PERIYAR UNIVERSITY

(NAAC 'A' Grade – State University – NIRF 83 – ATAL 4)
Salem – 636 011
Tamilnadu, India

DEPARTMENT OF BIOTECHNOLOGY

REGULATIONS AND SYLLABUS
MASTER OF PHILOSOPHY IN BIOTECHNOLOGY
(Outcome Based Education in M.Phil – Biotechnology)
(Under CBCS for University Department)
2018 – 19 Onwards

DEPARTMENT OF BIOTECHNOLOGY
PERIYAR UNIVERSITY, SALEM- 11
M.Phil Biotechnology
(Curriculum Details-2018-2019)

		Credits
I – Semester		
MPBT01	Research Methodology	4
MPBT02	Plant and Animal Biotechnology	4
MPBT03	Guide Paper	4
II – Semester		
	Dissertation	8
	Viva-Voce	4

		24

Preamble

This curriculum framework for the M.Phil. program in Biotechnology is developed keeping in view of the student centric learning pedagogy, which is entirely outcome-oriented and curiosity-driven. The curriculum framework focuses on pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field based studies. The platform aims at equipping the graduates with necessary scientific skills for biotechnology related careers, in Research, Industry and higher education sectors. Also this framework are master graduates may attribute critical thinking, scientific reasoning, moral ethical reasoning qualification descriptors that are specific outcomes pertinent to the discipline. While designing these frameworks, emphasis is given on the objectively measurable teaching-learning outcomes to ensure employability of the graduates. The pragmatic core of the framework has been designed such a way to enable the learners implementing the concepts to address the real-world problems. Above all, this framework is aimed to mould responsible Indian citizen who have adequate knowledge and skills in reflective thinking, rational skepticism, scientific temper, digital literacy.

Aims

- To transform curriculum into outcome-oriented scenario.
- To develop the curriculum for fostering discovery-learning.
- To equip the students in solving the practical problems pertinent to India.
- To adopt recent pedagogical trends in education including e-learning, and MOOCs.
- To mold responsible citizen for nation-building and transforming the country towards the future.

OBE Regulations and Syllabus

Vision

- Periyar University aims towards excellence in education, research, promoting invention, innovation and preserving culture identity for future generation.

Mission

- Provide a vibrant learning environment, fostering innovation and creativity inspired by cutting edge research.
- Aspire to be a national leader in developing educated contributors, career ready learners and global citizens.
- Provide well equipped facilities for teaching, research, administration and student life.
- Have well defined autonomous governance structure.
- To make a significant, consistent and sustainable contribution towards social, culture and economic life in Tamil Nadu, India.

Values

- Motivation of students to be responsible citizens making them aware of their societal role.
- Inculcate scientific temper, honesty, integrity, transparency, empathy, and ethical values amidst student.
- Impact a desire for lifelong learning to foster patriotic sensibility, accountability and holistic well being.
- Provide conducive and cosmopolitan environment for innovation and free thinking.
- Imbibe value-based education leading to inclusive growth.

Department Vision

The Department of Biotechnology was established in 2008, has offering quality M.Sc. M.Phil and Ph.D programmes in Biotechnology. These programmes have been designed to produce biotechnologists who can address the challenges and needs of the country and the world at large. We aim to become a leading centre of education, research and entrepreneurship in Biotechnology, guided by sound scientific and ethical principles.

Mission

- Provide a vibrant learning environment, fostering innovation and creativity inspired by cutting edge research.
- Aspire to be a national leader in developing educated contributors, career ready learners and global citizens.
- Provide well equipped facilities for teaching, research, administration and student life
- Have well defined autonomous governance structure.
- To make a significant, consistent and sustainable contribution towards social, culture and economic life in Tamil Nadu, India.

Program Educational Objectives

- Competent in applying theoretical and practical hands on approach in Biotechnology.
- To apply the knowledge in providing solution to health, environmental and research problems.
- Promote Innovation and Research in cutting edge biotechnological research.
- To address the problems faced by India and to become a responsible citizen.
- Promote a strong sense of team spirit and brotherhood for building a strong India.

Program Outcomes / Program Learning Outcome (Department Vision)

The graduates of Biotechnology student must have:

- **PO1** Ability to approach, analyze and bring out scientific solution for a given problem.
- **PO2** Knowledge to implement multidisciplinary concepts and ideas for the development of innovative technologies.
- **PO3** Demonstrate technical skills in operation and maintenance of sophisticated instrumentations.
- **PO4** Capability to bring out high quality research publications as well as protect their research through IPR.
- **PO5** Student would be competent discipline-specific study, as well as to begin entrepreneurship.

