



PERIYAR UNIVERSITY

PERIYAR PALKALAI NAGAR

SALEM – 636011

**DEGREE OF MASTER OF SCIENCE
CHOICE BASED CREDIT SYSTEM**

**SYLLABUS FOR
M.SC. BIOTECHNOLOGY
(SEMESTER PATTERN)**

**(For Candidates admitted in the Colleges affiliated to
Periyar University from 2017-2018 onwards)**

REGULATIONS

1. ELIGIBILITY

A candidate who has passed a Bachelor degree in Science with Biotechnology / Botany / Zoology / Biology / Microbiology / Microbial Gene technology / Bioinstrumentation / Bioinformatics / Biochemistry / Chemistry / Agriculture / Marine Biology / Home Science / Farm Science / Nutrition and Dietetics / Integrated Biology / Plant Science / Animal Science / Fisheries Science / Aquaculture / Mathematics with Physics, Chemistry as Ancillary / Medical Lab Technology / MBBS / BDS / B. Pharm / BSMS of this University or any of the above degree of any other University accepted by syndicates as equivalent thereto, subject to such conditions as may prescribed therefore shall be permitted to appear and qualify for the M. Sc., Biotechnology Degree Examination of this University after a course of study of two academic years.

2. DURATION OF THE COURSE

The course for the degree of Master of Biotechnology shall consist of two academic years divided into four semesters. Each semester consist of 90 working days.

3. MAXIMUM DURATION FOR THE COMPLETION OF THE PG PROGRAMME

The maximum duration for completion of the PG Programme shall not exceed 8 semesters.

4. TRANSITORY PROVISION

Candidates who were admitted to the PG course of study before 2017-18 shall be permitted to appear for the examinations under those regulations for a period of three years i.e., up to and inclusive of the examination of April/May 2020. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

COURSE OF STUDY AND SCHEME OF EXAMINATION

Course	Subject Title	Ins. Hrs/Week	Credit	University Examination			Total Marks
				Hours	Internal (25%)	External (75%)	
I SEMESTER							
Core - I	Cell and Molecular Biology	5	5	3	25	75	100
Core - II	Biological Chemistry	5	5	3	25	75	100
Core - III	Microbiology	5	5	3	25	75	100
Elective - I		5	4	3	25	75	10
Core - IV	Practical I -Lab in Cell and Molecular Biology & Biological Chemistry	5	3	6	40	60	100
Core - V	Practical II -Lab in Microbiology	5	3	6	40	60	100
	Total	30	25				600
II SEMESTER							
Core - VI	Immunology and Immunotechnology	5	5	3	25	75	100
Core - VII	Genetic Engineering	5	5	3	25	75	100
Elective - II		5	4	3	25	75	100
EDC	Course selected from other department	3	4	3	25	75	100
Common Paper	Human Rights	2	2	3	25	75	100
Core - VIII	Practical III- Lab in Immunology and Immunotechnology	5	3	6	40	60	100
Core -IX	Practical IV- Lab in Genetic Engineering	5	3	6	40	60	100
	Total	30	26				700

Course	Subject Title	Ins. Hrs/Week	Credit	University Examination			Total
				Hours	Internal (25%)	External (75%)	
III SEMESTER							
Core - X	Plant Biotechnology	5	5	3	25	75	100
Core - XI	Animal Cell Science and Technology	5	5	3	25	75	100
Core - XII	Bioprocess Technology	5	5	3	25	75	100
Elective - III		5	4	3	25	75	100
Core - XIII	Practical V- Lab in Plant Biotechnology & Animal cell Science and Technology	5	3	6	40	60	100
Core - XIV	Practical VI- Lab in Bioprocess Technology	5	3	6	40	60	100
	Total	30	25				600
IV SEMESTER							
Core - XV	Research Methodology and Bio statistics	5	5	3	25	75	100
Elective - IV		5	4	3	25	75	100
Core - XVI	Dissertation / Viva Voce	20	5		40	60	100
	Total	30	14				300
	Grand Total	120	90				2200

List of Elective Course: Select any one from each semester

Semester	Course	Elective Course Title
I	I	Biophysics and Bioinstrumentation
	II	Food and Agricultural Biotechnology
II	I	Genomics and Proteomics
	II	Pharmaceutical Biotechnology
III	I	Bioinformatics, IPR, Bioethics & Biosafety
	II	Plant and Animal physiology
IV	I	Environmental Biotechnology and Nanotechnology
	II	Bio-Entrepreneurship

List of Extra Disciplinary Course: (To be selected by other department students)

1. Applied Biotechnology
2. Concepts of Biotechnology
3. Microbial Technology

Marks Distribution Pattern:

a) Theory examination

Internal Maximum Marks: 25

(Attendance-5 Marks; Assignment-5 Marks;
Seminar-5 Marks; Test-10 Marks)

External Maximum Marks: 75

b) Practical examination

Internal Maximum Marks: 40

External Maximum Marks: 60

c) Project

Maximum Marks: 100

Dissertation- 80 Marks

2 Reviews- 20+20 = 40 Marks

Report Valuation = 40 Marks

Viva Voce - 20 Marks

Passing minimum:

S.NO.	Examination	Internal Marks	External Marks	Aggregate of Internal and External Marks
1	Theory	12	38	50
2	Practical	20	30	50
3	Project	20	30	50

There is no passing minimum for record note book. However submission of a record notebook is a must.

Question paper pattern (Theory)

Duration of Examination: Three Hours

Maximum: 75 marks

Section A (5×5 =25)

Answer all the questions

Two question from each unit with internal choice

Section B (5×10 =50)

Answer all the questions

Two question from each unit with internal choice

Note to questions paper setters

All units in the syllabus should be given equal weightage; key and scheme of valuation should be provided.

Question paper pattern (Practical)

Duration of Examination: 6 Hours

Maximum: 60 marks

1. Major Experiment - 20 Marks (1x20 Marks)
2. Minor Experiment - 10 Marks (1x10 Marks)
3. Spotters - 20 Marks (5x4 Marks)
4. Record - 5 Marks
5. Viva Voce - 5 Marks

M.Sc. BIOTECHNOLOGY
SEMESTER - I
CORE I - CELL AND MOLECULAR BIOLOGY

UNIT I

Structure and function of prokaryotic and eukaryotic cell; Structure and organization of cell membrane – membranes model, Glyco conjugates and proteins in membrane; Membrane dynamics-Active and passive transport; Cell adhesion and cell junctions; Cytoskeleton.

UNIT II

Structure and function of cell organelle: Mitochondria and Chloroplast- Molecular events of electron transport chain, ATP synthesis, photosynthesis and photorespiration, Endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes.

UNIT III

Nucleosomal structures; Cell cycle- Mitosis and Meiosis, Regulation of cell cycle. Molecular events of recombination. Cellular and viral oncogenes and tumor suppressor genes. Cell signaling – types of cell signaling - G protein mediated, Tyrosine kinase mediated signaling. Apoptosis.

UNIT IV

DNA replication-Prokaryotic and Eukaryotic; DNA repair mechanism; Prokaryotic and eukaryotic transcription – RNA polymerase, transcriptional factors, Regulatory elements and mechanism. RNA processing-rRNA, tRNA, mRNA-cap, polyadenylation. Splicing, RNA editing.

UNIT V

Translation -Prokaryotic and eukaryotic translation machinery, Regulation of translation, co-and post-translational modifications. Vesicular transport and protein import into cell organelles- Mitochondria, chloroplast and nucleus.

