Syllabus

For

M.S.C. MICROBIOLOGY

Under Choice based credit system

(I, II, III & IV Semester Course)

ACADEMIC SESSION

JULY (2017-2019)

Jiwaji University, Gwalior

(NAAC accredited ‘A’ grade University)
<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Title of the Paper</th>
<th>Core/Centric/Generic</th>
<th>Credits</th>
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<td>First</td>
<td>MB-101</td>
<td>Basics in Microbiology and General Bacteriology</td>
<td>Core</td>
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<td>MB-102</td>
<td>Virology and Mycology</td>
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<td>Cell biology and Biochemistry</td>
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<tr>
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<td>Bioinstrumentation</td>
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Total Credits 24

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<td>MB-203</td>
<td>Microbial Physiology and metabolism</td>
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<td>Biostatics, Computer application and Bioinformatics</td>
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Total Credits 24
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<table>
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<tr>
<th>Fourth</th>
<th>MB-401 A</th>
<th>Agriculture Microbiology</th>
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<th>Elective</th>
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<td><strong>Total Credits</strong></td>
<td></td>
<td>24</td>
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</tbody>
</table>

**Total Credits for the Course** 96

-Minimum Number of credits be earned for award of degree- 96 credits  [Valid credits 80 + Virtual credits 16]

**Note:** The first two semesters will have core papers in general. The optional papers under Elective or Generic/ Centric category may be exercised in the last two semesters. The Schools/Centres have the option with regard to number of theory papers either under Elective and/ or Generic category in 3rd and 4th semesters.

**NOTE:** Lecture (L): 1 hr = 1 Credit:  Tutorial (T): 2 hr = 1 Credit  .  Practical (P): 2 hr = 1 Credit
The generic credits may be obtained from other departments/faculties/Institutes.

Elective credits may be obtained from same or other departments of the faculty

Minimum credits be earned for award of degree - 96 Credit (Valid credits -80 + Virtual Credits - 16)

Minimum credits for promotion to next semester - 12 valid credits/semester

(Explanation: Student will have to pass in theory or lab course or seminar or assignment totaling 12 credits in a given semester for promotion to next semester).

For internal assessment three tests of 20 marks each (one test may be in form of quiz/debate etc. if desired so), will be conducted out of which the best two will be taken into consideration.

As part of skill development new product development will be practiced

Every student would deliver minimum one seminar in a semester which would be evaluated.

Comprehensive viva is based on all papers of given semester.

The grading will be made on 10-point scale as described below:

<table>
<thead>
<tr>
<th>Letter Grade</th>
<th>Grade Points</th>
<th>Description</th>
<th>Range of Marks (%)</th>
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<tbody>
<tr>
<td>O</td>
<td>10</td>
<td>Outstanding</td>
<td>90-100</td>
</tr>
<tr>
<td>A+</td>
<td>9</td>
<td>Excellent</td>
<td>80-89</td>
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<tr>
<td>A</td>
<td>8</td>
<td>Very good</td>
<td>70-79</td>
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<tr>
<td>B+</td>
<td>7</td>
<td>Good</td>
<td>60-69</td>
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<tr>
<td>B</td>
<td>6</td>
<td>Above Average</td>
<td>50-59</td>
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<tr>
<td>C</td>
<td>5</td>
<td>Average</td>
<td>40-49</td>
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<td>P</td>
<td>4</td>
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<td>Fail</td>
<td>0-34</td>
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<tr>
<td>Ab</td>
<td>0</td>
<td>Absent</td>
<td>Absent</td>
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</table>

The Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) will be calculated as weighted average of valid and virtual credit points secured by the student, except the credits of additional courses, if any. The SGPA and CGPA shall be rounded off up to 2 decimal places and reported in the grade sheet.

SGPA is a measure of performance of the student in a semester. It is ratio of total credit points secured by a student in various courses registered in a semester and the total course credits taken during that semester, i.e.

$$\text{SGPA (Si)} = \frac{\sum(Ci \times Gi)}{\sum Ci}$$

where Ci is the number of credits of the ith course in a semester and Gi is the grade point scored by the student in the ith course.
• CGPA is a measure of overall cumulative performance of a student over all the semesters completed. The CGPA is the ratio of total credit points secured by a student in various courses in all the semesters completed and the sum of the total credits of all courses in all the semesters completed, i.e.
\[ \text{CGPA} = \frac{\sum (C_i \times S_i)}{\sum C_i} \]
where \( S_i \) is the SGPA of the \( i \)th semester and \( C_i \) is the total number of credits in the semester.

• On completing all requirements for award of the degree, the CGPA will be calculated and this value will be indicated on the degree along with Division. The Final degree should also indicate the Division obtained as per follows:

<table>
<thead>
<tr>
<th>Division</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>First division with distinction</td>
<td>The candidate has earned minimum number of credits required for the award of the degree in first attempt with CGPA of 8.00 or above</td>
</tr>
<tr>
<td>First division</td>
<td>The candidate has earned minimum number of credits required for the award of the degree with CGPA of 6.50 or above</td>
</tr>
<tr>
<td>Second division</td>
<td>The candidate has earned minimum number of credits required for the award of the degree with CGPA of 5.00 or above but less than 6.50</td>
</tr>
<tr>
<td>Pass division</td>
<td>The candidate has earned minimum number of credits required for the award of the degree with CGPA of 4.00 or above but less than 5.00</td>
</tr>
</tbody>
</table>

• The student will be promoted to the next semester if he/she secures at least 12 valid credits in a semester. In case the student secures less than 12 valid credits in any semester, then the student will be asked to repeat the entire semester and that semester will be treated as zero semester.

• The student should not carry more than 5 courses (combining theory and practical) in 1st year, IIInd year or IIIrd year to be promoted to the next year.

• Repetition of a theory / practical course is allowed only to those candidates who get F or Ab in the course. The student has to pay the prescribed fee for repeating the course.

• On account of valid reasons, a student may withdraw from a semester. In such case the semester will be treated as zero semester.