Students Graduating With the Degree of M.Phil. Biotechnology should be able to Acquire

Core Competency

- The student will enable to learn and demonstrate about basic experimental techniques in classical and modern biotechnology.
- The students will able to understand and explain various aspects such as Plant and Animal Biotechnology, Research methodology, Genetic engineering, Molecular biotechnology, Geno--toxicology and Herbal Biotechnology.
- The students will gain sound knowledge in various fields including Insect Biotechnology, Microbial Biotechnology, Pharmaceutical Biotechnology, Medical Biotechnology and Environmental Biotechnology.

Analytical Ability

- The students will capable of demonstrate the knowledge in understanding research and addressing practical problems.
- Application of various scientific methods to address different questions by formulating the hypothesis, data collection and critically analyse the data.

Critical thinking and Problem solving ability

- An increased understanding of fundamental scientific concepts, principles and their applications is expected at the end of this course. Students will become critical thinker and acquire in depth knowledge in problem solving capabilities.

Digital knowledge

- Students will acquire digital skills and integrate the fundamental concepts with modern biotechnological tools.

Ethical and Moral Strengthening

- Students will also strengthen their ethical and moral values.

Team Work

- Students will learn team work in order to serve efficiently in institutions, industry and society.

Duration

The M.Phil. Programme spans over a period one year from the commencement of the programme comprising of two semesters.

Course of Study

There are three courses for semester I and Dissertation and Viva-Voce for semester II. The third course in the first semester shall be a specialization related to the dissertation.

Structure of Course

S. No.	Paper Code	Title of the paper	Exam Hours	Internal	External	Total Marks	Credits
FIRST SEMESTER							
Core Course							
1	MPBT01	Research Methodology	3	25	75	100	4
2	MPBT02	Plant & Animal Biotechnology	3	25	75	100	4
GUIDE PAPER							
1	MPBT03	Molecular Biology	3	25	75	100	4
2		Herbal Biotechnology	3	25	75	100	4
3		Insect Biotechnology	3	25	75	100	4
4		Microbial Biotechnology	3	25	75	100	4
5		Environmental Biotechnology	3	25	75	100	4
SECOND SEMESTER							
1		Dissertation				200	12

Dissertation / Project Work:

Part-II – Dissertation

The exact title of the Dissertation shall be intimated one month before the end of second semester. Candidates shall submit the Dissertation to the University through the Supervisor and Head of the Department at the end of the year from the commencement of the course which shall be valued by internal examiner (supervisor) and one external examiner appointed by the University from a panel of four names sent by the Supervisor through the Head of the Department at the time of submitting the dissertation.

Dissertation / Project Work

Dissertation / Project Work	**200 marks**	
Concise Dissertation		**150 marks**
Viva-Voce		**50 marks**
Total		**200 marks**

The examiners who value the dissertation shall report on the merit of candidates as "Highly Commended" (75% and above) or "Commended" (50% and above and below 75%) or "Not Commended" (below50%).

If one examiner commends the dissertation and the other examiner, does not commend, the dissertation will be referred to a third examiner and the third valuation shall be final.

Passing Minimum:

A Candidate shall be declared to have passed if he/she secures not less than 50% of the marks in each course.

Restriction in number of chances:

No candidate shall be permitted to reappear for the written examination in any paper on more than two occasions or to resubmit a dissertation more than once. Candidates shall have to qualify for the degree passing all the written papers and dissertation within a period of three years from the date of commencement of the course.

Conferment of Degree:

No candidate shall be eligible for conferment of the M.Phil. degree unless he/she is declared to have passed both the parts of the examination as per the Regulations.

Qualifications for persons conducting the M.Phil. Course:

No teacher shall be recognized as a Supervisor unless he possesses a Ph.D. degree or two years of PG teaching experience after qualifying for M.Phil. degree.

Teaching Learning Outcome

The learning outcomes-based course curriculum framework of biotechnology is designed to persuade the subject specific knowledge as well as relevant understanding of the course. The academic and professional skills required for biotechnology-based professions and jobs are also offered by same course in an extraordinary way. In addition, the learning experiences gained from this course is designed and implemented for cognitive development in every student. The practical associated with this course helps to develop an important aspect of the Teaching -Learning process.

- Class Lectures
- Tutorials
- Seminars

- ❖ Group discussions and Workshops
- ❖ Peer teaching and learning

Question Preparation

- ❖ Subjective Type
  - ➢ Analytical based question
  - ➢ Descriptive question
- ❖ Practical and project-based learning
- ❖ Field-based learning
- ❖ Substantial laboratory-based practical component and experiments
- ❖ Internship in industry, and research establishments

The effective teaching strategies are adopted to develop problem-solving skills, higher-order skills of reasoning and analysis. The designed course also encourages fostering the social values for maintaining and protecting the surrounding environment for improved living conditions. A learner centric and active participatory pedagogy is introduced in this framework.

