B.Sc. APPLIED MICROBIOLOGY
(Choice Based Credit System)

REGULATIONS AND SYLLABUS

From 2017-18 onwards
AIM OF THE COURSE
The B.Sc. Applied Microbiology course aims to impart the students with basic principles of Microbiology and their applications to humankind.

ELIGIBILITY FOR ADMISSION
Candidates for admission to B.Sc. Applied Microbiology shall be required to have passed H.Sc., (+2) or its equivalent with Botany/Zoology/Biology as one of the subjects of study.

DURATION OF THE COURSE
Prescribed studies in B.Sc. Applied Microbiology shall be of six consecutive semesters (three years). The maximum duration allowed for each student to acquire prescribed number of credits in order to complete the Programme of Study shall be twelve consecutive semesters (six years).

AGE LIMIT
The rules as applicable to other Under Graduate courses as prevailing in Pondicherry University.

MEDIUM OF INSTRUCTION
The medium of instruction shall be English

PATTERN OF EXAMINATION
- The End-Semester examination for each course in a B.Sc. Applied Microbiology shall be conducted by the Pondicherry University for a maximum of 75 marks and Internal Continuous Assessment for 25 marks.
- Internal Assessment for all theory courses shall be done on the basis of at least two Internal Assessment tests (15 marks), term papers/assignments/seminars/case demonstrations/presentations/write-ups/viva voce etc. (5 marks) and attendance (5 marks).
The following weightage shall be given to attendance:

- 95% - 100% (5 marks)
- 90% - 94% (4 marks)
- 85% - 89% (3 marks)
- 80% - 84% (2 marks)
- 75% - 79% (1 mark)

- For Skill Enhancement Course of Semester VI (SEC-4/APMB-361) Microbes and Their Applications (Credit Seminar) course’s End-Semester examination (75 marks) shall be internally conducted and evaluated by the Department of Microbiology.
- The Practical End-Semester examination for each course in a Programme of Study shall be conducted by the Pondicherry University for a maximum of 35 marks and Internal Continuous Assessment for 15 marks.
- Internal Assessment for all Practical courses involving Laboratory/Field work/Project work shall be done on the basis of one Internal Assessment test (5 marks), practical observation/demonstration/viva voce/model making or presenting (5 marks) and attendance (5 marks).
- End-semester examination shall be conducted for all courses offered. The duration of the end-semester examination shall be 3 hours.
- Every student has to pay examination fee per Credit basis as fixed by the University.
- A schedule of end-semester examinations will be prepared and displayed by the University much in advance.
- No student with less than 75% in any particular course shall be permitted to attend the end-semester examination and shall be given grade FA-failure due to lack of attendance. However, an overall condonation of 10% is permitted for valid reasons (NCC, NSS, Swachh Bharat) or medical reasons. A student who has been awarded FA shall repeat the course when offered. The Principal/Head of the Department shall ensure that the candidate is informed about the lack of attendance before the commencement of end-semester examination and confirm that such candidates are not permitted to write the examination.
- To pass a course the student must secure minimum of 40 out of 100 marks (40%) in the internal and in the end-semester examination.
A student who has earned the required number of 120 credits by clearing all the required courses shall be declared as pass even if he/she could not clear optional courses which were taken in excess of the required number of courses.

Result Passing Board for each Programme of Study shall be constituted by the Pondicherry University from time to time.

Revaluation and re totaling of the answer scripts shall be allowed within the stipulated period of time as decided by the Controller of Examinations (COE) after paying the required amount of fee.

SUPPLEMENTARY EXAMINATION

A failed student who meets the attendance requirement may be permitted to register for the next end-semester examination in the following semester itself.

Students who have failed due to insufficient attendance and/or less than 40% Internal Assessment marks should repeat the course as and when offered.
DISTRIBUTION OF MARKS

THEORY

Total: 100 Marks

End-Semester University Examination: 75 marks
Continuous Internal Assessment: 25 marks
[comprises of Internal assessment tests - 15 marks; term papers/assignments/seminars/case demonstrations/ presentations/write-ups/viva voce - 5 marks; Attendance - 5 marks]

- Requirement for minimum pass in Continuous Internal Assessment: 10 marks (40 %) out of 25 Marks
- Requirement for minimum pass in Term End University Examination: 30 marks (40 %) out of 75 Marks

For Skill Enhancement Course of Semester VI (SEC- 4/APMB-361) Microbes and Their Applications (Credit Seminar) course’s End-Semester examination (75 marks) shall be internally conducted and evaluated by the Department of Microbiology.

PRACTICALS

Total: 50 Marks

End-Semester University Practical Examination: 35 marks
Continuous Internal Assessment: 15 marks
[one Internal Assessment test (5 marks), practical observation/ demonstration/viva voce/model making or presenting (5 marks) and attendance (5 marks)].