• In case of zero semester, the student will not be promoted to the next semester till he/she clears that semester. The UTD may allow such a student to register in the subsequent semester whenever it is offered by the concerned UTD. The student has to pay semester fee again in such cases. If the student withdraws within one month from starting of the semester then semester fee will not be charged again.

• The practical course can be repeated as and when it is offered.

• Dissertation / project report/ internship of 3-6 credits will be assessed by the internal supervisor, in general, however, UTD may get it assessed by an internal supervisor and an external expert.

• A comprehensive viva-voce of 4 virtual credits will be conducted at the end of each semester of the programme by a board of four examiners, at least ONE of whom shall be external. The grades awarded in the viva-voce shall be shown separately in the grade-sheet.

• The conversion of CGPA in to percentage will be as follow to facilitate its application in other academic matters:
\[ \text{Equivalent Percentage} = \text{CGPA} \times 10 \]
## SEMESTERWISE SCHEME IN DETAIL
### Semester - 1

<table>
<thead>
<tr>
<th>Code</th>
<th>Title of Course</th>
<th>Core / Generic / Centric</th>
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<th>Total Credits</th>
<th>Marks</th>
<th>Internal</th>
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<td>60 21</td>
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Total Credit Value: # 24 (20 + 4 virtual credits)
MB: 101 (Core) BASICS IN MICROBIOLOGY AND GENERAL BACTERIOLOGY

UNIT-I
1. Introduction, history and scope of Microbiology.
2. General characteristics and composition of Prokaryotes and Eukaryotes.
3. Classification of Microorganisms: Haekel’s three kingdom concept, Whittaker’s five kingdom concept, three domain concept of Carl Woese, classification and salient features of bacteria according to Berger’s Manual of Determinative Bacteriology.

UNIT-II
2. Components external to cell wall: Structure and function of flagella, fimbriae and pili, capsule- types, composition and function, slime layers, S-layers.
3. Prokaryotic cell membrane and cytoplasmic matrix – cell membrane structure and function of bacteria and archeabacteria, mesosomes, ribosomes, cytoplasmic inclusion bodies (polyhydroxy butyrate, polyphosphate granules, oil droplets, cyanophycin granules) and nucleoid.

UNIT-III
1. Bacterial nutrition: Basic nutritional requirements, growth factors, nutritional categories, physical requirements of bacterial growth.
2. Bacteriological media: types (complex, synthetic, differential, enrichment and selective media) and their uses, culture characteristics of bacteria on different media.
3. Cultivation of bacteria: aerobic and anaerobic culture, pure culture techniques, shaker and still culture, maintenance and preservation of microbial culture.

UNIT-IV
1. General concept of Prokaryotic and Eukaryotic genome. Genome of E. coli.
2. Genetic recombination and transformation.
3. Transduction: generalized and specialized transduction, phage conversion.
UNIT-V
1. Staining methods: fixation, types of dyes, simple staining, differential staining (Gram and Acid-fast staining), staining of specific structures (capsule, flagella and spore staining)
2. Control of microorganisms: Microbial death curve, concept of bio-burden, thermal death time and decimal reduction time. Factors influencing the effectiveness of antimicrobial agents.
3. Control of microorganisms by physical agents: heat (moist and dry), filtration and radiation.
4. Chemical control of microorganisms: Halogens, phenol and other phenolic compounds, heavy metals, alcohols, ethylene oxide and aldehydes.

Reference Books
MB: 102 (Core) VIROLOGY AND MYCOLOGY

UNIT- I
1. Brief outline on discovery and origin of viruses.
2. General properties of viruses, morphology and ultra-structure of viruses, capsid and their arrangements, types of envelopes and their composition, measurement of viruses.
3. Viral genome; their types and structure, viral related agents-viroids and prions.
4. Classification and general properties of major families of viruses including detail account of their mode of replication.

UNIT-II
1. Cultivation of viruses- in embryonated eggs, experimental animals and cell lines; primary and secondary cell lines, diploid cell culture.
2. Assay of viruses: physical and chemical methods, plaque method, pock counting and end point method.
3. Serological methods: hemagglutination, hemagglutination inhibition, neutralization test, complement fixation, ELISA, RIA.

UNIT-III
1. Plant viruses: recent advance in classification of plant viruses. Structure and pathogenicity of TMV.
2. Transmission of plant viruses with vector (insect, nematodes and fungi) and without vector (contact, seed and pollens). Biochemical changes induced by virus in plant cell.
4. General idea about Cyanophage, and Mycophage.

UNIT-IV
2. One step growth curve (latent period, eclipse period, and burst of size.)
3. Life cycle: lytic and lysogenic life cycle of bacteriophages.
4. Brief account of M13, Mu, T4, Ø x174 and lambda phage

UNIT-V
1. Structure, reproduction and classification of fungi, general characteristics of Zygomycetes, Ascomycetes, Basidiomycetes, and Deuteromycetes.
2. Cultivation of fungi, culture media for fungal growth, effects of environment on growth, isolation, identification and preservation of fungi.
3. Dimorphic fungi, yeast morphology, general characteristics and reproduction. Lichens, Mycorrhiza, and Actinomycetes.
Reference Books

1. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA
MB: 103 (Core) CELL BIOLOGY AND BIOCHEMISTRY

UNIT-I
2. Structural organization and function of intracellular organelles of eukaryotic cell: nucleus, mitochondria, golgi body, lysosomes, endoplasmic reticulum, peroxisomes, plastids, chloroplast, vacuole, cytoskeleton.

UNIT-II

UNIT-III
1. Carbohydrates: structure of sugars, classification, properties, chemical reactions, stereoisomerism and optical isomers of sugars.
2. Structure, properties and function of disaccharides, oligosaccharides, and polysaccharides, carbohydrate derivatives; peptidoglycan, glycoproteins, glycolipids.
3. Lipids: classification, structure, properties and functions of fatty acids, triacylglycerols, phospholipids, sterols and terpenes.
4. Lipids with specific biological functions, micelles and liposomes.

UNIT-IV
1. Amino acids: structure, classification, properties and functions.
4. Basic structure and types of DNA and RNA.

