications of serological tests used in identification of pathogenic agents and initial sources of inoculum-precipitation tests in liquid media, single and double diffusion tests using agar gel media, immunoelectrophoresis, rocket immunoelectrophoresis, hemagglutination, bentonite and later flocculation tests, complement fixation test, labeled antibody techniques (tests with fluorescent antibody, test with radioisotope-labeled antibody and enzyme-labeled immunoassays ELISA) immunosorbent electron-microscopy, infectivity neutralization test, and western blotting and immunodetection of viral antigens, relative merits and demerits of the above tests. Blood groups and isohaemyglutin.

**UNIT – IV (17hrs):** Complement – nature, physicochemical properties, complement cascade pathway, complement fixation. Cell mediated immunity (CMI): Induction and mechanism. Allergy: classification and details. The major histocompatability complex. Immune tolerance, immune suppression. Transplantation and G.V.H. reactions.Immunopathology – Autoimmune diseases; immune complex diseases; immunodeficiency diseases; immunity to infection. Production of vaccines and sera – conventional and biotechnological.

**REFERENCES**


1. Advanced immunochemistry. 2nd ed. 1990. E.D. Day, Wiley Liss, Inc, New York. PP 633.
2. Basic and clinical immunology, 7th ed. 1991. D.P. Stites and A.I. Terr Eds, Appleton and Lange, Norwalk, CT, pp. 870.
3. Clinical immunology : A practical approach. 1990. H.C. Goo, and H. Chapel. Eds. IRL Press, Oxford, PP 263.
4. Immunology: A short course, 2nd. 1991. B. Benjamin and S. Leskowitz, Wiley-Liss, NY. PP 459.
5. Immunochemical protocols : Methods in Molecular biology. Vol. 10, 1992, M.M. Manson. Ed. Humanma Press. Totowa. NJ, PP 480.

6. Immunology, 1995, R.B. Gallagher, J. Gilder, G.J.V.Nossal and G. Salvatore. Ed. Academic Press. PP 300.
7. Cellular and Molecular Immunology. 1991. A.K. Abbas, A.K. Lichtman, J.S. Pober, Harcourt Brace. PP 480.
8. Monoclonal antibodies. 1992. J.H. Peters and H. Baumgarten. Eds. Springer –Verlag. New York. PP 488.

**Programme:** ***M. Sc.*****, Biotechnology**
**Course Title:** ***Enzymology***
**Type of Course:** **Core**
**Course No.:** 25084
**Semester:** **II**

**UNIT – I (16hrs):** Structure and functions of enzymes: Introduction to Enzymes, history, Nomenclature and Classification, structure and function, specificity of enzyme action, Fischer Lock and Key Hypothesis, Koshland induced Fit hypothesis, Monomeric-O-Serine proteases, oligomeric enzymes- lactate dehydrogenase, tryptophan synthase, pyruvate dehydrogenase, extraction and purification of enzymes.

**UNIT – II (17hrs):** Kinetics and chemical mechanism of enzyme catalysed reactions, introduction to bioenergetics, catalysis and kinetics. Concepts of Bioenergetics- $1^{st}$ and $2^{nd}$ Law of thermodynamics, enthalpy, entropy and free energy, standard free energy, factors effecting the rate of chemical reactions, Kinetics of single substrate enzyme catalysed reactions- Henry and Michaelis – Menton equation, Lineweaver Burk Plot.

**UNIT III (17hrs):** Enzyme inhibition- Reversible inhibition, competitive, uncompetitive, non competitive, Allosteric inhibitors, Irreversible inhibitors, Identification of Binding and catalytic sites, investigation of three dimensional structures of active sites. The chemical nature of enzyme catalysis, chymotrypsin, Ribonuclease, Lysozyme, Metalloenzymes, Coenzymes- $NAD^+$, FMN, FAD, ATP, ADP, AMP, CoASH, TPP, Hills coefficient, +/- cooperativity.

