

**I Semester**

Code	Title of the Paper	No of Credits	Hours per week	Max.Marks:100		Exam time (hrs)
				Internal	External	
15081	Cell Biology and Genetics	4	4	25	75	3
15082	Biomolecules	4	4	25	75	3
15083	Microbiology and Microbial Genetics	4	4	25	75	3
15084	Biochemical and Biophysical Techniques	4	4	25	75	3
15081P	Practical 1: Cell Biology, Genetics and Biomolecules	4	8	100		3
15082P	Practical 2: Microbiology & Microbial Genetics, Biochemical and Biophysical Techniques	4	8	100		3

**II Semester**

				Max.Marks :100		
				Internal	External	
25081	Molecular Biology	4	4	25	75	3
25082	Computer Applications & Biostatistics	4	4	25	75	3
25083	Immunology	4	4	25	75	3
25084	Enzymology	4	4	25	75	3
25081P	Practical 1: Molecular Biology and Computer Applications & Biostatistics	4	8	100		3
25082P	Practical 2: Immunology and Enzymology	4	8	100		3
<b>Non-core-1</b>	<b>Essentials of Biotechnology</b>	<b>4</b>	<b>4</b>	<b>25</b>	<b>75</b>	<b>3</b>

**III Semester**

				Max.Marks :100		
				Internal	External	
35081	Genetic Engineering	4	4	25	75	3
35082	Medical and Pharmaceutical Biotechnology	4	4	25	75	3
35083	Food and Industrial Biotechnology	4	4	25	75	3
35084	Bioprocess Technology	4	4	25	75	3
35081P	Practical 1: Genetic Engineering and Medical and Pharmaceutical Biotechnology	4	8	100		3
35082P	Practical 2: Food and Industrial Biotechnology and Bioprocess Technology	4	8	100		3
<b>Non-core-2</b>	<b>Introduction to Bioethics in Biotechnology</b>	<b>4</b>	<b>4</b>	<b>25</b>	<b>75</b>	<b>3</b>

**IV Semester: Theory**

Max.Marks :100

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45081	Plant Biotechnology	4	4	25	75	3
45082	Animal Biotechnology	4	4	25	75	3
45083	Functional Genomics	4	4	25	75	3
45084	Bioethics and Biosafety	4	4	25	75	3
45081P	Practical 1: Plant Biotechnology and Animal Biotechnology	4	8	100	3	
45082P	Practical 2: Functional Genomics and Bioethics and Biosafety	4	4	25	75	
<b>Total for core papers</b>		<b>96</b>	<b>128</b>	<b>400</b>	<b>2000</b>	
<b>Total for Non-core papers</b>		<b>8</b>	<b>8</b>	<b>50</b>	<b>150</b>	
<b>Grand Total (2600 marks)</b>		<b>104</b>	<b>136</b>	<b>450</b>	<b>2150</b>	

**External Member:**

1. Prof. D. V. R. Sai Gopal, -

**Chairperson and Convener**  
(Prof. P. Chandramati Shankar)

*M. Sc., Biotechnology CBCS syllabus for 2018-21 Approved by Board of Studies*

**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: Microtubules, Actin Filaments and Intermediate Filaments and functions. Role of cytoskeleton in intercellular transport and motor movements; implications in flagellar and other movement.

**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, Lysosomes and Peroxisomes. The Cell Nucleus: Structure and function of Nuclear Envelope, Nucleolus. Eukaryotic chromosome structure and characteristics– chromatin, and heterochromatin. Polytene and lamp brush chromosomes.

**UNIT – III (16hrs):**

**Classical Genetics:** Phenotype, Genotype, Trait, Mendelian Laws of Inheritance.

**Modification of Mendelian Ratios:** Incomplete Dominance, Codominance. Gene Interactions – Lethal Genes, Recessive Epistasis, Dominant Epistasis, Multiple Alleles, Pleiotropy, Penetrance and Expressivity. Cytoplasmic or Organellar Inheritance.

**Linkage** - Linkage and crossing over, cross over frequency, and interference.

**Sex Determination:** Genetics of sex chromosomes – 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, polyploidy – their fundamental and practical significance. Induction of mutations and mutagenesis – types of mutagens. Practical applications of mutations.

**UNIT – IV (18hrs):** Cell Division: **Mitosis:** Mechanism of cell division – mitotic apparatus, cytokinesis, chromosome movement – present concept. Meiotic process – stages, Metaphase Chromosomes: Centromere and Kinetochore. **Meiosis:** Stages of Meiosis, chromosome pairing, molecular mechanisms of recombination - synaptonemal complex and Gene Conversion. Comparison of mitosis and meiosis. Significance of Meiosis. **Cell Cycle:** Overview of Cell Cycle, Cell division control in multi cellular animals (regulation of eukaryotic cell cycle).

## REFERENCES

1. De Robertis EDP & EMF De Robertis. 2001. Cell and Molecular biology. Lippincott Williams & Wilkins. Bombay.
2. Freifelder D. 1990. Molecular biology. Narosa publication house, New Delhi
3. Harvey Lodish et al , Molecular Cell Biology, (W. H. Freeman; Sixth Edition edition)
4. Lewin B (2008). Genes IX, Jones and Barlett Publishers
5. Hardin, Jeff; Bertoni, Gregory Paul; Kleinsmith, Lewis J. (2009) Becker's World of the Cell, Benjamin Cummings.
6. Cooper Geoffrey, M. 2000. The Cell-a molecular approach. 2nd Edn. ASM Press. Washington.
7. Alberts B, Johnson A, Lewis J, Raff Martin, Roberts K and Walter P. (2007) Molecular Biology of the Cell. Garland Publ., New York.
8. D. Peter Snustad, Michael J. Simmons. 2002. Principles of Genetics. John Wiley & Son, USA.
9. Peter J. Russell 2009. *iGenetics* A Molecular Approach. Pearson Ltd. USA.
10. Daniel L. Hartl, Elizabeth W. Jones. 1997. Genetics: Principles and Analysis. Jones and Bartlett Publishers Inc. USA.
11. Tamarin, R. H. 2004. Principles of Genetics. McGraw-Hill Higher Education. USA
12. Hartwell, et al. 2004 : Genetics: From Genes to Genomes. McGraw-Hill Higher Education. USA
13. P K Gupta. 2010. Genetics. Rastogi Publications. India.
14. Gardner and Simmons Snustad, 2005. Principles of Genetics, John Wiley and Sons, Singapore.

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

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

**UNIT – II (17hrs)::** Chemical bonds – covalent, coordinate, electrostatic hydrogen, ionic bonds; VanderWal forces; hydrophilic and hydrophobic interactions; functional groups. Definition and classification of carbohydrates. Outlines of structures of starch, cellulose, lignins, suberins, hemicellulose, amylose, amylopectin.