- Requirement for minimum pass in Continuous Internal Assessment: 6 marks (40 %) out of 15 Marks
- Requirement for minimum pass in Term End University Examination: 14 marks (40 %) out of 35 Marks
QUESTION PAPER PATTERN FOR THEORY AND PRACTICALS

Theory External Examination (75 marks)

Time: 3 hours  Max. Marks: 75

Part – A  \(10 \times 1 = 10\) Marks
(2 questions from each unit)

Part – B  \(5 \times 7 = 35\) Marks
(Short answer type – either or choice, one question from each unit)

Part – C  \(3 \times 10 = 30\) Marks
(Essay answer type - 3 out of 5 Questions have to be answered, 1 question from each unit)

Practical External Examination (35 marks)

Time: 3 hours  Max. Marks: 35

I. Question 1 (20 Marks)

II. Question 2 Spotters (5 Marks)

III. Record (10 Marks)
(Submission of practical record for the End Semester Practical Examination is mandatory).
# Course Structure for B.Sc. Applied Microbiology

Implemented from 2017-18 onwards

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<tr>
<th>COURSE</th>
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<th>TITLE OF THE PAPER</th>
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| ENGLISH – 4  | ENGL 242      | English – IV                                             | 03     |             | 5      |            |
| DSC – 1D     | APMB 241      | Virology                                                | 03     |             | 4      |            |
| DSC – 2D     | APMB 242      | Medical Bacteriology                                     | 03     |             | 4      |            |
| DSC – 3D     | APMB 243      | Plant Pathology (Biological Science - II)                | 03     |             | 4      |            |
| DSC – 4D     | APMB 241P     | Practical - X Virology                                   | 01     |             | 2      |            |
| DSC – 5D     | APMB 242P     | Practical - XI Medical Bacteriology                      | 01     |             | 2      |            |
| DSC – 6D     | APMB 243P     | Practical - XII Plant Pathology                          | 01     |             | 2      |            |
| SEC – 2      | APMB 244      | Mushroom and Spirulina cultivation                        | 02     |             | 2      |            |

B.Sc. Appl Microbiology CBCS (2017-18 onwards)
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Total number of Credits - 120

*APplied Microbiology; the first numeral stands for year of collegiate education; second numeral stands for number of the semester; third numeral is for serial number of the course. P denotes practical course

*Among five papers, student have the choice of selecting any three papers (theory with practical course)

Abbreviations used: DSC - Discipline Specific Core course; AECC - Ability Enhancement Compulsory Course; SEC - Skill Enhancement Course; GE - Generic Elective course; DSE - Discipline Specific Elective course; MIL - Modern Indian languages
SEMESTER – I

DSC - 1A

APMB 111 FUNDAMENTALS OF MICROBIOLOGY (3 credits)

Unit - I

Unit - II
Microscope – principles and application – simple and compound microscope – dark field – phase contrast, fluorescent microscope, SEM and TEM. Types of staining – simple, differential (Gram’s, AFB), special – capsular staining (negative), spore, LPCB, KOH mount.

Unit - III
Ultrastructure of bacteria, cell envelope, cell wall – Gram positive and Gram negative bacterial cell wall, slime, flagella, capsule, pili.

Unit - IV

Unit - V

Text Books

Reference Books
DSC – 4A

APMB 111P    Practicals – I: FUNDAMENTALS OF MICROBIOLOGY    (1 credit)

1. Handling of instruments and laboratory safety measures.
2. Handling and maintenance of compound microscope.
3. Cleaning of glasswares and preparation of cleaning solutions.
4. Staining techniques a. simple, b. differential staining (Gram’s and Ziehl-Neelsen), c. special staining (spore and capsular staining methods) and wet-mount.
5. Hanging drop technique – motility.
6. Handling of laboratory instruments a. autoclave b. hot air oven c. laminar air flow d. pH meter.
7. Media preparation: a. liquid media – peptone water, nutrient broth; b. solid media – nutrient agar (agar slant, agar plate); c. enriched medium – blood agar; d. differential medium – Mac Conkey agar; e. enrichment medium – selenite F broth; f. selective medium – EMB, MSA.
SEMESTER – I

DSC – 2A

APMB 112             CELL BIOLOGY                  (3 credits)

Unit - I

History of cell biology, cell as basic unit of life, cell theory, protoplasm theory and organismal theory, broad classification of cell types, Bacteria, Archaea (prokaryotic) and Eukaryotic cells and their similarities and differences.

Unit - II


Unit - III

Structure and functions of cell organelles – endoplasmic reticulum (rough endoplasmic reticulum and smooth endoplasmic reticulum), golgi apparatus, lysosomes, microbodies (peroxysomes and glyoxysomes), vacuoles, ribosomes, centriole and basal bodies.

Unit - IV


Unit - V


Text Books


Reference Books

DSC – 5A

APMB 112P  Practical – II:  CELL BIOLOGY  (1 credit)

1. Study of plant and animal cell types basic structure using micrographs or model.
2. Study of bacterial cell structure, shape and arrangement using micrographs or model.
3. Blood as liquid tissue – demonstrating the different types of blood cells.
4. Cytoplasmic streaming in eukaryotic cells.
5. Stomatal cell type in plant tissues.
6. Mitosis demonstrated using onion root tip method
7. Studying the different cellular organelles of the eukaryotic and prokaryotic cells with animation and micrographs.
8. Demonstration of quorum sensing in bacteria using animation or micrographs.
SEMESTER – I

DSC – 3A

APMB 113 FUNDAMENTALS OF BIOCHEMISTRY (3 credits)
(Biochemistry - I)

Unit - I

Unit - II
Chemistry of amino acids: standard and non-standard amino acids and their properties, amphoteric nature, isoelectric point, isoelectric pH and Zwitter ion – Ramachandran plot for amino acids. Reaction with ninhydrin, 1-fluoro-2, 4-dinitrobenzene (FDNB) and Siegfried’s carbamino reaction.