**UNIT IV (17hrs):** Ligand protein interaction, application of enzymology, enzymes as analytical reagents, instrumental techniques available for using enzymatic analysis in Medicine and Industry, Biotechnological applications of enzymes- Food and Drink Industry, Recombinant DNA Technology, Immobilised Enzymes. Inborn errors of metabolism-Phenylketonuria, Alkaptonuria, Sickle Cell Anaemia, Fructosaemia, Galactosemia, Gaucher's and Krabbe's diseases.

**REFERENCES**

1. Principles of Biochemistry: White. A, Handler, P., and Smith.
2. Biochemsitry, Lehninger A.L.
3. Biochemistry, David E. Metzler.
4. Biochemistry, Lubert Stryer.
5. Review of Physiological Chemistry: Harold A. Harper.
6. Biochemistry, $2^{nd}$ Edition, G. Zubay (1988).

**Programme:** **M. Sc., Biotechnology**
**Course Title:** ***Genetic Engineering***
**Type of Course:** **Core**
**Course No.:** 35081
**Semester:** **III**

**UNIT – I (16hrs):** Introduction to genetic engineering. Outlines and tools for cloning - DNA cutting and joining. **Enzymes** – Restriction endonucleases, types, properties and applications, DNA ligases, polynucleotide kinase, alkaline phosphotases, S1 nuclease, terminal transferase, topoisomerases, methylases and gyrases. **Molecular vectors** – used for cloning in *E.coli.* (plasmids, bacteriophage derivatives, cosmids, BACs), yeast (YACs, shuttle vectors). Characteristics of expression vectors. Molecular cloning strategies: **Generation of DNA fragments:** RE digestion, mechanical shearing. **Joining of DNA fragments to vectors:** homopolymer tailing, linkers and adaptors, Cohesive and blunt end ligation

**UNIT – II (17hrs):** Delivery/introduction of recombinant molecules into selected host cells (transformation) - Introduction of Recombinant DNA molecules into appropriate hosts. Bacterial - Competent cells preparation, **e**lectroporation. Plant transformation methods – Agrobacterium (the natural genetic engineer, Ti- Plasmid, Agrobaterium mediated) Role of vir-genes in Agrobacterium, microinjection, particle bombardment. Chloroplast transformation, selection of transformants and its applications.

**UNIT – III (18hrs):** Sequencing of nucleic acids – Maxam –Gilbert chemical degradation and Sanger's dideoxy chain termination methods. Principle and applications of Polymerase chain reaction (PCR) in recombinant DNA technology, site directed mutagenesis for changing genes. Screening techniques - Southern, Northern and Western blotting. Construction of cDNA and genome libraries and screening of Libraries for selection of desired clones. Principles of preparation of DNA probes and their application.

**UNIT – IV (16hrs):**

Genetic Engineering – Applications in Medicine, Agriculture and Industry, social and moral implications.. Transgenic plants for Insect, pest,disease, abiotic stress, herbicide tolerance, Nutrition quality improvement and phytovaccines. Possible Ecological concerns and risks of transgenic crops.

**REFERENCES**


1. Principles of Gene Manipulation. 1991. R.W. Old and S.B. Prim-Rose. 2nd ed. Blackwell Scientific.
2. Genetic Engineering – Sandhya Mitra
3. Biotechnology, IPRs and Biodiversity – M. B. Rao and Manjula Guru
4. DNA replication, 2nd ed. 1991. A. Kornberg and T.A. baker. W.H. Freeman and Company, New York. Ny. PP 931.
5. Glossary of Genetics. 5 ed. Classical and molecular, 1994, Reiger. R. et al., Springer.
6. Gene regulation, 2nd ed. 1994. D. latchman. Sciential Publication.
7. Bacterial and Bacteriophage genetics. 1994. E.A. Birge. Springerscan Publication.