**UNIT – III (16hrs):–** Outline, structure, classification, chemical reactions of proteins and amino acids. Peptide bonding. 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. Biochemistry. 1992. R.H. Abeles, Panima Publication. PP 894.
2. Principles of Biochemistry. 2nd ed. 1993. A.L. Lehninger, D.L.Nelson.M.Cox. Panima Publications. PP. 1090.
3. Harper's biochemistry. 1988. R.K. Murray. D.K. Granner, P.A. Mayes. Printice Hall International.
4. Biochemistry of the Nucleic acids. 1992. 11<sup>th</sup> ed. R.L.P. Adams, J.T. Knowler, D.P. Leader, Chapman and Hall.
5. Proteins: Structure, function and evolution. Dickerson & Geis, 2<sup>nd</sup> Edn.Banjamin/Cummings, Meulo park, Calif 1983.
6. The Proteins: Neurath and Hill, 3<sup>rd</sup> Edn. Academic New York.
7. Biochemistry, A problem approach, 2<sup>nd</sup> ed. Wood, W.B., Addison Wesley, 1981.
8. Biological Chemistry, Mahler & Cordes.
9. Text book of Biochemistry West, W.S. Todd, Mason & Vanbruggen, Macmillian & Co.
10. Principles of Biochemistry – White –A, Handler, P and Smith E.L.Mc.Graw-Hill.
11. Biochemistry – Cantrow, A. Sehepartz. B. Sunders – Japan.
12. The Carbohydrates: Pigman & Hartman Vol.II – A & II-B.
13. Biochemistry Voet & Voet.
14. 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 woos 3 domain system, five kingdom systems. Nutritional requirements to microorganisms – mode of nutrition – phototrophy, chemotrophy – methylotrophy organotrophy, mixotrophy, saprophytic, symbiotic and parasitic, Interaction of microbes. Microorganisms and disease

**UNIT -11 ((17hrs):** Isolation, enumeration. approaches for obtaining pure cultures from different sources, 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.

**UNIT – 111 (16 hrs):** Ultra structure of nucleus and nuclear envelop. Organization of prokaryotic and Eukaryotic chromosomes – structure of nucleosome, c-value, cell cycle overview, cell growth and extra cellular signals, regulations of cell cycle progressions, unit of genes, establishments of cistrons, reons 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 –molecular mechanisms, Bacterial conjugation – Hfr transfer, Rec proteins. Bacteriophages T4 and Lamba – Genome organization, replication, recombination, generalized and specialized transduction . Eukaryotic viruses, Sub-Viral Agents (Prions).

#### **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. 4<sup>th</sup> ed. 1994. I.E. Alcamo. Scientific Publication.
4. Microbiology, 1990. 4<sup>th</sup> 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. 3<sup>rd</sup> ed. Brief Version. 1992. T.R. Johnson and C.L. Case. Addison Wesley International Publications. PP 350.
7. Microbiological Applications : A Laboratory Manual in General Microbiology. 5<sup>th</sup> ed. 1990. H.J. Benson. Panima Publications. PP 459.

#### **Practical Course**

1. Skerman, N.B.D. A guide to the identification of the Genera of Bacteria.
2. Bergey's Manual of Determinative Bacteriology.

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

**UNIT – I(15 Hrs):**

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(18 Hrs):**

Chromatography – general principles. paper, thin layer, gas-liquid, ion exchange, HPLC, molecular sieve and affinity chromatography techniques.  
Electrophoresis: Horizontal and Vertical Gel Electrophoresis. PAGE - Native and SDS PAGE. Agarose Gel Electrophoresis. Applications of PAGE and Agarose Gel Electrophoresis

**UNIT – III(18 Hrs):**

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

**UNIT – IV(18 Hrs):**

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. Non-radio labelled Probes (DIG labelling)

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. 4<sup>th</sup> ed. Eds. K. Wilson and J. Walker.
3. Physical Biochemistry: Applications to Biochemistry and Molecular Biology. 2<sup>nd</sup> 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. 2<sup>nd</sup> 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 detection, 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 (4<sup>th</sup> 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 – Fred Griffith, Avery, Hershey Chase Experiments. 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 organization. Replication 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. 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, attenuator, repressor, co-repressor, inducer, apoinducer, gratuitous 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. 2<sup>nd</sup> ed. 1994. D. Freifelder. Springer.
2. Molecular Biology by G. Padmanabhan, K. Sivaram Sastry, C. Subramanyam, 1995, Mac Millan.
3. Molecular Biology and Biotechnology 2<sup>nd</sup> ed. J.M. Walker and E.B. Gingold. Panima Publications. PP 434.
4. Dictionary of microbiology and molecular biology. 2<sup>nd</sup> ed. 1994. Sigleton. P. and Sainsbury, D. Sciential Publication.
5. Molecular Biology of the Gene, 1987. 4<sup>th</sup> 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. 11<sup>th</sup> ed. R.L.P. Adams, J.T. Knowler, D.P. Leader. Chapman and Hall.

**Practical Course**

1. Techniques in molecular biology. Vol.2. 1987. ed. J.M. Walker and Wim Gaestra. Panima Publications. PP 332.
2. Methods in Plant Molecular Biology. 1989. M.A. Schuler and R.E. Zielinski. Academic Press.
3. Methods for cloning and Analysis of eukaryotic genes. 1990. A Bothwell, G.D. yancoponlos and F.W. Alt: Jones and Bartlett Publishers. PP 1990.

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

**UNIT – I (18 Hrs):** Introduction to computers, Definition, block diagram, Components such as CPU etc. Storage devices, 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 (20 Hrs):** 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: gene isolation (primer designing), comparative genomics, Insilico analysis drug designing and modeling.

**UNIT –III (17 Hrs): 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 (18 Hrs):**, Mean, Standard deviation and coefficient of variation, Correlation and regression concept, Tests of significance: Null hypothesis, T test, f-test, Dunken Hypothesis Analysis of variance (ANOVA)-one-way and two-way classification. Elements of statistical quality control. Elements of Statistical packages and uses.

#### REFERENCES

1. Computing supplement to Models in Biology: Mathematics, Statistics and Computing. 1994. B. Brown and P. Rothery. Scintial Publication.
2. Meical informatics: Computer applications in Health care. 1990. E. H. Shortliffe, L.E. Pereault, G. Wiederhold and L.M. Fagan. Addison-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. 2<sup>nd</sup> 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):** Immunity – natural and acquired; specific and non-specific; 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. Blood groups and cytokines, interferons and interleukins

**UNIT–II (17hrs):** Antigen – definition, properties, specificity, cross reactivity, immunogenicity, antigenic determinants and haptens. Antibody: nature and formation, classification of immunoglobulins and types, valency and avidity. production of polyclonal antibodies, Hybridoma technology

**UNIT – III (17hrs):** *In vitro* serological tests : precipitation in liquid, single and double diffusion tests using agar gel media, immunoelectrophoresis, rocket immunoelectrophoresis, hemagglutination, and Enzyme-Labeled Immune Assays (ELISA), Radio immune assay.

**UNIT – IV (17hrs):** Complement –definition, complement cascade pathway, complement fixation. Hyper sensitivity and its types. The major histocompatibility complex. Transplantation and G.V.H. reactions. Immunopathology – Autoimmune diseases; immune complex diseases; immunodeficiency diseases, Tumor immunity

## REFERENCES

1. Advanced immunochemistry. 2<sup>nd</sup> ed. 1990. E.D. Day, Wiley Liss, Inc, New York. PP 633.
2. Basic and clinical immunology, 7<sup>th</sup> 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, 2<sup>nd</sup>. 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. Humanna 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.

## Practical Course

1. Serological methods for detection and identification of viral and bacterial plant pathogens. 1990. R. Hampton, E. Ball and S.De.Boer (eds.) American Phytopathological Society.
2. Practical immunology. 1989. 3<sup>rd</sup> ed. Hudson and F.C. Horp. Blackwell Scientific Publication.
3. Antibodies : A Laboratory Manual. 1988. E. Harlow and D.Lane. Cold Springer Harbor Lab. NY. PP 726.