Unit - III

Unit - IV
Chemistry of lipids: definition, classification and functions. Occurrence, chemistry and biological functions – simple lipids: tertiary compound lipids (e.g. phospholipids), derived lipids: steroids (e.g. cholesterol). Saturated and unsaturated fatty acids physical property – emulsification. Chemical properties – saponification, rancidity, definition of acid number, saponification number, iodine number and Reichert-Meissl number. Bile acid and bile salt functions.

Unit - V
Chemistry of nucleic acids: definition, sugar pucker – nucleoside, nucleotide and polynucleotide. Double helical model of DNA – super coil forms and linking numbers of DNA. Structure of RNA’s – occurrence, chemistry and biological functions. Differences between DNA and RNA, properties – quantification of nucleic acids – thermal denaturation – cot curve and cot value, Tm, hypo and hyperchromicity.

Text Books
Reference Books
DSC - 6A
APMB 113P    Practicals – III: FUNDAMENTALS OF BIOCHEMISTRY (1 credit)

1. Estimation of HCl using Na₂CO₃ as link and NaOH as primary standard.
2. Estimation of iron in ferrous ammonium sulphate using potassium permanganate as link solution and oxalic acid as primary standard.
3. Estimation of glucose by Benedict’s test.
4. Estimation of glycine by formal titration.
5. Estimation of ascorbic acid.
6. Preparation of starch from potatoes.
7. Qualitative analysis of protein.
8. Qualitative analysis of fats.
9. Preparation of ovalbumin from egg.
SEMESTER – II

DSC – 1B

APMB 121 MOLECULAR BIOLOGY (3 credits)

Unit - I
History of molecular biology, DNA and RNA as genetic materials, experiments of Griffith, Avery, Macleod and McCarty, Hershey and Chase, Leaderberg and Tatum, Chargaff’s principles, primary and secondary structure of DNA and RNA. Alternative forms of DNA double helices – types of RNA.

Unit - II

Unit - III
Steps involved in transcription of prokaryotes, promoters, transcription factors, RNA polymerases I, II and III – ribosomal RNA transcription and processing – genetic code, deciphering the genetic code, characteristics of genetic code, Wobble hypothesis, central dogma of life and reversal of central dogma.

Unit - IV

Unit - V

Text Books
Reference Books


1. Introduction to molecular biology laboratory techniques and development skills.
2. Elaboration of DNA and RNA structure and forms using micrograph or animation.
3. Working on Agarose gel electrophoresis.
4. DNA isolation from *E. coli*.
5. DNA estimation – spectrophotometric method.
6. UV irradiation – Percent survival curve.
7. Transformation (demonstration).
8. Isolation of plasmids (demonstration).
9. Isolation of RNA from cells (demonstration).
10. Identification of bacterial phylogeny using 16S rRNA gene sequencing (demonstration).
SEMESTER – II

DSC – 2B

APMB 122 IMMUNOLOGY (3 credits)

Unit - I
History of immunology, host parasitic relationships, microbial infections – types – sources of infection – steps involved in infection – transmission of infection, virulence – toxigenicity and invasiveness, host resistance. Innate immunity and acquired immunity.

Unit - II
Structure, functions and properties of immune cells: stem cell, T cell, B cell, NK cell, macrophage, neutrophil, eosinophil, basophil, mast cell, dendritic cell and immune organs – bone marrow, thymus, lymph node, spleen, GALT, MALT, CALT.

Unit - III

Unit - IV
Antigen and antibody reactions: In-vitro methods – agglutination, precipitation, complement fixation, immunofluorescence, enzyme linked immuno sorbent assay (ELISA), radioimmunoassay. In-vivo methods: skin tests – immune complex tissue demonstrations.

Unit - V

Text Books

Reference Books
DSC – 5B

APMB 122P Practical – V: IMMUNOLOGY (1 credit)

1. Identification of human blood groups – forward and reverse grouping.
2. Separation of serum from blood sample (demonstration).
3. Separation of plasma from blood (demonstration).
4. Differential leukocyte count of the given blood sample.
5. Precipitation reaction: Ouchterlony double immunodiffusion test.
6. Radial immunodiffusion.
7. Counter immunoelectrophoresis (CIE).
8. Rocket electrophoresis.
10. Agglutination Test – Widal test.
11. Antistreptolysin O (ASLO) test.
12. ELISA (demonstration).
SEMESTER – II  
DSC – 3B  

APMB 123  
CLINICAL BIOCHEMISTRY  
(3 credits)  
(Biochemistry - II)

Unit - I  

Unit - II  

Unit - III  

Unit - IV  

Unit - V  

Text Books  

Reference Books  
DSC – 6B

APMB 123P  
Practicals – VI: CLINICAL BIOCHEMISTRY  
(1 credit)

1. Blood sugar analysis.
2. Blood urea analysis.
5. Serum – cholesterol estimation.
7. Estimation of total protein.
9. Urine analysis.
10. Estimation of SGOT and SGPT.
SEMESTER – III
DSC – 1C

APMB 231 BACTERIAL PHYSIOLOGY AND METABOLISM (3 credits)

Unit - I

Unit-II

Unit - III
Biosynthesis of cell structures from glucose (cell wall, capsule, flagella structure and synthesis, cell inclusions) – biochemistry of nitrogen fixation – nitrogenase enzyme – nitrogen assimilation – sulfate assimilation – anaplerotic reactions in the catabolic pathways.