UNIT-V
1. Enzymes: basic concept as a biocatalyst, specificity, active sites, activity unit and iso-enzymes, enzyme classification.
2. Enzyme kinetics- Michaelis-Menton equation for simple enzymes, determination of kinetic parameters.
4. Vitamins and cofactors: structure, distribution and biological properties.
Reference books
MB: 104 (Core) BIOINSTUMENTATION

UNIT-I
1. Microscopy: history and principles of microscopy, properties of light, magnification power, resolution limit, resolving power, numerical aperture.
2. Principles and applications of light microscopy, bright field, dark field, phase contrast and fluorescent microscopy. Determination of size of microorganisms by micrometry.

UNIT-II
1. Chromatography: Principles, types and applications of partition, paper and thin layer chromatography.
2. Adsorption and Gel filtration chromatography: Principle, matrix, column packing and applications.
3. Affinity, ion exchange, and Gas chromatography: Principle and applications.
4. High performance liquid chromatography (HPLC) and FPLC: Principle, Instrumentation (Reservoirs, pumps, columns) and applications.

UNIT-III
1. Electrophoresis: principle, types and applications of Paper, Starch gel and Agarose gel electrophoresis.
2. Polyacrylamide Gel Electrophoresis: Native PAGE and SDS-PAGE.
3. Isoelectric focusing, Isotachophoresis and gradient gel electrophoresis.
4. Two dimensional gel electrophoresis and pulse field gel electrophoresis.

UNIT-IV
2. Principles, instrumentation and applications Infrared and fluorescence Spectroscopy.
3. Principles, instrumentation and applications of NMR and ESR.
4. Principle, instrumentation and applications Mass Spectroscopy (types of ion source, analyzers and detectors), GC-MS, MALDI-TOF.

UNIT-V
2. Ultracentrifuges: analytical and preparative with application. Rotors: types and applications.
3. Radioisotope techniques: half life, radioactive decay, radioactive assay methods based on ionization and excitation of gases-Geiger Muller counter, liquid scintillation counter and gamma counter.
4. Autoradiography- principle and applications. Quenching and application of radioisotopes in biological systems.
Reference Books

2. Physical Biochemistry: Applications to Biochemistry and Molecular Biology, David Frefelder,


5. Biological Spectroscopy, Campbell and Dwek.

M.Sc. Microbiology syllabus under CBCS scheme  
(2017-19)

MB – 105: LAB COURSE I

Practical Exercises

Lab course I (Basics in Microbiology and General Bacteriology & Virology and Mycology)

1. Good Microbiology laboratory practices: Laboratory safety (Dos and Don’ts), hazard from chemicals, handling of cultures and chemicals, disposal of chemicals and cultures.
2. Introduction to different Glass wares used in Microbiology Laboratory.
3. To learn handling of different instruments and Equipments used for culture and Sterilization.
4. To prepare basic liquid (Nutrient broth) and basic solid media (Nutrient Agar and Potato Dextrose Agar) for cultivation of bacteria and fungi.
5. To prepare selective, differential media and enriched media (MacConkey Agar and Blood Agar).
6. To learn pure culture techniques used for isolation and purification of microorganisms.
   a. Streak plate method.  
   b. Pour plate method.  
   c. Spread plate method.
7. Isolation and Enumeration of microorganisms from Air (plate exposure method), Soil and Water (serial dilution method).
8. To perform different staining methods to study morphological and structural characteristics of bacteria and fungi.
   a. Gram Staining.
   b. Acid fast staining.
   c. Fungal staining (Lacto-phenol cotton blue).
   d. Spore staining.
   e. Flagella staining.
   f. Capsule staining.
   g. Negative staining.
9. To check motility of bacteria by hanging drop and semi-solid agar methods.
10. To learn culture preservation techniques (Agar slants, stabs and glycerol stocks).
11. To study effect of salt, pH and temperature on microbial growth.
12. Determination of bacterial growth by turbidity measurements and to plot bacterial growth curve.
13. Inoculation and cultivation of viruses in embryonated eggs.
15. Enumeration of bacteriophage by plague forming unit method.
17. Isolation cultivation and morphological studies of fungi.
18. Isolation cultivation and morphological studies of Actinomycetes.
MB- 106: LAB COURSE II

Practical Exercises

Lab course II (Cell biology and Biochemistry & Bioinstrumentation)

1. To detect the presence of carbohydrate in the given sample by Molish test
2. To detect the presence of reducing sugar in the given sample by Fehling’s test
3. To detect the presence of pentose sugar in the given sample by Bial’s test
4. To determine the presence of monosaccharide using Anthrone test
5. To detect presence of reducing sugar using Benedict’s test.
6. To determine the presence of monosaccharide using Barfoed’s reagent
7. To determine the presence of starch in given sample by using iodine solution (starch-iodine test).
8. To determine the presence of ketose sugar by Seliwanoff’s reagent in given sample.
9. To determine the presence of protein by Biuret method.
10. To determine the presence of protein by Xanthoprotic test.
11. Quantification of protein contents in given sample by Folin’s- Lowry method.
12. To determine Saponification value of given fat sample.
14. To study different stages of mitosis in onion root tip preparations.
15. Verification of Beer-Lambert Law.
17. Calibration of an ocular micrometer for different objectives of microscope.
18. Measurement of microorganisms by the use of an ocular micrometer.
20. Separation of amino acids by Thin Layer Chromatography.
21. To study microorganisms under dark-field microscope.
22. Separation of sub cellular organelles by differential centrifugation.
MB-107: SEMINAR

Every student shall deliver at least one seminar on topic of the curriculum/ advances in Microbiology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also be encouraged to assess the seminar on the given criteria and their evaluation will also be given due consideration. The average marking will be taken into consideration.

MB 108: ASSIGNMENT/PERSONALITY DEVELOPMENT/ SKILL DEVELOPMENT ACTIVITY

Every student will be given an assignment/skill development in product development/personality development which will be evaluated by concerned teacher.