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

**UNIT – I (16hrs):** 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, extraction and purification methods of enzymes.

**UNIT – II (17hrs):** Introduction to bioenergetics, catalysis and kinetics. Concepts of Bioenergetics- 1<sup>st</sup> and 2<sup>nd</sup> 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. The chemical nature of enzyme catalysis, chymotrypsin, Ribonuclease, Lysozyme, Metalloenzymes, Cofactors, Coenzymes- NAD<sup>+</sup>, FMN, FAD, ATP, ADP, AMP, CoASH, TPP, Hills coefficient, +/- cooperativity. Iso enzymes and its physiological significance, Ribozymes and Abzymes.

**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.

#### **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<sup>nd</sup> Edition, G. Zubay (1988).

#### **Practical Course**

1. Practical Biochemistry – H. Varley.
2. Methods in Enzymology S.P. Colowick & N.O. Kaplan, Academic Press.
3. Methods in Biochemical analysis.
4. Oser: Hank's Physiological Chemistry.
5. Food analysis – Woodman.

**Programme :M.Sc.Biotechnology**

**Course Title: Essentials of Biotechnology**

**Course no: Non Core 1.**

**Semester: II**

**UNIT I:** History of Biotechnology.Introduction to Plant,Animal and Microbe cell structure. Introduction to Macromolecules:Nucleic Acids,Proteins,Carbohydrates.Mitosis,Meiosis, and its significance.

**UNIT II:** Introduction to Genetic Engineering and Bioinformatics.Genetic Engineering tools:Enzymes,Cloning Vehicles,Principle of cloning.Databases and their application in Biotechnology.

**UNIT III:** Introduction to Application of biotechnology in Agriculture,Industry,Medicine and Animal Biotechnology.

**UNIT IV:**

Introduction to Intellectual property Rights,Patents,Principles of Biosafety,GMO's

**References**

1. Basic Biotechnology-Colin Rotledge and Kristainsen
2. Cell and Molecular Biology-P.K.Gupta
3. Cell Biology-Verma and Agarwal
4. Cell Biology-Rastogi
5. Biochemical Techniques:Theory and Practical.1987.J.PRobftand B.J.White,waveland Press,Inc.Prospects HeightsIL,pp407
6. Biochemical Techniques:Theory and Practical.1987.J.PRobftand B.J.White,waveland Press,Inc.Prospects HeightsIL,pp407
7. Molecular Biology by G.Padmanabhan,K.Sivram Sastry,C.Subramanyam,1995,Mac Millan
8. Molecular Biology and Biotechnology2nd ed.J.M.Walker and E.B.Gingold,Panima Publications.PP434.
9. Dictionary opf microbiology and molecular biology2nd ed.1994.sigleton .P.and Sainsbury,D.Sciential Publications
10. Molecular Biology of Gene 1987.4<sup>th</sup> Ed.J.D.Watson,N.H.H opkins,J.W.Roberts,J.A.Steitz and A.M Weiner.2 VOL.Benjimin/Cummings
11. Biochemistry of Nucleic Acids.1992.11<sup>th</sup> ed.R.L.P.Adams.J.T.Knowler.D.P Leader.Chapman and Hall.
12. Genetic Engineering –Sandhya Mitra.
13. Biotechnology,IPRs and Biodiversity-M.B.Rao and Manjula garu

**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 phosphatases, S1 nuclease, terminal transferase, topoisomerases, methylases and gyrases. **Molecular vectors** – Properties and Characters of Cloning Vectors. *E. coli* Compatible Vectors - . Plasmids, Bacteriophage derivatives, Cosmids, BACs), yeast (YACs, shuttle vectors) and Algal 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 (18hrs): Cloning and Sequencing of nucleic acids:** Isolation of Desired Gene / Fragment – Genomic DNA Libraries and cDNA Libraries. Screening of Libraries for selection of desired genes. Principles of preparation of DNA probes and their application. Applications of Genomic and cDNA libraries.

**Sequencing Techniques:** Maxam –Gilbert chemical degradation and Sanger’s dideoxy chain termination methods.

**Modification Techniques:** Principle and applications of Polymerase chain reaction (PCR) in recombinant DNA technology, Site Directed Mutagenesis and its applications in Genetic Engineering. Screening techniques - Southern, Northern and Western blotting.

**UNIT – III (17hrs): Molecular Transformation:** Delivery/introduction of recombinant molecules into selected host cells (transformation) - Introduction of Recombinant DNA molecules into appropriate hosts. Bacterial - Competent cells preparation, electroporation. Plant transformation methods – Agrobacterium (the natural genetic engineer, Ti- Plasmid, Agrobacterium mediated) Role of vir-genes in Agrobacterium, microinjection, Other Methods of Transformation: Particle bombardment, Microinjection, PEG mediated and Electroporation. Chloroplast transformation, selection of transformants and its applications.

#### **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 phyto vaccines. Possible Ecological concerns and risks of transgenic crops and animals.

#### **REFERENCES**

1. Principles of Gene Manipulation. 1991. R.W. Old and S.B. Prim-Rose. 2<sup>nd</sup> ed. Blackwell Scientific.
2. Genetic Engineering – Sandhya Mitra
3. Biotechnology, IPRs and Biodiversity – M. B. Rao and Manjula Guru
4. DNA replication, 2<sup>nd</sup> 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, 2<sup>nd</sup> ed. 1994. D. latchman. Sciential Publication.
7. Bacterial and Bacteriophage genetics. 1994. E.A. Birge. Springerscan Publication.

**Programme:** *M. Sc., Biotechnology*  
**Course Title:** *Medical and Pharmaceutical biotechnology*  
**Type of Course:** **Core**  
**Course No.:** 35082  
**Semester:** **III**

### **UNIT-I**

Medical biotechnology- History, Definition, applications and uses of recombinant DNA technology Products like “Insulin, growth factor, factor- VIII, tissue plasminogen activator, interferons, B-cell, Blood products-Erythropoietin”

### **UNIT – II**

Disease Diagnosis - Gene therapy- vector engineering and gene delivery methods, gene replacement, gene augmentation, gene silencing. Current strategies for development of vaccines against HBV, Malaria, Tuberculosis. Role of PCR and RFLP in disease prognosis

### **UNIT – III**

Definition – history of development of pharmaceutical products by biotechnology, scope of biotech products in pharmaceutical industry. Drug designing, drug receptor interactions, antagonism- reversible and irreversible.

### **UNIT-IV**

Vaccines- Genetic recombinant vaccine, recombinant vector based vaccines- live, subunit and their production of Hepatitis-B vaccines, HIV vaccine, pre clinical, toxicological acute, sub acute and chronic studies, types of clinical trials Phase-I, Phase-II and Phase III.

