Sri Ramakrishna College of Arts and Science

(Autonomous)

(Formerly S.N.R. Sons College)
(Affiliated to Bharathiar University; Re-Accredited with 'A' Grade by NAAC)
(An ISO 9001:2008 Certified Institution)
Nava India, Coimbatore-641 006, Tamil Nadu, India.

"Scheme of Examination along with Distribution of Marks and Credits"

CBCS & OBE PATTERN

POST GRADUATE PROGRAMMES

M.Sc., Biotechnology

(For the students admitted during the academic year 2019 – 2020 and onwards)

Study Components and Course Title	CIA	Comprehensive Exam		Comprehensive Exam Total	Total	Credit
		Online	Descriptive Theory/viva -voce			
I SEMESTER						
CORE I: 19MBT101 Cell and Molecular Genetics	30	20	50	70	100	4
CORE II: 19MBT102 Biochemistry	30	20	50	70	100	4
CORE III: 19MBT103 Microbiology	30	20	50	70	100	4
CORE IV: 19MBT104 Bioinstrumentation and Research Methodology	30	20	50	70	100	4
CORE V: 19MBT105 Practical I Lab in Molecular Genetics and Microbiology	30	70		70	100	4
CORE VI: 19MBT106 Practical II Lab in Biochemistry	30	70		70	100	4
MACE I: 19CME01 Masters' Ability and Career Enhancement - I		Online : 50 Verbal Oral: 50		-	100$	2$
II SEMESTER						
CORE VII: 19MBT201 Immunotechnology	30	20	50	70	100	4
CORE VIII: 19MBT202 Genetic Engineering	30	20	50	70	100	4
CORE IX: 19MBT203 Plant Biotechnology	30	20	50	70	100	4
CORE X: 19MBT204 Animal Biotechnology	30	20	50	70	100	4
CORE XI: 19MBT205 Practical III Lab in Immunotechnology and Genetic Engineering	30	70		70	100	4
CORE XII: 19MBT206 -Practical IV Lab in Plant Biotechnology and Animal Biotechnology	30	70		70	100	4
Elective: I: 19MBTE01/02/03	30	20	50	70	100	4
MACE II: 19CME02 Masters' Ability and Career Enhancement - II		Online : 50 Verbal Oral: 50		-	100$	2$

III SEMESTER							
CORE XIII: 19MBT301 Environmental Biotechnology	30	20	50	70	100	4	
CORE XIV: 19MBT302 Bioprocess Technology	30	20	50	70	100	4	
CORE XV: 19MBT303 Medical Biotechnology	30	20	50	70	100	4	
CORE XVI: 19MBT304- Practical V Lab in Environmental Biotechnology	30	70		70	100	5	
CORE XVI: 19MBT305-Practical VI Lab in Bioprocess Technology	30	70		70	100	5	
Elective: - II 19MBTE04/05/06	30	20	50	70	100	4	
19MBT306 – Institutional Training/ Internship Report*	-	-	50	-	50$	2#	
IDC: 19MBTI01 First aid and Safety/Online Course	-	-	-	100	100$	3$	
IV SEMESTER							
CORE XVIII: 19MBT401 Bioethics, Biosafety and IPR	30	20	50	70	100	4	
CORE XIX: 19MBT402 Project Work and Viva voce	160	-	40	40	200	8	

List of Elective papers (Can choose any one of the paper as electives)		
Elective – I	19MBTE101	Agricultural Biotechnology
	19MBTE102	Food Biotechnology
	19MBTE103	Proteomics and Genomics
Elective – II	19MBTE104	Pharmaceutical Biotechnology
	19MBTE105	Marine and Nano Biotechnology
	19MBTE106	Stem Cell Technology

Subjects	**No. of Papers**	**Credit**	**Total credits**	**Papers**	**Marks**	**Total Marks**
Core (including Project work & Viva voce)	19	82	82	18	100	2000
				1	200	
Electives	2	4	8	2	100	200
Institutional Training / Internship Report		2#				50$
IDC	1	3$				100$
Total			**90**			2200

$ - NOT INCLUDED in total marks & CGPA calculations.
# - NOT INCLUDED in total marks & CGPA calculations. * Institutional training is mandatory
Note: Total credits may vary between 90 – 95

Prepared by
Dr J. Dinesh Babu

BoS Chairman
Dr R. Subashkumar

Academic Council
Dr D. Jayasheela

19MBT101-CELL AND MOLECULAR GENETICS

Semester	I
Credit	4
Paper Type	Core
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To understand the concept of basic structure and functions of organelles, mechanism of cell cycle and signaling pathway.
- To familiarize the properties, structures and functions of macromolecules.
- To understand the regulation and synthesis of genetic material.

UNIT– I 12

Membrane structure and function: Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Structural organization and function of intracellular organelles.

UNIT– II 12

Cell division and cell cycle: Mitosis and meiosis, their regulation, steps in cell cycle and control of cell cycle. Cell signaling: Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component Signaling systems, bacterial chemotaxis and quorum sensing.

UNIT– III 12

Eukaryotic DNA replication, repair and recombination: Unit of replication, enzymes involved, replication origin and replication fork. DNA damage and repair mechanisms. RNA synthesis and processing: Transcription factors and machinery, formation of initiation complex, transcription activators and repressors. Structure and function of different types of RNA.

UNIT– IV 12

Eukaryotic Protein synthesis and processing: Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, amino acylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post-translational modification of proteins. Control of gene expression at transcription and translation level.

UNIT– V 12

Inherited disorders - Autosomal and allosomal-molecular and cytogenetics, Teratology, Molecular Screening– Haematological malignancies, Cancer: Pharmacogenetics (Hep2 and breast cancer), Population Genetics, Quantitative genetics and multifactorial interactions, causes of variation and artificial selection, genetic load and genetic counseling. Genotoxicity and detection assays.

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

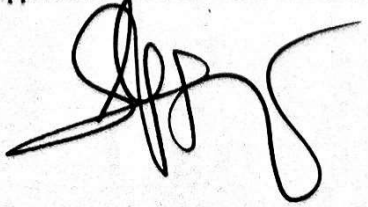
- Demonstrate the knowledge on the structure and function of cellular organelles and components **(L1)**
- Compare the receptor subclasses and their possible uses in cell signaling **(L2)**
- Illustrate specific processes and proteins involved in membrane transport and DNA repair mechanisms **(L3)**.
- Demonstrate the mechanism of gene expression at transcription and translation level **(L1)**.
- Illustrate complete understanding of the genetic disorders, cancer therapy and detection assays **(L3)**.

TEXT BOOK

1. Lodish *et al.* Molecular Cell Biology, 6th edition, Scientific American Books, Inc. 2007.

REFERENCE BOOKS

1. Stephen *et al.*, Lewin's Genes XI. Oxford University Press, UK.2013.
2. Hartl. D. L., A Primer of Population Genetics. 3rd Edition, Sinauer Associates Inc., Sunderland. 2000.
3. Alberts *et al.* Molecular Cell Biology, 5th Edition. Garland Publishing, Inc., NY. 2007.
4. Cooper, G., The Cell - A Molecular Approach.5th edition. ASM and Sinauer Press, Washington. 2009.



5. Strachan, T. and A. Read, Human Molecular Genetics. 4th edition, Garland Science. 2010.
6. Peter J Russell, Genetics: A Molecular Approach, 3rd Edition, Benjamin Cummings publication. 2002.
7. David Clark *et al.*, Molecular Biology 3rd Edn., Academic Cell, 2018.
8. Manish Biyani, Cell-Free Protein Synthesis, Janeza Trdine 9, 51000 Rijeka, Croatia, 2012.

Verified by Course Coordinator

Approved by BOS Chairperson

19MBT102–BIOCHEMISTRY

Semester	I
Credit	4
Paper Type	Core
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To acquire knowledge on structure and function of biomolecules
- To impart knowledge on metabolic pathways of biomolecules
- To gain knowledge on classification and mechanism of action of enzymes.

UNIT– I 12

Classification and functions of carbohydrates Glycolysis, TCA and Gluconeogenesis, Glycogenesis and Glycogenolysis, Electron transport chain and oxidative phosphorylation. Clinical Aspects - Glycogen storage disease and diabetes mellitus.

UNIT– II 12

Classification and functions of Lipids, ß - Oxidation and energetic of Palmitate. Ketone bodies – synthesis, utilization and over production of ketone bodies Clinical Aspects: Ketoacidosis Biosynthesis, regulation and degradation transport of Cholesterol Clinical Aspects – Hypercholesterolemia Lipoproteins – Structure and classification Clinical Aspects – Hyper-lipoproteinemia, Atherosclerosis, Biochemical changes of Alcoholism

UNIT– III 12

Classification of amino acids based on structure, and nutrition, Transamination and Deamination, Urea cycle and regulation, Clinical aspects - metabolic disorders of urea cycle, Hartnup's disease Classification of protein based on function, chemical nature and nutrition. Structural levels of organization of protein – Primary, Secondary, tertiary and Quaternary. Conformation of Protein – Ramachandran plot, domain, motif and folds.

UNIT– IV 12

Nucleic acid : DNA and RNA, Double helical structure of DNA, and functions of nucleic acids. Biosynthesis and degradation of Purine and pyrimidine. Hormones: Thyroid hormone - Biosynthesis, Biochemical functions and Abnormalities of thyroid hormone, Laboratory diagnosis of thyroid function. Vitamins: Structure, properties, metabolism and deficiency of Fat Soluble Vitamins (A and D) and water-soluble vitamins (B-Riboflavin and Niacin; C-Ascorbic acid).

UNIT– V 12

Nomenclature and classification of enzymes, Chemical nature of enzymes, factors influencing enzyme activity. Enzyme inhibition-reversible-irreversible inhibition. Enzyme specificity-stereospecificity. Mechanism enzyme action – Lock and key model, induced fit model.

