UNIVERSITY OF KERALA

COURSE STRUCTURE AND SYLLABUS

FOR

FIRST DEGREE PROGRAMME

IN

MICROBIOLOGY

UNDER

CHOICE BASED CREDIT- SEMESTER SYSTEM

(w.e.f. 2014 admission)
THE PROGRAMME

The programme is named as Bachelor of Science (B. Sc.) in Microbiology

ELIGIBILITY FOR ADMISSION

A pass in 10+2 (Higher Secondary/ISC/CBSE) Exam with Biology as one of the papers will be eligible.

OBJECTIVES OF THE PROGRAMME

• To impart knowledge of Science is the basic objective of education.

• To develop scientific attitude is the major objective to make the students open minded, critical & curious.

• To develop skill in practical work, experiments and laboratory materials and equipments along with the collection and interpretation of scientific data to contribute the science.

• To understand scientific terms, concepts, facts, phenomenon and their relationships.

• To make the students aware of natural resources and environment.

• To provide practical experience to the students as a part of the course to develop scientific ability to work in the field of research and other fields of their own interest and to make them fit for society.

• The students are expected to acquire knowledge of microbiology and related subjects so as to understand natural phenomenon, manipulation of nature and environment in the benefit of human beings.

• To develop ability for the application of the acquired knowledge to improve agriculture and other related fields to make the country self reliant and sufficient.

• To create the interest of the society in the subject and scientific hobbies, exhibitions and other similar activities.

• To enrich the students with the latest developments in the field of Information Technology, Biotechnology, Bioinformatics and other related fields of research and development
• To create enthusiasm to understand more about the beautiful planet Earth and to give awareness to the public the need to protect the planet from all kinds of exploitation

• To keep the scientific temper which the student acquired from school level and to develop a research culture.
Table 1. General Structure of the First Degree Programme in Microbiology

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* CH-Chemistry –Same syllabus of complementary Chemistry offered for Botany/Zoology may be followed
** BT-Biotechnology- New syllabus
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L = Lecture  P = Practical  
( )*Practical hour already distributed in the semester concerned
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(Core, Foundation & Open courses, Project/Dissertation)

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Duration of Examination (Theory & Practical): 3 Hours
Continuous Evaluation (CE): 25%; End Semester Evaluation (ESE): 75%
Total Weightage for Each Course (Theory & Practical): 30
Total credits for the entire programme: 120
<table>
<thead>
<tr>
<th>Semester</th>
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<th>Weightage</th>
<th>Duration of Univ. Exam</th>
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<td>II</td>
<td>MB 1221</td>
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<td>3 Hours</td>
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<td>III</td>
<td>MB 1341</td>
<td>Fundamentals of Microbiology</td>
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<td>3 Hours</td>
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<td>IV</td>
<td>MB 1441</td>
<td>Microbial Genetics &amp; Immunology</td>
<td>4</td>
<td>3 Hours</td>
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<td>V</td>
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<td>3 Hours</td>
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<td></td>
<td>MB 1542</td>
<td>Environmental Microbiology</td>
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<td>3 Hours</td>
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<td></td>
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<td>Medical Microbiology &amp; Molecular Biology</td>
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<td>3 Hours</td>
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<td>Microbial Waste Management</td>
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<td>MB 1551.3</td>
<td>Bio-fertilizer Technology</td>
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<td>3 Hours</td>
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<td>VI</td>
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<td>4</td>
<td>3 Hours</td>
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<td>3 Hours</td>
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<td>MB 1646</td>
<td>Project, Tour Diary Viva Voce</td>
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<td>3 Hours</td>
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</table>

CE= Continuous Evaluation  ESE= End Semester Evaluation
PATTERN OF THEORY QUESTION PAPER

Salient features:

• Question paper is set up based on grading system/marks
• The duration of exam for each course is fixed to 3 hours
• The question paper consists of five sections A, B, C & D Section A consists of 16 questions and a bunch of 4 questions carries 1 weightage
• Section B contains 12 very short answer questions of which the candidate can choose 8 and carries 1 weightage each
• Section C has 8 short answer type questions of which the candidate has to answer 5 with a weightage of 1 each
• The last section D consists of 3 questions and the candidate gets the freedom to answer 2 questions with a weightage of 4 each
• Total weightage is 30/paper

EVALUATION AND GRADING

The Evaluation of each course shall consist of two parts 1) Continuous Evaluation (CE) 2) End Semester Evaluation (ESE). The CE and ESE ratio shall be 1:4 for both courses with or without practical. There shall be a maximum of 80 marks for ESE and maximum of 20 marks for CE. For all courses (Theory and Practical), Grades are given on a 7-point scale based on the total percentage of mark (CE+ESE) as given below:

<table>
<thead>
<tr>
<th>Criteria for Grading</th>
<th>Percentage of marks</th>
<th>CCPA</th>
<th>Letter Grade</th>
</tr>
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<tbody>
<tr>
<td>90 and above</td>
<td>9 and above</td>
<td>A+</td>
<td>Outstanding</td>
</tr>
<tr>
<td>80 to &lt; 90</td>
<td>8 to&lt;9</td>
<td>A</td>
<td>Excellent</td>
</tr>
<tr>
<td>70 to &lt;80</td>
<td>7to&lt;8</td>
<td>B</td>
<td>Very Good</td>
</tr>
<tr>
<td>60 to &lt; 70</td>
<td>6to&lt;7</td>
<td>C</td>
<td>Good</td>
</tr>
<tr>
<td>50 to &lt; 60</td>
<td>5to&lt;6</td>
<td>D</td>
<td>Satisfactory</td>
</tr>
<tr>
<td>40 to &lt; 50</td>
<td>4to&lt;5</td>
<td>E</td>
<td>Adequate</td>
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<tr>
<td>Below 40</td>
<td>&lt;4</td>
<td>F</td>
<td>Failure</td>
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**Theory**

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage</th>
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<tbody>
<tr>
<td>Attendance</td>
<td>1</td>
</tr>
<tr>
<td>Assignment/ Seminar</td>
<td>1</td>
</tr>
<tr>
<td>Test paper</td>
<td>2</td>
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<tr>
<td><strong>Total</strong></td>
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**Practical**

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Attendance</td>
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<td>Viva-voce</td>
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<td>Test</td>
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<td><strong>Total</strong></td>
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**End Semester Assessment (ESA)**

<table>
<thead>
<tr>
<th>Details of Papers</th>
<th>Duration of Exam</th>
<th>Weightage</th>
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<td>Microbiology (Core ) Courses</td>
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<td>30</td>
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<tr>
<td>Complementary Courses</td>
<td>3 Hours</td>
<td>30</td>
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<tr>
<td>Open Courses</td>
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**Consolidation of Grades for CE for Theory course**

**Example:**

<table>
<thead>
<tr>
<th>Component</th>
<th>Weightage (W)</th>
<th>Grade awarded</th>
<th>Grade points (G)</th>
<th>Weighted Grade points(W×G)</th>
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<tbody>
<tr>
<td>Attendance</td>
<td>1</td>
<td>B</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Assignment/Seminar</td>
<td>1</td>
<td>C</td>
<td>2</td>
<td>2</td>
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</tbody>
</table>
Test paper | 2 | A | 4 | 8
---|---|---|---|---
Total | 4 | | | 13
CE Grade | Total weighted grade points/Total weights=13/4=3.25=Grade B

- With regard to the **attendance** (weight=1), the following grading scheme shall be followed:
  Below 75% - E; 75-79% - D; 80-89% - C; 90-94% - B; 95-100% - A.
- For **assignment/ Seminar** (weight -1), the teacher shall define the quality in terms of **structure, content, presentation** and **punctuality** in submission.
- **Test papers** (weight=2) shall be graded by the same procedure adopted for theory exam evaluation.

The students are required to write a minimum of 2 class tests in every semester for each course. Grades for the test component in CE shall be awarded on the basis of calculating average of the grades secured for the two class tests. Each student shall be required to do one assignment or one seminar for each Course. Valued assignments shall be returned to the students. The seminars shall be organized by the teacher/teachers in charge of CE and the same shall be assessed by a group of teachers including the teacher/teachers in charge of that Course.

**CONSOLIDATION OF THE GRADE OF A COURSE**
The grade of a course is consolidated by combining the ESE and CE grades taking care of their weights

**Example:**

<table>
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<tr>
<th>Exam awarded</th>
<th>Weight points(G)</th>
<th>Grade Points (WxG)</th>
<th>Grade</th>
<th>Weighted grade</th>
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<tbody>
<tr>
<td>ESE</td>
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<td>2.47</td>
<td>C</td>
<td>7.41</td>
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<td>Total</td>
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</table>

**Grade of Course** Total weighted grade points/Total weights=10.61/4=2.65=Grade B

**END SEMESTER ASSESSMENT (ESA)**
The University shall conduct the external examinations for all semesters. There will not be any supplementary exams. The practical examinations for **Core courses** shall be conducted at the end of 4th, 5th and 6th semesters and **Complementary** courses at the end of 4th semester according to the common calendar and questions set up by the University. The Board of Examiners constituted by the University will have the right to make necessary changes in the pattern of practical examination as and when needed.