Examination Pattern **Total Marks-100**

Internal Assessment-25 Marks
External Assessment-75 Marks
Internal Assessment (25 Marks)

1. Monthly test and model examination - 10 marks
2. Seminar - 5 marks
3. Assignment - 5 Marks
4. Attendance - 5 Marks

External Assessment (75 Marks)

Section A

(Analytical Questions) (5x5=25 Marks)

(One question from each unit with internal choice – Answer all questions)

1. (a) or (b)
2. (a) or (b)
3. (a) or (b)
4. (a) or (b)
5. (a) or (b)

Section B

(Descriptive Questions) (5x10=50 Marks)

(One question from each unit with internal choice – Answer all questions)

1. (a) or (b)
2. (a) or (b)
3. (a) or (b)
4. (a) or (b)
5. (a) or (b)

Learning Outcome Based Curriculum Framework

Graduate Attributes

Following the completion of the course the candidate will be proficient in various areas of biotechnology.

Core competency

M.Sc. graduates will know the fundamental concepts of biotechnology. These concepts would reflect the latest understanding of the field, and therefore, are dynamic in nature and require frequent and time-bound revisions.

Communication Skills

Biotechnology graduates will possess the standards of communication skills that will be applied in read and understand research document with in-depth analyses and logical arguments. Graduates are expected to be well-versed in speaking and communicating their ideas, findings and concepts to wider audience.

Critical Thinking

Students will have basics of cognitive skills, scientific methodology and constructing cogent scientific arguments.

Problem Solving

The Graduates will have the capability to apply the knowledge and understanding of biotechnology subject in new contexts and to identify problems and solutions for day to day life.

Analytical Reasoning

Graduates will have proficiency in analysis and interpretation of the results obtained from the experiment.

Research Skills

Graduates will be efficient in designing a scientific experiment through statistical hypothesis testing.

Team Work

Graduates will be team players, with productive co-operations involving members from diverse socio-cultural backgrounds**.**

Leadership Readiness

Graduates will be familiar with decision making process and basic managerial skills to become a better leader.

Vision and Mission of the M.Phil. Biotechnology Course (Qualification Descriptors)

The qualification descriptors for a Master degree in Biotechnology may include following:

(i) To demonstrate a systematic, extensive and coherent knowledge and understanding of academic fields of study as a whole and its applications and links to disciplinary areas of the study; including critical understanding of the established theories, principles and concepts of a number of advanced and emerging issues in the field of Biotechnology.

(ii) To explain procedural knowledge that creates different types of professionals in the field of biotechnology like in research and development, teaching government and public services.

(iii) Developing skills and ability to use acquired knowledge efficiently in areas related to specializations and current updates in the subject.

(iv) Demonstrate comprehensive knowledge in current research, scholarly and professional literature of advanced learning areas of Biotechnology.

(v) Use knowledge understanding and skills for critical assessment of wide range of ideas and problems in the Biotechnology fields.

(vi) Apply the gained knowledge and understanding of Biotechnology to new/unfamiliar contexts and to identify problems and solutions in ever day life.

M.Phil. Biotechnology Syllabus
MPBT01: Paper I - Research Methodology

Credits: 4
Hours: 4/Wk

Course objectives:

Students will understand the various principles, working mechanism, and functions of instruments and techniques like Ultra centrifuge, Gradient centrifuge, FT-IR, AAS, Microscopy, HPLC, NMR, GC-MS, MALDI-TOF, AGE, PAGE Electrophoresis, PCR techniques, Western blot. In addition the concepts of experimental design, statistical analysis and Bioinformatics application will also be studied

Unit I

Centrifugation: Basic principles, Ultra centrifuge, Density Gradient Centrifugation and Sub cellular fractionation by differential centrifugation, Spectroscopy: UV-Visible Spectrophotometer, FT-IR and AAS.

Unit II

Microscopy: Fluorescence, Confocal, Scanning and Transmission Electron microscopes, Super Resolution Microscopy, Image analysis technique for living cells, Gel filtration, Affinity chromatography, HPLC, NMR, GC-MS, MALDI-TOF and Microarray technique. Autoradiography and Liquid Scintillation Counter.

Unit III

Electrophoresis methods: PAGE, Agarose gel electrophoresis, Capillary Electrophoresis, 2D-Electrophoresis and Gel Documentation. Histochemical and Immunotechniques: Antibody generation, detection of molecules using ELISA, Western blot and Immunoprecipitation.

Unit IV

Principles and techniques of Southern and Northern hybridization: Principles and applications of PCR, RT-PCR, and qPCR. Automated DNA sequencing, Next Generation sequencing, DNA Chip Technology, preparation of DNA probes and hybridization, FISH, DNA and Protein Microarray, Flow Cytometry, Chromatin Immunoprecipitation. Fermentor-Types, design and downstream process.