Total Periods: 60

COURSE OUTCOMES

- Recognize the structure and metabolic pathways of biomolecules (**L1**).
- Distinguish the clinical aspects of various metabolic disorders (**L1**).
- Illustrate the Structural levels of organization of protein (**L2**)
- Asses the significance of vitamins in the proper functioning of living cells (**L2**).
- Recognize how fundamental chemical principles and reactions are utilized in biochemical processes (**L2**)

TEXT BOOK

1. Lehninger, A. L, Nelson D. L and Cox, M. M, Principles of Biochemistry, 4th edition, Freeman Publishers, New York, 2005.

REFERENCE BOOKS

1. Nelson D. L. and M. M. Cox, Lehninger's Principles of Biochemistry, 6th edn WH Freeman and Co., 2013.
2. Lubert Stryer. Biochemistry, W.H., 6th edition Freeman and Company. 2007.
3. Voet and Voet, Fundamentals of Biochemistry, 4th edition, John Wiley and Sons Inc., 2013.
4. Chatterjea, M. N. and Rana Shinde, Text Book of Medical Biochemistry, 7th edition, Jaypee Brothers. 2008.
5. Satyanarayana, U and Chakrapani, U., Biochemistry, 4th edition, Elsevier India, 2013.
6. Smith, Principles of Biochemistry, 8th edition, McGraw Hill International Book Company, 2001.

Verified by Course Coordinator **Approved by BOS Chairperson**

19MBT103–MICROBIOLOGY

Semester	I
Credit	4
Paper Type	Core
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To make the students to understand the basic concepts of the biology of microorganisms and its mechanism of action in host cells.
- To learn the techniques used for the classification of microorganisms
- To know the important role of microbes in various field of microbiology
- To understand the microbe-host interaction and their metabolic activities

UNIT– I **12**

History of microbiology- Development of microbiology in 20th century. Microbial taxonomy – classification systems– Molecular systematics: Polyphasic approach–16S rRNA gene sequencing, Phylogenetic grouping. Mol % G+C analysis, DNA-DNA hybridization, FAME analysis and Computational tools. Principles and nutritional requirements for the growth of bacteria - culture media and types. Sterilization - principles and applications of physical and chemical methods. Sterility tests. Antimicrobial chemotherapy evaluation.

UNIT– II **12**

Morphology, ultra-structure of bacteria. General characters of Fungi, Algae and Protozoa. Staining methods - bacteria and fungi. Virus: Discovery, structure and classification – Baltimore cultivation of viruses – the replication cycle of viruses, detection and enumeration, viral assays.

UNIT– III **12**

Soil Microbiology: Microbial flora of soil – bacteria, fungi, algae and protozoa. Microbial interactions among soil microorganisms - microbial populations and with plants (N_2 fixation) - Biogeochemical cycles (C, N, P and S cycles). Plant growth promoting bacteria. Photosynthesis in blue green algae, purple, non-S and green-S bacteria.

UNIT– IV **12**

Food and Industrial Microbiology: Principle of food preservation, methods, Contamination and spoilage of meat, fish, milk, vegetables and fruits - Food quality and control. Industrial important microbes, Microbial and Fermented foods (Fermented Vegetables, Dairy foods, Sausages) Industrial production of wine, beer, ethanol, organic acids (citric, acetic), amino acids (lysine), enzymes (amylase) and antibiotics (penicillin).

UNIT– V **12**

Medical Microbiology: Host parasite relationship, causative agent, epidemiology, pathogenesis, prophylaxis and treatment - Staphylococcosis, Salmonellosis Aspergillosis, Cadidiasis, Giardiasis, Malaria, Rickettsiosis, AIDS, Influenza and Mycoplasmosis.

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

- Perceive the basics of Structure and Functions of Microorganisms and their role in environment **(L1)**
- Infer the significant role of microbes in soil and their interactions **(L2)**
- Analyze the microbes play a vital role in food and industrial production of products **(L2)**
- Illustrate the microbial diseases and epidemiological profiles **(L3)**

TEXT BOOK

1. Willey, J., L. Sherwood, C. J. Woolverton, Prescott's Microbiology, 10th Edition. McGraw-Hill Education. 2017 (Reprint).

REFERENCE BOOKS

1. Frazier, W. C., D. C. Westhoff and N. M. Anitha, Food Microbiology. 5th Edition. Tata McGraw-Hill Publishing Co. Pvt. Ltd., New York. 2017.
2. Patel, A. H., Industrial Microbiology. Second edition Laxmi Publications. 2011.
3. Ananthanarayan and Paniker, Textbook of Microbiology. Ed., R. Kartungo, 10th edn, Universities Press, 2017.
4. Pelczar, M. J. JR., ECS, Chan and N. R. Krieg, Microbiology: Concepts and Applications. 5th edn, Tata McGraw-Hill Publishing Co. Ltd., New Delhi. 2001 (Reprint).

Verified by Course Coordinator **Approved by BOS Chairperson**

19MBT104– BIOINSTRUMENTATION AND RESEARCH METHODOLOGY

Semester	I
Credit	4
Paper Type	Core
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To gain knowledge on working principles and handling of different instruments
- To learn the applications of instruments for future research
- To understand the basics of research methodology
- To make the student to understand the methods and tools in biostatistics

UNIT– I 12

Microscopy: Principle and applications of light, fluorescence phase contrast, Confocal, electron microscopy and scanning tunneling microscopy. Centrifugation: Types of centrifuges, Principles and applications of analytical and preparative centrifuge, density gradient and ultra-centrifuge. Chromatography - Principle and applications: Paper, Thin layer, Ion exchange, Gel filtration, Affinity, GC, HPLC, GC-MS and LC-MS

UNIT– II 12

Spectrometry and Spectroscopy: Beer Lambert's law, Extinction coefficient, Principles and application of UV-VIS, Mass, IR and NMR spectrophotometry, Flourimetry and flame photometry. Electrophoretic techniques: Agarose, PAGE, isoelectric focusing and 2D gel electrophoresis, Southern, Northern and Western blotting techniques. PCR: Principle, types, instrumentation, and applications, Nucleotide sequencing

UNIT– III 12

Research methodology: Scope and significance, Types of Research, Stages in research - formulation of hypothesis, Research process, characteristics of good research, Defining the problems in research. Objectives of research, experimental/research design, Literature collection and citation, Research report writing: Result analysis and Discussion Plagiarism, manuscript/research article, bibliography. Seminar paper preparation and presentation

UNIT– IV 12

Introduction to Statistics- Measures of Central tendency - Arithmetic Mean, Median and Mode- Measures of dispersion - Standard deviation and Co-efficient of variation. Meaning and definition – Scatter diagram – Pearsons's correlation co-efficient – Computation and Interpretation – Rank Correlation. Meaning of regression and linear prediction – Regression in two variables – Uses of regression

UNIT– V 12

Testing of Hypothesis - Large sample test- Z test - Small sample test - Student's t test. Chi-square test and its applications. F test-ANOVA – One way –two-way- Simple Problems

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

- Infer the principle and applications of instruments in biotechnology (**L1**)
- Conceive techniques involved in Spectrometry and Electrophoretic technique (**L2**).
- Demonstrate the basic principles of research and steps involved in thesis and report writing (**L2**)
- Formulate the basics of statistics and solve problems on averages, correlation and regression and dispersion (**L3**).

TEXT BOOKS

1. Gurumani, N. Research Methodology for Biological Sciences. MJP Publishers, 2010.
2. Gupta S.C. and V. K. Kapoor, Fundamentals of Mathematical Statistics. 1st Edition 1970, Reprint 2016.

REFERENCE BOOKS

1. Skoog, D. A., F. J. Holler and S. R. Crouch. Principles of Instrumental Analysis. 7th Edition Cengage Learning. 2018.
2. Skoog and Leary, Principles of Instrumental analysis, 4th Ed. Saunder's College Publishing, NY. 2013.

3. Sundar Rao, P.S.S. and J. Richard, 2006. Introduction to Biostatistics and Research methods, PHI Publication, New Delhi.
4. Gupta. S. P., Statistical Methods, 1st Edition 1969, Reprint 2017.
5. Vittal P.R., Mathematical Statistics. 1st Edition 2002, Reprint 2016.
6. Pillai R.S.N. and Bhagavathi V., Statistics, Sultan Chand & Co., New Delhi. 2000.

Verified by Course Coordinator

Approved by BOS Chairperson

19MBT105– LAB IN MOLECULAR GENECTICS AND MICROBIOLOGY

Semester	I
Credit	4
Paper Type	Practical
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To get hands on experience and to learn the principles behind molecular techniques.
- To acquire hands on experience in estimation of nucleic acids and isolation of cell organelles
- To acquire knowledge on cultivation, identification and characterization of microorganisms.

EXPERIMENTS

1. Mitosis onion root tip
2. Meiosis – flower buds of *Rheo discolor*
3. Isolation of chloroplast and mitochondria
4. Isolation of genomic DNA- Plant
5. Isolation of genomic DNA- Blood
6. Mounting of polytene chromosomes
7. Isolation and identification of microbes from soil/water
8. Staining methods- Simple, Grams, endospore and capsule, acid fast staining and LCB
9. Biochemical characterization of microorganism
10. Culture media – Preparation and sterilization
11. Bacterial growth curve – Turbidity method
12. Antimicrobial susceptibility test – Kirby Bauer method
13. Isolation of Rhizobium from root nodules of Leguminous plant
14. Milk quality assay - Methylene Blue Reduction test

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

- Perceive the various methods of analysis of cell and molecular genetics (L1)
- Elaborate the techniques for isolation of nucleic acids (L2)
- Comprehend the various methods for isolation and identification of unknown microorganisms (L3)
- Illustrate the characterization of microorganisms and bacterial growth (L3)

REFERENCE BOOKS

1. Rajan S. and R. Selvi Christy, Experimental Procedures in Life Sciences, 1st edition, Anjana Book House, 2010.
2. Aneja, K. R., Experiments in Microbiology, Plant Pathology and Biotechnology, 4th edition, New Age International Publishers, 2017.