**ELIGIBILITY TO APPEAR FOR PRACTICAL EXAMINATION**
Submission of the following
- Certified and *bona fide* practical record
- Certified field work
- Certified tour report
• Project report/Dissertation (certified and *bona fide*)

**PROJECT**

Project work/Dissertation is compulsory. It can be carried out either individually or by a group not exceeding 15 students. The topics shall either be allotted by the supervising teacher or be selected by the student in consultation with the supervising teacher. The project report/dissertation duly attested by the Supervising teacher and Certified by the Head of the Department, has to be submitted on the day of examination of **Practical - II (Core)**. The project shall be evaluated by an external examiner. The project report/ Dissertation (not less than 40 pages) shall be prepared as per the format given below.

1. Title page /Front page (Certified by the **HOD**)
2. Declaration by the candidate
3. Certificate attested by the Supervising teacher
4. Acknowledgement, if any
5. Table of contents
6. Abbreviation, if any
7. Abstract/ Summary
8. Introduction & Review of Literature (10pages)
9. Material and Methods
10. Results and Discussion (Not less than 10 pages)
11. Conclusion
12. References

Tables, Graphs, Photographs etc. can be used to present the data. Topics selected once should not be repeated.

**STUDY TOUR**

• Visit to a Microbiology Laboratory/ Distillary /Biofertilizer unit etc within or outside Kerala with a minimum duration of 3 days is compulsory

• A brief report of the trip has to be submitted, along with appropriate photographs
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<td>MB1341</td>
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<td>3 L 2 P</td>
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<td>Microbial Genetics &amp; Immunology</td>
<td>3 L 2 P</td>
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<td>MB1541</td>
<td>Instrumentation in Microbiology</td>
<td>4 L 3 P</td>
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<td>Practical IV (MB1642 &amp; MB1643)</td>
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METHODOLOGY AND PERSPECTIVES OF SCIENCES

Course code: MB1141
Number of credits: 3
Number of contact hours: 54 hrs (Lecture); 18hrs (Practical)

Aim of the course: To introduce the methodology and perspectives of Science in general so as to enable the students to systematically pursue his particular discipline in science in relation to other disciplines that come under the rubric of sciences.

Objectives:
- To familiarize the students with the fundamental characteristics of science as a human enterprise
- To see how science works
- To apply scientific methods independently
- To interpret scientific data using basic statistical methods

MODULE-I
Science and Science Studies 10 hrs
1. Types of knowledge: practical, theoretical and scientific knowledge
2. Information: What is science; what is not science; laws of science; basis of scientific laws and factual truths.
3. Science as a human activity; scientific temper and empiricism, vocabulary of science, science disciplines
4. Revolution in Science and Technology

MODULE- II
Methods and Tools of Science 16 hrs
1. Hypotheses; theories and laws in science; Observations, evidences and proofs;
2. Posing a question; formulation of hypothesis; Hypothetico-deductive model; inductive model. Significance of verification (proving) corroboration and falsification (disproving), auxiliary hypothesis; adhoc hypothesis
3. Revision of scientific theories and laws.
4. Importance of models, simulations and virtual testing

MODULE-III
Experimentation in Science 10 hrs
1. Design of an experiment: experimentation; observation; data collection; interpretation and deduction.
2. Necessity of units and dimensions: repeatability and replication; documentation of experiments; record keeping, connection between measurements and underlying theory.
3. Types of Experiments-Experiments to test a hypothesis-to measure a variable or to gather data by preliminary and explorative experiments
4. Planning of experiments- Design-selection of controls-observational requirements,-
instrumental requirements.

**MODULE- IV**

**Data handling and Ethics in Science**  
1. Documentation of experiments: Nature and types of data-typical examples; Data acquisition; treatment of data; data interpretation Significance of statistical tools in data interpretation; errors and inaccuracies.
2. Data presentation: graphs, tables, histograms and pie diagrams.
3. Statistical testing of hypothesis, null hypothesis, Significance test. Statistics based acceptance or rejection of a hypothesis; Deduction of scientific correlation; patters and trends.
4. Ethics in Science: Scientific information; depositories of scientific information, primary secondary and digital sources; sharing of knowledge; transparency and honesty; danger of pre conceived ideas.

**Practical 18 hrs**
1. Workout problems on frequency distribution, measures of central tendencies, measures of dispersion.
2. Prepare charts on great biological inventions
3. Familiarizing with different biological instruments.

**REFERENCES**
FUNDAMENTALS OF MICROBIOLOGY

Course code: MB1341
Number of credits: 3
Number of contact hours: 54 hrs (Lecture); 36hrs (Practical)

MODULE I 12 hrs

MODULE-II 12 hrs
Principles and applications of microscopy simple, compound, bright field, dark field, phase contrast, fluorescent and electron microbiology. Principles of staining: Nature of dyes, types of staining – simple, differential, negative and spore staining, Sterilization: Principles and methods of physical (moist heat, dry heat, filtration, pasteurization, tyndallization, radiations) and chemical (alcohols, aldehydes, phenols, halogens and hypochlorites) sterilization. Antimicrobial chemotherapy.