Unit V

Research Ethics, Research/Experimental design, Preparation of Research report, Measures central tendency and Dispersion, Standard error, Regression and Correlation analysis; Student's t-test; Analysis of Variance; Chi-Square test; Application of computers in biostatistics; Bioinformatics: BLAST N & P, multiple sequence analysis, Gene discovery

using EST. Genbank Databases: NCBI, EMBL & DDBJ. Protein sequence Database: Swiss Prot & PDB.

Reference Books

- Keith Wilson and John Walker, 2010. Principles and Techniques of Biochemistry and Molecular Biology. 7th Edn. Cambridge University Press.
- Wayne W. Daniel, Chad L. Cross. 2013. Biostatistics: A foundation for Analysis in the Health Sciences. 10th Edn. Wiley Series in Probability and Statistics.
- Rastogi S. C., Mendiratta N. and Rastogi P. 2013. Bioinformatics Methods and Applications Genomics, Proteomics, and Drug Discovery. 3rd Edn. PHI Learning.
- Terrance G. Cooper. 1977. Tools in Biochemistry. Wiley-Interscience publication, New York.
- Joseph Sambrook & David W. Russell. 2001. Molecular Cloning – A laboratory Manual. 3rd Edn. Cold Spring Harbor Laboratory Press, Cold Spring Habor, New York.
- Charles N. Relly, Donals. T. Saweyer, Robert E. Krieger Huntington. 1979. Experiments of Instrumental methods: A Laboratory Manual, New York.
- Gelvin, S.B., and Schilperoort, R.A. 2000. Plant Molecular Biology Manual, 2nd Edn. Springer Netherlands.
- Norman T.S. Bailey, 1995. Statistical Methods in Biology. 3rd Edn. Cambridge University Press, UK

Course learning outcome:

By the end of the course, the student should able to

CO Number	CO Statement	Knowledge Level
CO1	Understand the Principle and Working of biotechnological equipments.	K2 – K5
CO2	Acquiring knowledge of working mechanisms of microscopy, imaging and analytical instruments	K3- K5
CO3	Understanding the principles and working of electrophoretic, histochemical and immunotechniques	K4 - K5
CO4	Understanding the principles and applications of molecular biology techniques.	K4 – K5
CO5	Unserstanding the fundamental concepts of experimental design, biostatics and Bioinformatics	K2-K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**S**	**S**	**S**
CO2	**S**	**S**	**S**	**M**	**M**
CO3	**M**	**S**	**S**	**S**	**M**
CO4	**M**	**M**	**S**	**S**	**S**
CO5	**S**	**S**	**M**	**S**	**S**

S- Strong; M-Medium

MPBT02: Paper II - Plant and Animal Biotechnology

Credits: 4
Hours: 4/Wk

Course objectives:

This course aims to help the students to gain an advanced level of understanding in the comprehensive components of plant biotechnology. The topics contributes knowledge for food security, sustainable agriculture, Germplasm conservation, secondary metabolites production, Vaccine production and Molecular markers. Perspective on recent advances in animal cell culture and various technical applications including cell line and stem cells. Helps to gain knowledge about IPR, GATT and TRIP.

Unit I

Plant tissue culture: Nutritional requirements, plant growth hormones, genetic variation and chromosome stability. Protoplast isolation, culture and Somatic hybridization. Production of haploid plants. Germplasm conservation. Application of Plant Tissue culture, callus and suspension culture, Protoplast culture: synthetic seed production.

Unit II

Transformation: Agrobacterium mediated, Particle bombardment and Virus mediated. Transgenic plants: Pest and Disease resistance. Recombinant proteins and edible vaccines. Molecular Markers: RAPD, RFLP, AFLP, SNPs. Reporter genes, GUS, resistant markers. Production of secondary metabolites.

Unit III

Cell cultures: primary, secondary, sub culture, pilot and large scale culture. Development of cell line, Separation of viable and non - viable cells, cytotoxicity of cultured cells. Tissue culture techniques. Recombinant subunit and DNA vaccines. Single domain antibody production.

Unit IV

Embryo transfer technology: *In-vitro* fertilization. Transfer of genes: microinjection, electroporation and liposome mediated transformation. Method of producing transgenic animals and applications – gene knockout and knock down. Stem cells – Embryonic and adult. Molecular pharming: Production of pharmaceuticals and biomolecules.

Unit V

Intellectual Property rights (IPR), General agreement on tariff and trade (GATT), Trade related intellectual property (TRIP), Patents for plants, animals, transgenic organisms and DNA sequences. Plant breeder's and farmer's rights. Biosafety and ethical issues.