REFERENCES:

1. Benjamin Lewin. (2004). Genes VIII, 6th Edition, Pearson Prentice Hall.
2. Darnell, Lodish, Baltimore. (1996). Molecular Cell Biology, 3rd Edition, Scientific American Books, Inc.
3. Gerald Karp. (2009). Cell and Molecular Biology, 6th Edition, John Wiley & Sons, Inc.
4. Alberts, Bruce et al. (2002). Molecular Biology of the Cell, 4th Edition, Garland Science, Taylor & Francis.
5. Cooper GM and Hausman RE. (2007). The Cell-A molecular approach, 4th Edition, Sinauer Associates Inc.USA.

M.Sc. BIOTECHNOLOGY
SEMESTER - I
CORE II - BIOLOGICAL CHEMISTRY

UNIT I

Chemical foundations of Biology: pH, pK, acids, bases and buffers, Henderson-Hasselbalch Equation, biological buffer solutions. Concept of free energy: Principles of thermodynamics; Kinetics, dissociation and association constants; energy rich bonds and weak interactions; Coupled reactions; group transfer; biological energy transducers.

UNIT II

Carbohydrates- classification, chemical nature, properties and biological importance. Carbohydrate metabolism: Glycolysis, TCA cycle, Glycogenesis, Glycogenolysis, Gluconeogenesis, interconversion of hexoses and pentoses.

UNIT III

Amino acid- classification, chemical nature, properties. Biosynthesis of amino acids. Catabolism of amino acids. Peptides. Primary, secondary, tertiary and quaternary structures of proteins; Ramchandranplot in protein structure validation and purification, X-ray crystallography.

UNIT IV

Lipids- classification, chemical nature, properties. Biosynthesis of fatty acids- Triglycerides, phospholipid, sterols. Oxidation of fatty acids. Nucleic acid chemistry, Purines and pyrimidines biosynthesis.

UNIT V

Enzymology: Enzyme Nomenclature; Enzyme kinetics (negative and positive cooperativity); Ordered and ping pong mechanism; Regulation of enzymatic activity; Enzyme catalysis. Active sites; Enzymes and coenzymes: Coenzymes interactions, activators and inhibitors, kinetics of enzyme inhibitors, isoenzymes, allosteric enzymes.

REFERENCES:

1. Donald Voet, Judith G Voet. (2010). Biochemistry, 4th Edition, John Wiley & Sons, Inc.
2. Robert K Murray, Darryl K Granner, Peter A Mayes, Victor W Rodwell. (2012). Harper's Illustrated Biochemistry, 29th Edition, McGraw-Hill Professional.
3. Geoffrey L Zubay. (1993). Principles of Biochemistry, 3rd Edition, Wm.C. Brown Publishers.
4. David Lee Nelson, Michael M Cox. (2008). Lehninger Principles of Biochemistry, 5th Edition, MacMillan Works Publisher.
5. Jeremy Mark Berg, John L Tymoczko, Lubert Stryer (2006). Biochemistry, 6th Edition, W. H. Freeman.
6. Trevor Palmer. (2001). Enzymes: Biochemistry, Biotechnology and Clinical Chemistry, 5th Edition, Horwood Publishing Limited.
7. Sathanarayana U and Chakrapani. U. (1995). Essentials of Biochemistry, 2nd Edition.

M.Sc. BIOTECHNOLOGY
SEMESTER - I
CORE III - MICROBIOLOGY

UNIT I :

History and development of microbiology. Microscopy- bright field, dark field, phase contrast, confocal and Electron. Ultrastructure of microbes- Bacteria, fungi, algae and viruses. Bergy's system of classification. Molecular systematic classification.

UNIT II

Culture media and their types. Isolation and pure culture techniques. Colony morphology and growth. Microbial Growth-Growth curve, mathematical expression of growth, measurement of growth. Synchronous culture and Continuous culture. Factors affecting microbial growth.

UNIT III

Nutritional requirements and types of microorganisms, Uptake of nutrients by microorganisms. Photosynthetic microorganisms. Nitrate and sulfur oxidizing bacteria, Nitrate and sulfate reducing bacteria. Nitrogen fixation. Hydrocarbon transformation. Role of microorganism in agriculture, food and dairy industry.

UNIT IV

Host – parasite relationship, normal microflora. Infection types and mode of disease transmission. Causative agent, pathogenesis and control measures of typhoid, cholera, tuberculosis, AIDS, hepatitis, malaria and candidiasis. Antimicrobial agents and their mode of action – antibacterial, antiviral, antifungal, antiparasitic agents.

UNIT V

Mutation and Mutagenesis: UV and chemical mutagens; Types of mutation; Ames test for mutagenesis. Plasmids and Transposons. Methods of genetic analysis – Transformation, Conjugation, Transduction. Bacterial genetic maps with reference to E. coli, viruses and their genetic system – Phage life cycle, Genetic systems of yeast and Neurospora.

REFERENCE BOOKS

1. Pelczar MJ, Chan ECS, and Krieg NR. (2006). Microbiology, 5th Edition, Tata McGraw Hill Publishing Company.
2. Prescott LM, Harley JP and Klein DA. (2005). Microbiology, 6th Edition, McGraw Hill.
3. Talero KP and Talero A. (2002). Foundations in Microbiology, 4th Edition, McGraw Hill.
4. Benson HJ. (1999). Microbiological Applications: A Laboratory manual in General Microbiology, 7th Edition, McGraw Hill.
5. Salle AJ. (1986). Principles of bacteriology, 7th Edition, Tata McGraw-Hill Publishing Company Ltd. New Delhi.
6. Modi HA. (1995). Elementary Microbiology (Volume- 1 Fundamentals of Microbiology). Akta Prakashan Nadiad Publication.
7. Freifelder D. (1995). Microbial Genetics, Narosa Publishing House.
8. Maloy SR, Cronan JE and Freifelder D. (1994). Microbial Genetics, 2nd Edition, Jones Barlett Publishers.
9. Cappuccino JG and Sherman N (1996). Microbiology - A Laboratory Manual, 5th Edition, Editors: Wirth AE and Olsen L. nology: concepts, applications and perspectives, Wiley VCH publishers.

M.Sc. BIOTECHNOLOGY
SEMESTER - I
CORE IV

**PRACTICAL I: LAB IN CELL AND MOLECULAR BIOLOGY &
BIOLOGICAL CHEMISTRY**

CELL AND MOLECULAR BIOLOGY

1. Measurement of cell size by micrometry
2. Identification of mitotic phases from onion root tip.
3. Identification of meiotic phases from grass hopper testis
4. Observation of Giant Chromosomes (Polytene-Chironomous larva)
5. Identification of Sex Chromatin (Barr Body) from human epithelial cell

BIOLOGICAL CHEMISTRY

1. Preparation of Buffers
2. Calibration of pH meter
3. Estimation of glucose (DNS method)
4. Estimation of DNA (Diphenylamine)
5. Estimation of RNA (Orcinol)
6. Estimation of Protein (Lowry's and Bradford Methods)
7. Extraction and Estimation of starch from potato/ tapioca
8. Separation of amino acids by Paper and Thin layer chromatography
9. Qualitative analysis of carbohydrate
10. Qualitative analysis of amino acids.

M.Sc. BIOTECHNOLOGY
SEMESTER - I
CORE V

PRACTICAL II: LAB IN MICROBIOLOGY

1. Handling of Microscopes
2. Preparation of liquid and solid media
3. Isolation and pure culture of microorganisms from soil and water - Serial dilution method, Plating and Streaking.
4. Maintenance of Microorganisms –Agar slant
5. Staining methods – Simple staining, differential staining-Acid fast, Endospore ; LCB mount.
6. Motility of bacteria by hanging drop method.
7. Cultural characteristics of microorganisms on Basal medium, Selective medium, Differential medium, Enriched medium, Enrichment medium.
8. Biochemical characterization of Bacteria – Catalase test, oxidase test, sugar fermentation, IMVIC, urease test, TSI test, starch hydrolysis.
9. Growth - Growth curve, Measurement of bacterial population by turbidometry, haemocytometry and serial dilution methods.
10. Antibiotic sensitivity test by Kirby- Bauer disc diffusion method
11. Determination of water potability by MPN method
12. Spontaneous mutation by gradient plate technique
13. Induced mutagenesis (UV, NTG)
14. Detection of mutants by replica plate technique
15. Study of mutation by Ames test

M.Sc. BIOTECHNOLOGY
SEMESTER - II
CORE VI - IMMUNOLOGY AND IMMUNOTECHNOLOGY

UNIT I :

History and scope of immunology; Types of immunity - Innate and adaptive; Haematopoiesis and the cells of immune system; Organs of immune system- Structure and function of Primary and secondary lymphoid organs.

