

Sri Padmavati Mahila Visvavidyalayam

Department of Applied Microbiology

M.Sc. Applied Microbiology

Program outcomes (PO), Program specific outcomes (PSO) and Course outcomes and SYLLABUS (With effect from the academic year 2020-2021 onwards)

Introduction

Applied Microbiology is a Post graduate program in Microbiology designed to educate the students on various aspects of microbiota and their relationship with environment. The curriculum of the program comprises courses on Basics of microbiology, Immunology, Biomolecules and metabolism, Analytical techniques and biostatistics, Medical microbiology, Molecular biology, Virology, Immuno technology & molecular signalling, Enzyme technology, Bioinformatics, Recombinant DNA technology, Fermentation technology, Bioremediation, Animal pharmaceutical biotechnology, molecular and Immuno diagnostics, Research methodology, Public health communication, Omic tools for microbial bioprospecting, Agri biotechnology, Techno entrepreneurship & bioethics.

The syllabus of each course is constructed to Provide students with a theoretical and practical Conceptual knowledge on emergence of recombinant DNA technology from knowledge gained in biochemistry, genetics, cell biology and molecular biology and to understand the basic principles and techniques in genetic manipulation and genetic engineering, describe gene transfer technologies for animals and animal cell lines. All the courses provide the overview and encourage the graduate with outcome based education pattern which provide space for Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation (K1 –K6).

General Graduate Attributes:

- **Communication skills:** The graduates attain the ability to communicate the information on microbiota and their applications through oral presentations and reports.
- **Research related skills:** the students gain knowledge on the significance of important enzymes and cloning and able to analyse the scientific research in the advanced areas of microbiology.
- **Team work:** The students acquires the ability to work effectively as a member and leader within a team. The graduates are capable to utilize the strategic methods to work collaboratively in a team.

- **Knowledge:** The graduates will gain integrated knowledge on various branches of microbiology, like Immunology, Biomolecules and metabolism, Analytical techniques and biostatistics, Medical microbiology, Molecular biology, Virology, Immuno technology & molecular signalling, Enzyme technology, Bioinformatics, Recombinant DNA technology, Fermentation technology, Bioremediation, Animal pharmaceutical biotechnology, molecular and Immuno diagnostics, Research methodology, Public health communication, Omic tools for microbial bioprospecting, Agri biotechnology, Techno entrepreneurship & bioethics.
 - **Global Perspective:** The students may gain the knowledge on the advanced and cutting edge issues of genomics, proteomics and trends in recombinant DNA technology as well as viruses.
 - **Critical thinking:** Through the curriculum the students inculcate the skill in the practical application of scientific knowledge, including the ability to assimilate and analyze the microbiological information.
 - **Problem solving:** The graduate will attain the ability to address the issues in microbiological and biochemical research
 - **Analytical reasoning:** The students are trained in enhanced learning and analytical skills to understand the applications of microbiology
 - **Scientific reasoning:** The graduates attain the knowledge to analyse and demonstrate scientific and experimental data.
 - **Digital literacy:** The graduates sustain the skills to analyse bioinformatics and genomic tools through computational methods and microbial data bases.
- Entrepreneurial competence:** The students acquire an awareness of innovations and intellectual property rights, ethical issues and plagiarism tools.

Programme Specific Qualification Attributes

Programme specific qualification attributes achieved through courses in the programme in terms of

- Knowledge and understanding level (K1 and K2)
- Application level (K3)
- Analytical level (K4)
- Evaluation capability level (K5)
- Scientific or synthesis level (K6)

Program objectives

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO1: The Graduates will be able to work independently on lab protocols involving isolation of microbes from environment samples, immunological tools, biochemical techniques, identification of unknown pathogens, molecular techniques and genomics and proteomic tools.

PSO2: Plan and design experiments to establish scientific process and to synthesize several products through fermentation process / exploit the microbiota for the benefit of community.

PSO3: Microbiologist usually works in hospitals/ clinical laboratories, food industry, environment, research laboratories, beverage industry, pharmaceutical industry and will be able to

understand industrial processes, cleanrooms, and how to effectively evaluate microbial risks to products from people and processes.