Recommended Books

- Ralf Pörtner, 2007. Animal Cell Biotechnology: Methods and Protocols (Methods in Biotechnology). 2nd Edition. Humana Press.
- Spier R. and J.Griffiths, 1994. Animal Cell Biotechnology. Academic Press.
- Darling D.C. and S.J. Morgan, 1994. Animal Cells: Culture and Media: Essential Data (Essential Data Series), Wiley-Blackwell Publishers.
- Jennie P. Mather and David Barnes, 1998. Methods in Cell Biology, Volume 57: Animal Cell Culture Methods Academic Press.
- Kalyan Kumar De, 1992. Plant Tissue Culture, New Central Book Agency, Calcutta.
- Robert N. Trigiano, and Dennis J. Gray, 1996. Plant Tissue Culture Concept and Laboratory Exercises, CRC Press, London.
- Srivasta P.S. 1998. Plant Tissue Culture and Molecular Biology, Narosa Publishing House, New Delhi.
- Narayanaswamy, S. 1994. Plant Cell and Tissue Culture, Tata McGraw Hill Publishers.

Course learning outcome:

Upon successfully completing this course, the students could be able to:

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic principles plant tissue culture and its application	K3 – K4
CO2	Design experiments for functional characterization of plant genes and to identify those suitable for creating agronomically important traits. Conceptualize plant transformation, selection of desirable genes for crop improvement and Molecular marker.	K4
CO3	Understand the fundamentals of animal cell culture, and development of	K2 -K4
CO4	To improve artificial embryo transfer and nuclear transfer methods and applications. Stem Cell and production of biopharmaceuticals	K3- K5
CO5	Get updated knowledge about IPR, Patents, Farmer's Rights	K2-K5

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	M	S	S	M	S
CO2	S	S	M	S	S
CO3	S	S	M	S	S
CO4	S	M	S	S	M

CO5	**M**	**S**	**S**	**M**	**S**

S- Strong; M-Medium

MPBT03 Paper III: **Molecular Biology**

Course objectives:

This paper is designed to develop an understanding of fundamental and applied aspects of molecular biology with the ability to use that knowledge in a wide range of modern science. The content include classical molecular genetics, and various aspects of molecular biology which include replication, transcription, translation, gene regulation, DNA binding motifs, DNA methylation and epigenetic regulation. The paper will be helpful for the students in understanding and applying the core concepts in their project and higher studies.

UNIT I

Molecular basis of life – an introduction. The structure of DNA and RNA. Chemical structure of nucleic acids- Nucleotides and Nucleosides, central dogma of molecular biology. Replication of DNA - Prokaryotic replication and Eukaryotic replication, DNA polymerases.

UNIT II

Transcription in prokaryotes and eukaryotes – RNA polymerase and promoters. Transcription in Eukaryotes – RNA polymerase, promoters, enhancers and silencer. Post transcriptional modifications-capping, poly adenylation and splicing mechanisms. Translation –mRNA, tRNA, Ribosome. Post translational modification, Molecular chaperones, protein targeting – Mitochondria, Nucleus, Lysosomes and Peroxisomes.

UNIT III

Isolation and purification of nucleic acid (genomic/plasmid DNA and RNA), Quantification and Storage of nucleic acids, Construction of cDNA library, Construction of Genomic library, Screening and preservation of DNA libraries, colony hybridization, Methods of nucleic acid hybridization – Southern, Northern blot analysis.

Formatted: Font: Not Bold

UNIT IV

PCR – Principle, components of PCR, steps in PCR, Optimization of PCR, Types of PCR. . Cloning of genes by PCR (gene specific and degenerate primers), nested PCR, 5' and 3' RACE-PCR, inverse PCR, hybrid PCR, TAIL PCR, Nested PCR, hot start PCR, Multiplex PCR, Quantitative PCR, Applications of PCR

UNIT V

DNA sequencing – Sanger's method and Maxam and Gilbert method of sequencing, Pyrosequencing and Next generation sequencing. DNA microarray, mRNA differential display, Single strand hybridization probe, Gene therapy: Introduction and Methods, Gene targeting and silencing, Gene therapy in thetreatment of diseases, Challenges and future of gene therapy

References Books:

1. *Peter Snustad, D. and Michael J. Simmon*, 2000. **Principles of Genetics.** [Second Edition]. John Wiley and Sons Publication.
2. *Peter, J. Russell*, 1997. **Genetics.** [Fifth Edition]. Benjamin – Cummings Publishing Company.
3. *Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, HiddePloegh, Paul Matsudaira*, 2007. **Molecular Cell Biology.** [Fifth Edition]. W.H. Freeman and Company. New York.
4. *Robert F. Weaver*, 1999. **Molecular Biology.** [First Edition]. McGraw Hill Publication Company, USA.
5. *Williams. S. Klug and Michael. R. Cummings*, 2004. **Concepts of Genetics**. [Seventh Edition]. Pearson Sons Education (Singapore) Pvt. Ltd., Indian Branch, Delhi.