UNIT II

Antigens: properties and classes, haptens, mitogens, adjuvants and epitopes. T cell receptors- its organization and role in antigen recognition; MHC-general organization, antigen processing and presentation. T-cell: maturation, activation and differentiation; B-cell: maturation, activation, proliferation and differentiation; Clonal selection and immunological memory.

UNIT III

Immunoglobulin: Structure, classes, properties and functions; Organization and expression of immunoglobulin genes; Antigen- antibody interactions: Principles and applications of Precipitation and agglutination reaction, RIA, ELISA, Immunofluorescent microscopy; FACs. Hybridoma technology: monoclonal antibody production. Antibody engineering.

UNIT IV

Cytokines: properties, structure and functions; Cytokine receptors; Therapeutic uses of cytokines and their receptors. Complement system: properties, activation pathways-classical, alternative and lectin. Transplantation: immunological basis of graft rejection and immunosuppressive therapy, immunological tolerance, clinical transplantations, molecular aspects of HLA typing.

UNIT V

Hypersensitivity reactions-Type I, II, III and IV. Autoimmune disorders- types, mechanism and treatment. Immune response to infectious diseases. Tumor immunology and cancer immunotherapy; Vaccines: Immunization schedule, traditional and novel strategies in designing vaccines.

REFERENCE BOOKS

1. Goldsby RA, Kindt TJ, Osborne BA, Kuby J. (2003). Immunology, 6th Edition, W.H. Freeman & Co. New York.
2. Kuby J. (2000). Immunology, 4 th Edition, W.H. Freeman & Co. New York.
3. Benjamini E, Coico R and Sunshine G. (2000). Immunology, 4th Edition, John Wiley & Sons, Inc.
4. Tizard IR. (1995). Immunology, 4th Edition. Saunders College Publishing Harcourt Brace College Publishers.
5. Ivan Riot and Peter I Delvis. (2004). Essentials of Immunology, 10th Edition, Blackwell Scientific Publications, Oxford
6. Abul K Abbas, Andrew H Litchman. (2004). Basic Immunology: Functions and disorders of the immune system, 2nd Edition, Elsevier Publications.
7. Gerd Rudiger Burmester and Antonio Pezzuto. (2003). Color Atlas of Immunology, Thieme Stuttgart, New York
8. Gabriel Virella. (1998). Introduction to Medical Immunology, 4th Edition, Marcel Dekker. Inc. New York
9. William E and Md. Paul. (2003). Fundamentals of Immunology, 5th Edition, Lippincott William and Wilkins Publishers.
10. Myron M. Levine, James B Kaper, Rino Rappuoli, Margret A Liu, Michael F Good. (2004). New Generation Vaccines, 3rd Edition, Marcel Dekker, Inc. New York.
11. Rajasekara Pandian M and Senthilkumar B. (2007). Immunology and Immunotechnology. Panima Publishing Corporation, New Delhi. n L. nology: concepts, applications and perspectives, Wiley VCH publishers.

M.Sc. BIOTECHNOLOGY
SEMESTER - II
CORE VII - GENETIC ENGINEERING

UNIT I:

History of genetic engineering. Enzymes in Genetic engineering – Restriction enzymes, DNA polymerase- Klenow, DNA polymerase I, T4 DNA polymerase, Taq DNA polymerase, BstI polymerase; Reverse transcriptase, terminal transferase, polynucleotide kinase, alkaline phosphatase, DNA ligase, Nucleases –Bal 31, S1 nucleases, DNase I, Mungbean nucleases, Ribonuclease, EXO III.

UNIT II

Bacterial vectors- pBR322 and pUC vectors; Phage vectors – Lambda, M13, Cosmid and Phagemid; Artificial chromosomes – YAC, BAC, PAC, HAC; Expression vectors and Shuttle vectors. Plant vectors- Ti and Ri; Animal virus derived vectors- SV40, Vaccinia, Retro viral vectors. Host strain for transformation.

UNIT III

Cloning strategies – Construction of recombinant molecule- Linkers, Adaptors, homopolymer tailing; TA cloning, gateway cloning. Bacterial transformation- Principle and methods. Gene library construction- Genomic and cDNA libraries. Screening and analysis of recombinants- radiolabeled and non radiolabeled probes, Blotting techniques- Southern/ Northern/ Western. Immunological screening of expressed genes. PCR and types; Site directed mutagenesis.

UNIT IV

Expression strategies - Gene Expression in *E. coli*, *Saccharomyces cerevisiae*, *Schizosaccharomyces*, Expression in insect cells, higher eukaryotic system – Tet On/Off systems. Processing recombinant protein- purification and refolding, characterization of recombinant proteins, stabilization of proteins; Phage display.

UNIT V

Molecular mapping of genome-Genetic and physical maps, physical mapping and map based cloning. Molecular marker linked to disease resistance genes. DNA finger printing- SNPs, VNTRs and microsatellites. Recombinant Products: blood products, vaccines, interferon, interleukins and therapeutic proteins.

REFERENCE BOOKS

1. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th Edition, Blackwell Publishing Co., USA.
2. Joseph Sambrook and David W Russell. (2001). Molecular Cloning – A laboratory Manual, Volume 1 to 3, 3rd Edition, Cold Spring Harbor Laboratory Press, New York.
3. Ernst L Winnacker. (2003). From Genes to Clones, Panima Publishing Co. Bangalore
4. Brown TA. (2007). Gene Cloning and DNA Analysis: An Introduction, 7th Edition, Wiley Blackwell.
5. Reece RJ. (2004). Analysis of Genes and genomes, John Wiley and Sons Ltd., USA.
6. James D Watson, Richard M Myers, Amy A Caudy, Jan A Witkowski. (2006). Recombinant DNA, 3rd Edition, W.H Freeman & Company, New York.
7. Micklos DA, Freyer GA and Crotty DA. (2005). DNA Science, IK International Private limited, New York.

M.Sc. BIOTECHNOLOGY
SEMESTER - II
CORE VIII

**PRACTICAL III: LAB IN IMMUNOLOGY AND
IMMUNOTECHNOLOGY**

1. Study on Blood Cells
Identification of blood cells
Differential count of white blood cells
Separation of mononuclear cells from Human peripheral blood
2. Preparation of specimen for Immunology
 - a) Preparation of serum
 - b) Preparation of plasma
 - c) Preparation of blood antigens
3. Agglutination test
 - a) ABO Blood grouping
 - b) Widal test for typhoid fever (qualitative and quantitative test)
 - c) Haemagglutination test
4. Passive agglutination test
 - a) Anti - Streptolysin O (ASO) test
 - b) C-reactive protein (CRP) test
 - c) Rheumatoid arthritis (RA) test
5. Agglutination inhibition test - Pregnancy test for detection of HCG
6. Flocculation test - Rapid Plasma Reagin Test (RPR)
7. Precipitation test
 - a) Ouchterlony's Double Immunodiffusion Technique (ODD)
 - b) Counter Current Immunoelectrophoresis (CIE)
 - c) Immuno Electrophoresis (IE)
 - d) Radial Immuno Diffusion (RID)
 - e) Rocket Immuno Electrophoresis (RIE)

M.Sc. BIOTECHNOLOGY
SEMESTER - II
CORE IX
PRACTICAL IV: LAB IN GENETIC ENGINEERING

1. Isolation of genomic DNA from bacteria and animal tissue & Detection in AGE
2. Isolation of plasmid DNA & Detection in AGE
3. Determination of molecular weight of Nucleic acids by Gel Doc.
4. Screening of Bacteriophages.
5. Isolation of Lambda phage DNA
6. Quantification of DNA by UV spectrophotometer.
7. Restriction digestion
8. Ligation
9. Bacterial Transformation.
10. Bacterial Conjugation
11. Amplification of DNA - PCR.