**Programme:** ***M. Sc.*****, Biotechnology**
**Course Title:** ***Pharmaceutical Biotechnology***
**Type of Course:** **Core**
**Course No.:** 35083
**Semester:** **III**

**UNIT – I :** Definition – History of development of Pharmaceutical Products by biotechnological methods like genetic recombinant vaccines, microbial and non-microbial products – scope of biotech products and biochemical in pharmaceutical industry. Need to design a drug, drug receptor interactions, antagonisms, biological activity, efficacy and stimulus, receptors and ion channels, ion gating co-operatively effect of solvent on drug- receptor interactions, drug docking.
**UNIT-II :** In vitro development of drugs and pharmaceuticals : Methods of testing products for abti-microbial potentials, pharmacological activates and biopesticidal Properties-conventional and rapid enzyme inhibitor techniques; in vivo methods- use of animals models for confirmation of in vitro properties- transgenic systems- preclinical, toxicological studies, Acute, subacute, chronic studies.Clinical trials- definition-design- specific objectives- types of clinical trials-phase I,II & II – randomized controlled clinical trails- multicentric double nlind clinical trials-pharmaceutical / drug regulations for commercializing new biotech products for human use-FDA and Indian regulations.
**UNIT – III** Biotech products as medicines and pharmaceutical products: Biochemicals - enzymes like proteases – Chemical like ethanol, vinegar, citric acid and glutamic acid; vitamins like B12; drugs for infection and metabolic, immunomodulatory – insulin – interferons, B-cell growth factiors, Tissue plasminagen activator, r-DNA based production of regulatory protins, blood products hormones, vaccines, Application of RELP in forensic, disease prognosis, genetic counseling, pedigree, variation.
**UNIT – IV :** Caccines – cell culture based vaccines – genetic recombinant vaccines-recombinant vector based vaccines- live and subunit- their production model- fermentation technology-expression systems- guideline for the production of genetic recombinant vaccines – Eg. Hepatitis B vaccine, HIV vaccine and other vaccines in pipeline.
Application of biotechnology to Animal health and disease diagnosis, Development of kits and their application in disease diagnosis. Gene therphy, vector engineering, strategies of gene defiver, gene replacement, augmentation, gene correction, gene regulation and silencing safety and bioethical issues in biotechnology.
REFERENCES :


- Biopharmaceuticals-Walsh, John Willey and Sons, New York 1998
- Pharmaceutical Biotechnology – Daan J.A. Crommelin, Robest D. Sindelar, Daan J.A. Crommelin Amazon. WM
- Physical Methods to characterize Pharmaceutical Protines- James N. Herron, Wim jishkoor and Daan J.A. Crommelin Amazon. Wm
- From clone to clinic (Developments in Biotherapy) Daan J.A. Crommelin and H. Schellekom Amazon.Wm
- Hand Book of Pharmaceutical Biotechnology - Jay P.Rho, Star 4 lonie
  The Haworth press
  10 Alice Sr. Bringhamtoon, NY 13904, US
  Tramas bartifai, Harold L. Dorn's

**Programme:** ***M. Sc.*****, Biotechnology**
**Course Title:** ***Food and Industrial Biotechnology***
**Type of Course:** **Core**
**Course No.:** 35083
**Semester:** **III**

**UNIT – I(15hrs):**

Scope of biotechnology in the food and drink industry: Principles of food preservation, foods produced by micro organisms.
Milk and Dairy products, Cereal products, Brewing, Protein products, Food additives and ingredients, large scale cultivation of edible mushrooms.

**UNIT – II (16hrs):**

Nitrogen fixation and mass production of biofertilizers – diazotrophic microorganisms, Blue Green Algae and Azolla, Micorrhizae, Vermiculture.
Mass cultivation of commercially valuable macro and micro algae for agar agar, alginates, single cell protein and other products.

**UNIT – III (17hrs):**

Energy and Biotechnology : Biomass, solar energy technology, Agriculture and forestry, conversion to fuel, bio fuel cells and other devices, Production of Biogass.
Microbial leaching, Metal transformation, accumulation and immobilization by microbes. Application of microbes in mining and petroleum industry. Microbial enhanced oil recovery.