### **BOOKS RECOMMENDED:**

1. Biotechnology by B.D.Singh (Kalyani).
2. Molecular Biology and Biotechnology by Meyers, RA, A comprehensive Desk reference (VCH Publishers).
3. Biotechnology by U. Satyanarayana (Books & Allied (P) Ltd).
4. Biopharmaceuticals-Walsh, John Willey and Sons, New York 1998
5. Pharmaceutical Biotechnology – Daan J.A. Crommelin, Robert D. Sindelar, Daan J.A. Crommelin Amazon. WM
6. Physical Methods to characterize Pharmaceutical Protines- James N. Herron, Wim jishkoor and Daan J.A. Crommelin Amazon. Wm
7. From clone to clinic (Developments in Biotherapy) Daan J.A. Crommelin and H. Schellekom Amazon.Wm
8. Hand Book of Pharmaceutical Biotechnology - Jay P.Rho, Star 4 Ionie The Haworth press, 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: Traditional fermented foods – Curd, yoghurt, dhokla, miso, shrikand, cheese, butter milk, dosa. Modern fermented products – Wine, beer, brandy, vinegar, baker's yeast, sauerkrauts, sausages, fermentation of milk, meat, fruits and vegetables. Types of organisms in food like meat, poultry, sea foods, dairy products, fruits, vegetables and Cereal products.

**UNIT – II (16hrs):** General principles of food preservation; Microbiological standards Scope and importance of food processing. Principles and methods of food preservation-freezing, heating, dehydration, canning, additives, fermentation, irradiation, microwave processing. Juices and concentrates/membrane technology. Storage of food, modified atmosphere packaging. Refrigeration, freezing and drying of food, minimal processing, radiation processing. Food contamination and food borne disease, control and food safety. Food laws and standards,

**UNIT – III (17hrs):** Introduction, to Microbes and enzymes of industrial importance different types of bioreactors and bioreactor design. High fructose corn syrup, Dairy products and Cheese making, Single Cell Protein (SCP) production. Vaccines production, Biofuels, Brewing.

**UNIT – IV(20hrs):**

Biomolecules production – organic acids, amino acids, vitamins, antibiotics, enzymes, alcohols, food flavors,

Pharmaceuticals Applications – vaccines, hormones. Applications of enzymes in industry and medicine; immobilized enzymes – their preparation and applications, Nutraceuticals and their significance

**REFERENCES:**

1. Frazier, W.C., and D.C. Esthoff: Food Microbiology, 4<sup>th</sup> ed., Mc Graw-Hill, New York, 1988.
2. Fermentation : A Practical approach. 1990. B. Mc Neil and L.M. Harvey. IRL Press. PP 226.
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. Industrial Microbiology by Samuel Cate Prescott and Cecil Gordon Dunn
6. Industrial Microbiology by L.E.J.R.Casida

**Practical Course**

1. Manual of Industrial microbiology and biotechnology. 1986. Edited by Arnold L. Demain and Nadine. A. Solomon. PP 466.
2. Vanderzant, C., and D. Splittstoesser. : Compendium of Methods for the Microbiological Examination of Foods, American Public Health Association, Washington, D.C. 1992.

**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, Conventional and Synthetic media for industrial fermentation processes,

**UNIT – III (17hrs):**

Downstream processing – Filtration (batch filters and continuous filters), centrifugation (Continuous Flow method) , 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 Introduction 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 Richardson ,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, Affiliated East West Press Private ltd.

*M. Sc., Biotechnology CBCS syllabus for 2018-21 Approved by Board of Studies*  
**Programme :M.Sc.Biotechnology**  
**Course Title: Introduction to Bioethics in Biotechnology**  
**Course no: Non Core 2.**  
**Semester: III**

**UNIT I:** What is ethics?Definition of bioethics,Principles of Bioethics.Principle of Biosafety,Globalization of Biosafety and Bioethic Issues.

**UNIT II:** Food and Agriculture Organization(FAO),World Health Organization(WHO),United Nations Environment Program(UNEP),International Center for Genetic Engineering and Biotechnology(ICGEB).United Nations Education, Scientific and Cultural Organization,(UNESCO),United Nation Industrial Organization(UNIDO),Global Environmental Facility(GEF)

**UNIT III:** Introduction to international conventions, treaties and agreements on biosafety. Overview of wide application of biotechnology and concerns world wide, ethical. legal and social implications(ELSI) of biotechnology in agriculture, medical environmental.

**UNIT IV:**

Bioethical Issues in Biotechnology, Research and Application, Bioethical Issues on rDNA Technology. Other Scientific Research with Bioethics Considerations. Environmental and Health aspects of Biotechnology.

References

1. Gene Cloning-Brown
2. Concepts in Biotechnology-Balsubramanyam.D
3. Basic Biotechnology-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-SmithJ.E.
7. Molecular Biology and Biotechnology-Meyer R A
8. Biotechnology expanding horizons by B.D. Singh Kalyani Publisher
9. Biological warfare in the 21<sup>st</sup> century by M.R.Dando
10. Intellectual Property Rights in Agricultural Biotechnology by F.H. Erbsich and K.M.Maredia.



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

**UNIT – I (16hrs):** Introduction and History of Plant Biotechnology, Organization of Plant Tissue culture Lab, Sterilization, Media Preparation and different types of media, Instrumentation. concept of totipotency, Dedifferentiation, Redifferentiation, Types of plant tissue culture-Anther culture, Protoplast culture, Embryo culture, Shoot tip, callus and Cell suspension culture. Regeneration- Organogenesis and Somatic Embryogenesis. Acclimatization. Hydroponics and Aero Phonics

**UNIT – II (18hrs):** Plant Genetic Engineering- Gene cloning techniques. Vector mediated or Indirect gene transfer (Agrobacterium-mechanism of T-DNA transfer, Ti and Ri plasmids as vectors), Direct Gene transfer-microinjection, electroporation, particle gun, Chloroplast transformation. Development of Herbicide Resistant, Virus resistant, Pest Resistant and Stress tolerant plants (drought and salt), Identification of transgenic plants. Gene silencing.

**UNIT – III (17HRS):** Laboratory culture of micro algae, Large scale production of microalgae. Marine algae and their products, Edible sea weed and their production. Blue green algal biofertilizers- Azolla, Anabaena. Biofertilizers, Biopesticides.

**UNIT – IV (16HRS):** Introduction to molecular markers, different types-PCR based and Non PCR based, types of maps-physical and genetic map, applications of molecular markers in plant biotechnology. Phytodiagnosics using ELISA and PCR techniques, transgenic plants as biofactories- edible vaccines and plantibodies.

## **REFERENCES**

1. Molecular approaches to crop improvement. 1991. Dennis 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.
7. Plant Biotechnology by A. Slater, N.W. Scott M.R. Fowler (Oxford University Press)

## **Practical Course**

1. Plant cell and Tissue culture. A laboratory manual. 1994. Reinert, J. and yeoman, M.M. Springer
2. Plant Biotechnology by H.S. Chawla



*M. Sc., Biotechnology CBCS syllabus for 2018-21 Approved by Board of Studies*

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

**UNIT – I (16hrs):** Definition and history of animal tissue culture- Equipment and materials (culture vessels, CO<sub>2</sub> incubator, inverted microscope, cell counters and Biosafety Cabinet). Principles of sterile techniques. Sources of tissues, types of tissues - epithelial, muscle, connective, nerve and blood. Cell culture media - components and their functions. Role of serum, Measurement of cell number - hemocytometer, coulter counter. Measurement of cell viability and cytotoxicity.

**UNIT – II (17hrs):** Primary culture – Mechanical and enzymatic mode of desegregation, establishment of primary culture. Subculture - passage number. Cell lines - maintenance and preservation of cell lines. Contamination - bacterial, viral, and fungal, detection and control, cell transformation – normal vs. transformed cells, Scale-up of animal cell culture –Batch reactor, continuous culture.