Unit - IV

Unit - V

Text Books
**Reference Books**


DSC – 4C
APMB 231P  Practical – VII: BACTERIAL PHYSIOLOGY AND METABOLISM
(1 credit)

1. Determination of growth curve of bacteria.
2. Bacterial population count by turbidity method.
4. Effect of temperature on bacterial growth.
5. Effect of pH on bacterial growth.
7. Nitrification and denitrification by bacteria.
8. Biolog/API based biochemical tests (demonstration).
SEMESTER – III
DSC – 2C
APMB 232 RECOMBINANT DNA TECHNOLOGY (3 credits)

Unit - I
Introduction to recombinant DNA technology – tools for rDNA technology – DNA manipulative enzymes: restriction enzymes, ligases, polynucleotide kinase, phosphatase, cutting of DNA molecules – joining of DNA molecules – homopolymer tails, linkers, adapters.

‘Unit - II

Unit - III
Transformation of r-DNA into target host organisms: calcium chloride mediated gene transfer, Agrobacterium mediated DNA transfer, electroporation, microinjection, liposome fusion, particle gun bombardment. Screening and selection of recombinant host cells: blue/white screening.

Unit - IV
Construction of gene libraries: genomic and cDNA libraries. Blotting techniques, polymerase chain reaction (PCR) and its applications.

Unit - V
Applications of rDNA technology in industry, medicine, agriculture and pharmacy. Social impact of recombinant DNA technology.

Text Books

Reference Books
DSC – 5C

APMB 232P  
Practicals-VIII: RECOMBINANT DNA TECHNOLOGY  
(1 credit)

1. Agarose gel electrophoresis.
2. Isolation of total bacterial DNA.
3. Isolation of yeast DNA.
4. Isolation of DNA from red blood cells.
5. Isolation of plasmid DNA.
6. Restriction digestion.
7. Ligation.
8. Production of competent *E. coli* cells.
UNIT I
Classification of insects according to Order – Pests of crops: any three pests for each crop, their life cycle and control measures: food crops – rice, sorghum; pulses – red gram, green gram, black gram; cash crops – sugarcane; fibre – cotton; oilseeds – groundnut, coconut; vegetables – brinjal, tomato, ladies’ finger; spices; condiments and beverages – cardamom, chilly, tea, coffee; fruit trees – mango, citrus, grapes.

UNIT II
Pests of stored products, their life cycle and control: beetles – red grain beetle; rice weevil, paddy bore beetle, pulse beetle, carpet beetle; moths – paddy grain moth, rice meal worm. termites and their control – insect vectors of plant diseases and their control.

UNIT III
Beneficial insects: honeybee, silkworm, lac insects – their biology, life cycle and uses to humankind. Insect predators, parasites and parasitoids that destroy crop pests and other harmful insects of human live stocks.

UNIT IV

UNIT V

TEXT BOOKS
Reference Books
DSC – 6C

APMB 233P  Practical – IX: ECONOMIC AND MEDICAL ENTOMOLOGY

(1 credit)

1. Collection, preservation and display of insects (representing any 15 insect orders).
2. External morphology of an insect (e.g. grasshopper).
3. Demonstration of Insects metamorphosis.
4. Life cycle of honey bee; beehive and their parts.
5. Rearing of mulberry silkworms.
6. Collection, observation and importance of crop pests.
7. Collection, observation and importance of storage pests.
8. Collection of medically important pests and understanding their role in human diseases.
SEMESTER – III
SEC– 1
APMB 234 PUBLIC HEALTH MICROBIOLOGY (2 credits)

Unit - I
Introduction to public health: definition, scope, concept and importance of public health microbiology – roles of microbiologist in public health – microbial association of water, air and soil.

Unit - II

Unit - III

Unit - IV
Food borne diseases: definition and importance of food hygiene – types (spoilage of meat and its products, milk and dairy product, fish and fish products and eggs) – role of microorganisms in food spoilage and poisoning – food borne diseases – types of food borne diseases – food poisoning – food borne infection.

Unit - V
Hospital acquired infection: Prophylactic immunization – disposal of infective hospital and laboratory materials – monitoring of sanitation in community – techniques used for the diagnosis of hospital acquired infection.

Text books

Reference books
SEMESTER – IV

DSC – 1D

APMB 241

VIROLOGY (3 credits)

Unit - I

Unit - II

Unit - III
Morphology, classification, characteristics pathogenicity, laboratory diagnosis, prevention and control of infections produced by the following group of viruses. Adeno virus, Pox virus, Herpes virus, Papiloma virus, viral Hepatitis, Ebola and Zika viruses.

Unit – IV
Morphology, classification, characteristics pathogenicity, laboratory diagnosis, prevention and control of infections produced by the following group of viruses. Polio, HIV, Picorna viruses, Influenza and Rhabdo viruses. Teven and Todd phages, viriods and prions.

Unit - V

Text Books

Reference Books
APMB 241P Practical – X: VIROLOGY (1 credit)

1. Isolation of bacteriophage from sewage sample.
2. Preparation of bacteriophage stock.
3. Titration of bacteriophage.
4. One step growth of bacteriophage.
5. Plaque assay.
6. Chick embryo inoculation.
7. Study of plant viral symptoms (demonstration).
8. Study of disease symptoms caused by viroids (demonstration).
SEMESTER – IV
DSC – 2D

APMB 242        MEDICAL BACTERIOLOGY        (3 credits)

Unit - I
Infection: definition, sources of infection, types of infections, methods of transmission of infections. General attributes and virulence factors of bacteria causing infections.