**UNIT – IV(20hrs):**

Materials and Biotechnology : Biomolecules production – microbial polysacchrides, organic acids, amino acids, vitamins, antibiotics, enzymes, alcohols, food flavours, Microbial toxins.
Pharmaceuiticals – vaccines, hormones. Applications of enzymes in industry and medicine; immobilized enzymes – their preparation and applications. Microbes in Biodegradation of waste products.

**REFERENCES:**


1. Fermentation : A Practical approach. 1990. B. Mc Neil and L.M. Harvey. IRL Press. PP 226.
2. Biofertilizers in Agriculture and Agroforestry. 3ed. 1994. Subbarao. Oxford & IBH Publications.
3. Manual of Industrial Microbiology and Biotechnology. 1986. Edited by Arnold L. Demain and Nadine. A. Solomon. PP 466.
4. Bioreactors in Biotechnology – A Practical Approach. AR. Seregg.
5. Frazier, W.C., and D.C. Esthoff: Food Microbiology, 4th ed., Mc Graw-Hill, New York, 1988.
6. U.S. Congress, Office of Technology Assessment: "Biotechnology in a Global Economy" OTA-BA-494, Government Printing Office, Washington, D.C., 1991.

**Programme:** **M. Sc., Biotechnology**
**Course Title:** ***Bioprocess Technology***
**Type of Course:** **Core**
**Course No.:** 35084
**Semester:** **III**

**UNIT – I (16hrs)**:

Introduction to Bioprocess technology, Upstream processing- strain selection, media preparation, sterilization, seed inoculum, types of Bioreactors - Air Lift Reactor, Tower fermenter, Packed tower fermenter, Rotating disc, Stirred tank reactors.

**UNIT – II (18hrs)**:

Bioprocess principles, Types of Fermentation process - Microbial mass, enzymes, metabolites and recombinant products., Batch culture, continuous culture, fed batch culture, Isolation, preservation and improvement of industrially important microorganisms, media for industrial fermentation processes, development of inocula for fermentation.

**UNIT – III (17hrs)**:

Downstream processing - precipitation, filtration(batch filters and continuos filters), centrifugation(basket, multi chamber centrifuges) , cell disruption(physical, mechanical and chemical methods), extraction(liquid-liquid), chromatography(Adsorption, Ion, Affinity chromatography, HPLC), membrane processes ( ultrafiltration and reverse osmosis), drying(spray drying,freeze drying,fluidized bed drier) crystallization, whole broth processing.

**UNIT – IV(16hrs)**:

Applications of Bioprocess Technology- Industrial production of Chemicals, alcohol (ethanol), Acids (Citric acid and Acetic acid), Antibiotics (Penicillin, Streptomycin, Tetracyclin), Amino acid (Lysine, Glutamic acid), Single cell proteins,Vitamins,insulin, Human growth hormone

**REFERENCES**


1. Bio processing Engineering principles.1995. P.M.Doran. Har court Brace. PP 464
2.Biochemical engineering . 1992. James .M.Lee Prentice – Hall.
3. Biochemical engineering Fundamentals. 2ed 1986.J.E.Bailey and D.F.Oilis. Mc Graw-Hill Publication.
4.Chemical Process Control: An Introducation to theory and practice. 1984.G.Stephanopoulos, Prentice-hall.
5. Modelling and controlling of fermentation Process. Ed. J.R.Leigh
6.Biochemical Engineering by S.Aiba, AE Humphery, NF Millis, University, of Tokyo Press.
7. Chemical Engineering by JM Coulson and JF Richarson ,Pergamen Press
8.Fundamentals of Biotechnology by P.Prave , U.Faust W.Sitting and DA Sukatsch, VCH.
9. A Text Book on Biotechnology by HD Kumar, Affliated East West Press Private ltd.