M.Sc. BIOTECHNOLOGY
SEMESTER - III
CORE X - PLANT BIOTECHNOLOGY

UNIT I:

History of plant tissue culture. Concept of totipotency. Application of plant tissue culture- Agriculture, horticulture, forestry, cryopreservation, germ plasm conservation. Design of Plant tissue culture laboratory. Nutritional requirements of plant tissue culture. Composition of MS media, Gamborgs media, Nitchs media, Whites media and their preparation. Plant growth regulators. Sterilization techniques.

UNIT II

Plant micro propagation- micro grafting, advantages of hairy root culture and culturing of meristem and shoot tip. Establishment and maintenance of callus and suspension culture. Somatic embryogenesis-Synthetic seeds.

UNIT III

Haploid plant production - Anther and microspore culture, triploid production, embryo culture and embryo rescue. In vitro pollination and fertilization. Protoplast isolation – fusion and culture regeneration. Somatic hybrids and cybrids. Somaclonal and gametoclonal variation.

UNIT IV

Plant genome organization. Role of RFLP in plant breeding. DNA barcoding in plants. Transposable elements in plant. Plant transformation technology: Ti and Ri plasmids, binary & co-integrated vector systems; viral vectors and their applications; 35S and other promoters; genetic markers; reporter genes; virulence genes; Cloning Strategies; Gene transfer methods in plants – Direct DNA transfer methods, Agrobacterium mediated gene transfer.

UNIT V

Application of gene transformation in plant: Insect resistance, fungus resistance, virus resistance, drought, cold resistance, saline resistance, Transgenic plant with vitamin A, Gene silencing in crop plants, Terminator seed technology, Production of therapeutic antibodies, edible vaccine. Extraction of secondary metabolites using plant tissue culture.

REFERENCE BOOKS

1. Hammond J, McGarvey P and Yusibov V. (2000). Plant Biotechnology, Springer verlag.
2. Satyanarayana U. (2005). Biotechnology, Books and Allied (p) Ltd.
3. Bhojwani SS and Razdan MK. (2004). Tissue Culture Theory and Practice.
4. Paul Christou and Harry Klee. (2004). Hand Book of Plant Biotechnology Vol.I & II, John Wiley & Sons.
5. Guptha PK. (1996). Elements of Biotechnology, Rastogi and Co. Meerut.
6. Chawla. HS. (1998). Biotechnology in crop improvement, International Book.
7. Slater, Scott and Fowler. (2003). Plant Biotechnology (The genetic manipulation of plants), Oxford University, UK.

M.Sc. BIOTECHNOLOGY
SEMESTER - III
CORE XI - ANIMAL CELL SCIENCE AND TECHNOLOGY

UNIT I:

Structure, organization and physiology of animal cells. History, Scope and applications of animal cell culture- Advantages and limitations. Types of animal cell culture. Biology of cultured cells. Animal cell culture Laboratory-Design and layout, Equipment and materials.

UNIT II

Culture vessels and substrate. Preparation and sterilization of media and supplements. Physicochemical properties of medium. Balanced salt solution, complete media and its biochemical ingredients. Selection of medium and serum. Serum free media. Aseptic practices in animal cell culture.

UNIT III

Basic techniques of animal cell culture invitro, disaggregation of tissue and primary culture, subculture and establishment of cell line, Cloning and selection, Cell separation, Characterization, Differentiation, Transformation and immortalization, Quantification of cell culture. Scale-up and cell synchronization.

UNIT IV

Cytotoxicity: Viability, toxicity and survival assay. Cryopreservation and cell banks. Organotypic culture and histotypic culture, tissue engineering and its application. Stem cell culture and its application.

UNIT V

Invitro fertilization (IVF), Embryo transfer and test tube babies. Transgenic Animals: Production Methodology-Embryonic Stem Cell method, Microinjection method; Applications of transgenic animals in therapeutic protein production and live stock improvement. Cell culture based vaccine. Somatic cell genetics.

REFERENCE BOOKS

1. Freshney RI. (2005). Culture of animal cells: A manual of basic techniques, 5th Edition, John Wiley and Sons.
2. John R W Masters. (2000). Animal cell culture, 3rd Edition, Oxford University Press.
3. Migel J. (2005). Animal cell Biotechnology- Methods and Protocols, Humana press.
4. Florence PR. (2006). Animal Biotechnology, Dominant Publishers and Distributors.
5. Sandy Primrose, Richard Twyman and Bob Old. (2001). Principles of Gene Manipulation, 6th Edition, Blackwell Science Ltd. p: 174-319.
7. Ranga MM. (2006). Animal Biotechnology.

M.Sc. BIOTECHNOLOGY
SEMESTER - III
CORE XII - BIOPROCESS TECHNOLOGY

UNIT I :

Principles of Fermentation technology, Isolation and Screening of industrial important microbes-Primary and secondary. Detection and assay of fermentation products. Strain improvement. Culture preservation and stability, Fermentation-Submerged, solid state and immobilization of Enzymes & Cells.

UNIT II

Media formulation. Sterilization. Thermal death kinetics. Batch and continuous sterilization systems. Sterilization of air. Fibrous filter. Bioreactor design, parts and their functions, Alternative vessel designs - CSTR, Tower, Airlift, Loop jet, Bubble Column, Packed bed.

UNIT III

Mass transport phenomena in Bioprocess: Mass transfer, Mass transfer coefficient for gases and liquids. Dimensionless groups. Mass transfer resistance. Rate of oxygen transfer. Determination of oxygen transfer coefficients. Biological properties of medium. Biological heat transfer. Heat transfer coefficients.

UNIT IV

Bioprocess control and monitoring process variables such as temperature, agitation, pressure, pH. On line measurement. On/Off control. PID control. Control systems, Computer control Fermentation process- Data analysis.

UNIT V

Downstream Processing – Disruption of Microbial Cells, Centrifugation, Filtration of Fermentation Broths, Ultrafiltration, Liquid-Liquid Extraction, Chromatography - Ion Exchange, Molecular Sieve, Affinity, HPLC. Distillation, Fluid Extraction & Electro dialysis.

REFERENCE BOOKS

1. Michael L Shuler Fikret Karg. (2001). Bioprocess Engineering Basic concepts, 2nd Edition, Prentice Hall International services.
2. EMT El-Mansi and CF A Bryce. (2002). Fermentation Microbiology and Biotechnology, Taylor & Francis.
3. Wulf Crueger and Anneliese Crueger. (2000). Biotechnology-A Textbook of Industrial Microbiology, 2nd Edition, Panima Publishing Corporation New Delhi.
4. Peter F Stanbury, Allan Whitaker, Stephen J Hall. (2007). Principles of Fermentation Technology, 2nd Edition, Elsevier Science Ltd.
5. Pauline M. Doran. (2006). Bioprocess Engineering Principles, Elsevier.
6. Juan AA senjo. (2007). Separation Process in Biotechnology, Taylor & Francis group.
7. Patel AH. (2005). Industrial Microbiology, Mac Millan India Ltd, New Delhi.