Unit - II

Unit - III
Morphology, classification, cultural characteristics, pathogenicity, laboratory diagnosis and prevention of infections caused by the following organisms: *Staphylococcus aureus*, *Streptococcus pyogenes*, *Streptococcus pneumoniae*, *Neisseria meningitidis*, *Neisseria gonorrhoeae*, *Corynebacterium diphtheriae*, *Clostridium tetani*, *Clostridium botulinum*.

Unit – IV
Morphology, cultural characteristics, pathogenicity, laboratory diagnosis and prevention of infections caused by the following organisms: *Escherichia coli*, *Shigella*, *Salmonella*, *Vibrio cholerae*, *Pseudomonas*, *Mycobacterium tuberculosis*, *Mycobacterium leprae*.

Unit - V
Morphology, cultural characteristics, pathogenicity, laboratory diagnosis and prevention of infections caused by the following organisms: Zoonotic bacterial diseases such as plague, anthrax, leptospirosis, brucellosis.

Text Books

Reference Books
DSC – 5D

APMB 242P  Practical XI: MEDICAL BACTERIOLOGY  (1 credit)

1. General requirements of collection, transport of clinical specimens, direct examination, staining of specimens, methods of enriched, selective, and enrichment culture techniques used to isolate organisms from clinical specimens.
2. Simple, differential and special staining of clinical material.
3. Isolation of microflora from human throat.
4. Differential test of *Staphylococcus* by examining growth on agar plates.
5. Antimicrobial sensitivity Testing.
6. Quantitative urine culture.
7. Isolation and identification of bacterial pathogens from clinical specimens.
8. Biochemical reactions of the isolated and identified bacterial pathogens.
9. Identification of ectoparasites – mosquitoes, fleas, lice, mites, ticks, etc. (spotters only).
SEMESTER – IV

DSC – 3D

APMB 243  PLANT PATHOLOGY  (3 credits)
(Biological Science - II)

Unit - I
Concept of plant disease – definitions of disease, disease cycle and pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, economic losses and social impact of plant diseases. Significant contributions by scientists in the field of plant pathology.

Unit- II
Infection, invasion, colonization, dissemination of pathogens and perennation. Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle and disease pyramid, forecasting of plant diseases and its relevance in Indian context.

Unit - III
Virulence factors of pathogens: enzymes, toxins (host specific and nonspecific) growth regulators, virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction).

Unit - IV
Concept of resistance (r) gene and avirulence (avr) gene; gene for gene hypothesis, types of plant resistance – Concepts of constitutive defense mechanisms in plants, inducible structural defenses – inducible biochemical defenses hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts.

Unit - V
Basic principles of the disease management – study of important plant diseases with emphasis on its etiological agent, symptoms, epidemiology, life cycle and management: fungal diseases – diseases of phytopathogenic bacteria – phytoplasmas – viruses and viroids.

Text Books
Reference Books
   ICAR E-course.
DSC – 6D

APMB 243P  
Practicals – XII: PLANT PATHOLOGY  
(1 credit)

1. Demonstration of Koch’s postulates in fungal, bacterial and viral plant pathogens.
2. Preparing a plant pathology herbarium
3. Study of important diseases of crop plants by cutting cross sections and microscopic examination fungal conspicuous structures from infected plant materials – (a) *Albugo* and *Puccinia*.
4. Study of important diseases of crop plants by cutting cross sections and microscopic examination fungal conspicuous structures from infected plant materials – (a) *Ustilago* and *Colletotrichum*.
5. Study of important diseases of crop plants by cutting cross sections and microscopic examination fungal conspicuous structures from infected plant materials – (a) *Fusarium* (b) *Verticillium* (c) *Rhizoctonia*
6. Examination of citrus canker symptoms and isolation of the causal organism.
7. Isolation of pectinolytic phytopathogens and testing their pectinolytic activity.
8. Isolation of antagonists bacterial population from soils.
9. Detecting and measuring extracellular enzymes of fungi and bacteria
SEMESTER – IV

SEC– 2

APMB 244 MUSHROOM AND SPIRULINA CULTIVATION (2 credits)

Unit - I
Edible and non-edible mushroom – historical account, most commonly cultivated mushrooms in the world, distribution and production in various countries.

Unit - II
Cultivation of button, oyster and paddy straw mushroom – raising a pure culture – spawn preparation and mass cultivation – harvest pests and diseases in mushroom

Unit – III
Economics of mushroom cultivation – precautions in mushroom cultivation – precaution to be taken while selecting the area, spawn preparation, spawn run, during cropping harvesting etc. Mushroom recipes (western and Indian recipes, pickles, powders, jams etc.

Unit – IV

Unit - V
Natural production – laboratory cultivation – small scale commercial production – commercial and mass cultivation (tank construction, culture medium, strain selection, scaling up of the process) – importance of light and pH in Spirulina cultivation – harvesting, drying and packing.

Text Books

Reference books
SEMESTER – V
SEC– 3

APMB 351 MANAGEMENT OF MICROBIOLOGY LABORATORY (2 credits)

Unit - I
Rules and regulations to be followed in a microbiology laboratory – maintenance of records – familiarizing with common chemicals, instruments and equipments of microbiology laboratory.