**Programme:** ***M. Sc.*****, Biotechnology**
**Course Title:** ***Plant Biotechnology***
**Type of Course:** **Core**
**Course No.:** 45081
**Semester:** **IV**

**UNIT – I (16hrs):** Introduction to Plant Biotechnology, History, Organization of Plant Tissue culture Lab, Sterilization, Media Preparation, Instrumentation. Architecture of plant genome, mitochondrial and chloroplast genome. concept of totipotency, Dedifferentiation, Redifferentiation, Organogenesis, Shoot tip culture for virus free plants, Somatic Embryogenesis, Synthetic seeds, Cell suspension culture, Haploid culture, Protoplast culture, Acclimatization, Cryopreservation and Germplasm conservation. Introduction to Molecular Markers.

**UNIT – II (18hrs):** Plant Transformation Technology, Vector mediated or Indirect gene transfer(Agrobacterium-mechanism of T-DNA transfer and its integration into plant genome,basis of tumor formation ,role of virulence gene, use of Ti and Ri plasmids as vectors), Direct Gene transfer-microinjection,electroporation,particle gun, Choloroplast transformation and applications Gene silencing. Application of Plant Transformation for Productivity and Performance- Herbicide Resistance, Male sterility, Virus resistance, Pest Resistance, Fungal resistance. Genetic Engineering of plant Oils and extended shelf life of fruits, manipulation of starch biosynthesis ,Terminator technology.transgenic plants for production of viral antigens.

**UNIT – III(17HRS):** Nitrogen fixation and biofertilizers (nitrogen fixation genes, transfer of nif gens to microorganisms). Algae as a source of food, feed, single cell proteins, industrial uses of algae.Mass cultivation of commercially valuable marine microalgae for agar agar, alginates and other products of commerce and their uses.Mass cultivation of macroalgae as a source of protein and feed.

**UNIT – IV(16HRS):** Introduction to molecular markers, different types-PCR based and Non PCR based,role of molecular marker in plant breeding, types of maps-physical and genetic map, applications of molecular markers in plant biotechnology
phytodiagnostics based on immunological and molecular techniques, biopesticides, transgenic plants as biofactories-biodegradable plastics, therapeutic proteins

**REFERENCES**

1. Molecular approaches to crop improvement. 1991. Dennnis and Liwelly eds. PP. 164.
2. Plant cell and Tissue culture. A Laboratory Manual. 1994. Reinert. J. and Yeoman, M.M. Spring.
3. Plant biotechnology, 1994. Prakash and Pierik. Oxford & IBH Publishing Co.
4. Gene transfer to plants. 1995. Potrykus-I and Spangenberg, G. Des. Springer Scan.
5. Microalgal Biotechnology. 1988. Borocotizka M.A. and Borocoitzka L.J. Cambridge University Press.
6. Algal and Cyanobacterial biotechnology, 1989. Cresswell. R.C. Rees, T.A.V. and Shah, N.Eds. Longman Scientific and Technical, Essex, London.

**Programme:** ***M. Sc.*****, Biotechnology**
**Course Title:** ***Animal Biotechnology***
**Type of Course:** **Core**
**Course No.:** 45082
**Semester:** **IV**

**UNIT – I (16hrs):** History and development of animal tissue culture. Equipment and materials (culture vessels, $CO_2$ incubator, inverted microscope, cell counters). Principles of sterile techniques. Sources of tissues, types of tissues - epithelial, muscle, connective, nerve and blood. Introduction to balanced salt solutions. Cell culture media - components of the medium, physical, chemical and metabolic functions of media. Role of serum and supplements, Measurement of cell number - hemocytometer, coulter counter. Measurement of cell viability and cytotoxicity. Measuring parameters of growth – growth curves, PDT, Plating efficiency and factors influencing growth.