**UNIT – III (18hrs):** Cloning - concept of nuclear transfer, and creation of Dolly. In vitro fertilization in cattle. Embryo culture, embryo transfer in farm animals. Stem cells - embryonic and adult stem cells. Transgenic animals - retroviral, microinjection, and engineered embryonic stem cell method of transgenesis. Application of transgenic animals - biopharming, disease models, functional knockouts mice.

**UNIT – IV (16HRS).**

Aquaculture- fresh water fish culture practices and types. Freshwater prawn culture. Brackish water fish, shrimp and crab culture practices. 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.

**Referencee:**

1. Culture of Animal Cells, (3<sup>rd</sup> 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 projects- Human, Arabidopsis, Rice, *C. elegans* and Zebra fish. Whole genome analysis: Preparation of ordered cosmid libraries, bacterial artificial chromosome libraries, short gun libraries. cDNA libraries: Preparation of 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, Next Generation Sequencing (NGS)

**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. **QTL:** Quantitative traits loci (QTL) and its applications.

**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. Gene expression analysis: Global pattern of gene expression using fluorescent labeled cDNA or end labeled RNA probes, Real Time PCR and its applications. Applications of DNA and cDNA chips. **Genome Editing Technologies:** CRISPR technology principle, methodology and applications in crop improvement.

**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 EcoTILLING,. TILLING vs EcoTILLING. Application of biodiverse lines in EcoTILLING. Application of EcoTILLING in superior gene discovery. **RNA interference (RNAi):** Introduction to miRNA, siRNA, RNAi. Mechanism of RNAi and its applications. **Metagenomics:** Introduction to Metagenomics: Concept of metagenomics and its application in novel gene discovery.

## REFERENCES

1. DNA replication, 2<sup>nd</sup> 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. Humana 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. Adolph, 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):Introduction to Bioethics**, Intellectual property rights – Definition – types of patents, copy rights and trade marks. IPR, Pan-Co-operation treaty (PCT), Positive and negative aspects of Biotechnology. Legal and Ethical aspects of Biotechnology.

**UNIT – II (17hrs):**– Prenatal diagnosis – Genetic screening – Surrogate mothers. gene therapy – cloning, Technology transfer. Social impacts and socioeconomic aspects of Biological weapon. Ethics and Biosafety consideration in Bioremediation.

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

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

#### **REFERENCES**

1. Gene cloning – Brown
2. Concepts in Biotechnology – Balasubramanyam.D
3. Basic Biotechnology – 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 21<sup>st</sup> century by M.R.Dando
10. Intellectual Property Rights in Agricultural Biotechnology by F.H. Erbisch and K.M. Maredia.

## **PRACTICAL SYLLABUS**

**Programme:** M. Sc., Biotechnology

**Course Title:** *Cell Biology, Genetics and Biomolecules*

**Type of Course:** Practical

**Course No.:** 15081P

**Semester:** I

1. Karyotyping, transduction, study of mutations by Ames test
2. Chromosomal aberrations
3. Mitosis and Meiosis – fresh and Permanent
4. Polytene chromosomes – Drosophila and Chironomes larvae
5. Instrumental methods for Cell biology
6. Subcellular fractionation and marker enzymes
7. Histochemical techniques
8. Estimation of protein by Lowry / Bradford method
9. Estimation of carbohydrates
10. Estimation of aminoacids
11. Estimation of lipids
12. Estimation of Vitamins, Hormones and Vitamins
13. Analysis of oils –Iodine number, Saponification value and Acid Value
14. Estimation of DNA by DPA method

**Programme:** M. Sc., Biotechnology

**Course Title:** *Microbiology and Microbial Genetics and Biochemical and Biophysical Techniques*

**Type of Course:** Practical

**Course No.:** 15082P

**Semester:** I

1. Sterilization techniques
2. Preparation of culture media
3. Isolation and maintenance of organisms by plating, streaking and serial dilution methods.
4. Slants and stab culture storage of microorganisms
5. Isolation of pure culture from soil, water and air
6. Growth , Growth curve, measurement of bacterial population by turbidity and serial dilution methods
7. Effect of temperature, pH, carbon and Nitrogen sources on growth of microorganisms
8. Microscopic examination of bacteria, yeast and molds – fresh preparation and permanent slides
9. Study of organisms by Gram stain, acid fast stain and staining of spores
10. Assay of antibiotics and domestication of antibiotic resistance
11. Bacterial conjugation
12. Biochemical characterization of soil microbes, one step growth curve of coliphage

13. Bacterial phage culture

14. Separation techniques-Centrifugation and Chromatography - TLC, paper

**Programme: M. Sc., Biotechnology**

**Course Title: Molecular Biology and Computer Applications & Biostatistics**

**Type of Course: Practical**

**Course No.: 25081P**

**Semester: II**

1. Isolation of genomic DNA from plant, animal and microbes
2. Isolation of RNA from plant, animal and microbes
3. Estimation of DNA and RNA by agarose gel electrophoresis and spectrophotometry
4. Isolation of plasmid DNA from *E.coli*
5. Biostatistics problems
6. Hand on experience in handling biostatistics softwares
7. General Bioinformatics Websites
8. Introduction to databases and uses
9. Extraction of gene of interest from databases
10. Primer designing for desired gene
11. Introduction to sequence analysis software , Internet access to software and databases
12. Nucleic acid sequence analysis - detecting ORFs, Gene prediction, codon usage, editors, sequence assembly
13. Sequence Alignment and applications - Pair wise and multiple

**Programme: M. Sc., Biotechnology**

**Course Title: Immunology and Enzymology**

**Type of Course: Practical**

**Course No.: 25082P**

**Semester: II**

1. Instrumental training in Biochemistry and Immunology
2. Blood grouping / Typing
3. Double diffusion and Immuno electrophoresis
4. ELISA
5. Rocket and radial Immuno electrophoresis
6. Haemagglutination
7. Hapten conjugation quantisation
8. Immunodiagnostics
9. Blood film preparation and identification of cells (Differential cell counting)
10. Purification of Ig G from serum
11. Methods for immobilisation of enzymes
12. Effect of Enzyme activity ( Amylase on starch)
13. Determination of Alpha amylase activity
14. Effect of ph on Enzyme activity
15. Effect of Temperature on Enzyme activity
16. Methods for immobilisation of enzymes
17. Enzyme isolation from various tissues and different methods for protein precipitation

**Programme: M. Sc., Biotechnology**

**Course Title: Genetic engineering and Medical and Pharmaceutical Biotechnology**

**Type of Course: Practical**

**Course No.: 35081P**

**Semester: III**

1. Total genomic DNA isolation from plants
2. Restriction enzyme analysis of genomic DNA
3. Preparation of competent cells - calcium chloride method
4. Bacterial Transformation
5. Plasmid isolation from *E.coli*
6. Restriction mapping of Plasmid
7. Colony PCR
8. Bacterial transformation
9. Fragment isolation and ligation
10. Selection of recombinants (Blue / white selection)
11. Total protein isolation, SDS PAGE / Native PAGE and Western Blotting
12. Sterilization By Autoclaving And Test For Sterility
13. Sterilization By Dry Heat And Test For Sterility
14. Sterilization By Heating With Bactericide And Test For Sterility
15. Test For Presence Of Fungi In Tap Water
16. Immobilization Of Microbial Cells By Entrapment In Sodium Alginate
17. Bioinformatic software-Hex
18. Bioinformatic software -Rasmol
19. Drug Receptor interactions (Molecular docking)
20. DNA Finger printing for disease diagnosis