M.Sc. BIOTECHNOLOGY
SEMESTER - III
CORSE XIII

**PRACTICAL V: LAB IN PLANT BIOTECHNOLOGY & ANIMAL
CELL SCIENCE AND TECHNOLOGY**

Plant Biotechnology

1. Preparation of media.
2. Sterilization Techniques.
3. Organ cultures.
4. Callus induction, organogenesis, transfer of plants, hardening process.
5. Protoplast isolation and culture.
6. Anther and pollen cultures - production of haploids.
7. Isolation of plant DNA
8. Agrobacterium induction reporter gene (GUS) assay - Demo

Animal cell science and technology

1. Preparation of tissue culture media and membrane filtration.
2. Preparation of single cell suspension from spleen and thymus.
3. Cell counting and cell viability.
4. Preparation chicken embryo fibroblast culture (monolayer).
5. Trypsinization of monolayer and sub-culturing.
6. Embryonated egg inoculation.

M.Sc. BIOTECHNOLOGY
SEMESTER - III
CORE XIV

PRACTICAL VI: LAB IN BIOPROCESS TECHNOLOGY

1. Isolation of Amylase and protease producing organisms from soil.
2. Isolation of antibiotic producing microbes from soil.
3. Culture optimization (pH, Temperature, Carbon & Nitrogen sources).
4. Production and assay of amylase and protease by submerged fermentation.
5. Production and assay of amylase and protease by solid-state fermentation.
6. Bioassay of Antibiotics.
7. Microbial production of citric acid using *Aspergillus niger*.
8. Immobilization of cells for enzyme production.
9. Alcohol production by yeast fermentation and its estimation.
10. Purification of enzymes by salting and dialysis and column chromatography technique.

M.Sc. BIOTECHNOLOGY

SEMESTER - IV

CORE XV- RESEARCH METHODOLOGY AND BIOSTATISTICS

UNIT I :

Definition- Objectives- Types- Significance of Research- Steps in research process- Criteria for good research. Defining and formulating a research problem- Literature survey- Development of working hypothesis.

UNIT II

Research design: Definition and related concepts, Basic principles of experimental designs- Informal and formal experimental designs; Sampling design: Steps in sample design, Non-probability sampling and Probability sampling -random sampling; Measurement and scaling techniques- Methods of data collection - Execution of project -Processing and analysis of data- Hypothesis testing - Interpretation and report writing- Steps and layout of research report- Types of report and presentation.

UNIT III

Sampling techniques & errors- Diagrammatic and graphical representation of data- Measure of central tendency (Mean, median and mode) - Measure of dispersion: Variance & Standard deviation- Skewness & Kurtosis.

UNIT IV

Correlation and regression: Types- Methods- Significance and uses. Chi square test- Characteristics & applications- Test of goodness of fit, test of independence and test of homogeneity.

UNIT V

Test of significance- Hypothesis testing, level of significance- Student 't' test (one tailed & two tailed tests) - Analysis of Variance (One way and two way ANOVA), Analysis of covariance, Multivariate analysis. Statistical software: SPSS, Epi info, Biplot analysis.

Note: Question paper setters- Problem 50% and Theory 50% should be asked from Unit III, IV & V

REFERENCE BOOKS

1. Kothari CR. (2010). Research Methodology: Methods and techniques, 2nd Edition, New age International Publishers
2. Gurumani N. (2006). Research Methodology for Biological Science, MJP Publishers, Chennai.
3. Lee T. (2007). Introductory Biostatistics, Wiley – Interscience Publishers.
4. Stephen W Looney. (2002). Statistical methods, Humana publications.
5. Gerald Van belle. (1993). Biostatistics: A Methodology for the Health Sciences, 2nd Edition. Wiley – Interscience publication
6. Khan and Khanum. (2004). Fundamentals of Biostatistics, Ukaaz Publications
7. Daniel WW. (1983). Biostatistics- A foundation for health Sciences, John Wiley Publications.
8. Jerrold H Jar. (2009). Biostatistical analysis, 5th Edition, Pearson Publications.

**M.Sc. BIOTECHNOLOGY
SEMESTER -I****ELECTIVE I – PAPER I****BIOPHYSICS AND BIOINSTRUMENTATION****UNIT I :**

Scope and methods of Biophysics. Various bonding: structure and properties of water. Understanding various structure of proteins, globular and fibrous protein; protein stability; protein folding. The physics of nucleic acids: Forces stabilizing structures; Double helical structures; properties; helix – coil; transitions.

UNIT II

Spectroscopy Techniques: Beer-Lamberts law, UV- Visible, Raman and IR Spectroscopy. Theory and application of Circular Dichroism. Fluorimetry and its types. Fluorescence, NMR, PMR, ESR and Plasma Emission spectroscopy. Mass spectrometry-Matrix Assisted Laser Desorption Ionization and Surface Enhanced Laser Desorption Ionization.

UNIT III

Centrifugation: Basic principles- RCF, Sedimentation coefficient, Types of centrifuges, Preparative & Analytical centrifugation.

Chromatography Techniques: Principle and applications of Paper, Thin layer, LPCC, HPLC, Affinity, Gel permeation and Ion exchange chromatography.

UNIT IV

Electrophoretic techniques: Principle and applications of Poly acrylamide gel electrophoresis, Capillary electrophoresis, Isoelectric focusing, 2D Electrophoresis, Disc gel electrophoresis, Gradient electrophoresis, Pulsed field gel electrophoresis and Agarose gel electrophoresis.

Radiation Biophysics: Basic concept and measurement of radioactivity. Radioisotope techniques – GM Counter, Liquid scintillation and Solid scintillation counter.

UNIT V

Physical Biomedical method of Imaging techniques, Intact biological structures -X-ray, CAT, SCAN, ECG, EEG. Autoradiography, X ray crystallography, Photography, ultrasound, MRI, Angiography.

REFERENCE BOOKS

1. Voet D & Voet JG. (1995). Biochemistry, 2nd Edition, John Wiley & Sons.
2. John Webster. (2004). Bioinstrumentation, John Wiley & Sons.
3. Veerakumari. (2006). Bioinstrumentation, 1st Edition, MJP Publishers.
4. James D Watson Hopkins, Roberts NH. (1987). Molecular Biology of the Gene, The Benjamin/Cumminngs Publishing Company, New York.
5. Zubay GL. (1993). Biochemistry, 4th Edition, WmC.Brown Publishers.
6. Bryan W & Keith W. (1975). A Biologist guide to principles and techniques of practical biochemistry
7. Wilson K & Walker J. (1995). Practical Biochemistry, 5th Edition, Cambridge University Press.

M.Sc. BIOTECHNOLOGY

SEMESTER - I

ELECTIVE I - PAPER II

FOOD AND AGRICULTURAL BIOTECHNOLOGY

UNIT I:

Constituents of food and dietary sources of food – Carbohydrates, Lipids, Proteins, Water, Vitamins and Minerals. Extrinsic and intrinsic factors of food that affect microbial growth. Principles and methods of food preservation: Asepsis removal, High temperature, Low temperature, Drying, Irradiation , Chemical and Biopreservatives.

UNIT II

Food and beverage yeast: Bread, Alcoholic beverages-wine, beer. Dairy products – cheese. Meat, poultry and fish products. Vegetable and fruit products- Sauerkraut, Pickles. Microbial Pigments, SCP-bacteria, algae and fungi. Probiotics and prebiotic. Feed Additives: Monensin, phytases, carbohydrases, proteases, lipases, pectinase, xylanases, cellulase, Beta glucanase.

UNIT III

Raw material characteristics; cleaning, sorting and grading of foods; physical conversion operations - mixing, emulsification, extraction, filtration, centrifugation, membrane separation, crystallization, heat processing. Food sanitation, food control agencies and their regulations. Safety evaluation of novel food products.