Course learning outcome:

Completely read this course student will learn following knowledge in genetics and molecular biology

CO Number	CO Statement	Knowledge Level
CO1	Gain knowledge about fundamental concepts of molecular biology	K2-K4
CO2	Understand the various celluar process like transcription, translation , replication and other post modifications	K2-K5
CO3	Understand the methods for isolation, purification and quantification of DNA	K2- K4
CO4	Understand the Principle and Application of various types of PCR	K2-K5
CO5	Understand the principles, working and application of gene sequencing methods, microarrays, and gene therapy	K3- K5

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**S**	**S**	**S**
CO2	**S**	**S**	**S**	**S**	**S**
CO3	**M**	**S**	**S**	**S**	**S**
CO4	**S**	**S**	**M**	**S**	**S**
CO5	**M**	**S**	**S**	**S**	**M**

S- Strong; M-Medium

MPBT03 Paper III: Herbal Biotechnology

Course objectives:

The purpose of this course is to provide basic knowledge in the area of basic science, herbal biotechnology, agriculture and human health. This course will be helpful for the students from various science disciplines to explore the application of medicinal values of herbs.

Unit I:

An introduction to medicinal plants, medicinal plants in traditional system of medicine: Ayurveda, Siddha, Unani, Homeopathy and folklore system of medicine. Diversity hot spots, Endemic plants: endangered and threatened species.

Unit II:

Cultivation of traditional medicinal plants, postharvest technology of medicinal plants, storage of harvested products, processing and packaging of medicinal plant products. Important medicinal phytochemical products and bioactive compounds from plants: Essential oils, volatile and non-volatile oils and oleoresin.

Unit III:

Methods in extraction of phytochemical compounds (Homogenization, Serial exhaustive extraction, Soxhlet extraction, Maceration, Decoction, Infusion, Digestion, Percolation, Sonication, Super Critical Fluid Extraction); Detection of bioactive compounds and qualitative as well as quantitative analysis using GC-MS, HPLC, HPTLC.

Unit IV:

Conservation of medicinal plants- *In situ* & *Ex situ* conservation, Centres for medicinal plant conservation in India, Application of Molecular Biology in authentication of medicinal plants (RAPD, RFLP, AFLP, SSR), Sequence based markers (ITS, 5s rRNA, 18s rRNA, rbcl, trn L, trn F), DNA barcoding.

Unit V:

Plant biomolecules: future prospects in drug industry. Introduction to Human disease management- anti diabetic, anticancer, antiobesity, anti-HIV, antioxidant, antidermatophytes, hypertension.

References Books:

1. P. C. Trivedi. 2006. Medicinal plants – Traditional knowledge. I.K. International publishinghomo Pvt. Ltd.
2. Jitendra Singh. 2007. Medicinal and aromatic crops. Aavishkar Publisher & Distributor, Jaipur

3. Vaidyaratnam P S. 2002. Varier's Indian medicinal plants volume-1-5 a compendium of 500 species -1994, 1995,1996,2001,2002. Arya vaidya sala,orient longman.
4. Anil Kumar. 2010. Medicinal plants. International Scientific Publishing Academy
5. Ravindra Sharma. 2003. Medicinal plants of india – an encylopaedia. Daya Publishing House, Delhi.
6. L. D. Kapoor. 1990. Handbook of Ayurvedic medicinal plants CRC press. Herbal References Library.
7. Kiritikar K.R. and Basu, B.D. 2011. Indian medicinal plants Vol. VIII , CSIR Publications, New Delhi.
8. Janardhan Reddy, K. 2007. Advances in medicinal plants, University Press.
9. Sharma, P.D. 2006. Plant Pathology, Alpha Scientific International, India.
10. Cheng, 1986 3th Edn. Molecular parasitology, Elsevier Publications, London.
11. Lee Lerner and Brenda Wilmoth, 2007. Biotechnology: Industry Vol. III, Thomas-Gale Publications, US.

Course learning outcome:

Upon successfully completing this course, the students could be able to:

CO Number	CO Statement	Knowledge Level
CO1	Understand the basic principles of traditional system of herbal medicine	K3
CO2	Obtain the knowledge on basics of plant diseases and their control measures using herbal plants	K2-K4
CO3	Explain technical aspects of plant biomolecules	K2-K4
CO4	Describe the basics of parasitic diseases and their herbal control measures	K2- K3
CO5	Summarize various forms of human diseases and their treatments using herbal plants	K3-K5

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**S**	**S**	**S**	**S**
CO2	**S**	**M**	**M**	**S**	**S**
CO3	**S**	**S**	**S**	**S**	**M**
CO4	**M**	**M**	**M**	**S**	**S**
CO5	**S**	**S**	**S**	**S**	**M**

S- Strong; M-Medium

MPBT03 Paper III: Insect Biotechnology

Course objectives:

Students will understand the various aspects of Insect biotechnology, like general biology of insects, Neuro-endocrine system, Immunity of Insect, Pest management and Insect pathology.