**UNIT – II (17hrs):** Primary culture – Mechanical and enzymatic mode of desegregation, establishment of primary culture. Subculture - passage number. Cell lines - definite and continuous cell lines, characterization, maintenance and preservation of cell lines. Contamination - bacterial, viral, fungal and mycoplasma contaminations, detection and control, cell transformation – normal vs. transformed cells, growth characteristics of transformed cells. Viral and chemical-mediated methods of cell immortalization
Scale-up of animal cell culture – Factors to be considered. Scale-up of suspension cultures - Batch reactor, continuous culture.

**UNIT – III (18hrs):** Cloning - concept of nuclear transfer, nuclear reprogramming and creation of Dolly. Stem cells - embryonic and adult stem cells. Tansgenic animals - retroviral, microinjection, and engineered embryonic stem cell method of transgenesis. Application of transgenic animals - biopharming, disease models, functional knockouts mice.
Human genome - complexicity of the genome, outlines of human genome project, human disease genes. Genetherapy - *ex vivo* and *in vivo* gene therapy methods, applications.

**UNIT – IV(16HRS)** Application of animal cell culture - Vaccine production, Concepts of tissue engineering - skin, liver, kidney, bladder and heart. Pearl culture - pearl producing mollusks, rearing of oysters, nucleation for pearl formation and harvesting of pearls. Molecular tools for the identification of diseases in aquatic species. Sericulture - species of silkworm, artificial rearing, seed production, technology of silk production and recent advances.

**BOOKS RECOMMENDED**


1. Culture of Animal Cells, (3rd Edn) R Ian Fredhney. Wiley-Liss
2. Animal Cell Culture – Practical Approach, Ed. John RW. Masters, Oxford
3. Cell Growth and Division: A Practical Approach Ed. R. Basega, IRL Press
4. Cell Culture Lab Fax. Eds. M Butler & M Dawson, Bios Scientific Publications Ltd. Oxford
5. Animal Cell Culture Techniques Ed Martin Clynes, Springer
6. Methods in Cell Biology, Vol. 57, Animal Cell Culture Methods Ed. Jenni P Mather and David Bames. Academic Press

**Programme:** **M. Sc., Biotechnology**
**Course Title:** ***Functional Genomics***
**Type of Course:** **Core**
**Course No.:** 45083
**Semester:** **IV**

**UNIT I (16hrs):** Introduction to Genomics- Model organisms. Genome sizes, organelle genomes. Genome projects- Human, Arabidopsis, Rice, C. elegans. Whole genome analysis: Preparation of ordered cosmid libraries, bacterial artificial chromosome libraries, short gun libraries. cDNA libraries: Preparation, large scale EST generation and application of EST's in identification and cloning of full length genes. Sequencing methods: conventional sequencing (Sangers, Maxam and Gilbert methods), Automated sequencing – chemistry of automated sequencing.

**UNIT II (17hrs):** Genome Mapping: Introduction and outlines of Genome mapping. Principles and applications of Molecular markers. DNA polymorphism and different kinds of molecular markers - Morphological markers, Biochemical markers, molecular markers, non PCR based and PCR Based molecular markers- RFLP, RAPD, SCARs, Simple Sequence Repeats, AFLP, ISSRs, CAPs, STMS, SNPs and its applications.. Fingerprinting vs marker assisted selection (MAS). Genetic and physical maps, physical mapping and map-based cloning.

**UNIT III (17hrs):** Applications of Genomics – Experimental analysis (Gene inactivation by antisense RNA, Gene Overexpression), Yeast two hybrid system, microarray technology. DNA Microarrays: Printing of oligonucleotide and PCR products on glass slides, Nitrocellulose paper. Gene expression analysis: Global pattern of gene expression using floourescent labeled cDNA or end labeled RNA probes, Real Time PCR and its applications. Applications of DNA and cDNA chips.

**UNIT IV(17hrs):** TILLING: Introduction and history of TILLING. Overview of TILLING, principle and mechanism of TILLING. TILLING projects and its applications. Determination of gene function through TILLING technique. Concept of EcoTILLIG,. TILLING vs EcoTILLING. Application of biodiverse lines in EcoTILLING. Application of EcoTILLING in superior gene discovery. Introduction to miRNA, siRNA, RNAi. Introduction to Metagenomics: Concept of metagenomics and its application in novel gene discovery.