Verified by Course Coordinator **Approved by BOS Chairperson**

19MBT106–LAB IN BIOCHEMISTRY

Semester	I
Credit	4
Paper Type	Practical
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To learn the principle and technique involved in Biochemistry.
- To develop the skills of quantifying the various biomolecules
- To understand the principle involved in quantification of Biomolecules
- To acquire knowledge on enzyme kinetics

EXPERIMENTS

1. Quantification of Starch from potato by Anthrone method
2. Quantification of fructose from fruit by Resorcinol method
3. Quantification of casein from Milk.
4. Quantification of Ascorbic acid
5. Quantification of Amino acid – Ninhydrin method
6. Quantification of DNA by DPA method
7. Quantification of RNA by Orcinol method
8. Quantification of Protein by Bradford's method
9. Effect of pH on Amylase activity
10. Effect of Temperature on Amylase activity
11. Effect of Substrate on Amylase activity
12. Urease activity
13. Separation and identification of Amino acid by TLC .

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

- Apprehend the principles involved in quantifying biomolecules present in the given samples (L1)
- Analyze through tests and identify the different carbohydrate, amino acid and lipid molecules (L2)
- Apply the reaction principle to quantify the proteins, amino acids and nucleic acids using colorimeter (L2)
- Apply basic knowledge on the properties of biomolecules from food sources and quantify them (L2)
- Ability to apply the enzyme kinetics (L3)

REFERENCE BOOKS

1. S. Sadasivam and A. Manickam, Biochemical Methods, New Age International (P) Limited, 2007.
2. S. Rajan and Mrs. R. Selvi Christy, "Experimental Procedures in Life Sciences", Anjana Book House, 1st edition, 2010.

Verified by Course Coordinator

Approved by BOS Chairperson

19MBT201 – IMMUNOTECHNOLOGY

Semester	II
Credit	4
Paper Type	Core
Max. Marks	CIA -30 + CE -70 Total =100

COURSE OBJECTIVES

- To impart basic knowledge on structure and function of the immune system at the celluar and molecular level
- To familiarize with antigen and antibody interactions monoclonal antibodies and immuno therapies
- To facilitate immunological techniques and have an overview on their applications in biotechnical industries

12

UNIT – I

Introduction of immune cells: History of the immune system. Types of immunity-Innate and Acquired immunity, Haematopoiesis, Cells and organs of the immune system: Lymphoid organs- primary and secondary lymphoid organs, lymphoid cells-lymphocytes, T cells, B cells, null cells. Myeloid cells – monocytes, macrophages, dendritic cells, neutrophils, eosinophils, basophils and mast cells.

12

UNIT - II

Cell mediated and humoral immunity: Nature and biology of antigen and super antigens, Haptens, Mitogens, Adjuvants and APC. Cell mediated immunity – Activation and killing by CTL, killing by macrophages, role of NK and killer cells, antibody dependent cell mediated cytotoxicity, role of cytokine in cell-mediated immune response. Humoral response – activation phase, effector phase-signal transduction events, production of memory cells, primary and secondary immune response.

12

UNIT – III

Immunoglobulins and immunoassay: Immunoglobulins: Structure-primary, secondary, tertiary and quaternary structures, types of antibodies. Antigen and antibody reactions – Agglutination, immunoabsorbant chromatography, immunoprecipitation, immunodiffusion, Radioimmune assay, ELISA, types of ELISA, ELISOPT. CD markers, surface markers and receptors.

12

UNIT - IV

Immunotechniques: Western blotting, southern blotting, northern blotting, immunofluorescent assay- types of FIA, FACS, Chemiluminescent Immunoassay, Immunological screening of recombinant protein- screening in replica plate by sandwich method, formation of precipitin zone, dot blot analysis, Protein/Antibody Microarray Technique.

12

UNIT - V

Monoclonal antibodies and immunotherapy: Hybridoma technology-production of antibodies and its, applications. Transplantation graft. Immunotherapies - Vaccines and vaccination, Immunotherapies to cancer, infectious diseases, autoimmune diseases (Multiple sclerosis, Rheumatoid arthritis) and allergy.

Total Periods: 60

COURSE OUTCOMES

Upon the successful completion of the course students will able to

CO1: Explain the structure and function of the immune defence at the celluar and molecular level
CO2: Demonstrate the competence on basic antigen and antibody interaction
CO3: Analyse the principles of immunological techniques and their applications in biotechnical industries
CO4: Acquire comprehensive knowledge on monoclonal antibodies and immunotherapies
CO5: Analyse the therapeutic and diagnostic molecules
CO6: Evaluate information related to immunotechniques.

TEXTBOOKS

1. Kuby, J. 2013, Immunology. W.H. Freeman and Company, New York.
2. Fathimunisa Begum,2014, PHI learning private limited, New Delhi

REFERENCES

1. Seemi Farhat Basir., 2008, Text Book of Immunology, First edition, PHI Learning Pvt Ltd, New Delhi.
2. Madhavee Latha, P., 2005, A Text Book of Immunology, First Edition. S. Chand and Company Ltd, New Delhi
3. Abul K. Abbas, Andrew K. Lichtman & Jordan S. Pober, 2001, Cellular and Molecular Immunology. 3rd Edn., W.B. Saunders Company.
4. Ivan Roitt, Jonathan Brostoff and David Male., 2002, Immunology, 5th Edn., Mosby Publication.

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19MBT202 GENETIC ENGINEERING

Semester	II
Credit	4
Paper Type	Core
Max. Marks	CIA -30+ CE -70 TOT =100

COURSE OBJECTIVES

- To familiarize the students with the basic concepts in genetic engineering.
- To acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology and to appraise them about applications genetic engineering.

UNIT - I 12

Introduction and applications, Enzymes in gene manipulation – Types, properties and applications of Restriction enzymes, Polymerases (Eukaryotic), Reverse transcriptase, End modifying enzymes, Homopolymer tailing, Methylases, Ligation - DNA ligases, Linkers and adaptors.

UNIT - II 12

Cloning Vectors and cloning strategies: Plasmids (pBR322 and pUC18), Phages (λ phage and M13 vectors), Phagemids (pBluescript, pEMBL8), Cosmids (pJB8) and artificial vectors (BAC and YAC). Plant and Animal viral vectors (papova virus, simian virus 40). Specialized vectors - Expression vectors, Shuttle vectors, Fusion vectors.

UNIT - III 12

Alternative cloning strategies: Shot gun cloning, One and two hybrid expression systems. Construction of genomic and cDNA library. Metagenomic approach. Screening of libraries - Plaque and colony hybridization. Operon concept (*lac* and *trp*), Transposons – Types and gene fusions.

UNIT - IV 12

Screening: Probes - Types (DNA and RNA), properties and methods of labeling. Southern and Northern hybridization, PCR based screening – RT PCR, Antibody based screening. *In vitro* transcription and *in vitro* translation. Cell free translation systems: HRT and HART selection.

UNIT - V 12

Application: Recombinant protein (Insulin), recombinant vaccines (Hepatitis – B), DNA microarray – applications. Site directed Mutagenesis - Types and uses. RNA interference, Gene silencing, Gene targeting, Molecular diagnosis of infectious diseases and genetic disorders.

Total Periods: 60

COURSE OUTCOMES

Upon the successful completion of the course students will able to

CO1: Gain knowledge about the tools and strategies used in genetic engineering.
CO2: Demonstrate the defined skill of gene cloning strategies
CO3: Analyze the applications of recombinant DNA technology and genetic engineering and industrial perspective.
CO4: Apply the analytical skills necessary for successful research career
CO5: Outline the strategy in producing genetically engineered protein product on health perspective

TEXTBOOK

Bernard J. Glick, Jack J. Pasternak, Cheryl L. Patten, Molecular Biotechnology: Principles and Applications of Recombinant DNA, American Society for Microbiology,4th edition, 2010.

REFERENCES

1. Brown, T A., Gene Cloning and DNA Analysis: An Introduction Wiley - Blackwell, 7th edition, 2016.
2. Sandy B. Primrose, Richard Twyman, Principles of Gene Manipulation and Genomics, Wiley - Blackwell, 7th edition, 2013.

Prepared by **Verified by** **Approved by**

19MBT203 - PLANT BIOTECHNOLOGY

Semester	II
Credit	4
Paper Type	Core
Max. Marks	CIA -30 + CE -70 Total = 100

COURSE OBJECTIVES

- To present an overview of plant tissue culture and transformation techniques of plants
- To impart knowledge in principles underlying plant metabolism
- To understand the modern technologies underlying plant breeding and plant protection

UNIT – I 12

Tissue culture media (composition, preparation and sterilization), Plant hormones-Auxins, cytokinins, Gibberellins abscisic acid and ethylene. Callus and suspension culture; Micropropagation, Somaclonal variation, Organogenesis; Somatic embryogenesis; Haploidy; Anther, pollen, ovary and embryo culture for production of haploid plants and homozygous lines. Embryo rescue.

UNIT- II 12

Protoplast fusion and somatic hybridisation; Cybrids, Artificial seeds, hardening-transfer and establishment of whole plants in soil. Genome organisation in plants: Nucleus, Chloroplast and Mitochondrial genome organisation. Vectors - Ti and Ri and uses, use of reporter genes, viral vectors and their applications. Molecular Marker-aided Breeding: RFLP and RAPD markers, Microsatellites, SCAR (Sequence Characterized Amplified Regions). QTL map-based cloning.