Unit - II

Unit - III
Laboratory quality control assessment: Internal quality control and external quality control.

Unit - IV
Maintenance of type strains or reference strain of microbes: culture collection centres – preservation and maintenance of cultures.

Unit - V
Laboratory waste disposal system: national and international guidelines for the disposal of waste. Basic concepts of bio-safety and its universal precautions.

Text books

Reference books
SEMESTER – V
DSE – 1A
APMB 352  MICROBIAL DIVERSITY AND BACTERIAL PHYLOGENY (4 credits)

Unit -I

Unit-II

Unit-III
Archaea and Gram negatives:– An overview of their ecological occurrence, morphological diversity, structural, metabolic and genetic diversity, their importance and classification of Archaeal phyla – Gram negative bacteria including cyanobacteria – Deeply branching phyla – Proteobacteria – their classes.

Unit-IV

Unit-V

Text Books
Reference Books
DSE – 6A

APMB 352P  Practicals – XIII:  MICROBIAL DIVERSITY  
AND BACTERIAL PHYLOGENY  
(1 credit)

1. Microscopic observation of bacteria, fungi, algae, protoza.
2. Isolation and observation on a Gram positive bacteria.
3. Isolation and observation of a Gram negative bacteria.
4. Observation of morphologically distinct cyanobacteria.
5. Observation of morphologically distinct algal populations.
6. Observation of fungi and their types – spores.
7. Comparative observation of fungi and actinobacteria.
8. Isolation and observation of an Archaea.
9. Demonstrating the great plate count anomaly.
10. Visit to microbial rich environments like solar saltern, lakes and demonstrate the presence of distinct and conspicuous microorganisms.
SEMESTER – V

DSE – 2A

APMB 353  MEDICAL MYCOLOGY AND PARASITOLOGY  (4 credits)

Unit - I
General properties of fungi – morphology, taxonomy, nomenclature and classification of fungi – virulence factors of fungi causing infection.

Unit -II

Unit -III

Unit –IV
Introduction to medical parasitology – morphology, classification, characteristics, pathogenesis, laboratory diagnosis, prevention and control of the following agents. Entamoeba histolytica, Giardia lamblia, Trichomonas vaginalis, Trypanosoma brucei, Trypanosoma cruzi.

Unit –V
Morphology, classification, characteristics, pathogenesis, laboratory diagnosis, prevention and control of the following agents. Leishmania donovani, Leishmania tropica, Plasmodium falciparum, Balantidium coli, Taenia saginata, Taenia solium, Echinococcus granulosus, Ancylostoma duodenale, Ascaris lumbricoides and Wuchereria bancrofti.

Text Books

Reference Books
DSE – 7A

APMB 353P  
Practicals – XIV: MEDICAL MYCOLOGY AND PARASITOLOGY  
(1 credit)

1. KOH preparation for skin scrapings for fungi.
2. Lactophenol preparation for fungi – *Aspergillus*, *Rhizopus* and *Mucor*.
3. Germ tube test for *Candida albicans*.
4. Wet mount preparation for *Candida* and *Cryptococcus*.
5. Sugar fermentation and sugar assimilation test for yeasts.
6. Cultivation of fungi and yeast on SDA or corn meal agar.
7. Slide culture technique.
8. Saline wet mount examinations of stool for parasites.
9. Iodine mount examinations of stool for parasites.
10. LPCB mount examinations of stool for parasites.
11. Stool culture for amoeba and hookworm.
12. Floatation sedimentation techniques for stool examination.
13. Staining of peripheral blood smear for malarial parasite.
SEMESTER – V
DSE – 3A

APMB 354 PHARMACEUTICAL MICROBIOLOGY (4 credits)

Unit - I

Unit - II
Drug development: Biology guided fractionation methods: in vitro assay systems based on enzymes, tissue, and organ or growth inhibition. Animal models: transgenic animals, cell lines. Antimicrobial activity studies (antibacterial, antiviral, antifungal and antiparasitic activities).

Unit - III
Gene therapy: general introduction, ex vivo and in vivo gene therapy, potential targets for gene therapy, inherited disorders. Vaccine design and production, classification, genetically recombinant vaccines, advantages and disadvantages – examples – hepatitis B vaccines, cholera vaccines, edible vaccines, DNA vaccines – principles and mechanism.

Unit - IV

Unit - V

Text Books

Reference Books
DSE – 8A

APMB 354P  Practicals –XV: PHARMACEUTICAL MICROBIOLOGY (1 credit)

1. Preparation of medicinal plant extracts.
2. Sterility testing of vaccines and injections.
3. Antibacterial activity of antibiotic preparations.
4. Antifungal tests.
5. Estimation of thiamine, riboflavin, ascorbic acid content of multivitamin formulations.
6. MIC- by broth and agar dilution method.
7. Phenol co-efficient test.
10. Visit to a vaccine production unit and observe the unit operation procedures.
SEMESTER – V

DSE – 4A

APMB 355  INDUSTRIAL MICROBIOLOGY  (4 credits)

Unit - I
General concepts of industrial microbiology, principles of exploitation of microorganisms of their products, screening, strain development, immobilization methods, fermentation media, raw materials used in media production, antifoaming agents, industrial sterilization.