UNIT IV

Microbes based Biofertilizers: Azolla and Anabena, Rhizobium, Azotobacter, Azospirillum, Mycorrhiza. Biochemistry of nitrogen fixation, Nif genes. Biopesticide – Trichoderma, Bt and NPV. Plant growth regulators from soil microbes.

UNIT V

Transgenic plants in quality modifications –Starch, Oil, Protein, and Golden Rice. Plants derived vaccines, flower modification and color. Advantages and applications of transgenic plants. Current status of transgenics, Biosafety norms and controlled field trails and release of transceincs (GMO).

REFERENCE BOOKS

1. Byong H Lee. (2016). Fundamentals of food Biotechnology, 2nd Edition, Wiley - Blackwell
2. Ravishankar Rai V. (2016). Advances in Food Biotechnology, Wiley- Blackwell
3. Kalidas shetty . (2005). Food Biotechnology, Taylor & Francis group.
4. Kumar HD. (2005). Agricultural Biotechnology, Daya Publishing house.
5. Rajmohan joshi. (2006). Agricultural Biotechnology, Isha Books, Delhi.
6. Ahindra Nag. (2008). Text book of Agricultural Biotechnology, PHI Learning Private Limited, New Delhi.

M.Sc. BIOTECHNOLOGY
SEMESTER - II
ELECTIVE II - PAPER I
GENOMICS AND PROTEOMICS

UNIT I

Genome study: Genetic Mapping-Markers for genetic mapping; RFLP, SSLP-VNTR's, STR's, SNP's; Physical Mapping: In situ hybridization, Sequence Tagged sites mapping and DNA data bases.

UNIT II

Determination of nucleotide sequence: Chemical degradation method, Sanger's dideoxynucleotide synthetic method. Direct DNA sequencing using PCR, Sequencing by conventional shotgun method, Whole genome shot gun method, Clone contig method. Next generation sequencing.

UNIT III

ORF scanning: Codon bias, Exon-Intron boundaries-Exon trapping and CpG island. Gene location: Southern and Northern blotting hybridization and Zoo blotting. Transcriptome analysis- Microarray or chip- Data analysis, SAGE. Organization of genome projects- human, plant, animal and microbial genome.

UNIT IV

Proteomics: DNA polymorphisms as expressed in proteomes. Protein profiling, 2DGE, multidimensional chromatography, Quantitative Mass spectrometry- Peptide mapping, N & C terminal sequencing, and analytical protein chips-computational pattern, recognition of proteomes- protein networks and pathway. Protein structure prediction- homology modeling, fold recognition, comparison of 3D structures of protein, protein data banks.

UNIT V

Protein- protein interaction- domain fusion, gene neighbors, sequence homology, phylogenetic information and hybrid methods. Active site determination of enzymes; design of enzyme inhibitors- drug response. Application of proteomics in disease diagnosis -Biomarker, drug development and their target identification.

REFERENCE BOOKS

1. Ajoy Paul. (2011). Text Book of Genetics- from Genes to Genomes, 3rd Edition, Books and Allied (P) Ltd, Kolkata.
2. Keith Wilson and John Walker. (2010). Principles and techniques of practical biochemistry, 7th Edition, Cambridge University Press.
3. Sathayanarayana U. (2008). Biotechnology, Books and Allied (P) ltd., India.
4. Hubert Rehn. (2006). Protein Biochemistry and Proteomics, Academic Press.
5. Liebler Humana. (2002). Introduction to proteomics: Tools for new Biology, W.CBS Pub.,
6. Apweiler R. (2000). Protein sequence databases, Adv. Protein Chem. 54: 31-71.
7. Pearson WR. (1996). Effective protein sequence comparison, Methods Enzymol., 266: 227-258.
8. Spang R and Vingron M. (1998). Statistics of large scale sequence searching. Bioinformatics. 14: 279-284.
9. Baker D and Sali A. (2001). Protein structure prediction and structural genomics, Science, 294: 93-96.
10. Stekel D. (2003). Microarray bioinformatics, Cambridge University Press, Cambridge, UK.
11. Huynen MA, Snel B, Mering C and Bork P. (2003). Function prediction and protein Networks, Curr. Opin. Cell Biol., 15: 191-198.
12. Twyman RM. (2004). Principles of proteomics, York: Garland Science/Bios Scientific Publishers.

M.Sc. BIOTECHNOLOGY

SEMESTER II

ELECTIVE II - PAPER II

PHARMACEUTICAL BIOTECHNOLOGY

UNIT I

Introduction to Pharmaceutical Biotechnology and Drug discovery. Drug targets- Structure and functions; Physiochemical properties of drugs; drugs from natural sources. Pharmacodynamics, pharmacokinetics and drug metabolism. Screening and isolation of bioactive compounds.

UNIT II

Adverse response to drugs, Drug tolerance, Drug intolerance, drug allergy, drug induced side effects. Tachyphylaxis, biological effects of drug abuse and drug dependence, vaccination against infection, factor that modifies the effect of drug. Assay of drug potency- bioassay and immunoassay.

UNIT III

Protein mode of action and pharmacodynamics- Overview of the mode of action of a biopharmaceutical Pre-clinical studies- -Toxicity (Reproductive toxicity and Teratogenicity, Mutagenicity, Carcinogenicity and Other tests); Clinical trials - Clinical trial design, Trial size design and study population.

UNIT IV

Biopharmaceutical and biological drug development, Manufacturing of biopharmaceutical, therapeutic proteins and peptides. Recombinant growth hormones, growth factors, therapeutic monoclonal antibodies, therapeutic enzymes and their application in health care.

UNIT V

Role and remit of regulatory authorities- The Food and Drug Administration (FDA), Investigational new drug application, New drug application; European regulations- National regulatory authorities, European medicines agency and the new EU drug approval system, Centralized procedure, Mutual recognition, Indian drug regulations & pharmacopeia.

REFERENCE BOOKS

1. Gary Walsh. (2007). Pharmaceutical Biotechnology-Concepts and Applications, John Wiley & Sons Ltd.,
2. Laurence Brunton, Bruce A Chabner, Bjorn Knollman. (2013). Goodman & Gillman's. The Pharmacological Basis of Therapeutics, 12th Edition, McGraw-Hill Education.
3. Roop K Khar, Vyas SP, Farhan J Ahmad, Gaurav K Jain. (2013). Lachman/Liebermans: The Theory and Practice of Industrial Pharmacy, 4th Edition, CBS Publishers and Distributors.
4. Barar FSK. (2013). Textbook of Pharmacology, 1st Edition, S. Chand Publishing.

M.Sc. BIOTECHNOLOGY

SEMESTER - III

ELECTIVE III - PAPER I

BIOINFORMATICS, IPR, BIOETHICS & BIOSAFETY

UNIT I

Biological Databases: Nucleic Acid sequence Databases: Genbank, NCBI, EMBL, DDBJ; Protein Sequence Databases: Swiss Prot, PIR; Structural Data Bases: PDB, CATH, SCOP and specialized databases.

UNIT II

Tools for Bioinformatics: Pairwise alignment –Dotplots –scoring matrices –Blosum Matrices –PAM Matrix –Gap Penalty Alignment Algorithms: Needleman –Wunsch Global Alignment Algorithm ; Smith –Waterman Local Alignment Algorithm. Genome aligners- BLAST, MUMmer, WABA, Glass, Dialign, Avid, LAGAN and Multi LAGAN. Protein gene prediction method-ORF finder, restriction analysis, secondary structure prediction. Homology modeling and drug designing.

UNIT III

Introduction to IPR, WTO, GATT, TRIPS, WIPO – Establishment and function. Intellectual property Rights, definition and types. Patent, trademark, trade secret, copyright. Geographical indication and industrial design. Patents in Biotechnology. Plant Breeders and farmer rights. Patenting in India: Indian patent act.