MB 109: COMPREHENSIVE VIVA

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.


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Total Credit Value: # 24 (20 + 4 virtual credits)
MB: 201 (Core) MICROBIAL GENETICS AND MOLECULAR BIOLOGY

UNIT-I
1. Organization of genetic material in prokaryotes and eukaryotes.
2. Concept of gene, genome, genome size, C-value, and C-value paradox.
3. Nucleic acid as a genetic information carriers; experimental evidence.
4. Gene is a unit of mutation and recombination; molecular basis of mutations, physical and chemical mutagens, spontaneous and induced mutation, selection of mutant.

UNIT-II
1. Structure of DNA, super helicity of DNA, linking number, topological properties and role of topoisomerase. DNA denaturation and renaturation.
2. DNA damage and repair: types of DNA damage (deamination, oxidative damage, alkylation and pyrimidine dimers), repair mechanism; mismatch repair, nucleotide excision repair, recombination repair, SOS repair.
3. DNA replication: general principle, various mode of replication, unwinding of DNA helix, continuous and discontinuous synthesis of leading and lagging strands.
4. Enzymes of DNA replication in prokaryotes and eukaryotes; DNA polymerases, DNA ligase, primase.

UNIT-III
1. Structural features of RNA (rRNA, tRNA, mRNA) and polycistronic and monocistronic RNA.
2. Transcription: general principle and processes of transcription; initiation, elongation and termination, types of RNA polymerases, inhibitors of RNA synthesis.
3. Control of Transcription by interaction between RNA polymerases and promoter region, use of alternate sigma factors, controlled termination; Rho dependent and Rho independent.
4. Post transcriptional modification, maturation and splicing of RNA transcripts, catalytic RNA.

UNIT-IV
1. Genetic code: nature of genetic code, codon, anticodon, wobble hypothesis.
2. Protein synthesis: steps, details of initiation, elongation and termination.
3. Inhibitors of protein synthesis: signal hypothesis.

UNIT-V
1. Regulation of gene expression: operon concept; regulatory and structural gene, operator, promoter, repressor, induction and repression, positive and negative control.
2. Lac-operon, ara-BAD operon, trp operon, attenuation, mechanism of regulation of transcription.
3. Regulation of gene expression in eukaryotes: Britton and Davidson’s model of regulation involve HCP and NHCP and hormones.
4 Transposable elements.

**Reference Books**

5. Genomes by T.A. Brown, John Wiley and sons (Asia)PTE LTD, New York.
9. An Introduction to Genetic Analysis, Griffths *et al.*, W. H. Freeman
MB: 202 (Core) IMMUNOLOGY

UNIT-I
1. History of immunology, development of immunology as discipline.

UNIT-II
2. Antigens- structure and properties, factors affecting the immunogenicity, properties of B and T- cell epitopes, haptens, mitogens, super antigen, adjuvants.
3. Antibody: structure, properties, types and function of antibodies, antigenic determinants on immunoglobulin; isotypes, allotypes, and idiotypes, molecular mechanism of antibody diversity and class switching.

UNIT-III
1. Major histocompatibility complex: organization of MHC genes, types and function of MHC molecules, antigen presentation, MHC polymorphism, MHC related diseases.
3. Cytokines: types, structure and functions, cytokines receptors, cytokine regulation of immune receptors.
4. Immune response to infectious diseases: viral infection, bacterial infection, protozoan diseases, helminthes related diseases.

UNIT-IV
3. Transplantation immunology: immunologic basis of graft rejection, clinical manifestation of graft rejection and clinical transplantation.
UNIT-V

1. Vaccines: Active and passive immunization, vaccine schedule, whole organism vaccine, subunit vaccine, vaccine, DNA vaccine, recombinant vaccine, subunit vaccines and anti-idiotype vaccine.

2. Hybridoma technology: murine monoclonal antibody production, principle of selection, characterization and applications in diagnosis, therapy and basis research.

3. Antibody engineering: Chimeric and Humanized monoclonal antibodies.

4. Antigen- antibody interaction: avidity and affinity measurements, detection of antigen- antibody interaction by precipitation, agglutination, RIA, and ELISA.

Reference Books


MB: 203 (Core) MICROBIAL PHYSIOLOGY AND METABOLISM

UNIT-I
1. Bioenergetics and metabolism: Basic concepts.
2. First and second law of thermodynamics, concept of free energy, entropy and enthalpy.
3. High energy phosphate compounds, role of ATP, ATP cycle, structural basis of free energy change during hydrolysis of ATP.
4. Biological redox reactions, Biological reducing power and its role in biological system.

UNIT-II
2. Pentose phosphate pathway, E-D pathway, Kreb’s cycle and glyoxalate pathway.
3. Electron transport system in Mitochondria, Electron carriers and multi enzyme complex I to IV.
4. ATP synthesis: substrate level and oxidative phosphorylation and un-couplers, inhibitors of oxidative phosphorylation.

UNIT-III
3. Lipid biosynthesis: Biosynthesis of lipids and fatty acids, triglycerol and phospholipids and their regulation.
4. Lipid Metabolism: Degradation of Lipids, oxidation of unsaturated, saturated, even and odd chain fatty acids, ketone bodies.

UNIT-IV
1. Amino acid metabolism: Biosynthetic families of amino acids - Outlines
2. Catabolism of amino acids: Breakdown of amino acids into six common intermediates and urea cycle and relationship with TCA cycle. - Outlines
3. Nucleotide metabolism: Biosynthesis of purines and pyrimidine nucleotides by de novo and salvage pathways.
4. Degradation of Purines and Pyrimidine nucleotides.

UNIT-V
1. Nitrification, denitrification, Nitrate and ammonia assimilation pathways, Nitrogen cycle.
2. Diazotrophs and Biochemistry of nitrogen fixation, Structure of nitrogenase complex.
3. Regulation of nitrogenase complex by oxygen and combined nitrogen sources.
4. Nif genes and their regulation.