Unit - II
Fermentation equipment and its uses, types of fermentation – single, batch, continuous, multiple, surface, submerged, and solid state fermentation.

Unit - III
Food fermentations and food produced by microbes: bread, cheese, malt beverages, vinegar, fermented dairy products and oriental fermented foods. Microbial cells as food – single cell proteins.

Unit - IV

Unit - V

Text Books

Reference Books
DSE – 9A

APMB 355P Practical s – XVI: INDUSTRIAL MICROBIOLOGY (1 Credit)

1. Wine production.
2. Isolation of lactic acid bacteria from curd.
3. Isolation of lipolytic organisms from butter or cheese.
4. Immobilized bacterial cells for production of hydrolytic enzymes.
5. Enzyme production and assay – cellulase, protease and amylase.
6. Alcohol production.
7. Immobilization of yeast.
8. Visit and observe an industry unit pertaining to microbiological products manufacturing.
SEMESTER – V

DSE – 5A
APMB 356  BIOSTATISTICS AND COMPUTER APPLICATIONS  (4 credits)

Unit - I

Unit - II
Measures of central tendency: mean, median, mode, geometric mean, harmonic mean, measures of dispersion, range, mean deviation, quartile deviation and standard deviation, standard error.

Unit - III
Introduction to computers: computer application, basics, organization, PC, mainframes and super-computers, concept of hardware and software, concept of file, folders and directories, commonly used commands, flow charts and programming techniques.

Unit - IV

Unit - V
Networking fundamentals, client, server, LAN, WAN, TelNET, INTERNET, NICNET, WWW, html, e mail, introduction to MEDLINE, CCOD and PUBMED, for accessing biological information.

Text Books

Reference Books
DSE – 10A

APMB 356P Practical – XVII: BIOSTATISTICS AND COMPUTER APPLICATIONS (1 credit)

1. Representation of Statistical data by
   a) Histograms b) Ogive Curves c) Pie diagrams.
2. Determination of Statistical averages/ central tendencies.
   a) Arithmetic mean b) Median c) Mode.
3. Determination of measures of Dispersion
   a) Mean deviation 
   b) Standard deviation 
   c) Quartile deviation.
4. Computer operations-getting acquainted with different parts of Computers. [DOS] and basics of operating a computer.
5. Creating files, folders and directories.
6. Applications of computers in biology using MS-Office.
7. Creating an e-mail account, sending and receiving e-mails.
8. An introduction to INTERNET, search engines, websites, browsing and downloading.
SEMESTER – V

GE – 1

APMB 357 BIOINFORMATICS (3 credits)

Unit - I
Analysis of DNA and protein sequences – codon distributions, frequency statistics, pattern and motif searches – randomization.

Unit - II

Unit - III

Unit - IV

Unit - V

Text Books

Reference Books
SEMESTER – VI
SEC-4

APMB 361 MICROBES AND THEIR APPLICATIONS (Credit Seminar)  
(2 credits)

Unit – I
Identifying suitable topic in fundamentals of microbiology or applications of microbiology to human kind and society.

Unit – II
Literature survey and collection.

Unit – III

Unit – IV
Presentation of the seminar in powerpoint format.

Unit – V
Discussion on the topic and evaluation of the seminar report.

Reference

1. Microbiology Senior Seminar (MB490) syllabus Fall and Spring every year  
   https://microbiology.ncsu.edu/HH/MICROBIOLOGY%20SENIOR%20SEMINAR-%20online%20info.pdf
SEMESTER – VI

DSE – 1B

APMB 362 FOOD AND DAIRY MICROBIOLOGY (4 credits)

Unit - I
Food as a substrate for microorganisms – microorganisms important in food microbiology: molds, yeasts and bacteria – factors affecting the growth of microorganisms in food, feed and fodder.

Unit - II
Principles of food preservation: general principles and application methods – asepsis, removal of microorganisms, anaerobic conditions, high temperature, low temperature, drying and food additives.

Unit - III
Spoilage of food: vegetables, eggs, milk and milk products, meat and meat products, fish and sea foods and canned foods.

Unit - IV
Fermented foods: pickled cucumber, sauerkraut, bread, cheese, vinegar, fermented dairy products – spoilage of fermented dairy products.

Unit - V

Text Books

Reference Books
APMB 362P  Practical – XVIII: FOOD AND DAIRY MICROBIOLOGY (1 credit)

1. Bacterial counts of food samples.
3. Isolation and counting of fecal bacteria in water.
4. Test of quality of milk by methylene blue dye reduction test.
5. Detection of mastitis through milk test.
6. Isolation of microorganisms from curd.
7. Isolation of bacteria and fungi from spoiled food.
8. Microbial populations in fruit juices, soft drinks and ice cream.
9. Isolation of lipolytic organisms from butter.
10. Visit to a microbiology based Food industry and observe the unit operation procedures.
SEMESTER – VI
DSE – 2B

APMB 363 MICROBIAL ECOLOGY AND ENVIRONMENTAL MICROBIOLOGY
(4 credits)

Unit - I
Environment ecosystems, food chain – niche, soil, water and air environment. Microbial interactions – symbiosis, neutralism, commensalism, synergism, mutualism, ammensalism, competition, parasitism and predation.