UNIT – III 12

Transplastomics: Methods of gene transfer in plants – Physical methods of gene transfer, Particle bombardment, Electroporation, microinjection, chemical-mediated transformation, silicon carbide mediated gene transfer. Biological methods – Agrobacterium mediated transformation, Transformation of monocots. Chloroplast transformation.

UNIT- IV 12

Application of plant transformation for productivity and performance; Engineering plants for herbicide resistance, insect resistance, Virus resistance, disease resistance, nematode resistance, abiotic stress resistance. PR proteins, Bt genes, Non-Bt like protease inhibitors, alpha-amylase inhibitor, Transgene stability and gene silencing- Flavr Savr.

UNIT -V 12

Metabolic engineering and Industrial Products: plant secondary metabolites, control mechanisms and manipulation of shikimate pathway; alkaloids, enzymes, plantibodies, edible vaccines, Golden rice, Bt corn, blue rose. Applications of plant tissue culture techniques in pharmaceuticals products.

Total Periods: 60

COURSE OUTCOMES

Upon the successful completion of the course students will able to

CO1: Explain the general procedures of plant breeding programme
CO2: Explain the DNA technology, plant cell as bio factories for the production of Secondary metabolites.
CO3: Apply the relevant techniques for gene isolation, transformation and gene expression pattern in transgenic plants
CO4: Apply the possibilities of the applications of plant biotechnology from technical and social point of views
CO5: Develop the strategies for biochemical pathway engineering to improve or alter the production of compounds

TEXTBOOK

H.S. Chawla, Introduction to Plant Biotechnology, Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi, 3rd Edition, 2017.

REFERENCES

1. P.K. Gupta, Elements of Biotechnology, Rastogi and Co. Meerut, 2nd Edition, 2010.
2. R.A. Dixon and R.A. Gonza-les, Plant cell culture, A practical approach, Oxford University Press, Oxford, 3rd Edition, 1995.
3. Murray.D.R, "Advanced methods in plant breeding and biotechnology" CAB International, 2nd Edition, 1991.

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19MBT204- ANIMAL BIOTECHNOLOGY

Semester	II
Credit	4
Paper Type	Core
Max. Marks	CIA -30 + CE -70 Total =100

COURSE OBJECTIVES

- To make students understand about the basics of animal science
- To equip students with culture techniques and scope of animal biotechnology
- To provide knowledge on genetic engineering in the improvement of animal for human welfare

UNIT – I 12

Animal cell culture media; Balanced salt solution (BSS) Natural media, synthetic media, constituents of media and sterilization, Role of carbon dioxide, serum and glutamine in cell culture, protein free defined media and their advantages. *In vitro* fertilization and embryo transfer: Composition of IVF media, steps involved in IVF, PZD and ICSI.

UNIT- II 12

Types of cell culture: Primary and established culture, Cell separation, Biology and characterization of cultured cells, Cell synchronization and cryopreservation, Measuring parameters of growth, Measurement of cell death (Cytotoxicity tests: MTT and Clonogenic assay), Organotypic culture: Bone tissue engineering.

UNIT III 12

Molecular techniques in cell culture. Physical, Chemical and Biological methods of gene transfer. Stem cells and gene therapy and iPSCs. Manipulation of genes: Gene silencing (transcriptional and post-transcriptional) and Gene targeting (Knock-in and knock-out).

UNIT IV 12

Expression vectors for animal cells: Viral; SV40, Adeno, AAV, Vaccinia, Retro and hybrid viral vectors, Baculo virus as biocontrol and foreign gene expression, Plasmid expression vectors in animal cells.

UNIT V 12

Transgenics: Transgenic animals as models for human diseases, Applications of transgenic animals and their products. Reproductive and Therapeutic cloning. Ethical issues and use of Animal Models for Tissue Culture.

Total Periods: 60

COURSE OUTCOMES

Upon the successful completion of the course students will able to

CO1: Explain the principle and various methods of animal tissue culture techniques and approaches.
CO2: Describe the molecular techniques employed in animal tissue culture.
CO3: Illustrate the vectors used in animal tissue culture.
CO4: Illustrate the expression of vectors in animal cells
CO5: Gain knowledge of animal biotechnology on *in vitro* analysis

TEXTBOOK

1. Ranga, M.M. 2004 Animal Biotechnology. 2nd Edition. Agrobios Publishers, Jodhpur, India.
2. Singh, B., Gautam, S.K. Chauhan, M.S. and Singla, S.K. 2013. Text book of animal biotechnology. The Energy and Resource Institute Press, New Delhi, India.

REFERENCE BOOKS

1. Freshney, R.I. 2015. Culture of Animal Cells: Manual of basic technique and specialized applications, 7th edition. John Wiley Publications, New Jersey, USA.
2. Masters, J.R.W. 2000. Animal cell culture: A practical approach series. 3rd Edition. Oxford University Press, London.
3. Primrose, S.B. and Twyman R.M. 2006. Principles of gene manipulation and genomics.7th edition. Wiley Publications, New Jersey, USA.
4. Bernard R. Glick and Jack G/Pasternak. 2010. Molecular Biotechnology. 4th edition. ASM Press, Washington, USA.

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19MBT205 PRACTICAL III - LAB IN IMMUNO TECHNOLOGY AND GENETIC ENGINEERING

Semester	II
Credit	4
Paper Type	Practical
Max. Marks	CIA-30 + CE -70 Total=100

COURSE OBJECTIVES

- To detect different antigen and antibody interactions, isolation of different lymphocyte cells.
- To provide students with the experimental knowledge of molecular biology and genetic engineering.

PRACTICALS

1. Preparation of Blood smear and staining using Leishman's Stain
2. ABO, ASO, RA and CRP tests
3. ODD and SRID
4. Immuno Electrophoresis
5. Rocket Immuno Electrophoresis
6. ELISA Test
7. Isolation of lymphocytes
8. Isolation of genomic DNA from animal tissue sample
9. Isolation of plasmid DNA from bacterial Sample
10. Agarose Gel Electrophoresis (AGE)
11. Recovery of DNA from agarose gel
12. Restriction Digestion and Ligation of DNA
13. Poly Acrylamide Gel Electrophoresis (PAGE)

COURSE OUTCOMES

Total Periods: 60

Upon the successful completion of the course students will able to

CO1: Gain hands-on experience on gene cloning, protein expression and purification.

CO2: Acquired knowledge to begin a career in industry that engages in genetic engineering as well as in research laboratories conducting fundamental research.

CO3: Identify and evaluate the usefulness of immunology in different pharmaceutical companies.

CO4: Apply their knowledge and design immunological experiments to demonstrate innate, humoral or cytotoxic T lymphocyte responses in the setting of infection.

REFERENCE BOOKS

- Rajan S, Selvi Christy R, Experimental Procedures in Life Sciences, CBS Publishers, 1st edition, 2019.
- John Vennison S, Laboratory Manual for Genetic Engineering, Prentice Hall India Learning Private Limited, revised edition, 2009.

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19MBT206 - PRACTICAL IV - LAB IN PLANT BIOTECHNOLOGY AND ANIMAL BIOTECHNOLOGY

Semester	II
Credit	4
Paper Type	Practical
Max. Marks	CIA -30 + CE -70 Total =100

COURSE OBJECTIVES

- To understand the significance of cultivation of the cells *invitro*. To learn the fundamentals of plant and animal tissue culture
- Construct and analyse an explant preparation and induction of callus
- To analyse cell viability test, apply basic knowledge on extraction and quantification of metabolites from cell lines
- To understand and execute the preparation and preservation of cell line

PRACTICALS

1. Preparation of Plant tissue culture medium
2. Callus induction
3. Micro- propagation
4. Protoplast isolation and fusion
5. Embryo culture in *in vitro* methods
6. *Agrobacterium* mediated gene transfer
7. Extraction and analysis of phytochemical and secondary metabolites from *In Vitro* plants
8. Evaluation of antioxidant potential of plant extract by DPPH assay
9. Animal handling and route of administration.
10. Preparation of aanimal cell culture medium and filter sterilisation by membrane filtration unit
10. Primary cell culture – chick embryo
11. Viability cell counting – Trypan blue assay
12. Trypsinisization and passaging
13. DNA fragmentation assay.

Total Periods: 60

COURSE OUTCOMES

Upon the successful completion of the course students will able to

CO1: Learn the basics of plant and tissue culture and requirements to set up the lab
CO2: Demonstrate the different techniques in tissue culture and concepts will be a stepping stone for research.
CO3: Evaluate and critically assess the theoretical basis and practical application of selected medical biotechnologies

TEXTBOOKS

1. Experimental Procedures in Life Sciences – Dr S. Rajan and Mrs R. Selvi Christy, Anjana Book House, 1st edition, 2010

REFERENCES

1. Ian R Freshney, Animal cell culture: A manual of basic technique and specialised applications, Wiley and sons, 2nd edition, 2011.
2. S. Narayanaswamy, Plant Cell & Tissue Culture, Tata Mc Graw-Hill, 5th edition 2008.
3. Bernard R. Glick, Jack J. Pasternak, Molecular Biotechnology: Principles and Applications of Recombinant DNA, ASM Press, U.S.A, 3rd Edition 2010.

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19MBTE101 – AGRICULTURAL BIOTECHNOLOGY

Semester	II
Credit	4
Paper Type	Core
Max. Marks	CIA – 30 + CE – 70 Total=100

COURSE OBJECTIVES

- To understand the basic knowledge of the traditional and modern agriculture.
- To develop the skills of the students in the area of plant and agricultural biotechnology.
- To know the role and application of recombinant microbes in modern agriculture methods, viz., biofertilizers and biopesticidesin sustainable farming and the molecular marker-aided agro-products.