Program outcomes

PS1 Demonstrate the knowledge of basic concepts of microbiology, principles and applications of the microbial techniques for isolation, identification & growth parameters of bacteria and fungi.

PS2 Demonstrate the knowledge about the role of immune cells, organs and their functional mechanisms of each & diagnostic tests for antigen-antibody interactions.

PS3 Demonstrate the theoretical and practical knowledge of structure and metabolic functions of biomolecules.

PS4 Ability to use with appropriate techniques and handle the equipment with standard operating procedures, safety aspects, limitations for separation and purification of biomolecules used in pharma & food industry, designing microbiological experiment for statistical analysis, and interpretation of results

PS5 To acquaint the practical skills in the process of purification and quantification of nucleic acids and transfer of genes in bacteria and develop practical skills in tools and techniques used in r-DNA technology.

PS6 Demonstrate the theoretical and practical knowledge of virus classification, multiplication, pathogenic role, newly emerging virus and their control

PS7 To acquaint with practical skills in various microbial fermentation processes, processes for commercially valuable products & attain knowledge about IPR and patents and learn appropriate methodologies, analyze and interpret data and provide solutions.

PS8 Demonstrate the theoretical and practical knowledge of bioremediation, xenobiotics, and effluent treatment methods and global environmental problems & online courses in relevant disciplines, build up Professionals in Pharmaceutical Analysis, immunodiagnostics.

PS9 To develop practical skills in understanding and manipulating the genetic makeup of agricultural products to increase its productivity & efficiency, development of professionals in Agricultural Biotechnology.

PS10 To promote development of techno entrepreneurship and build up Professionals in R&D work and develop practical skills effectively to accomplish research tasks independently/ diverse teams and in multidisciplinary.

3. Duration of the programme

The duration of the course is for two academic years consisting of four semesters.

4. CBCS structure of the program

5. CBCS- Scheme of Examinations semester wise structure

There shall be four semester examinations: first semester examinations at the middle of the first academic year and the second semester examination at the end of the first academic year. Similarly, the third and fourth semester examinations shall be held at the middle and end of the second academic year, respectively.

6. Scheme for Evaluation and Attainment Rubrics

Evaluation will be done on a continuous basis and will be evaluated with two internal exams, assignment and seminar in each semester. The end semester examination is a University theory examination with prescribed question paper pattern with two sections.

Attainment Rubrics for Theory Courses

External : 80 Marks

Internal : 20 Marks

Total : 100 Marks

Time : 3 hours

The following procedure will be followed for Internal Marks:

Theory Papers Internal

Average of two tests: 10 marks

Seminar : 5 marks

Assignment : 5 marks

20 marks

Attainment Rubrics for Lab courses

Practical : 50 external Marks

Practical Test : 40 marks

Record : 5 marks

Viva-voce : 5 marks

Attainment Rubrics for Research project

Internal Mark : 50 marks

External marks:100 marks

Viva - voce : 20 marks

Project presentation : 20 marks

Project Report : 60 marks

11. Grading System

Evaluation of performance of students is based on ten-point scale grading system as given below. **Ten Point Scale**

Grade of Marks	Letter Grade	Description
75 - 100	O	Outstanding
65 - 74	A	Very Good
55 - 64	B	Good
50 - 54	C	Average
35 - 49	D	Below Average
25 - 34	E	Poor
0 - 24	F	Fail
ABSENT	AAA	ABSENT

Course name	course outcome	PS 1	PS 2	PS 3	PS 4	PS 5	PS 6	PS 7	PS 8	PS 9	PS10
First Semester											
BASICS OF MICROBIOLOGY	Demonstrate theory and practical skills in microscopy and their handling techniques and staining	✓	✓								
	Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi. Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively.		✓								
	Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement .										
	Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively										

Semester I (Core Course)

AMB 101

BASICS OF MICROBIOLOGY

Course Outcomes:

- Demonstrate theory and practical skills in microscopy and their handling techniques and staining.
- Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also Understand the structural similarities and differences among various physiological groups of bacteria/archaea.
- Know various Culture media and their applications and also understand various physical and chemical means of sterilization.
- Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi. Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively.
- Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.