Unit - II

Unit - III

Unit - IV

Unit - V

Text Books

Reference Books
1. Bacteriological examination of water by multiple tube fermentation tests.
2. Water analysis for total bacterial population by standard plate count method.
3. Isolation of cellulolytic organism for various soil.
4. Determination of salinity of water.
5. Estimation of oxygen by Winkler’s method.
7. Estimation of COD of water.
8. Isolation of bacteriophage from the sewage.
9. Isolation of microorganism from air by open plate method.
10. Determination of total bacterial population in water by standard plate count method.
11. Visit and observe unique ecosystems and understanding the role of microorganisms.
SEMESTER – VI

DSE – 3B

APMB 364                SOIL AND AGRICULTURAL MICROBIOLOGY                (4 credits)

Unit-I
Introduction to soil microorganisms – bacteria (cyanobacteria and actinobacteria), algae, fungi, protozoans, nematodes and viruses – Role of microbes in soil fertility.

Unit-II

Unit-III

Unit-IV

Unit -V
Plant growth promoting rhizobacteria – Biological control of phytopathogens – Mechanism of control – Trichoderma sp. and Pseudomonas fluorescens as biocontrol agents – Disease suppressive soils – Biopesticide and their importance: Bacterial, fungal and viral.

Text Books

Reference Books
DSE – 8B

APMB 364P    Practical –XX: SOIL AND AGRICULTURAL MICROBIOLOGY (1 credit)

1. Isolation of bacteria, fungi and actinobacteria from soils.
2. Isolation of nitrogen fixing bacteria from root nodules of legumes.
3. Enumeration of rhizosphere to non rhizosphere population of bacteria.
4. Isolation of antagonistic *Pseudomonas* from soil.
5. Microscopic observations of root colonization by VAM fungi.
6. Isolation of *Azospirillum* sp. from the roots of grasses.
7. Isolation of phyllosphere microflora.
8. Isolation of P solubilizing microorganisms.
9. Observation of *Anabaena* from *Azolla* plants.
10. Demonstration on different biofertilizers types, formulation and application methods.
11. Visit to biofertilizers and biopesticides unit to understand about the Unit operation procedures.
SEMESTER – VI
DSE – 4B

APMB 365  HAEMATOLOGY AND BLOOD BANKING  (4 credits)

Unit - I

Unit - II

Unit - III

Unit - IV

Unit - V
ABO Grouping: History, slide and tube technique, Rh typing: slide and tube technique, Coombs test: direct and indirect method, donor screening – cross matching, collection of blood, preservation and storage.

Text Books

Reference Books
DSE – 9B

APMB 365P  
Practicals – XXI: HAEMATOLOGY AND  
BLOOD BANKING  
(1 credit)

3. Staining of blood smears and differential count of WBC.
4. Platelet count by various methods.
5. Erythrocyte sedimentation rate by various methods.
6. Preparation of reagents for coagulant studies.
7. Preparation of anticoagulant fluids.
8. Coomb’s test.
9. Screening of HbS Ag.
SEMESTER – VI
DSE – 5B

APMB 366 MICROBIAL PRODUCTION OF PIGMENTS, (4 credits)
FLAVOUR AND AROMA COMPOUNDS

Unit –I
Scope of the subject – Importance of microbial products over chemically synthesized products – ill effects of chemicals – overall view of microbes involved in pigment, flavour and aroma production.

Unit -II
Biochemical and physiological basis of pigment, flavour and aroma compounds production – compound synthesis and biocatalysis – Culture dependent and culture independent methods to identify the organisms – Techniques used to identify novel potential organisms.

Unit - III

Unit - IV

Unit - V
Genetic engineering in pigment, flavour and aroma production – Mass multiplication – up scaling – product recovery – purification of pigments, flavour and aroma compounds – future strategies and innovative areas of research – ethical, biosafety and legal aspects of production.

Text books

Reference books
DSE – 10B

APMB 366P  Practicals – XXII: MICROBIAL PRODUCTION OF PIGMENTS, FLAVOUR AND AROMA COMPOUNDS  (1 credit)

1. Observation of *Dunaliella* sp.– a beta carotene producing algae.
2. Isolation of *Monascus* sp. from soil.
4. Isolation of pigment producing bacteria/actinobacteria.
5. Mass multiplication of the pigment producer and pigment extraction.
6. Production and estimation (HPLC) of vanillin from precursor using microbial cultures.
7. Microbial production of xylitol from xylose and their estimation using HPLC.
8. Microbial biocatalysis of precursor to vitamin C and their estimation using HPLC.
9. Usage of yeast for the biocatalysis of flavour and aroma compounds.
SEMESTER – VI

GE -2

APMB 367 MICROBIAL GENOMICS (3 credits)

Unit-I
Introduction to microbial genomics – sequencing genomes – first generation DNA sequencing – shot gun sequencing – second generation DNA sequencing – third and fourth generation DNA sequencing

Unit-II
Biological sequences as information – DNA, RNA and protein as informative molecules – general characteristics of microbial genomes – genome assembly – genome annotation – identification of an open reading frame in a genome.

Unit-III
Microbial genomes size and content – small genomes and large genomes – genomes of organelles – symbionts and organelles – eukaryotic microbial genomes an introduction: genomes of microbial parasites – the yeast genome.

Unit-IV

Unit-V
Culture independent studies of microorganisms – metagenomics: principles and applications – steps in construction of a metagenomes – examples of metagenomic studies – metagenomics as a tool to reveal the vast microbial diversity.

Text Books

Reference Books