UNIT– I 12

History of Indian Agriculture, Green Revolution and Cropping patterns in India. Organic farming. Importance and Applications of Biotechnology in Agro based industries. Significant advances recent development risk factors, safety regulations.

UNIT– II 12

Microbes and soil fertility: Role of microbes in soil fertility. Decomposition of organic matter by microorganisms - cellulose, hemicellulose, lignin, xylan and pectin. Soil fertility evaluation and improvement. Effect of pesticides on soil microflora.

UNIT– III 12

Biological nitrogen fixation (BNF): Nitrification, denitrification; symbiotic nitrogen fixation (Rhizobium, Frankia), non-symbiotic nitrogen fixation (Azotobacter, Azospirillum); Nitrogenase enzyme, *nif* genes and molecular mechanism of nitrogen fixation. Role of nodulin genes in nodule development and symbiosis.

UNIT– IV 12

Bioinoculants: Biofertilizer - types, production and quality control. Cultivation and massproduction of bioinoculants- Azotobacter, Rhizobium, Azospirillum, Cyanobacteria,phosphate solubilising microorganisms, Azolla. Carrier-based inoculants - production and applications.Biopesticides – types and applications (*Pseudomonas fluroscence, Bacillus thuringiensis, Trichoderma harzianum, Trichoderma viridae*, Nuclear Polyhedrosis Virus).

UNIT– V 12

Conventional breeding programme, Application of Recombinant Microorganisms in Agriculture-Agrobacterium and virus mediated gene transfer and improvements of crops Microorganisms and Agriculture –Marker assisted breeding,QTL mapping,

Total Periods: 60

COURSE OUTCOMES

Upon the successful completion of the course students will able to

CO1: Analyze the various approaches to manipulate and improve plants, animals and microbes in agriculture
CO2: Illustrate the principle function and application of microbial interactions
CO3: Perceive the process of production of bioinoculants, biofertilizers and biopesticides
CO4: Acquire the knowledge on rDNA technology in agriculture and current trends in crop production.

TEXT BOOK

1. Rangaswami. Gand D.J. Bagyaraj. Agricultural Microbiology. 2nd Ed. PHI. India, 2009.

REFERENCE BOOKS

1. Dickinson M. Molecular Plant Pathology. BIOS Scientific Co.2003.
2. Beynon J Dickinson M. Molecular plant pathology Sheffield Academic Press.2000.
3. David Castle, Handbook on Agriculture, Biotechnology and Development. Edward Elgar Publishing Co. 2014.
4. Altman, A., P. Hasegawa, Plant Biotechnology and Agriculture: Prospects for the 21st Century. 2011.
5. Subbarao, N.S. and Dommergues, Y.R. Microbial Interactions in Agriculture and Forestry. Science Publishers, 2000.

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19MBTE102 - FOOD BIOTECHNOLOGY

Semester	II
Credit	4
Paper Type	Core
Max. Marks	CIA – 30 + CE – 70 Total=100

COURSE OBJECTIVES

- To convey better knowledge among the students about the basics of food and techniques to find the food pathogens
- To study the food preservation methods and its associated techniques
- To gain the knowledge on fundamentals of beverages, dairy and dairy products
- To enhance the knowledge on food safety and regulations through applying state-of -art techniques.

UNIT - I

12

Introduction to food Biotechnology - 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. Spoilage of food and food borne diseases (botulism). Detection of food pathogens – Phenotypic (TVC) and genotypic (gene probes - PCR detection of pathogens) analysis.

UNIT - II

12

Principles and methods of food preservation: Asepsis, High temperature, Low temperature, Drying, Irradiation, Chemicals and Biopreservatives. Modification of atmosphere, control of water activity. Food Packaging: definition, selection of a food package, Types of packaging and their functioning. Canning.

UNIT - III

12

Introductory Dairy Biotechnology – Chemistry of milk.Dairyproducts - Cheese – Production and types, other products (Butter, fermented milk products-acidophilus milk, yoghurt, Kefir, Koumiss). Dairy enzymes-Recombinant chymosin.Functionalfoods – probiotics and prebiotic, bioactive peptides, LAB oral vaccines.

UNIT - IV

12

Food and beverages: Bread, Meat, poultry and fish products. Vegetable and fruit products- Sauerkraut, Pickles. Alcoholic beverages-wine, beer. Foodadditives:Monensin, phytases, carbohydrases, proteases, lipases, pectinase, xylanases, cellulase, Beta glucanase and Food colorants (canthaxanthin, prodigiosin) Bioconversion – bacteriocins.

UNIT - V

12

Concepts of food safety and food quality assurance; Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents. Good Manufacturing Principles, Sanitary Standard Operating Principles Codex Alimentarius Commission and HACCP program. Role of national and international regulatory agencies, Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI), USFDA, International organization for standards (ISO).

Total periods: 60

COURSE OUTCOMES

Upon the successful completion of the course students will able to

CO1: Acquired the knowledge on nutritive values of food and spoilage of food by microorganisms.

CO2: Familiarize the processing and preservation techniques of food and dairy products

CO3: Describe the values of beverages and food additives

CO4: Describe the importance of food safety, food quality, food sanitation, food laws and regulations, food engineering and packaging in food industry

TEXT BOOKS

1. M.R. Adams and M.O. Moss Adams. Food Microbiology: Moss Royal society Pub. Cambridge, 2nd edition, 1995.
2. George J Ban wart, Basic Food Microbiology –2nd edition, 2004.

REFERENCE BOOKS

1. C. Frazier, Dennis, C. Westhoff, Food Microbiology William, Tata Mc Graw Hill Publications, 3rd edition, 1998.
2. Daham I Alani and M.M.Young, Perspectives in Biotechnology and Applied Microbiology, 2nd edition, 2003.

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19MBTE103–GENOMICS AND PROTEOMICS

Semester	II
Credit	4
Paper Type	Core
Max. Marks	CIA – 30 + CE – 70 Total =100

COURSE OBJECTIVES

- To understand the basic principle in the instrumentation, proteomics and genomics
- To learn the various topologies of super-secondary, tertiary and quaternary structures
- To appreciate the structure, function, correlation and the prediction of protein properties
- based on its sequence.
- To give students an application based knowledge on various proteomics tools.

UNIT - I 12

Genomes: Viruses – Bacteriophages and viruses of eukaryotes, Prokaryotic genomes, Eukaryotic genomes. The human genome – the content of the human nuclear genome, genes, related sequences and functions. Pseudogenes and other evolutionary relics, Genome anatomies – Prokaryotic and eukaryotic. Human Genome Projects – mapping, sequencing and the future of human genome project.

UNIT - II 12

Genomics: Types of genomics – Structural and functional genomics. Genome Sequencing – Methodology for DNA Sequencing. Sequencing entire genomes – Strategies for genome sequencing. Sequence assembly and gap closure.Comparative genomics – Comparative genomes of bacteria, organelles and eukaryotes. Comparative genomics in the study human disease genes. Genomics and its application to health and agriculture, including gene therapy

UNIT - III 12

Mapping of genomes: Genetic mapping – DNA markers for genetic mapping, Physical mapping – Restriction mapping, Fluorescent in situ hybridisation (FISH), and Sequence tagged site mapping, RFLP, AFLP. Analysing gene expression – DNA microarrays – design, analysis and visualisation of data, RNA data handling/manipulation.

UNIT - IV 12

Proteomics: Serial analysis of gene expression, gene expression analysis by microarray technology – types and their applications. Proteomics – structural proteomicsbased NMR and X ray crystallography. MALDI-TOF MS and SELDI-TOF MS. Protein expression analysis – RNA interference (RNAi).Functional Proteomics: Expression profiling, protein arrays – definition and applications, protein interactions – Yeast two hybrid systems. 2D - PAGE – first and second dimension criteria and its applications

UNIT - V 12

Pharmacogenomics: Immunomics and vaccinomics - Introduction. Role of proteomics in drug discovery, identification of drug targets and drug development and its applications.

Total periods: 60

COURSE OUTCOMES

Upon the successful completion of the course students will able to

CO1: Acquire the knowledge on nutritive values of food and spoilage of food by microorganisms

CO2: Familiarize about the processing and preservation techniques of food and dairy products

CO3: Emphasize the importance of food safety, food quality, food plant sanitation, food laws and regulations, food engineering and packaging in food industry.

TEXT BOOKS

1. M.R. Adams and M.O., Food Microbiology –Moss Royal society Pub. Cambridge, 2nd edition, 1995.
2. George J Ban wart, Basic Food Microbiology –2nd edition, 2004.

REFERENCE BOOKS

1. C. Frazier, Dennis, C. Westhoff, Food Microbiology William, Tata Mc Graw Hill Publications, 3rd edition, 1998.
2. Daham I Alani and M.M.Young, Perspectives in Biotechnology and Applied Microbiology, 2nd edition, 2003.

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19MBT301 - ENVIRONMENTAL BIOTECHNOLOGY

Semester	III
Credit	4
Paper Type	Core
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To reveal the status and basics of environmental condition and its impacts.
- To make the students to understand the concepts of ecology and conservation of environment.

UNIT– I

12

Biogeochemical cycling in ecological systems, Concept of ecosystems and ecosystem management, Environmental problems- ozone depletion, greenhouse effect, water, air and soil pollution. Bioindicators and environmental monitoring, environmental impact assessment, environmental management.

UNIT– II

12

Treatment of Wastewater – Primary - Coagulation, Sedimentation and Secondary- UASB, Trickling filter, Tertiary – Chlorination and Ozonization. Microbial system for heavy metal accumulation, Biosorption, Bioleaching (Copper, Uranium). Bioremediation: Types, applications and examples. Bioindicators, Biosensors and Environmental impact assessment.