**Programme: M. Sc., Biotechnology**

**Course Title: Food and Industrial Biotechnology and Bioprocess Technology**

**Type of Course: Practical**

**Course No.: 35082P**

**Semester: III**

1. Media preparation and sterilization (plant and microbe)
2. Isolation of industrially important microorganisms from different sources
3. Development of inoculums for industrial fermentation (Bacterial and mycelial)
4. Recovery and purification of fermentation products
5. Preparation of wine
6. Production of citric acid
7. Design of a fermentor
8. Types of bioreactors
9. Design of a typical aerobic fermenter
10. Preservation of industrially important microorganisms
11. Isolation of amylase producing microorganism from soil
12. Lethal effects of temperature on microorganisms (TDP)



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13. Lethal effects of temperature on microorganisms (TDT)
14. Effects of pH on different microorganisms
15. Cell suspension culture for production of secondary metabolites

**Programme: *M. Sc., Biotechnology***

**Course Title: *Plant Biotechnology and Animal Biotechnology***

**Type of Course: Practical**

**Course No.: 45081P**

**Semester: IV**

1. Instrumentation in Plant and Animal Biotechnology laboratory
2. Preparation of different types of culture media
3. Sterilization techniques
4. Inoculation techniques - embryo, shoot tip, axillary buds, leaves, nucellus, organ, anther
5. Development of callus and suspension cultures
6. Preparation of Artificial seeds
7. In-vivo and in-vitro seed germination techniques
8. Training for Acclimatization
9. Plant transformation
10. Screening of transgenics
11. Animal cell culture and characteristics
12. Staining and viability testing of Animal cells
13. Media preparation and membrane filtration
14. Preparation of single cell suspension from spleen and thymus

**Programme: *M. Sc., Biotechnology***

**Course Title: *Functional Genomics and Bioethics and Biosafety***

**Type of Course: Practical**

**Course No.: 45082P**

**Semester: IV**

1. Restriction digestion - RFLP (Restriction Fragment Length Polymorphism) analysis
2. RNA isolation
3. cDNA synthesis
4. cloning of desired gene
5. construction of cDNA library
6. Analysis of manual sequencing Gel
7. PCR techniques - RAPD (Rapidly Amplified Polymorphic DNA)
8. SSR (Simple Sequence Repeats) analysis
9. Primer designing for desired gene
10. Concept of TILLING
11. Biosafety rules and Regulations for transgenics and GMO,s
12. Patenting- Examples of patents in Biotechnology

**M. Sc., Degree Examination (Biotechnology) Model Paper**

**BT ----: Title of paper**

(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

Answer any five questions. Each question carries three marks **5 x 3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

- 1.
- 2.
- 3.
- 4.
- 6.
- 7.
- 8.

**PART B**

**4 x 15 = 60**

- |     |   |           |    |
|-----|---|-----------|----|
| 9.  | } | Unit -I   | or |
| 10. |   |           |    |
| 11. | } | Unit -II  | or |
| 12. |   |           |    |
| 13. | } | Unit -III | or |
| 14. |   |           |    |
| 15. | } | Unit -IV  | or |
| 16. |   |           |    |

**MODEL QUESTION PAPER**

**M.Sc. Degree Examinations, November 2008**

**First Semester**

**Biotechnology**

**Paper 15081: Cell Biology and Genetics**

**Time ; 3 Hours**

**Max. Marks:75**

(No additional sheet will be supplied)

**PART A**

Answer any five questions.

Each question carries three marks

Each Answer should not exceed **one** page

5 X 3= 15 Marks

1. Cell theory
2. Microtubules
3. Nucleolar organizing region
4. Linkage
5. Cytokinesis
6. Cell adhesion
7. Aneuploidy
8. Cell cycle

**PART B**

**4x15=60**

9. Write in detail principle of centrifugation? Give its applications in cell biology?  
Or
10. What is the medium that separate the cell from the external environment? Explain its models and give its functions?
11. What are peroxisomes? Explain in detail their role in plant metabolism  
Or
12. What is chromatin? What are different forms of chromatin? Give its molecular organization and functions?
13. Explain the laws of Mendelian inheritance? Explain non-mendelian inheritance and deviations of Mendelian laws?  
Or
14. What are mutations? Explain mutagens and their molecular mechanism causing mutations? Give its applications in breeding?
15. Meiosis and its molecular events? Explain its significance?  
Or
16. Define Oncogenesis and explain about the process and impediments leading to this phenomenon?

**M. Sc., Degree Examination (Biotechnology) Model Paper**

**Paper 15082: Biomolecules**

**Time ; 3 Hours**

**Max. Marks:75**

(No additional sheet will be supplied)

**PART A**

Answer any five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

1. Peptide Bonding
2. Nucleoside and Nucleotide
3. Plant Growth Regulators
4. Ribose Puckering
5. Secondary metabolites
6. DNA binding proteins
7. Modified Nucleotides
8. Cytochromes

**PART B**

**4X15=60**

9. Write about the methods involved in identification of DNA and RNA as a genetic material?

Or

10. Define DNA&RNA Explain about structural polymorphism of DNA and RNA  
11. Explain the formation and classification of polysaccharides?

Or

12. Define chemical Bond, write about Non-covalent interactions.  
13. Write about structures and classification of Amino acids. Add a note on their properties.  
14. What are vitamins? Write about structures and functions.  
15. What are pigments, describe few biological pigments and their significance?

Or

16. Define and explain in detail about alkaloids, terpenes and its biological importance

**Paper 15083: Microbiology and Microbial Genetics**

**Time ; 3 Hours**

**Max. Marks:75**

(No additional sheet will be supplied)

**PART A**

Answer any five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

1. Bacteriophages
2. Virioids
3. Nucleus structure
4. Fermentation
5. Rec proteins
6. Phototrophy
7. C-value
8. Recon and muton

**PART B**

**4X15=60**

9. Describe five kingdom classifications of microbes?

Or

10. How microbes are classified on the basis of their growth, Temp, pH, and O<sub>2</sub> requirement?

11. What is a synchronus culture? How is synchrony obtained in the culture

Or

12. How the microbes will be controlled, explain principle & mechanism of physical & chemical agents to control it?

13. Describe the cell growth and regulation. Explain the role of cyclins?

Or

14. What is complementation ? Discuss complementation test along with 3 examples.

15. Describe the role of usage of microorganisms in Biotechnology for useful purpose, write a note on limitations of usage of microorganisms?

Or

16. Explain briefly about different gene transfer mechanisms in bacteria and viruses and explain in detail about bacterial conjugation?

**M.Sc. DEGREE EXAMINATIONS**  
**FIRST SEMESTER**  
**Biotechnology**

**Paper 15084: Biochemical and Biophysical Techniques**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART- A**

Answer *any Five* questions.

**5x3=15 Marks**

Each question carries *Three (3)* marks .  
Each answer should not exceed *One (1)* pages.

1. Beer – Lambert’s law.
2. Reverse dialysis
3. Native PAGE
4. Lyophilization
5. Partition Coefficient
6. Sedimentation Coefficient
7. Safety Measures in handling radio isotopes
8. TLC or GM Counter

**PART- B**

**4X15=60 Marks**

Answer *ALL* questions.