IMMUNOLOGY

Course Outcomes:

- To provide students with knowledge on how the immune system works building on their previous knowledge from biochemistry, genetics, cell biology and microbiology.
- Be able to articulate the roles of innate recognition receptors (i.e. Toll-Like Receptors) in immune responses, compare and contrast humoral versus cell-mediated immune responses.
- Be able to distinguish various cell types involved in immune responses and associated functions, role of CD4+ T helper cell lineages Th1, Th2, Th17, and regulatory T cell.
- Be able to distinguish and characterize antibody isotypes, development, and functions, understand the role of cytokines in immunity and immune cell activation.
- Understand the significance the Major Histocompatibility Complex in terms of immune response and transplantation, describe lymphocyte development and the expression of their receptors, an overview of hypersensitive reactions.

BIOMOLECULES AND METABOLISM

Course Outcomes:

- Overview on classification, structure and function of carbohydrates, lipids, proteins, amino acids and nucleic acids, biological significance of carbohydrates, lipids and nucleic acids in the metabolism
- Theoretical knowledge on biosynthesis and catabolism of carbohydrates, lipids and nucleic acids,
- Classification of proteins and structure of proteins - primary, secondary, super secondary, tertiary and quaternary structures
- Specify the significance of urea cycle and ammonia assimilation in the Nitrogen catabolism.
- Explain the Structure, function of enzymes, enzyme kinetics and their allosteric regulation and Catalytic Mechanism of Lysozyme and chymotrypsin and immobilised enzymes, hands on training, on Qualitative and quantitative detection of biomolecules and enzyme kinetics

ANALYTICAL TECHNIQUES AND BIostatISTICS

Course Outcomes:

- Guide the students to select the most suitable technique that can be adapted for their research projects, assist the students to undertake the correct sample preparation.
- Design an analytical work flow to acquire the required data in fulfilling the research Objectives, provides the student with detailed scientific information about the instruments, their merits and limitations.
- Ensure students to write their methodology and justification for choosing the technique in their research work in their scientific publications, to learn the basic microbial techniques like different types of microscopy, electrochemical techniques and centrifugation, and their applications in diverse fields.
- To learn about various chromatographic and electrophoresis techniques in separation and purification of bio molecules, to learn how to and where to apply radioisotopes and molecular characterization of compounds by spectroscopy, biostatistics tools makes the students to interpret their experimental data in a systematic manner.
- Motivates the students to choose relevant industries for their career based on their interest in a particular technique, Preference will be given to the skilful students in appropriate techniques in food, pharmaceutical, chemical , dairy, industries, medical research field and other areas.

MEDICAL MICROBIOLOGY

Course Outcomes:

- To study the main characteristics of medically important microbes and to teach aseptic techniques, to provide understanding of microbial agents like Sterilization, Disinfection, antisepsis.
- To determine the activity of biocide, Germicide, Bacteriostatic, and asepsis by theoretical method, upon completion of this subject, the student will be able to evaluate information about careers.
- Learn about bacterial pathogenesis and diagnosis of urine, blood, CSF, sputum and swab and genital swab.
- To learn about antimicrobial techniques and microbial resistance etc.
- Students gain practical experience in diagnosis of pathogens found in clinical specimens, treatment of infectious diseases by antimicrobial agents.

VIROLOGY

Course Outcomes:

- The Paper will give an overview of medically important virus families and viral infectious diseases. Know how viruses are classified, to understand the architecture of viruses, Know the methods used in studying viruses
- Discern the replication strategies of representative viruses from the seven Baltimore classes, Principles of virus structure.
- Various methods of virus cultivation, alterations in the genetic material of a virus -such changes may result in the creation of new viral serotypes or viruses of altered virulence.
- Explain vaccine strategies and mechanisms of antiviral drugs and interferons. Pathogenicity, transmission of viruses and additionally diagnosis, prevention, treatment of human viral diseases.
- Emphasis will be put on virus-host interactions as a key to understanding the diversity of viruses.