**Reference Books**
MB: 204 (Core) BIOSTATISTICS, COMPUTER APPLICATION & BIOINFORMATICS

UNIT–I
1. Definition of statistics and scope of statistics in bio research.
2. Types of sampling methods, survey design, organization and graphical representation of data.
3. Measures of central tendency
4. Measure of dispersion, correlation, calculation of Karl Pearson’s coefficient of correlation, theory of multiple correction and property.

UNIT–II
1. Regression Analysis, linear regression, regression equation
2. Hypothesis testing: Types of hypothesis testing: t-test, 2 -test, and F- test.
3. Introduction of Design of Experiment (DOC) and factorial design.
4. Application of SPSS software.

UNIT–III
1. History & development of computer organization of a basic computer. computer application in molecular biology.
2. Number system, computer arithmetic & Boolean algebra.
3. Type of operating systems, DOS, WINDOWS & LINUX. Introduction to MS Office.
4. Basic concept of programming; algorithm, flow charts & introduction to computer languages, basic idea of internet. Use of various software in microbiology.

UNIT–IV
3. Sequence Database: EMBL, DDBJ, GenBank, UniGen, PIR, SWISS-PROT and TrEMBL. Structure Database: PDB, CATH, DALI, SCOP.
4. Data mining tools: Modelling tools ( Rasmol, SPDV, HyperChem), Data submission tools (Bankit, Sequin, Webin, Sukura, Spin, AutoDep).

UNIT–V
1. Algorithms: Classification of algorithms, Sequence Comparison algorithms (Dot matrix), Submission metrics algorithms (PAM, BLOSUM), Tools for sequence alignment (FASTA, BLAST, ORF finding).
4. Proteomics: Proteome analysis, Tools for Protein sequence analysis and proteomics (PSI- BLAST, CD search, CDART), structure analysis (Cn3D, CD search).

**References Books**
8. Introduction to Bioinformatics by Teresa. K. Attwood and David J. Parry- Smith, Low Price edition, Pearson Education
MB – 205: LAB COURSE III

**Practical Exercises**

LAB COURSE-III (MICROBIAL GENETICS AND MOLECULAR BIOLOGY & IMMUNOLOGY)

1. To induce mutation by UV radiations and to exhibit DNA repair by photo reactivation.
2. To isolate and produce UV induced auxotrophic mutants by replica plating method.
3. Demonstration of genetic recombination in bacteria by conjugation.
4. To perform Ames test for detecting carcinogen or mutagen.
5. Quantification of DNA by DPA method.
6. Quantification of RNA by Orsinol method
7. To check purity and quantity of DNA by Spectrophometric method.
8. To isolate genomic DNA from Gram positive and Gram Negative bacteria.
9. To isolate total RNA and mRNA from bacteria
10. To perform SDS-PAGE for separation of proteins in given sample.
11. To prepare soluble antigen by different methods.
12. To demonstrate various routes of immunization in mice.
13. To prepare serum and plasma from blood.
14. To precipitate immunoglobulins by ammonium sulphate and to determine total protein contents.
15. To determine Blood group and Rh factor by slide agglutination test
16. To determine Total Leukocyte Count (TLC) for given blood sample
17. To determine Differential Leukocyte Count (DLC) for given blood sample using Leishman stain.
18. To perform Widal agglutination test (slide and tube) for diagnosis of typhoid.
19. To perform Ouchterlony double diffusion test for detection of antigen and antibody reaction and to demonstrate relationship between antigens.
20. To perform Redial immuno-diffusion test for detection of antigen and antibody reaction and for quantification of antigens.
21. To perform immune-electrophoresis for separation of antigens and for detection of antigen and antibody reaction
22. To perform Rocket immuno-electrophoresis for detection of antigen and antibody reaction
23. To perform ELISA for assay of antibodies in serum sample against given antigen.
MB- 206: LAB COURSE IV

Practical Exercises

Lab course - IV (Microbial Physiology and Metabolism & Biostatistics, Computer Application and Bioinformatics)
1. To study catalase activity of given microbial culture.
2. To study oxidase activity of given microbial culture.
3. To study ability of microorganisms to hydrolyse casein.
4. To demonstrate phenylalanine deaminase activity of given bacterial culture.
5. To demonstrate L-lysine decarboxylase activity of bacterial culture.
6. To demonstrate carbohydrate metabolism (oxidation and fermentation of Glucose) in microorganisms.
7. To demonstrate Fat hydrolysis (lipase activity) by bacteria.
8. To study ability of microorganisms to hydrolyze gelatin.
9. To demonstrate degradation of sulphur containing amino acids by bacteria.
10. Representation of statistical data by
12. Collection of data using different sampling methods.
13. Determination of measures of dispersion (Mean deviation, Standard deviation and Coefficient of variation, Quartile deviation).
16. To access scientific data from Literature data bases (PUBMED, LITDB, Medline).
17. To access nucleic acid databases for retrieval of gene sequence.
18. To access protein databases for retrieval of amino acid sequence of target protein.
19. To perform pair wise sequence alignment using Dot matrix.
20. To perform multiple sequence alignment using BLAST.
21. To perform multiple sequence alignment using CLUSTAL-W and to find conserved sequences using JAL view.
22. To prepare Phylogenetic tree and Cladogram using CLUSTAL-W.
23. 3D protein structure prediction and structure refinement using Swiss-PDB viewer.
MB-207: SEMINAR

Every student shall deliver at least one seminar on topic of the curriculum/ advances in Microbiology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also be encouraged to assess the seminar on the given criteria and their evaluation will also be given due consideration. The average marking will be taken into consideration.

MB 208: ASSIGNMENT/PERSONALITY DEVELOPMENT/ SKILL DEVELOPMENT ACTIVITY

Every student will be given an assignment/skill development in product development/personality development which will be evaluated by concerned teacher.

MB 209: COMPREHENSIVE VIVA

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of each semester of the programme by a board of four examiners, at least ONE of whom shall be external. The grades awarded in the viva-voce shall be shown separately in the grade-sheet.