Unit-1

General biology of insect, Basic body plan, life cycle and homometabolous and hemimetabolous insects, General classification of insect.

Unit- 2

Neuro-endocrine system in insect, Midgut physiology, Insect hormones, Pheromones, Insect Reproduction.

Unit-3

Insect immunity, Insect Haemocyte, phenol oxidases, Eicosanoids action in insects, Immunology, immunity to viruses, Parasitoid poly-DNA viruses and insect immunity RNAi and insect immune system.

Unit-4

Pest Control methods, Integrated Pest Management, Insecticide Resistance- Metabolic, Behavioural and Target site insensitivity. Insecticide Detoxification Enzymes, Gene families involved in Insecticide Resistance.

Unit -5

Insect pathology, Baculoviruses, RNA viruses, Fungal Entomopathogens, Bacterial Entomopathogens, Wolbachia infection in Arthropod host, Defense against microbial Invaders.

Reference Books:

- R.L.Chapman (2001). The insects: structure and function, Cambridge University Press.
- Nancy E. Bekage (2011) Insect immunology IstEdn, Academic press (USA)
- Robert L. Metcalf William H. Luckmann (2011). Introduction to Insect Pest Management 3rd Edn. Wiley India. (New Delhi).
- Alka Fenemore and Prakash (1992). Applied Entomology, Wiley Eastern Limited.

Course learning outcome:

Upon successfully completing this course, the students could be able to:

CO Number	CO Statement	Knowledge Level
CO1	Understand the general morphology of insect	K2-K3
CO2	Obtain the knowledge on neuro endocrine system in insect	K4
CO3	Explain technical aspects of Insect Immunity Pest control methods	K3-K5
CO4	Gain knowledge about principles of insect pest control and their application in the feild	K2-K5
CO5	Gaining keen knowledge about microbial control of insect pests and their future in pest control	K3-K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**M**	**S**	**M**	**S**	**M**
CO2	**S**	**M**	**M**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**
CO4	**S**	**M**	**M**	**M**	**M**
CO5	**S**	**S**	**S**	**S**	**S**

S- Strong; M-Medium

MPBT03 Paper III: Microbial Biotechnology

Course objectives:

Students will understand the basics Important microorganisms, Fermentation types, Vaccines, Algal Cultivation, Production of microbial products and probiotics.

UNIT: I

Isolation of industrial important microorganisms, Strain improvement, Culture preservation and stability, Preparation and Sterilization of media. Types of fermentation – Batch & Continuous. Immobilization of Enzymes& Cells.

UNIT: II

Microbial synthesis of commercial production-pharmaceutical products-Insulin-interferons-rDNA vaccines – HBV and FMD-Gene therapy methods. Enzyme biotechnology-enzyme production from microbes-applications.

UNIT: III

Algal technology-cultivation methods of spirulina- biotechnological potentials of microalgae-Food, Feed and Fuel production. Pharmaceutically Valuable Compounds of microalgae.

UNIT: IV

Production of commercial Products: Antibiotics-Penicillin, Streptomycin, Cephalosporin, Cephamycin. Pharmacologically Active and Related Microbial Products, Anticancer Agents. Production of biotechnological products-SCP (Yeats, Mushroom), Biofertilizer-VAM, Biopesticides-*Bacillus thurinensis*-Biopolymers-*Xanthomonas campestris*.

UNIT: V

Probiotics: Definition and history, Bacterial cell structure, Sources of Probiotics, Mode of action of probiotics. Uses of LAB in food fermentation. Bacteriophages from LAB. Current status of probiotic foods in market.Probiotics in human and animal health, probiotics in feed additives, Probiotics in bioconservation. Probiotic exoenzymes: Enzymes as feed additives.

References Books:

1. Comprehensive Biotechnology. 1-4 Volumes. Murry Moo-Young. Pergamon Press Ltd.
2. Principles of Fermentation Technology. Peter F. Stanbury. Butterworth-Heinemann, Elsevier Science Ltd.
3. Biotechnology: A Text Book of Industrial Microbiology, WulfCrueger and Anneliese Crueger. Science Tech Publishers.USA.
4. Fermentation Biotechnology. JayantoAchrekar. 2006. Dominant Publishers and Distributors. New Delhi.