IMMUNO TECHNOLOGY & MOLECULAR SIGNALLING

Course Outcomes:

- Understand the structure and function at the molecular and cellular level of the immune defence, provide the knowledge about the transfusion and transplantation immunological reactions able to provide an overview for polyclonal, monoclonal and humanized antibodies and production of hybridoma
- To gain a deep knowledge about the auto immune diseases and Immune deficiency disorders, describe immunization/vaccination, immunological disease and immunotherapy.
- Discuss immunological techniques and their applications in biotechnical industry, the key roles of mitosis and meiosis during the life cycle. Compare and contrast different life cycle strategies, focusing on the human life cycle.
- Stages of mitosis and meiosis, highlighting similarities and differences, understand the cancer and cell cycle.
- Understand the basic principles of signal transduction mechanisms, in particular the concepts of response specificity, signal amplitude and duration, signal integration and intracellular location

ENZYME TECHNOLOGY

Course Outcomes:

- The course provides the theory and knowledge relevant to the enzymology principles including fundamental properties of enzymes, enzyme catalytic mechanisms and enzyme kinetics.
- Compare methods for production, purification, characterization and immobilization of enzymes.
- Students will also be introduced to the theory as well as applications of enzyme technology in food, medical, and household industries.
- Apply biochemical calculation for enzyme kinetics and plot graphs based on kinetics data.
- Discover the current and future trends of applying enzyme technology for the commercialization purpose of biotechnological products.

Semester II (Internal Elective)

AMB 204

BIOINFORMATICS

Course Outcomes:

- Aimed to provide an overview of various bioinformatics tools, databases available and sequence analysis.
- Retrieve information from available databases and use them for microbial identifications.
- Provide knowledge on database concept, management, retrieval along with utilization in gene and protein analysis. Protein Structure and prediction Molecular Modeling and docking.
- Gain ability to modify gene and protein structures in simulated systems.
- Develop competence to retrieve information from biological databases and integrate these biological information with computational software

RECOMBINANT DNA TECHNOLOGY

Course Outcomes:

- To provide students with Conceptual knowledge on emergence of recombinant DNA technology from knowledge gained in biochemistry, genetics, cell biology and molecular biology.
- Overview of the important techniques used in sequencing, amplification and cloning of DNA
- Gain knowledge on the significance of important enzymes and cloning. Able to Importance of different type of vectors available and basis for their construction and selection.
- Understand the major issues in heterologous expression of gene and strategies employed to overcome Conceptual knowledge on ways to maximize the expression in prokaryotic and eukaryotic systems.
- Study the application of r DNA in various fields benefitting mankind. Gain practical experience in amplification and isolation of gene fragments and cloning. Use of *insilico* tools to design primers. Generation of restriction maps and identification of genes.

FERMENTATION TECHNOLOGY

Course Outcomes:

- Outline the different fermentation techniques, bioreactor design, media formulation and strain improvement for industrial fermentations and explain the different stages in the downstream processing.
- Conceptual knowledge on production of Single cell protein, Wine and beer.
- Understanding of industrial production and purification of antibiotics, enzymes, amino acids, alcohol, acetone and butanol, discuss the spoilage and preservation of Foods and Dairy products.
- Explain the implication of Immobilized enzymes and cells in industrial production.
- Hands on training on submerged and solid state fermentation and exploitation of bacteria, yeast and fungi in the industrial production of various products.

BIOREMEDIATION

Course Outcomes:

- Familiarize students with general principles and subject knowledge in the field of environmental Microbiology.
- The main purpose of this paper is to pay attention towards Extremophiles, Biobleaching, Aerobiology, Marine Microbiology, Sewage Microbiology and Bioremediation.
- Describe role of microorganisms in varied fields of environmental microbiology like bioremediation and waste water treatment from leather, textile and food processing industries, various solid waste treatment technologies.
- Degradation of Xenobiotic compounds and the process to remove different heavy metals, other waste compounds which are harmful to human beings.
- Applications of bioremediation technology. Genetically Modified Microorganisms fate in environment and associated hazards.