The conversion of CGPA in to percentage will be as follow to facilitate its application in other academic matters:  Equivalent Percentage = CGPA x10
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MB: 301 (Core) MEDICAL AND PHARMACEUTICAL MICROBIOLOGY

UNIT-I

1. Infection: types of infection, sources of infection, reservoirs and vehicles of infection, predisposing factors.

2. Host-parasite relationship governing the infection and establishment of disease, factors affecting virulence.


4. Mode of spread of infection; Respiratory, skin, wound & burn infection, venereal infections, alimentary tract infection, blood born infection and nosocomial infection.

UNIT-II

1. Infections caused by Gram positive cocci and Gram negative cocci: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Staphylococcus*, *Streptococcus* and *Neisseria* (meningitis, gonorrhea)

2. Infections caused by Gram negative bacteria of family Enterobacteriaceae: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *E.coli*, *Klebsiella*, *Proteus*, *Pseudomonas*, *Shigella dysenteriae* and *Salmonella typhi*.

3. Infection caused by Gram Positive bacilli: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Corynebacterium diphtheriae*, *Bacillus anthracis*, *Clostridium tetani*, *Vibrio cholerae*.

4. Disease caused by acid-fast bacteria and intracellular bacteria: Source of infection, Pathogenicity, Epidemiology & Lab diagnosis of *Mycobacterium tuberculosis*, *Mycobacterium leprae*, *Rickettsia* and *Chlamydia*.

UNIT-III

Morphology, pathogenesis, immune response, diagnosis and prevention of

1. Pox viruses (Variola, Vaccinia, Small pox) Herpes Simplex type I and type II, Picorna viruses (Entero viruses and Polio viruses).

2. Paramyxvo viruses (Rubella virus and Para influenza viruses), Orthomyxo viruses (Measles & Mumps viruses).

3. Hepatitis viruses (Type A, B, C, D, E), Arbo viruses (Alpha virus and Flavi viruses), Rhabdo viruses (Rabies virus).

4. Oncogenic viruses, HIV virus.

UNIT-IV
1. Important protozoal diseases: Route of entry, Life Cycles, Immunity, disease produced, diagnosis & prophylaxis of *Plasmodium vivax*, *P. falciparum*, *P. malariae* (Malaria), *Entamoeba histolytica* & *Entamoeba coli* (amoebiasis),

2. Route of entry, Life Cycles, Immunity, disease produced, diagnosis & prophylaxis of *Leishmania*, *Trypanosoma* and *Toxoplasma*.

3. Fungal infections: description & classification of pathogenic fungi, Infection caused by dermatophytes (Microsporum, Trichophyton & Epidermatophyton)

4. Definition, Causative agent, Source of infection, Epidemiology, Symptomatology & Diagnosis of Candidiasis, Aspergillosis and Histoplasmosis.

**UNIT-V**

1. Antimicrobial agents: Histroy, Antibiotics, Antifungal and Antivirals (common drugs, their spectrum and mode of action)

2. Methodologies for testing of antibacterial, antifungal, and antiviral drugs (*in vivo* and *in vitro* infectivity models), mechanism drug resistance.

3. Preclinical development: Safety profile of drugs (Pyrogenecity, Toxicity –hepato, - nephro, -cardio and neurotoxicity), Toxicological evaluation of drug (LD50, Acute, subacute and chronic toxicity), Mutagenecity (Ames test, micronucleus test) and Carcinogenicity.


**Reference Books**


4. Virology; Renato Dulbecco and Harold S. Ginsberg, Fourth edition, J.B. Lippincott Company, USA


6. Medical Microbiology; Jawetz, Melnick, & Adelberg's, Fifth edition, MacGrow Hills

7. Medical Bacteriology, Medical Mycology and AIDS; N.C.Dey, T.K. Dey and D. Sinha, New Central Book Ajency (P) Ltd.


MB: 302 (Core) FERMENTATION AND MICROBIAL TECHNOLOGY

UNIT-I
1. Industrially important strains of bacteria, fungi, and actinomycetes. Novel microbes for future industry.
2. Isolation and screening of the industrially important strain from diverse ecosystem.
3. Method of strain improvement, mutagenesis, strain breeding by protoplast fusion, sexual and para sexual recombination.

UNIT-II
1. Downstream processing: filtration of fermentation broths recovery of biological products by distillation, superficial fluid extraction.
2. Detection, analysis and quality control of fermentation products and row materials.
3. Industrial production of alcohols: vinegar, wine and alcohol.
4. Industrial production of solvents-glycerol, acetone, and butanol.

UNIT-III
1. Industrial production of citric acid and glutamic acid.
2. Microbial production of enzyme of industrial important: amylase and proteases.
3. Methods of whole cell immobilization, enzyme immobilization and application.
4. Industrial production of antibiotics, penicillin and streptomycin.

UNIT-IV
1. Hygiene and safety in fermentation industries.
3. Microbial production of Interferon, Insulin, flavours and fragrances.

UNIT-V
1. Microbial production of vaccines.
3. Microbial transformations: Steroid biotransformation
4. Intellectual property rights (IPR) and protection (IPP)

Reference Books:


2. Biotechnology - A Text Book of Industrial Microbiology by Cruger.

3. Fermentation Biotechnology: Industrial Perspectives by Chand.


MB: 303 (Elective I) RECOMBINANT DNA TECHNOLOGY

UNIT-I
1. Enzymes used in DNA technology: Restriction and modification enzymes, nucleases, polymerases, ligase, kinases and phosphatases. Linkers and adapters.
2. Cloning vectors: Plasmids, Phages (Lamda and M13) Phagmids, Cosmids and Expression vectors.
3. Cloning vectors for Yeast (shuttle vector and YAC) and cloning vector for animal cells: SV 40, Vaccinia and Retroviruses.

UNIT-II
1. Genomic and cDNA library.
2. Screening of clones from libraries: Expression based screening, Interaction based screening.
4. Mutagenesis: Site directed mutagenesis, Transposon mutagenesis.