Each question carries *Fifteen (15)* marks .  
Each answer should not exceed *Six (6)* pages.

9. a. Explain the Principle involved in Phase-contrast microscope?  
b. State the procedure for preparation of specimen for microscopy.  
Or
10. a. Write short notes on Centrifugal force & Principle of sedimentation.  
b. Explain Rate zonal centrifugation, Equilibrium density gradient centrifugation.
11. Explain the terms of stationary phase, mobile phase and effective distribution coefficient.  
Or
12. Write the principle of affinity chromatography and describe the procedure with a clear flow chart
13. How is NMR is different than X – Ray diffraction and describe the principle of NMR spectroscopy and describe its applications  
Or
14. Write the principle of fluorescence spectroscopy and its applications
15. What is meant by concentration of macro molecules? Explain with any of the methods and write the applications of radioactivity in biological sciences.  
Or
16. Write a specific nuclear reaction example for alpha, beta, and gamma decay

**M. Sc., Degree Examination (Biotechnology) Model Paper**

**Paper Paper 25081: Molecular Biology**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

Answer any five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

1. SOS repair
2. Promoters and enhancers
3. Lac Operon
4. RNA polymerase
5. tRNA structure
6. Transcription factors
7. Helicases
8. Repressor and Inducer

**PART B**

**4X15=60**

9. Describe the salient features to distinguish DNA replication in *E.coli* and eukaryotic DNA replication?

Or

10. Explain the different methods of DNA repair mechanisms.

11. Discuss the role of following in eukaryotic gene expression? A) Alternative splicing of mRNA b) Capping and polyadenylation of mRNA

Or

12. Explain the mechanism of transcription initiation, elongation and termination in eukaryotes

13. Explain mechanism by which newly synthesized proteins are transported to various organelles?

Or

14. Write in detail about different steps involved during translation process in prokaryotes

15. Explain how the gene expression is regulated in prokaryotes

Or

16. Explain hormonal regulation of genes in plants and animals?

**YVU M. Sc., Biotechnology syllabus Proposed for 2018-21(CBCS)**  
**M. Sc., Degree Examination (Biotechnology) Model Paper**

**Paper 25082: Computer Applications and Biostatistics**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

Answer any five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

1. Primary Databases
2. BLAST and FASTA
3. Domains and Motifs
4. Clustal W and Clustal X
5. What is a scatter diagram? Give an example
6. Write about type-I and type – II errors
7. When do you use ANOVA? Give an example.
8. Write a note on Excel to handle statistical data.

**PART B**

**4X15=60**

9. In which databases would you find the following type of data? Where are these databases located?
- a) The DNA sequence corresponding to human hydrofolate productase gene
  - b) The protein sequence of the gene listed in (a)
  - c) The structure of this protein
  - d) Metabolic pathway effected by this protein

Or

10. What is the difference between pairwise and Multiple alignment? How is the score and E value derived in BLAST ?
11. What are databases, mention different types and functions of these databases, implications of these databases in genomics and proteomics?

Or

12. Write a note on virtual library and bibliographic database giving some example?
13. What are various measures of central tendency? Write the method of working out the median of a data.
14. Calculate the Median of. Body length of an animal (in cms) from the following data.

Length	Less than 10	10-20	20-30	30-40	40-50	50 and above
No,. of animals	6	15	21	9	4	3

15. Explain in detail (i) Conditional probability and (ii) Random variable (iii) Geometric curve

Or

16. Describe Normal distribution and state its properties and applications in Biostatistics.



**YVU M. Sc., Biotechnology syllabus Proposed for 2018-21(CBCS)**  
**M. Sc., Degree Examination (Biotechnology) Model Paper**

**Paper 25083: Immunology**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

Answer any five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

1. Interferons
2. Major histocompatibility complex
3. Rocket immune electrophoresis
4. Isohaemagglutinins
5. Antigenic determinants and haptens
6. T-lymphocytes
7. Blood groups
8. ELISA

**PART B**

**4X15=60**

9. Explain different cells and organs of immune system?  
Or
10. Explain different modes of immunity?
11. What are monoclonal antibodies and give and account of the production and application of monoclonal antibodies ?  
Or
12. Antigen presentation by MHC Class II molecules is important for the development of an antibody response. Explain Why?
13. Write about serological test in liquid and agar gel media?
14. Enzyme linked immune sorbent assay?  
Or
15. What is hypersensitivity explain about type I, II, and III hypersensitivity?  
Or
16. Write about auto immune diseases?

**M. Sc., Degree Examination (Biotechnology) Model Paper**

**Paper 25084::Enzymology**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

Answer any five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

1. Fisher lock and Key Hypothesis / Koshland Induced Fit hypothesis
2. Lineweaver burk Plot
3. Competitive and Non competitive Inhibition
4. Immobilization of Enzymes
5. Spectrophotometry
6. What is enzyme specificity? Write about Fischer hypothesis.
7. Write about ligand protein interaction.
8. Explain about the significance of double-reciprocal plot.

**PART B**

**4X15=60**

9. To what major classes do the following enzymes belong: alkaline phosphatase, trypsin, Thrombin, esterase, RNA polymerase, Eco RI, helicase, DNA Topo Isomerase. Explain in detail about RNA Polymerase?

Or

10. How is the activity of enzyme measured and expressed and what is the relation between 1 Unit of Enzyme activity and one katal?

11. Explain about different inborn errors in metabolism and give a brief account on sickle cell anaemia and phenylketonuria?

Or

12. Describe the methods used to study the enzyme activity?

13. State different techniques used in extraction and purification of enzymes and give a brief account on chromatography?

Or

14. Write a note on Hills coefficient and Scatchard plot?

15. What are isoenzymes? Explain the significance of Isoenzymes with the help of suitable example?

Or

16. Describe the biotechnological uses of enzymes

**YVU M. Sc., Biotechnology syllabus Proposed for 2018-21(CBCS)**  
**M. Sc Degree Examination (Biotechnology) Model Paper**

**Paper 35081:: Genetic Engineering**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

Answer any Five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

1. YAC
2. Phytovaccines
3. Restriction FLP
4. Bacterial transformation
5. Polymerase chain reaction (PCR)
6. Ti Plasmid
7. cDNA synthesis
8. Bacteriophages as vectors

**PART B**

**4X15=60**

9. Discuss in detail about different molecular vectors used in cloning?  
Or
10. Write about the different enzymes necessary for cloning and explain the mechanism of molecular cloning strategy
11. Explain the agrobacterial mediated gene transformation into plants  
Or
12. Discuss the particle bombardment technique for the chloroplast transformation and explain the advantages over nuclear transformation
13. Write in detail about the construction of cDNA libraries  
Or
14. Explain the different DNA sequencing methods
15. Discuss about the applications of genetic engineering in the field of agriculture, medicine and industry  
Or
16. Explain the national and international guide lines and ethics for developing transgenics?