ANIMAL PHARMACEUTICAL BIOTECHNOLOGY

Course Outcomes:

- Providing students with a theoretical and practical understanding of animal biotechnology.
- Describe the structure of animal genes and genomes.
- Describe how genes are expressed and what regulatory mechanisms contribute to control of gene expression.
- Describe basic principles and techniques in genetic manipulation and genetic engineering, describe gene transfer technologies for animals and animal cell lines.
- Describe techniques and problems both technical and ethical in animal cloning.

MOLECULAR AND IMMUNO DIAGNOSTICS

Course Outcomes:

- To explain the available molecular, genomic, proteomic and metabolomics diagnostic procedures available for various diseases
- To interpret certain molecular reasons behind the certain hereditary diseases
- To learn the technologies available and lacuna for the non-cultured and slow growing pathogens.
- To explain the available molecular, genomic, proteomic and metabolomics diagnostic procedures available for various diseases
- To learn the technologies available and lacuna for the non-cultured and slow growing pathogens.

Semester III (Core Course)

AMB 304

RESEARCH METHODOLOGY

Course Outcomes:

- Identify and discuss the role and importance of research in the social sciences.
- Identify and discuss the issues and concepts salient to the research process.
- Identify and discuss the complex issues inherent in selecting a research problem, selecting an appropriate research design, and implementing a research project.
- Identify and discuss the concepts and procedures of sampling, data collection, analysis and reporting.

Semester III (External Elective)

PUBLIC HEALTH COMMUNICATION

Course Outcomes:

- Students identify the socio-economic, behavioural, biological, environmental, and other factors that impact human health and contribute to health disparities.
- Students understand the types of diseases and infections for promoting and protecting health across the life course.
- Students get deeper understanding on communicable and non-communicable diseases.
- Students will develop health communication strategies to address public health issues.
- Students will be able to develop health messages using mass media tools to a variety of audiences and will be able to translate scientific information for the benefit of different audiences.

OMIC TOOLS FOR MICROBIAL BIOPROSPECTING

Course Outcomes:

- Understanding the basic concepts of genomics, metagenomics, proteomics, learning of genomics tool box with special focus on PCR and Non PCR based approaches
- Understanding of DNA microarrays ,Protein arrays, Community genome arrays
Phylogenetic oligonucleotide arrays, depth of knowledge on application of Omic technologies in Bioprospecting and Agriculture.
- Explain the principles and protocols of 2DE, Mass spectrometry analysis MS 2-DE/MS, ICAT
- Conceptual knowledge on Yeast two hybrid analysis; Peptide finger printing, protein chip assay
- Training on bioinformatics tools like nBLAST, pBLAST, Multiple Sequence Analysis and Gene Annotation of genome sequences Amplification of 16S DNA, Separation and characterization of proteins.

AGRI BIOTECHNOLOGY

Course Outcomes:

Describe the role of agri biotechnologies in food production, food processing, and food security

- Summarize the methods used to produce transgenic plants, and explain the selection processes for identifying transformed plant cells Describe the role that *Agrobacterium tumefaciens* plays in producing genetically modified plant crops
- Discuss how proteins of interest may be purified from plant samples and how DNA or protein samples may be assayed for their concentration and purity
- Explain how genomic and plasmid DNA can be isolated from cells, including the additional steps required for plant cell DNA isolation
- Give specific examples of agricultural biotechnology applications, including genetically modified organism (GMO) crops, hydroponics, and plant-made pharmaceuticals
- Benefits of Selective Breeding: and Improved nutritional value Increased growth rate Plants Resistant to selected viruses Benefits of Hydroponics ,microgreens and mushrooms -Soil-less, water-based medium to grow.

TECHNO ENTRENEURSHIP & BIOETHICS

Course Outcomes:

- Understand their personal characteristics and interests to that of the “successful” entrepreneur,
- Identification and assess sources of support for small businesses and entrepreneurs.
- Evaluate methods of entering an entrepreneurship venture – including but not limited to starting a new venture, buying an existing business, or becoming a franchisee
- Acquire idea and information on funding for start-ups
- Different forms of patents, terms and conditions of patents