UNIT-III
1. DNA Sequencing: Sangers method, Maxmam Gilbert method, Thermocycle sequencing and Pyrosequencing
3. Oligonucleotide synthesis, Restriction mapping, S1 nuclease and RNase mapping.
4. Polymerase Chain Reaction (PCR): Principle, Types and variants of PCR (Touch-Down PCR, Hot start PCR, Inverse PCR, RT-PCR, multiplex PCR, nested PCR), Real time PCR.

UNIT IV
1. Molecular typing: RFLP (Ribotyping, IS based), RAPD, AFLP, VNTR, SNP, Whole genome sequence: GIS

2. Promoter characterization: promoter analysis through reporter genes, electrophoretic mobility, shift assay, DNA foot-printing & DNA fingerprinting.

3. Transgenic animals: Strategies and methods.

UNIT-V

1. Applications of Recombinant DNA Technology in Medicine, Molecular diagnostics, recombinant and DNA vaccines.


3. Applications of Recombinant DNA Technology in Agriculture and Industry.

4. Biosafety & ethical considerations for GMOs.

Reference Books


MB: 304 (Elective II) ENVIRONMENTAL MICROBIOLOGY

UNIT-I

1. Microbial ecology: basic concepts, types and microbial habitats, factors affecting microbial population.
2. Microbial interactions: competition, commensalism, parasitism, mutualism, commensalisms, synergism.
3. Population ecology: characteristics of population, population growth curves (r and k selection), population regulation.

UNIT-II

1. Microbiology of air: microorganism of air, enumeration of air micro flora.
2. Significance of air micro flora.
3. Brief account of air borne transmission of bacteria, fungi, pollens and viruses.
4. Air borne diseases and their prevention.

UNIT-III

2. Role of microorganisms in organic matter decomposition (cellulose, hemi cellulose, lignin).
4. Microbial degradation of xenobiotics, petroleum and oil spills in environmental decay behaviours and degradative plasmid.

UNIT-IV

2. Water purity test and indicator organisms, method used in environmental studies – BOD, COD, DO.

UNIT-V

2. Bioremediation of contaminations.
3. Extremophiles – acidophilic, alkalophilic, thermophilic microbes with adaptation and application in ecosystem.
4. Microbial biofilms: physiology, morphology, biochemistry of microbial biofilms, mechanism of microbial adherence, beneficial and harmful role of biofilms.

Reference Books


2. Environmental chemistry, A.K. De, Wiley Eastern Ltd., New Delhi

3. Environmental Science, Physical Principles and applications; Egbert Boeker et. al.


6. Environmental Biotechnology Theory and Application by Gareth M. Evans and Judith C. Furlong, John Wiley and Sons, LTD, U.S.A.

7. Ecology and Environment by P.D. Sharma, Rastogi Publications, New Delhi, India

MB: 305 Lab course V (Core) (MEDICAL AND PHARMACEUTICAL MICROBIOLOGY & FERMENTATION AND MICROBIAL TECHNOLOGY)

1. To prepare various basic, selective, enrichment and enriched media used for isolation of medically important bacteria from clinical samples.
2. To perform various biochemical tests (IMVIC, oxidase, catalase, urea utilization test, sugar utilization and H₂S production on TSI agar slant) used for identification of medically important bacteria.
3. To perform sugar fermentation tests used for identification of medically important bacteria.
4. Preparation of transport media for different clinical samples.
5. Demonstration normal microbial flora of skin, mouth and throat
6. Isolation and identification of Staphylococcal species using suitable media, staining techniques and biochemical tests.
7. Isolation and identification of Staphylococcal species using suitable media, staining techniques and biochemical tests.
8. Identification of bacterial species belonging to Enterobacteriaceae family using suitable biochemical tests (E. coli, Proteus, Pseudomonas, Klebsiella)
9. Isolation and identification of enteric fever causing bacteria (Salmonella typhi) using suitable media and biochemical tests.
10. Isolation and identification of Bacillus species using suitable media, staining techniques and biochemical tests.
11. Microbiological analysis of urine specimens.
12. Microbiological analysis of sputum specimens
13. Isolation of dermatophytes and their identification based on colony morphology and microscopic characteristics.
14. To determine antibiotic sensitivity for Gram negative and Gram positive bacteria by disc diffusion method
15. To determine Minimal Inhibitory Concentration (MIC) and Minimal Bactericidal concentration of an antibiotic for test bacteria.
16. To study antibiotic resistance in bacteria
17. Determination of thermal death point (TDP) of an Organism
18. Determination of thermal death time (TDT) of an Organism
19. Isolation of amylase producing microorganisms from Soil
20. Isolation of cellulase and pectinase producing microorganisms from vegetable and fruit waste.
21. Isolation of lipase producing microorganisms from butter.
22. To isolate antibiotic producing microorganisms form soil
23. To isolate Penicillium species producing penicillin.
24. Production of penicillin and to evaluate it activity.
25. To demonstrate handling and sterilization of Fermenter.
26. Production of wine from grapes.
27. To demonstrate strain improvement of industrially important bacteria or yeast by mutagenesis and selection of improved strains.
MB: 306 Lab course VI (Elective) (RECOMBINANT DNA TECHNOLOGY & ENVIRONMENTAL MICROBIOLOGY)

1. Preparation of LB broth, LB Agar with antibiotic for culture and maintenance of Host *E. coli* and *E. coli* with plasmid vector.
2. Isolation of plasmid DNA (or plasmid vector DNA).
3. Restriction digestion of given DNA with suitable restriction enzymes.
4. Ligation of insert (gene) and vector DNA.
5. Preparation of competent cells.
6. Transformation of host *E. coli* with recombinant DNA and selection of recombinants.
7. To perform PCR for amplification of target DNA segment (or gene).
8. Determination of Total Dissolve Solids (TDS) of given water sample.
9. Determination of chemical oxygen demand (COD) of given water sample.
10. Determination of Dissolved oxygen (DO) of given water sample.
11. Determination of BOD of given water sample.
12. Determination of total bacterial population by standard plate count technique.
13. Determination of the most probable number (MPN) of coliform bacteria in water.
14. Microbiological analysis of water by membrane filter method.
15. Microbiological analysis of air for presence of pathogenic microorganisms in air.
16. Microbiological analysis of water for presence of pathogenic microorganisms.
MB-307: SEMINAR

Every student shall deliver at least one seminar on topic of the curriculum/ advances in Microbiology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also be encouraged to assess the seminar on the given criteria and their evaluation will also be given due consideration. The average marking will be taken into consideration.