5. Separation Process in Biotechnology. Juan.A.Asenjo. 2007. Taylor & Francis group.
6. Fermentation and Biochemical Engineering Handbook. Henry C.Vogel& Celeste L. Torado. 2005. Standard Publishers Distributors. New Delhi.
7. Patel, A.H. (2005). Industrial Microbiology. Mac Millan India Ltd, New Delhi.

Course learning outcome:

Completely read this course student will learn following knowledge about microbes

CO Number	CO Statement	Knowledge Level
CO1	Relate modern techniques to the understanding the importance of microorganism, Fermentation types and Immobilization of enzyme	K2- K5
CO2	Fundamental knowledge about commercial production of pharmaceuticals and enzymes using microbes	K3-K4
CO3	Apprise the importance pharmaceutical importance of algal products	K2 - K4
CO4	Understand the importance of production of commercial products using microbial sources	K3-K4
CO5	Explaining of the importance probiotics in human and animal health	K3-K4

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**M**	**S**	**S**	**S**
CO2	**S**	**S**	**M**	**S**	**S**
CO3	**S**	**S**	**M**	**M**	**S**
CO4	**S**	**M**	**S**	**S**	**M**
CO5	**S**	**S**	**M**	**S**	**M**

S- Strong; M-Medium

MPBT03 Paper III: Environmental Biotechnology

Course objectives:

Students will understand the various fields of the Environmental biotechnology, i.e. Ecosystems, Biodiversity, Threats and policy. Sources for environmental pollution and its remedial measures, Toxic chemicals and their impact on environment and human health, Role of microbes in remediation of environmental pollutants, applications of bio-products in society.

UNIT-I

Ecosystem, Food Chain, Food web, Energy flow, Environment: Basic concepts and issues. Environmental pollution**:** Types of pollution, Methods for measurement of pollution.

UNIT-II

Water pollution and its control: Need for water management, Types of Waste water treatment – physical, chemical and biological treatment processes. Microbiology of waste water treatments: Aerobic process, Activated sludge, Trickling filters, towers, rotating discs, rotating drums, oxidation ponds.

UNIT-III

Anaerobic processes: Anaerobic digestion, Anaerobic filters, Upflow anaerobic sludge blanket reactors. Treatment schemes for waste waters of dairy, distillery, tannery, sugar, antibiotic industries.

UNIT-IV

Microbiology of degradation of xenobiotics in environment: Ecological considerations, decay behavior & degradative plasmids; Hydrocarbons, substituted hydrocarbons, oil pollution, surfactants, pesticides. Bioremediation of contaminated soils and wasteland. Biopesticides in integrated pest management.

UNIT-V

Solid wastes: Sources and management (composting, vermiculture and methane production).Global environmental problems: Ozone depletion, UV- B, Green house effect and acid rain, their impact and biotechnological approaches for management.

References Books:

1. Environmental Science and Biotechnology: Theory and Techniques, A.G.Murugesan and C.Rajakumari, (2005).
2. Environmental microbiology, K.VijayaRamesh(2004).
3. Industrial and Environmental Biotechnology,Wise(2005)
4. Encyclopaedia of Environmental Biology, Chhatwal(2005).

5. Environmental Biology, P.D.Sharma(1994) Rastogi Publications.
6. Environmental Biotechnology and cleaner Bioprocesses, Eugenia J.Olguin(2000) Tayloir and Francis.
7. Principle Environmental Science, William P. Conningham and Mary Ann Conningham (2003) Tata McGraw-Hill publishing Company.
8. Environmental Biotechnology, K.V. Agarwall(2005) Nidhi Publishers.
9. Introduction to Environmental Biotechnology, A.K. Chatterji(2002) Prentice- Hall of India.
10. Environmental Biotechnology, Hans-Joachim Jordening, Josefwinter (2005).
11. Environmental Biotechnology by Jogdan.
12. Microbial Ecology, Atlas and Bhartha.2005. Pearson Education.
13. Getting sound knowledge for application of several bio-products in the betterment of society.

Course learning outcome:

By the end of the course, the student should be able to

CO Number	CO Statement	Knowledge Level
CO1	Understanding the various types of ecosystems, biodiversity components, environmental threats and Policy	K2 - K4
CO2	Studying the impact of Water pollution and its remediation measures	K3 – K4
CO3	Understand the process and method of treatment of waste water	K4 – K5
CO4	Explaining the role of microbes in remediation of various products, i.e. pesticides, heavy metals, plastics and oil spills,	K3- K5
CO5	Knowing Solid waste management and climate change	K2- K3

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	**S**	**S**	**S**	**S**	**S**
CO2	**M**	**M**	**S**	**S**	**S**
CO3	**M**	**S**	**S**	**S**	**M**
CO4	**S**	**S**	**S**	**S**	**S**
CO5	**M**	**S**	**M**	**M**	**S**

S- Strong; M-Medium