**YVU M. Sc., Biotechnology syllabus Proposed for 2018-21(CBCS)**  
**M. Sc., Degree Examination (Biotechnology) Dec, 2013.**

**Paper 35082: Medical and Pharmaceutical Biotechnology**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

Answer any Five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

- 1) Receptors and ion channels
- 2) Antagonisms
- 3) Biopesticides
- 4) FDA
- 5) B-Cell growth factors
- 6) Placebo
- 7) Gene Replacement
- 8) Hepatitis B vaccine

**PART B**

**4X15=60**

- 9) Define drug explain the methods involved in drug designing  
Or
- 10) Write the definition, history and development of pharmaceutical products.
- 11) Write about the conventional and rapid enzyme inhibitor techniques  
Or
- 12) Define clinical trials explain steps involved in it
- 13) What are vaccines? Write about the r-DNA based vaccines  
Or
- 14) write an account of biotech products that have medical and pharmaceutical importance
- 15) Explain gene therapy& its vectors based system in detail  
Or
- 16) Write an account of various strategies used in gene delivery

**YVU M. Sc., Biotechnology syllabus Proposed for 2018-21(CBCS)**  
**M. Sc., Degree Examination (Biotechnology) Model Paper**

**Paper 35083: Food and Industrial Biotechnology**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

Answer any five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

1. Brewing
2. Food preservation
3. Vermiculture
4. Bio fuel cell
5. Bioleaching
6. Blue green algae
7. Alginates
8. Microbial toxins

**PART B**

**4x15=60**

9. Describe different methods used for preservation of food?  
Or
10. Write a note on large scale cultivation of edible mushrooms?
11. Explain in detail the pathway of nitrogen fixation in plants and mention the role of different enzymes in the pathway?  
Or
12. What are biofertilizers? Describe the techniques of preservation of biofertilizers?
13. What are SCP? Explain the method of large scale production of SCP?  
Or
14. Describe in detail the role of microbes in Bioremediation?
15. Explain the bioprocess for the production of antibiotics?  
Or
16. Describe biodegradation of waste products with respect to microbes?

*YVU M. Sc., Biotechnology syllabus Proposed for 2018-21(CBCS)*  
**M. Sc., Degree Examination (Biotechnology) Model Paper**

**Paper 35084: Bioprocess Technology**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

Answer any five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

1. Microbial mass
2. Antibiotics
3. Vitamins and Hormones
4. Whole cell Immobilisation
5. Air Lift Fermentor
6. Continuous culture
7. Affinity chromatography
8. Single cell protein

**PART B**

**4x15=60**

9. Explain the different stages involved in setting up a fermentation reaction with an appropriate example?

Or

10. Explain the different steps involved in purification and recovery of fermentation products?

11. Write a note on isolation, preservation and improvement of industrially important microorganisms?

Or

12. Explain what is batch and continuous culture ? State their advantages and disadvantages?

13. What is whole cell immobilization and write a note on its industrial application?

Or

14. Explain in detail about treatment and disposal of effluents?

15. Explain how monoclonal antibodies are produced using animal cell culture?

Or

16. Animal cells lack cell walls. Explain how this effects our ability to grow them in fermentors designed for the growth of microorganisms?

**YVU M. Sc., Biotechnology syllabus Proposed for 2018-21(CBCS)**  
**M. Sc., Degree Examination (Biotechnology) Model Paper**

**Paper 45081: Plant Biotechnology**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

**Answer any five questions. Each question carries three marks 5x3= 15**  
**Each Answer should not exceed 1 page**  
**Answer all questions at one place**

1. Totipotency
2. Haploid culture
3. Ti-plasmid
4. Plants as Bioreactors
5. Herbicide resistance
6. Biofertilizers
7. PCR
8. Male sterility

**PART B**

**4X15=60**

9. Describe in detail about the architecture of plant genome?  
Or?
10. Define somatic embryogenesis? Explain the different factors affecting the process of Somatic Embryogenesis?
11. Explain the different methods of plant transformation methods?  
Or
12. What are viral antigens? Explain the production of viral antigens through plant genetic engineering
13. Discuss in detail about the regulation of nif genes involved in nitrogen fixation  
Or
14. What are single cell proteins? Describe the production of single cell proteins?
15. What are molecular markers? Describe the different classes of molecular markers?  
Or
16. What are physical and genetic map? Explain in detail how they are constructed?

**M. Sc., Degree Examination (Biotechnology) Model Paper**

**Paper 45082: Animal Biotechnology**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

**Answer any five questions. Each question carries three marks 5x3= 15**  
**Each Answer should not exceed 1 page**  
**Answer all questions at one place**

1. Hemocytometer
2. Artificial rearing
3. microinjection
4. Primary culture
5. Cytotoxicity
6. PDT
7. Batch reactor
8. Cell counters

**PART B**

**4X15=60**

9. What are the basic constituents of animal cell culture media? Describe the importance of each constituent?  
Or
10. Explain in detail about the equipment and materials required to set up animal cell culture lab?
11. Describe in detail about the detection of different bacterial, viral, fungal and mycoplasma contaminations in maintaining cell lines?  
Or
12. What is Scale-up of animal cell culture? Discuss about the different factors to be considered in Scale-up of suspension and continuous cultures
13. What are stem cells? Describe the different types of stem cells and its application?  
Or
14. Explain the different gene transfer techniques in animals and describe about microinjection methods?
15. Discuss in detail about the applications of animal cell culture?  
Or
16. What is seri culture? Explain the role of biotechnology in silk production?



*YVU M. Sc., Biotechnology syllabus Proposed for 2018-21(CBCS)*  
**M. Sc., Degree Examination (Biotechnology) Model Paper**

**Paper 45083: Functional Genomics**

(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

Answer any five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

- 1) Model Organisms
- 2) Polymorphism
- 3) antisense RNA
- 4) chemical method of sequencing
- 5) Real time PCR
- 6) RFLP
- 7) SSR
- 8) DNA chips

**PART B**

**4x15=60**

- 9) What is Genome project? Explain in brief about human genome project and its applications in human health?  
Or
- 10) What are ESTs? Explain in brief, their generation and application in genomics?
- 11) What is a marker? Explain different kinds of markers and their applications in plant and animal biotechnology?  
Or
- 12) What are physical and Genetic maps? Explain their advantages and disadvantages?
- 13) What are microarrays and how are they constructed? Give its applications?  
Or
- 14) Explain in brief about the method of yeast two hybrid system? Give its practical applications in elucidation of gene function?
- 15) What is RNAi? Discuss in detail about the role of RNAi in gene silencing?  
Or
- 16) Explain in detail about the TILLING and its applications

**YVU M. Sc., Biotechnology syllabus Proposed for 2018-21(CBCS)**  
**M. Sc., Degree Examination (Biotechnology) Model Paper**

**Paper 45084: Bioethics and Biosafety**  
(No additional sheet will be supplied)

**Time : 3 Hours**

**Max. Marks : 75**

**PART A**

Answer any five questions. Each question carries three marks **5x3= 15**

Each Answer should not exceed 1 page

Answer all questions at one place

1. Surrogate mother
2. TRIPS
3. Intellectual property rights
4. GMO
5. Cartagena protocol
6. GATT
7. Trademarks
8. Aspect of biological weapon

**PART B**

**4x15=60**

9. Intellectual Property rights?

Or

10. Explain briefly The Cartagena Protocol and Biological Weapons ?

11. Write critical notes on patenting of life forms with examples?

Or

12. Indian Patent Act?

13. Write in detail on bio safety guidelines and regulations for release of GMO in India and Europe?

Or

14. WTO, Procedure of filing patents & Examples of patents in biotechnology?

15. Introduction of novel species and natural equilibrium?

Or

16. Write notes on role of Biotechnology in increased yield in agriculture?