UNIT IV

Bioethics- Ethical, Legal & Social Issues of Biotechnology. National & International issues on Genetic modification & recombinant DNA technologies, Release of GMO's in environment, Human embryonic cloning & stem cell research, transgenic plants and animals.

UNIT V

Biosafety-Introduction to biosafety and health hazards concerning biotechnology. Introduction to the concept of containment level, General guidelines for rDNA research. Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP).

REFERENCE BOOKS

1. David R Westhead, J Howard parish and Richard M Twyman. Instant Notes- Bioinformatics, Viva Books Private Limited, Chennai.
2. Sillince JA and Sillince M. (1991). Molecular databases for protein sequence and structure studies, Springer Verlag.
3. Gribskov M, Devereux J. (1989). Sequence analysis, Primer Stockton Press.
4. Seizberg DB searls, S.Kasif. (1998). Computational methods in Molecular biology now comprehensive Biochemistry, Vol 32.S.L Elsevier.
5. Garfield LI. (1992). Information theory and living systems, Columbia University Press.
6. Recombinant DNA safety guidelines, Department of Biotechnology, Ministry of Sciences & Technology, Government of India.
7. Recombinant DNA safety guidelines & regulation, Department of Biotechnology, Ministry of Sciences & Technology, Government of India.
8. Revised guidelines for research in transgenic plants Department of Biotechnology, Ministry of Sciences & Technology, Government of India.
9. Radhakrishnan R and Balasubramanian S. (2008). Intellectual Property RIGHTS text and case. Excel books.
10. Jose Cibelli, Robert Planza, Keith HS. (2002). Principles of cloning, Campbell, Michael D.West, Academic Press.
11. Sateesh MK. (2010). Bioethics and Biosafety, IK International Publishing House Pvt.Ltd.
12. Sreekrishna V. (2007). Bioethics and Biosafety in Biotechnology, New Age International Pub.
13. Singh K. (2010). Intellectual Property Rights on Biotechnology, BCIL, New Delhi.
14. Shaleesha and Stanley. (2008). Bioethics, Wisdom Educational Service.
15. WIPO Intellectual Property Handbook. (2008). www.wipo.int

M.Sc. BIOTECHNOLOGY

SEMESTER III

ELECTIVE III - PAPER II - PLANT AND ANIMAL PHYSIOLOGY

UNIT I

Photosynthesis- Light harvesting complex; Photoprotective mechanisms; CO₂ fixation-C3, C4 and CAM pathways. Sensory photobiology: Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

UNIT II

Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

UNIT III

Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress.

UNIT IV

Respiratory system: anatomy and structure transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration. Digestive system: Digestion, absorption, energy balance, BMR.

UNIT V

Excretory system: Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid-base balance. Endocrinology and Reproduction- Endocrine glands, basic mechanism of hormone action, hormone and diseases, neuroendocrine regulation.

REFERENCE BOOKS

1. Frank B Salisbury and Cleon Wross. Plant Physiology, CBS Publishers and Distributors, New Delhi.
2. Malcolm S Wilklins. Advanced Plant Physiology.
3. Pushit SS. Hormonal regulation of plant growth and development.
4. Sltyar RG. Plant water relationships.
5. Roy G Noggle and George J Fritlz. Introductory Plant physiology.
6. Ganong H. (1989). Review of Medial Physiology, 14th Edition, Appleton &Lange publisher, New York
7. Shier D, Butler J and Lewis R. (2003). Hole's Human Anatomy and Physiology, 10th Edition, WCB/McGraw Hill, Boston.
8. EcKert R. (2002). Animal Physiology, 5th Edition, W.H.Freeman.
9. Williams S Hoar. (1991). General and Comparative Physiology, 3rd Edition, Prentice Hall of India- New Delhi.

M.Sc. BIOTECHNOLOGY
SEMESTER – IV
ELECTIVE IV - PAPER I
ENVIRONMENTAL BIOTECHNOLOGY AND
NANOTECHNOLOGY

UNIT I

Basic concepts and global issues-Global warming & Acid rain. Pollution measurements- air and water. Biosensor in environmental monitoring. Bioremediation of environmental pollutants in soil and water- oils, heavy metals and detergents. Biodegradation of xenobiotics- Ecological considerations, decay behavior and degradative plasmids, hydrocarbon, hydrocarbon substitutes, pesticides and surfactants. Phytoremediation.

UNIT II

Air pollution and its control through biotechnology. Waste water treatment: Physical, chemical and biological treatment processes. Various industrial effluent treatment methods- Sugar, distillery, dairy, tannery and pharmaceutical industries. Solid wastes: Types and characteristics. Solid waste disposal- land filling, incineration. Biogas from solid waste. Composting and vermicomposting. Monitoring parameters for composting.

UNIT III

Nanobiology- Concepts, definition & prospects. Classification of Nanostructures- Bionanoparticles& nanocomposites. Types of biomaterials & biodegradable polymers. Applications of nanomaterials – Catalysis in dye & heavy metal removal, cosmetics, batteries, biosensor, food, agriculture, energy, tissue engineering (wound healing). Nanobiotechnology in medicine, drug designing & cancer treatment.

UNIT-IV

Synthesis of nanomaterials- bottom-up approach- Sol-Gel synthesis, hydrothermal, Physical vapor deposition, chemical vapor deposition, top-down approach -ball milling, microfabrication, lithography-iron beam lithography.

UNIT-V

Characterization techniques- X-ray diffraction, Electron Microscopy -Scanning & Transmission, Energy dispersive analysis, Scanning Probe Microscopy, Atomic Force Microscopy, X-ray photo electron Spectroscopy, Fourier transform Infrared spectroscopy – Ultraviolet and visible spectroscopy– Thermogravimetric Analysis– Differential Thermal Analysis– Differential Scanning Calorimetry.

REFERENCE BOOKS

1. Murugesan AG and Rajakumari C. (2005). Environmental Science and Biotechnology: theory and Techniques.
2. Sharma PD. (1994). Environmental Biology, Rastogi Publications.
3. Eugenia J.Olguin. (2000). Environmental Biotechnology and cleaner Bioprocesses, Tayloir and Francis.
4. William P. Conningham and Mary Ann Conningham. (2003). Principle Environmental Science, Tata McGraw-Hill publishing Company.
5. Agarwall KV. (2005). Environmental Biotechnology, Nidhi Publishers.
6. Chatterji A.K. (2002). Introduction to Environmental Biotechnology, Prentice- Hall of India.
7. Jogdand SN.(2008).Environmental Biotechnology, 4th Edition, Himalaya Publishing House Pvt. Ltd.
8. Atlas and Bhartha.(2005). Microbial Ecology, Pearson Education.
9. Ramachandra Rao MS, Shubra Singh. (2014). Nanoscience and Nanotechnology: Fundamentals of Frontiers.Wiley India Pvt. Ltd., 370pp.
10. Pradeep T. (2012). A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education Pvt. Ltd.,ISBN: 9781259007323.
11. Hari Singh Nalwa. (2002). Nanostructured Materials and Nanotechnology, Academic Press.

M.Sc. BIOTECHNOLOGY
SEMESTER – IV
ELECTIVE IV - PAPER II
BIO-ENTREPRENEURSHIP

UNIT I

Principles of management: Introduction, definition –principles and decisions on starting a venture; sources of financial assistance – making a business proposal, approaching loan from bank and other financial institutions, budget planning and cash flow management, basics in accounting practices - balance sheet, P&L account, and double entry book keeping; estimation of income, expenditure, profit, income tax etc.

UNIT II

Human Resource Development (HRD): Recruitment and selection process; leadership skills; managerial skills; organization structure; training; team building; teamwork; Marketing: Assessment of market demand for potential product(s) of interest; Market conditions, segments; prediction of market changes; identifying needs of customers including gaps in the market.