UNIT– III

12

Xenobiotic compounds - recalcitrant, hazardous wastes, and genetic engineering approach for biodegradation, degradative plasmids detoxification methods. Solid-waste management (4R principle) and sewage-sludge disposal and utilization, Composting process and techniques.

UNIT– IV

12

Biodegradation of wastes from pesticide, textile, tannery, paper, food and distillery industries. Biomass from wastes- ethanol from lignocellulosic wastes and SCP. Biofuels and sources, Advantages, Biofuels, Biogas, landfill gas, bioethanol, biohydrogen; detoxification-cyanide, oxalate, urea, toxic organics phenols.

UNIT– V

12

Biomedical waste (management and handling) 1998-categories of biomedical waste, colour coding and type of container for disposal of biomedical wastes. Waste management facilities like incinerator/autoclave/ microwave system, form-I, II, III.

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Infer the knowledge about ecosystem, bioremediation and metal mining (**L1**)
CO2: Integrate various recycling methods (**L2**)
CO3: Create various approaches for material reuse (**L3**)
CO4: Evaluate the potential for biodegradation of organic pollutants (**L3**)

TEXT BOOK

1. Daniel Vallero. A. Environmental Biotechnology - A Biosystems Approach (2nd Edition). Academic Press, 2015.

REFERENCE BOOKS

1. Gareth M. Evans, Judith C. Furlong, Environmental Biotechnology: Theory and application, Second Edition, John Wiley & Sons, 2011.
2. Pradipta Kumar Mohapatra, Textbook of Environmental Biotechnology, I. K International, 2006.
3. Cheremisinaff, N. P., A textbook for waste and wastewater treatment. Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
4. Cruger, W. and A. Cruger, A Textbook of Industrial Microbiology. Panima Publishing Corporation, New Delhi, 2003.
5. Glick, B.R. and J.J. Pasternak, Molecular Biotechnology. 2nd Edition, ASM Press, Washington, 1998.

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19MBT302 –BIOPROCESS TECHNOLOGY

Semester	III
Credit	4
Paper Type	Theory
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To gain knowledge about the importance of bioprocess technology and medium optimization.
- To describe the working principle and importance of a fermentor and control analysis.
- To learn the concepts of downstream processing and screening techniques.

UNIT – I 12

Principles of Fermentation technology

Introduction to biological processes – the range of fermentation processes. Isolation of industrially important microorganisms – Screening methods – Primary and Secondary screening. Strain development – Selection and isolation of mutant strains. Culture preservation and stability. Quality control of preserved stock cultures.

UNIT – II 12

Media for Industrial Fermentations

Media formulation and Optimization. Medium Sterilization – Design of batch and continuous sterilization processes. Process of Fermentation – Types of fermentation – Submerged and Solid state. Bioreactor design, parts and their functions. Alternative vessel designs – CSTR, Tower, Airlift, Bubble column and Packed bed.

UNIT – III 12

Development of inocula for Industrial fermentations

Development of inocula for yeast, bacterial and mycelia processes. Mass transport phenomena in bioprocess – Mass transfer, Mass transfer coefficient for gases and liquids. Biological properties of medium – Determination of oxygen transfer and heat transfer coefficients.

UNIT – IV 12

Design of a Fermentor

Body construction, Aeration and Agitation, maintenance of aseptic conditions – Sterilization, monitoring and control of various parameters. Instrumentation and control – Methods of measuring process variables – Temperature, gas – liquid flow, agitation, pressure, pH and foam control. Control systems – Manual and Automatic control – Two position controllers (ON/ OFF control) and PID control. Computer applications in fermentation technology – Components of Computer – linked system.

UNIT – V 12

Downstream processing

Removal of microbial cells, filtration of fermentation broth, centrifugation, cell disruption methods. Liquid – liquid extraction, Solvent recovery, Chromatography, Adsorption, ion-exchange, Affinity and HPLC. Membrane processes, Drying and Crystallization.

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Relate the knowledge of principles, concepts and importance of bioprocess technology **(L1).**

CO2: Determine the optimization of medium and types of fermentation process for the specific production. **(L2).**

CO3: Analyze the working, sterilization and design of fermentor and its control systems **(L2).**

CO4: Demonstrate the greater use of industrially important microbial production in commercial scale **(L3).**

CO4: Apply various techniques of the recovery and purification of fermented products **(L3).**

TEXT BOOK

1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. Principles of Fermentation Technology, 3rd edition, Butterworth – Heinemann Ltd, 2016.

REFERENCE BOOKS

1. Crueger W. and Crueger A. Biotechnology – A Textbook of Industrial Microbiology, 3rd edition, Medtech Publishers, 2017.
2. Pauline M. Doran, Bioprocess Engineering Principles, 2nd edition, Elsevier Science Publishing Co Inc., Academic Press, Inc., 2012.
3. Shuler M. L. and Kargi F., Bioprocess Engineering – Basic concepts, 2nd edition, Pearson Education India, 2015.
4. Patel AH. Industrial Microbiology, 2nd edition, Laxmi Publications, New Delhi, 2015.

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19MBT303–MEDICAL BIOTECHNOLOGY

Semester	III
Credit	4
Paper Type	Theory
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To acquire knowledge on the basics of metabolic, immune, genetic disorders
- To comprehend perspectives on the Physiological and biochemical changes of ageing and disease diagnosis
- To get acquainted with therapy and disease management

UNIT – I

12 Hours

Carbohydrate Metabolic Disorders -.Diabetes mellitus, Glycogen Storage Disease, Protein Metabolic Disorders - Phenylketonuria, Albinism, Alkaptonuria. Lipid metabolism – Atherosclerosis, Types of Jaundice, Tangier.Immune disorders - Addison's disease, Graves' disease, Gout.

UNIT- II

12 Hours

Chromosomal disorders - Numerical disorders e.g. Trisomies and Monosomies, Structural disorders e.g. Deletions, Duplications, Translocations and Inversions. Single gene disorders- Huntington's disease, cystic fibrosis, Sickle Cell Anaemia and Thalassemia; Polygenic diseases -Alzheimer's disease, Mitochondrial diseases- MELAS, MERRF

UNIT – III

12 Hours

Degenerative disease - Alzheimer, Muscular dystrophies, Spinocerebellar ataxia Industrial Toxicants –Minamatadisease, Itai-Itai disease, Wilson Disease, Hemochromatosis. Ageing:- Physiological and biochemical changes in ageing. Importance of superoxide dismutase in ageing, plasticity and regeneration

UNIT- IV

12 Hours

Diagnosis using protein and enzyme markers (PKU- Guthrie test, Dystrophy- Creatine kinase), Diagnosis using monoclonal antibodies- hormonal disorders and infectious diseases DNA/RNA based diagnosis - Hepatitis, CML– bcr/abl, HIV Microarray technology- genomic and cDNA arrays, application to disease diagnosis Genetic counselling- calculating risk & discussing the options

UNIT -V

12 Hours

Gene therapy- Strategies of Gene Therapy- Gene augmentation, Prodrug therapy/Suicide gene, Antisense therapy, Ribozyme .Gene therapy trials: ADA deficiency, Cystic fibrosis, HIV, Parkinson disease. RNA interference and its applications in prevention of cancer and generation of antiviral drugs; Therapeutic genome editing- ZFN, CRISPR-Cas gene editing technology (HIV), TALENS (Leukaemia) DNA based vaccines - Attenuated vaccines- Cholera; Vector vaccines- Rabies

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Explain the acquired knowledge on the disorders of Carbohydrates, Protein, Lipids and immune system **(L1).**

CO2: Demonstrate the different chromosomal aberration and genetic disorders **(L2).**

CO3: Analyze the Degenerative disease and Industrial Toxicants and Physiological and biochemical changes of ageing **(L2).**

CO4: Validate and interpret the techniques for diagnosis of various diseases **(L3).**

CO5: Critically evaluate the therapeutics and Management of diseases **(L3).**

TEXT BOOK

A. Gerald Litwack Gerald Litwack Human Biochemistry and Disease Academic Press, 2008

REFERENCE BOOK

A. George FeuerF. A. de la Iglesia Molecular Biochemistry of Human Diseases2019 CRC Press

B. Eric News holme, Anthony Leech Functional Biochemistry in Health and Disease Wiley, 2011

C. Georg F., Zschocke, Johannes, Nyhan, A Clinical Approach - Inherited Metabolic Diseases Hoffmann, William L. (Eds.)

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19MBT304- Practical V- LAB IN ENVIRONMENTAL BIOTECHNOLOGY

Semester	III
Credit	5
Paper Type	Practical
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To enable the student to carry of industrial process in the laboratory scale.
- To understand the production of modern Biotechnology products.
- To learn about the production of primary and secondary metabolites.

PRACTICALS

1. Water quality tests for pH
2. Determination of total solids
3. Determination of Chemical Oxygen Demand
4. Determination of Biological Oxygen Demand
5. Analysis of heavy metals (Iron/Chromium)
6. Production of Ethanol / wine
7. Preparation of Biofertilizer
8. Determination of total hardness Ca and Mg
9. Influence of Carbon and nitrogen source on any one industrial enzyme. Determination of COD
10. Downstream processing of the protein
11. Downstream processing of the protein
12. Immobilization of cells

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Demonstrate about the production of various metabolites **(L2)**.
CO2: Understand about the various industrial bioprocesses **(L1)**.
CO3: Learn the basics of industrial bioprocesses for the production of various primary and secondary metabolites **(L2)**.
CO4: Apply various modern bio techniques for producing several value added products **(L3)**.