MB 308: ASSIGNMENT/PERSOALITY DEVELOPMENT/ SKILL DEVELOPMENT ACTIVITY

Every student will be given an assignment/skill development in product development/personality development which will be evaluated by concerned teacher.

MB 309: COMPREHENSIVE VIVA

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.
SEMMESTER IV (with detailed scheme)

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Total Credit Value: # 24 (20 + 4 virtual credits)
MB: 401 A (Centric) AGRICULTURE MICROBIOLOGY

UNIT I
1. Microorganisms of soil
2. Rhizosphere and phyllosphere microflora
3. Brief account of Microbial interactions: antagonism, symbiosis, mutualism, commensalisms, synergism and parasitism.

UNIT II
1. Role of enzymes and toxins in pathogenesis.
2. Fungal diseases of plants: Rusts of wheat, linseeds; late blight of potato; red rot of sugarcane.
3. Bacterial diseases of plants: Citrus canker, blight of rice
4. Viral diseases of plants: Leaf curl of Papaya, vein clearing of lady’s finger

UNIT III
1. Physical and chemical control of plant diseases.
2. Bacterial control of insect pests: Bacillus thuringiensis as bacterial insecticide
3. Viral control of insect pests: Nuclear polyhedrosis visuses (NPV) and cytoplasmic polyhedrosis viruses (CPV)
4. Fungal control of insect pests: Entomopathogenic fungi: Metarhizium anisopliae, Beauveria bassiana, Verticillium lecani, Hirsutella thompsoni

UNIT IV
1. Storage fungi: Categories of storage fungi, conditions during storage in relation to damage of seeds, harmful effects.
2. Mycotoxins and their effect on human being.
3. General idea about quarantine.
4. Production of biogas and alcohol from agricultural wastes.

UNIT V
1. Biofertilizers: Types, production and application.
2. Mycorrhizae: Types and their application in agriculture and forestry.
3. Vermicomposting.
4. Reclamation of waste agricultural land by microorganisms.

Reference Books

**MB: 401 B (Elective) FOOD MICROBIOLOGY**

**UNIT I**
1. Microorganisms important in food microbiology: molds, yeast and bacteria –general characteristics, classification and importance.
2. Principles of food preservation, preservation by use of high temperature, low temperature, drying and dessication.
3. Chemical preservatives and additives.

**UNIT II**
1. Factors influencing microbial growth in food: Extrinsic and intrinsic factors.
2. Microbial spoilage of food. Chemical changes caused by the microorganisms during spoilage.
3. Spoilage of fish, meat, poultry, eggs, fruits and vegetables.
4. Detection of spoilage and characterization.

**UNIT III**
1. Classification of food borne diseases.
2. Food borne infections: *Brucella, Bacillus cereus, Clostridium perfringens, Yersinia enterocolitica and Escherichia, Salmonella* spp.
3. Food intoxication: Staphylococcal intoxication, Clostridial poisoning (*Clostridium Botulinum*).
4. Food adulteration and prevailing food standards in India.

**UNIT IV**
1. Microbiology of Milk: Sources of microorganisms in milk and types of microorganisms in milk.
2. Microbiological examination of milk (standard plate count, direct microscopic count, reductase, and phosphatase test).
3. Dehydration and pasteurization of milk.
4. Dairy products from microorganisms: Butter, yoghurt and cheese.

**UNIT V**
1. Microorganisms as source of food: Single Cell Protein (SCP)
2. Mushrooms and food value of mushrooms
3. Food conversions: Lactic acid conversions, soyabean conversions and Bakery
4. Microbiological estimation of food: Sample collection, preparation and analysis techniques

**Reference Books:**
MB: 402- Lab course VII A (Centric)

AGRICULTURE MICROBIOLOGY

1. To study viral diseases in plants.
2. To study bacterial and fungal diseases in plants.
3. Isolation of rhizobia from root nodules of leguminous plants.
4. Testing of nodulation ability of rhizobia.
5. Inoculation of seeds with rhizobia.
6. To study pesticidal activity of *Bacillus thuringiensis*.
7. Isolation of VAM spores from soil.
8. Isolation of *Azotobacter* species from soil.
9. Isolation of microorganisms from rhizosphere.

MB: 402 Lab course VII B (Elective)

FOOD MICROBIOLOGY

1. Detection of adulterants in spices, pulses, sugar, tea.
2. Detection of adulterants in milk and milk products.
3. Detection of arsenic by microbiological methods.
4. Detection of nicotinic acid by bioassay.
5. Detection of number of bacteria in milk by SPC.
6. Determination of quality of milk sample by methylene blue reductase test.
7. To demonstrate role of yeast in bread-making.
8. Isolation of microorganisms from spoiled food.
9. Isolation of pathogenic microorganisms from food.
MB-403: SEMINAR

Every student shall deliver at least one seminar on topic of the curriculum/ advances in Microbiology which will individually be assessed by every available teacher on the basis criteria laid down by the Staff council. Students in audience will also be encouraged to assess the seminar on the given criteria and their evaluation will also be given due consideration. The average marking will be taken into consideration.

MB 404: ASSIGNMENT/PERSOANLITY DEVELOPMENT/ SKILL DEVELOPMENT ACTIVITY

Every student will be given an assignment/skill development in product development/personality development which will be evaluated by concerned teacher.

MB 405 (Core) Project work: It consists of 3-4 months project work/ Industrial training followed by presentation and Viva-voce of 100 marks. The project work shall be evaluated by both the internal and external examiner at the time of oral presentation

MB 406: COMPREHENSIVE VIVA

A comprehensive viva-voce of 4 virtual credits will be conducted at the end of semester of the programme by a board of four examiners.