UNIT III

Entrepreneur: Meaning of entrepreneur, evaluation of the concept, function of an entrepreneur types of entrepreneur, evolution of entrepreneurship, development of entrepreneurship, stages in entrepreneurial process, role of entrepreneurs in economic development entrepreneurship in India, entrepreneurship - its barriers.

UNIT IV

Small Scale Industry: Definition, characteristics, need and rationale, objectives, scope, role of SSI in economic development, advantages of SSI, steps to start an SSI – Govt policy towards SSI, different policies of SSI, Govt support for SSI during 5 year plans. Impact of liberalization, privatization, globalization on SSI, effect of WTO/ GATT, supporting agencies of Govt for SSI, meaning; nature of support, objectives, and functions, types of help, ancillary industry and tiny industry (Definition only).

UNIT V

Institutional Support: Different Schemes, TECKSOK, KIADB, KSSIDC, KSIMC, DIC single window Agency SISI, NSIC, SIDBI, KSFC. Preparation of Project-Meaning of Project; Project Identification Project Selection. Project Report, Need and significance of Report, Contents, Formulation Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report, Project Appraisal, Identification of Business Opportunities. Market Feasibility Study, Technical Feasibility study, Financial Feasibility Study & Social Feasibility study.

REFERENCE BOOKS

1. Tripathi PC, Reddy PN. Principles of Management, Tata Mc Graw Hill.
2. Vasant Desai. Dynamics of Entrepreneurial Development & Management, Himalaya Publishing House
3. Poornima M Charanthmath . (2005). Entrepreneurship Development – small Business Enterprises, Pearson Education – (2 & 4)
4. Robert Lusier. Management Fundamentals – Concepts, Application, Skill Development, Thomson.
5. Khanka SS. Entrepreneurship Development” S Chand & Co
6. Stephon Robbins. (2003). Management, 17th Edi, Pearson Education/PHI.

M.Sc. BIOTECHNOLOGY

Extra Disciplinary Course

PAPER I - APPLIED BIOTECHNOLOGY

UNIT I : Plant Biotechnology

Genetic Engineering of Plants: Insect resistance, Virus resistance, Stress tolerant Plants. Delayed fruit ripening, artificial seeds

UNIT II : Animal Biotechnology

Transgenic cattle, Super ovulation, Embryo transfer. Gene knock out and mice model for human genetic disorder. Stem cell therapy.

UNIT III : Industrial Biotechnology

Fermentor- Types. Production of enzymes-amylase, protease& lipase. Antibiotic- Penicillin. Amino acid- Glutamic acid. Production of Alcohol.

UNIT IV : Environmental Biotechnology

Biosensors- Types, Xenobiotic degradation, Bioleaching, Sewage treatment. Bio gas production. Role of Super bug in biodegradation.

UNIT V : Bioethics & Biosafety

Intellectual Property Rights. General ethics and ethical issues. Animal rights, Environmental safety of GMO's, Regulations of GMO's, Bioethics for the future.

REFERENCE BOOKS

1. Chawla HS. (1998). Biotechnology in crop improvement, International Book Distributing Company.
2. Satyanarayana U. (2005). Biotechnology, Books and Allied (p) Ltd.
3. Peter F Stanbury, Allan Whitaker, Stephen J Hall. (2007). Principles of Fermentation Technology, 2nd Edition, Elsevier Science Ltd.
4. Chatterji AK. (2002). Introduction to Environmental Biotechnology, Prentice- Hall of India.
5. Nigel Jenkins. Animal Cell Biotechnology: Methods and protocols, Humana Press.

M.Sc. BIOTECHNOLOGY
Extra Disciplinary Course
PAPER II - CONCEPTS OF BIOTECHNOLOGY

UNIT I : Biotechnological Perspectives

Scope of Biotechnology, Conventional & Modern Biotechnology, Biotechnology Tree. Prospects of Biotechnology in India, Impact of Biotechnology, New Goals of Biotechnology.

UNIT II : Genetic Engineering

Cloning strategies- Genome Organization. Physical and genetic mapping, gene tagging, gene silencing and DNA sequencing.

UNIT III : Tools of gene cloning

Enzymes- Restriction endonucleases, Ligases; Vectors – Bacterial- PBR322 ,PUC vectors, Agro bacterium vectors, yeast vectors and phage vectors.

UNIT IV : Techniques of gene cloning and genome analysis

Gene transfer methods – vector mediated and direct transfer methods, PCR techniques. RAPD, RFLP. Methods of screening of recombinants.

UNIT V : Modern concepts

Principles of Bioinformatics- Protein engineering – Genome projects – HGP. Structural genomics, Nanobiotechnology – Bionano particles – Nano biosensors, IPR.

REFERENCE BOOKS

1. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation, 7th Edition, Blackwell Scientific Publishers, Oxford.
2. James D Watson. (2001). Recombinant DNA, Scientific American Books. USA
3. Glick B Pasternak JJ. (2007). Molecular Biotechnology, ASM Press, Washington
4. Dubay RC. (2008). A Text book of Biotechnology, S.Chand & Company, New Delhi.
5. Sathyanarayana U. (2005). Biotechnology, 1st Edition, Books and Allied (P) Ltd,Kolkata.
6. Christof M.Niemayer, Chad A Mirkin. (2004). Nano biotechnology: Concepts, Applications and Perspectives, Wiley VCH publishers.
7. Irfan Ali Khan. (2004). Fundamentals of Biotechnology, Forensic Science and Genetic Engineering, Ukaaz Publications. Hyderabad.

M.Sc. BIOTECHNOLOGY
Extra Disciplinary Course

PAPER-III MICROBIAL TECHNOLOGY

UNIT I

Scope of Microbial technology, Production of Proteins: Bacteria- Chymosin, Yeast- Hepatitis B surface Ag, Production of Recombinant and synthetic Vaccines, Peptide Vaccines.

UNIT II

Biocontrol agents: Trichoderma, Pseudomonas, Bacillus. Microbial Insecticides- B.thuringiensis, B.sphaericus, B.popillae and Baculovirus. Microbial Biofertilizer- Rhizobium sp., Azospirillum. Phosphobacteria, Azolla, BGA. Production of SCP.

UNIT III

Microbial Production of Polysaccharides- Xanthane Gum and Polyesters. Aminoacids- Histidine. Production of Microbial Enzymes- Amylase, Protease. Microbial degradation of Lignin, Cellulose.

UNIT IV

Microbial production of Vitamin B12. Production of Alcohol, Beer, Wine, Vinegar, Cheese. Mold modified Foods- Soy Sauce, Miso, Hamanatto, Sufu, Tempeh.

UNIT V

Microbial treatment of sewage- Primary & Secondary treatment. Degradation of Xenobiotics, Bioremediation. Genetic aspects of Biodegradation, Microorganisms in mineral recovery and removal of heavy metals.

REFERENCE BOOKS

1. Alexander N Glazer & Hiroshi Nikaido WH. (1995). Microbial Biotechnology, Freeman and Company.
2. Pepler HJ & Perlman D. (2004). Microbial Technology. Volume I & II, 2nd Edition, Academic press.
3. Wulf Crueger & Anneliese Crueger. (2000). Biotechnology, 2nd Edition, Panima Publications.
4. Dubay RC. (2008). A text book of Biotechnology, S.Chand & Company, New Delhi.
5. Ronald M Atlas & Richard Bartha. (2005). Microbial Ecology, 4th Edition, Benjamin/Cummings Science Publishing.
6. Subbarao NS. (1995). Biofertilizers in Agriculture and forestry, 3rd Edition, Oxford and IBH Pub.Co.Pvt.Ltd, New Delhi.
7. Sathyanarayana U. (2005). Biotechnology, 1st Edition, Books and allied (P) Ltd, Kolkata.
8. Patel AH. (2005). Industrial Microbiology, Mac Millan India Ltd, New Delhi.