TEXT BOOK

A. Rajan S. and Selvi Christy S., Experimental Procedures in Life Sciences, Anjana Book House, 1st edition, 2010.

REFERENCE BOOKS

1. Casida, L.E., Industrial Microbiology, New Age International (P) Ltd, 2005.
2. Crueger, W and Anneliese Crueger, Biotechnology: A Textbook of Industrial Microbiology, Panima Publishing Corporation, 2nd edn. 2003.
3. Sathyanarayana, U., Biotechnology, Books and Allied (P) Ltd. Kolkata, 2005.

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19MBT305- Practical VI- LAB IN BIOPROCESS TECHNOLOGY

Semester	III
Credit	5
Paper Type	Practical
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To gain knowledge about the importance of bioprocess technology and medium optimization.
- To perform the screening process of acid/ antibiotic producing organisms and culture optimization.
- To perform the technique of production and quantification of organic components.

EXPERIMENTS

1. Screening of organic acid / antibiotic producing organism
2. Screening of vitamin producing organism.
3. Isolation of cellulase producing microorganism.
4. Isolation of protein degrading microorganism.
5. Determination of culture optimization - pH and Temperature
6. Determination of culture optimization - Carbon and Nitrogen source
7. Assay of amylase/protease and specific activity
8. Microbial production of Citric acid using *Aspergillus niger*.
9. Immobilization of cells for enzyme production.
10. Production of Wine.
11. Quantification of alcohol from Wine.
12. Purification of enzymes by Salting out and Dialysis.
13. Estimation of Biomass production.

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Determine the screening of acid/antibiotic producing microorganisms (**L1**).
CO2: Analyze the optimization of medium using various culture conditions (**L2**)
CO3: Demonstrate the greater use of industrially important microorganism production in a commercial scale (**L2**).
CO4: Demonstrate the enzyme purification techniques (**L2**).
CO5: Apply various techniques of the recovery and purification of fermented products (**L3**)

REFERENCE BOOK

1. S. Kulandaivel and S. Janarthanan, Practical Manual on Fermentation Technology. I. K. International Publishing House Pvt. Ltd. 2012.

Prepared by **Verified by** **Approved by**

19MBTE104–Pharmaceutical Biotechnology

Semester	III
Credit	4
Paper Type	Theory
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To enable the students to learn about various drugs, its effects, drug metabolism, drug receptors, drug tolerance, dependence and resistance with therapeutic monitoring of drugs.
- To offers the students comprehensive information and insights in pharmaceutical biotechnology and the development of biopharmaceuticals in pharmaceutical industry.

UNIT I

12

Introduction to pharmacology. Drugs- influencing factors Drug concentration-response relationship, Receptor mechanisms of drug action and signal transduction mechanisms Introduction to agonist, antagonist, competitive antagonist, partial antagonists Therapeutic index, LD_{50}, IC_{50}, ED_{50}, Drug toxicity and drug allergy.

UNIT II

12

Principles of drug design - Denovo drug design techniques, Properties of drug likeliness, lipinski rule, In-silico calculation of ADME parameters , Structural activity relationships in drug designing, Lead optimization and validation, Molecular modeling, molecular docking and pharmacophore optimization.

UNIT III

12

Pharmacokinetics and Pharmacodynamics- General Principles of pharmacokinetics Pharmacodynamics parameters like absorption, distribution, metabolism & excretion Factors affecting drug action and enzyme inhibitory studies, Phases of clinical trials, personalized medicine, Pharmaceutically important biotechnological products and their actions.

UNIT IV

12

Mechanism of action of drugs: used in therapy of Respiratory system – cough, bronchial, asthma, pulmonary tuberculosis, Antimicrobial drugs – sulfonamides, trimethoprim, penicillins, aminoglycosides and bacterial resistance, Cancer chemotherapy, Thyroid and antithyroid drugs, insulin and oral antidiabetic drugs, antifertility and ovulation inducing drugs.

UNIT V

12

Enzyme based inhibition activity IC_{50} calculation. Antioxidant activity of super oxide dismutase (SOD) and catalase. Analysis of biological specifications for drug content and estimation of the pharmacokinetic parameters, Measures of bioavailability, Cmax, tmax, and Area under the Curve (AUC) In-silico calculation of drug likeliness of small molecules by using lipinski rule and ADME parameters.

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Recollecting the concept, classification production and application of pharmaceutical substances **(L1)**.

CO2: Imparting a comprehension of basic skills necessary for employing biotechnology principles **(L1)**.

CO3: The knowledge gained in this course would be used to understand and evaluate the different pharmaceutical parameters of the current and future biotechnology related products on the market **(L2)**.

CO4: Understanding in both scientific knowledge of designing and mechanism of action of drugs **(L3)**.

TEXT BOOK

A. The pharmacology, Volumes I and II – Goodman, Gilman.

B. Pharmacology 3rd edition – Rang, Tale. Principles of medicinal chemistry – Foye, Waverks Pvt. Ltd. New Delhi.

REFERENCE BOOKS

A. Basic and clinical pharmacology 7th edition – Katzung, Printice Hall, New Delhi.

B. Pharmacology and pharmaco therapeutics – Satoskar*et al.*, Popular Prakashar, Mumbai.

C. Burger's medicinal chemistry and drug discovery: Principles and Practice – Wolf, John Wiley.

D. Molecular basis of inherited diseases – Davies, Read, IRL Press.
Molecular biotechnology 2nd edition – Glick, Pasternak, Panima Publishers, 2002

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19MBTE105 - BIOMEDICAL NANOTECHNOLOGY (SWAYAM COURSE)

Semester	III
Credit	4
Paper Type	Core
Max. Marks	100

COURSE OBJECTIVES

- To impart knowledge on biomedical applications of nanotechnology
- To gaining overwhelming response in healthcare sector
- To emphasis, the current and future applications of nanostructured materials with respect to their impact in health and health care products.

Week 1: Introduction to nano, Nano-biomimicry, Synthesis of nanomaterials by physical and chemical methods, Synthesis of nanomaterials by biological methods, Characterization of nanomaterials.

Week 2: DNA nanotechnology, Protein & glyco nanotechnology, Lipid nanotechnology, Bio-nanomachines, Carbon nanotube and its bio-applications.

Week 3: Nanomaterials for cancer diagnosis, Nanomaterials for cancer therapy, Nanotechnology in tissue engineering, Nano artificial cells, Nanotechnology in organ printing.

Week 4: Nanotechnology in point-of-care diagnostics, Nanopharmacology & drug targeting, Cellular uptake mechanisms of nanomaterials, *In vitro* methods to study antibacterial and anticancer properties of nanomaterials, Nanotoxicology.

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Explain the fundamentals of nanotechnology and their application to biomedical sciences.
CO2: Describe tools for properties of nanostructures.
CO3: Relate the unique properties of nanomaterials to the reduce dimensionality of the material
CO4: Discuss applications of nanomaterials and implication *in vivo* and *in vitro* biomedical sciences.

TEXT BOOKS

1. Malsch, N.H., Biomedical Nanotechnology, CRC Press. 2005.

REFERENCE BOOKS

1. Mirkin, C.A. and Niemeyer, C.M., Nanobiotechnology II: More Concepts and Applications, Wiley-VCH. 2007.
2. Kumar, C. S. S. R., Hormes, J. and Leuschner C., Nanofabrication towards Biomedical Applications: Techniques, Tools, Applications, and Impact, WILEY -VCH Verlag GmbH & Co. 2005.
3. Lamprecht, A., Nanotherapeutics: Drug Delivery Concepts in Nanoscience, Pan Stanford Publishing Pte. Ltd. 2009.
4. Jain, K.K., The Handbook of Nanomedicine, Humana press. 2008.

Prepared by

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Approved

19MBTE106- Stem cell Technology

Semester	III
Credit	4
Paper Type	Theory
Max. Marks	CIA – 30 + CE – 70

COURSE OBJECTIVES

- To make students understand the basics of stem cells.
- To give a detailed idea about the application of stem cells.
- To provide ideas on the technologies implied in stem cell culturing and application.

UNIT I **12**

Cell Diversification and responses in the early animal embryo: *Xenopus*- Blastomeres and Spatial Segregation, inductive interactions, progressive pattern of new cell types generation. Morphogen gradient organization of complex pattern of cell responses, cell signal response, intracellular signals, early mammalian embryo and developmental potential, responses of mammalian embryonic stem cells to environmental stress and their pathway of development

UNIT II **12**

Renewal by stem cells: Stem cells division, epidermis and differentiated progeny, various keratins synthesis during stem cell development, basal cells, basal cell proliferation and thickness. Epidermal stem cells, secretory cells in the epidermis and population kinetics.

UNIT III **12**

Specialized cells and their functions: Genesis, modulation, and regeneration of skeletal muscle: myoblasts fusion, muscle cells properties and protein isoforms, quiescent stem cells in the adult.

UNIT IV **12**

Fibroblasts and their transformations: the connective-tissue cell family fibroblasts response to signals in the extracellular matrix, connective-tissue cell differentiation, fact cells signaling and production, bone remodeling, osteoblasts and bone matrix, osteoclasts and their ole to connective-tissue framework and body structure.

UNIT V **12**

Hematopoietic stem cell: Types and functions. Hematopoietic stem cell disorders-classification and manifestations of aplastic, myelodysplastic, myeloproliplastic disorders. Clinical applications of colony stems. Complications of germline therapy, replacement therapy and marrow transplantation. Immunological principles, preservation and clinical use of blood and blood components, hemapheresis procedures and oxiplantation.