**REFERENCES**


1. DNA replication, 2nd ed. 1991. A. Kornberg and T.A. baker. W.H. Freeman and Company, New York. Ny. PP 931.
2. Gene transfer and expression protocols: Methods in Molecular Biology, Vol.7, 1991. E.J. Murray Ed. Human Press, Clifton, NJ. PP 439.
3. Genes IV, 1990. B. Lewin. Oxford University Press. PP 857.
4. Microbial genetics. 1994. Freifelder, D. Springer.
5. Glossary of Genetics. 5 ed. Classical and molecular, 1994, Reiger. R. et al., Springer.
6. Methods in Enzymology. Vol.152. Guide to molecular cloning techniques. 1987. S.L. Berger and A.R. Kimmel. Eds. Academic Press.
7. Recombinant DNA Laboratory manual. 1989. J.W. Zyskind and S.I. Bernstein. Academic Press.
8. Methods in Molecular Genetics. Vol. 7, Viral Gene Techniques. Ed. By Kenneth W. Adoph, Academic Press, 1995.

9. Gene transfer and expression protocols : Methods in Molecular Biology, Vol.7. 1991. E.J. Murray Ed. Humana Press. Clifton, NJ. PP 439.

**Programme:** ***M. Sc.*****, Biotechnology**
**Course Title:** ***Bioethics and Biosafety***
**Type of Course:** **Core**
**Course No.:** 45084
**Semester:** **IV**

**UNIT – I (17hrs):** Intellectual property rights – Definition – types of patents, copy rights and trade marks. Essential requirements for IPR, procedures of filing patents - provisional and complete specifications-Pan-Co-operation treaty (PCT) application: GATT and IPR: WTO Act – Global and Indian Biodiversity Act – Indian Patent Act and their revised versions. Social and Moral aspects of Biotechnology – Biotechnology and International trade. Positive and negative aspects of Biotechnology.

**UNIT – II (17hrs):** Legal and Ethical aspects of Biotechnology – Prenatal diagnosis – Genetic screening – Surrogate mothers. Manipulation of human genome – gene therapy – cloning, Technology transfer. Designing of plants and animals- guidelines for research in transgenic plants and animals. Social impacts and socioeconomic aspects of Biological weapon. Ethics and Biosafety consideration in Bioremediation.

**UNIT – III (17hrs):** Privatization and patenting of Biotechnology products – Role of Government, Industries and society in promoting, accepting and regulating the rDNA research, Intellectual Property Rights (IPR), WTO, TRIPS, Patenting- Examples of patents in Biotechnology.

**UNIT – IV(16hrs):** Environmental and Health aspects of Biotechnology – Generally engineered organisms – Introduction of novel species and natural equilibrium – Environmental security and safety – Precautionary measures – Genetically modified foods – health safety. Cartagena Protocol on Biosafety, Biosafety concerned with radioactivity.

**REFERENCES**

1. Gene cloning – Brown
2. Concepts in Biotechnology – Balasubramanyam.D
3. Basic Biotechnolgy – Colin Rotledge and Kristainsen
4. Gene Biotechnology - Jogdand
5. From Genes to Clones , Introduction to Gene Technology- Winnacker, Ernst.L
6. Safety, Moral, Social and Ethical issues related to geneticalls modified foods – Smith J.E.
7. Molecular Biology and Biotechnology – Meyer R A
8. Biotechnology expanding horizons by B.D. Singh, Kalyani Publisher
9. Biological warfare in the 21st century by M.R.Dando
10. Intellectual Property Rights in Agricultural Biotechnology by F.H. Erbisch and K.M. Maredia.
11. Basic Biotechnology by Colin, Ratledge and Kristiansen
12. Biopharmaceutical, Drug design and development by S. WU-Pong and Y. Rojanasakul, Humana Press.