Total Periods: 60

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Remember the scientific terms by repeated learning **(L1).**

CO2: Understand the concepts with help of videos displayed during class hours **(L2).**

CO3: Trained to choose the correct method and solve the problem by applying the specific techniques **(L2).**

CO4: Students are trained to distinguish even small variations by simple analysis **(L3).**

TEXT BOOK

A. Gilbert. S.F. 2000, Developmental Biology. 6th Edition. Sinauer Associates, Inc. NY

REFERENCE BOOKS

A. Kiessling A. A. and C. S. Anderson, 2003. Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential. Amazon Publishers.

B. Alberts, B., 2002. Molecular Biology of the Cell. 4th Edition. Garland Publishing, Inc., NY.

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19MBTI01 – FIRST AID AND SAFETY

Semester	III
Credit	3
Paper Type	IDC
Max. Marks	100

COURSE OBJECTIVES:

- To Know the limits of basic first aid and deal with emergency situations
- To familiarize themselves with First aid regulations and safety measures.
- To get awareness on Hazard prevention and Control

UNIT – I

9

History of First aid, First aid kit, The Red Cross. Blisters and bruises, Wounds – Types of wounds, Caring for minor and major open wounds, Special problems. Fracture – open fracture, dislocation, sprains, strains, How to make a sling. Severe bleeding.

UNIT- II

9

Poisoning: What is poison, what to do when ingested, inhaled, adsorbed. Animal bites – minor wounds, deep wounds, infection, suspected rabies. Insect stings, spiders and snake bites.

UNIT – III

9

Burns: Minor burns - First degree, Second degree, Third degree burns, Major burns Electric burns, Chemical burns. Cold burns and frost bites. Heat exhaustion and heat stroke – Signs and Symptoms, Precautionary and safety measures.

UNIT- IV

9

Cardiopulmonary resuscitation (CPR) – Assessing the situation, breathing for the person restore blood circulation, CPR on a child and on an infant – airway, breathing, circulation. Choking – in case of conscious and unconscious adult infants and children in conscious and unconscious.

UNIT –V

9

General emotional first aid – reaching out physically and emotionally, protection, reassurance, reinforcement, fainting, shock – causes, symptoms, and help. Anaphylaxis – Foreign body in eyes, ears, skin, inhaled, ingested.

Total Periods: 45

COURSE OUTCOMES

After completion of this course, the students will be able to

CO1: Ability to design and implement a workplace first-aid programs
CO2: Ability to minimize the outcome of accidents.
CO3: Ability to identify and assess the workplace risks that have potential to cause worker injury/ illness.

TEXTBOOK

1. Popli Sharma ,Emergency First-Aid Safety Oriented, CBS Publisher, New Delhi, 2000.

REFERENCES

1. Anatomy of First Aid: A Case Study Approach by Ronald A. Bergman - Anatomy Atlases , 2004.
2. The East West Rescue First Aid Manual Kimberley Chawla - Smashwords , 2014.
3. First Aid and Management of Minor Injuries by Jon Dallimore - Preppers , 2003.

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19MBT306 – INSTITUTIONAL TRAINING / INTERNSHIP

Semester	III
Credit	2[5]
Paper Type	Internship
Max. Marks	CIA - CE-50 Total -50

COURSE OBJECTIVES

- The objectives of this course are to prepare the students to adapt to the research environment and understand how projects are executed in a research laboratory.
- It will also enable students to learn practical aspects of research and train students in the art of analysis and thesis writing.
- Students should be able to learn how to select and defend a topic of their research, how to effectively plan, execute, evaluate and discuss their experiments.

Internship Training

- Students should undergo compulsory Internship Training for a period of 15 days during the second semester summer vacation. Submission of Internship Training report should be done before the completion of Semester – II. Submission is mandatory for acquiring the Degree.
- Viva-voce examination will conducted and the report will be evaluated by the external examiner

Components and Evaluations

	Report			**Marks**
Components	Techniques learnt	Execution	Interpretation of results	
Marks	**10**	**20**	**10**	
	Viva-voce			
Components	Clarity in presentation	Defense		**10**
Marks	**5 marks**	**5 Marks**		
Total				**50**

COURSE OUTCOMES

CO1: Students should be able to demonstrate considerable improvement in Capability to critically and systematically integrate knowledge to identify issues that must be addressed within framework of specific thesis.

CO2: Competence in research design and planning, create, analyse and critically evaluate different technical solutions.

CO3: Ability to conduct research independently, perform analytical techniques/experimental methods Project management skills, Report writing skills, Problem solving skills, Communication and interpersonal skills.

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19MBT401 – BIOETHICS, BIOSAFTEY AND IPR

Semester	IV
Credit	4
Paper Type	Core
Max. Marks	CIA -30 + CE -70 Total 100

COURSE OBJECTIVES

- To understand the basics of the Intellectual Properties, Biosafety and Bioethics and their classification through studying their features
- To discuss about various aspects of biosafety regulations, IPR and bioethic concerns arising from the commercialization of biotech products.
- To comprehend a perspectives on the sustainability of providing protection in patent and patent law

UNIT – I 12

Bioethics-Introduction. General issues related to the environmental release of transgenic plants, animals and microorganisms. Bioethics- positive and negative effects, ethics in biotechnology – rice with vitamin A, slow ripening of fruits, virus resistance crops, fast growing trees and fishes, risk assessment, Ethical issues related to research in embryonic stem cell cloning.

UNIT- II 12

Biosafety-Introduction. Different levels of biosafety. Regulation frame work in various countries- USA, European, Asian. Guidelines for rDNA research activities. General guidelines for research in transgenic plants, Good Laboratory Practices (GLP). Containments-Types and Risk management issues. Basic Laboratory and Maximum Containment Laboratory.

UNIT – III 12

Introduction to IPR, General Agreement on Trade and Tariff (GATT) and World Trade Organizations. Establishment and functions of GATT, WTO and WIPO. WTO Summits. Role of IBSC and RCGM, TRIPS , Physical and Intellectual Property

UNIT- IV 12

Different types of IPR - Patents, Trade mark, Trade secret, Copy right and Geographical indications. trademark, trade secret and copy right, Patenting and the Procedures Involved in the Application for Grading of a Patent, Steps to a Patent, Compulsory Licenses, Rules governing patents. Licensing - Flavr Savr™ tomato as a model. IPs of relevance to Biotechnology - case Studies

UNIT -V 12

Types of patent, Patent application procedure in India, Documents required for filling for an application, examination of application, compulsory license, infringement of patent, security issues, Implementation in developing countries, patent search databases – USPTO and EPO. Indian database search process and engine, biotechnology related patent and database. Public education to increase the awareness of bioethics - case studies

Total Periods: 60

COURSE OUTCOMES

CO1: Able to have a detailed knowledge on the basic issues of biosafety and, bioethics and also to Review international agreements and protocols for Biosafety

CO2: Able to demonstrate the design of confinement facilities at different Biosafety levels

CO3: Able to analyze the social and ethical issues related to plant, animal and modern Biotechnology and also Understand risk management in IP commercialization

CO4: Able to validate the role of IPR in biotech sector and able to apply patent application procedure in India

TEXTBOOKS

Sree Krishna, V., Bioethics, Biosafety in Biotechnology, New Age International Private, 2012

REFERENCES

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2014.
3. Derek Bosworth and Elizabeth Webster,the Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

Course Coordinator **BoS Chairman** **Academic council**

19MBT402 - PROJECT WORK AND VIVA VOCE

Semester	IV
Credit	8
Paper Type	Project
Max. Marks	CIA -160 + CE–40 Total 200

COURSE OBJECTIVES:

- The objectives of this course are to prepare the students to adapt to the research environment and understand how projects are executed in a research laboratory.
- It will also enable students to learn practical aspects of research and train students in the art of analysis and thesis writing.
- Students should be able to learn how to select and defend a topic of their research, how to effectively plan, execute, evaluate and discuss their experiments.

AREA OF STUDIES

Microbial Biotechnology, Animal and Plant Biotechnology, Environmental Biotechnology, Agricultural Biotechnology, Industrial Biotechnology, Biomedical Sciences, Bioinformatics*, Bio nanotechnology and Herbal Technology.

1. The project has to be done in college or any Recognized Research Institute / University / Industry and a certificate has to be obtained for the same from the organization concerned.
2. The project has to be done in any area relating to Biotechnology field.
3. The project has to be done compulsory with more than 70% wet lab and less than 30% of dry lab works.
4. The students will be instructed to follow the guidelines with regard to preparation of project writing.
5. The dissertation should be submitted in type-written, bound form to the department for record
6. The students are requested to present himself / herself for a review for two times, which will be considered for internal evaluation.
7. The project would be evaluated and awarded a maximum of 160 marks in the internal and 40 marks in the external.

INTERNAL MARKS (160 marks)

8. Based on the project preparation marks will be awarded by the respective faculty guide giving weightage to the three aspects viz., the content (160), presentation (160) and viva voce (40).
9. While evaluation of dissertation, 160 marks (80+80 as internal) should be based on oral presentation before the faculty members of department in the presence of concerned supervisor during the period of CIA examinations and 160 marks (internal) should include:

   (a) Evaluation of project work (160 marks) based on:

   (b) Scientific content (100 marks)

   (c) Experiments and final outcome (20 marks)

   (d) Presentation style (20 marks)

   (e) Viva voce (20 marks)

EXTERNAL MARKS (40 marks)

The students have to present himself / herself for a viva voce along with the Project Report. Assessment through presentation by internal examiner at the time of examination

COURSE OUTCOMES:

CO1: Able to demonstrate and capability to integrate knowledge on current research and to identify the issues are systematically addressed within framework of specific field of research.

CO2: Able to compete the thrust area of research, design and planning, create, analyze and critically evaluate different technical solutions.

CO3: Ability to conduct research independently, perform analytical techniques/experimental methods Project management skills, Report writing skills, Problem solving skills, Communication and interpersonal skills.

Course Coordinator **BoS Chairman** **Academic council**