MODULE- III 6 hrs
Physiology of microbial growth and nutrition. Batch, continuous and synchronous cultures; Growth Curve. Nutritional requirements. Transport of nutrients by active and passive transport. Sporulation.

MODULE- IV 14 hrs
Energy production in bacteria- Energy and ATP, aerobic respiration, Glycolysis and tricarboxylic acid cycle, Electron transport and oxidative phosphorylation in Bacteria, catabolism of other carbohydrates. Anaerobic respiration- Fermentation, alcohol fermentation by yeasts and bacteria, lactic acid fermentation, Methnogenic bacteria, Acetobacter and acetic acid fermentation.

MODULE-V 10 hrs
Methods of bacterial identification- morphological, physiological, biochemical and serological properties. Culture techniques: Types of media simple, defined, enriched and transport media with specific examples for each type. Types of streaking. Maintenance and preservation of microbes.

Practical 36 hrs
1. Study the parts and usage of a Compound Microscope
2. Study the parts and working and uses of Autoclaves, Hot air oven, Membrane Filter, Safety Cabinet, Anaerobic Jar, Centrifuge, and Incubator.
3. Preparation of culture Media and dispensing media in test tubes, bottles, petridishes.
4. Cultivation of Bacteria on nutrient Agar for obtaining isolated colonies. Study of cultural colony characters- Size, shape, colour etc.
5. Viable Count of bacteria by pour plate/ spread plate and streak plate method.
6. Examination of wet films under high power objectives.
7. Preparation and examination of Hanging drop mount for studying the motility of bacteria.
8. Preparation of slide smears for staining.

10. Microscopic study of Bacteria - Cocci, Bacilli
11. Preparation of Fungal media
12. Cultivation of fungi study of colony characters of yeast and mold.

REFERENCES

MICROBIAL GENETICS & IMMUNOLOGY

Course code: MB1441
Number of credits: 3
Number of contact hours: 54 hrs (Lecture); 36hrs (Practical) Total: 90 hrs

MODULE I 15 hrs


MODULE II 15 hrs

Immunoglobulins-Structure types and properties. Monoclonal antibody Complement structure properties, function of complement components and pathways, Major histocompatibility complex-HLA, H2-Antigen Antibody reaction-Precipitation reactions, agglutination reactions Immunofluorescence, ELISA, RIA

MODULE III 4 hrs


MODULE IV 10 hrs


MODULE V 10 hrs


Practical 36 hrs

1. Slide agglutination test, Blood grouping, ASO
2. Bacterial agglutination test
3. Precipitation reaction - RPR, VDRL, ODD, RID
4. ELISA-Demonstration
5. Titration of Antibody - Widal Test.

REFERENCES

INSTRUMENTATION IN MICROBIOLOGY

Course code: MB1541
Number of credits: 4
Number of contact hours: 72 hrs (Lecture); 36hrs (Practical) Total: 108 hrs

MODULE- I
Basic laboratory Instruments 8 hrs

MODULE- II
Chromatographic techniques 4 hrs
Theory, principles and applications of paper, thin layer, gel filtration, ion exchange,

MODULE-III
Electrophoretic techniques 6 hrs
Basic principles of electrophoresis, theory and application of paper and agarose electrophoresis.

MODULE-IV
Spectroscopy 8 hrs

MODULE-V
Radioisotopic techniques 10 hrs
Use of radioisotopes in life sciences, radioactive labeling, principle and application of tracer techniques, detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters, autoradiography and its applications.

Practical 36 hrs
1. Separation of bacterial lipids/amino acids/sugars/organic acids by TLC or Paper Chromatography.
2. Separation of serum protein by horizontal submerged gel electrophoresis.
3. Study of UV absorption spectra of macromolecules (protein, nucleic acid, bacterial pigments).
5. Demonstration of PCR, DNA sequencer, Fermenter, Flow cytometry

REFERENCES
2. A Biologists Guide to Principles and Techniques of Practical Biochemistry. 1975 by Williams, B.L. and Wilson, K.


5. Analytical Biochemistry by Holme.

ENVIRONMENTAL MICROBIOLOGY

Course code: MB1542
Number of credits: 3
Number of contact hours: 72 hrs (Lecture); 54 hrs (Practical) Total: 126 hrs

MODULE I 18 hrs
Introduction: Organization of the biosphere and components of ecosystem, Natural habitats of microorganisms, Microbial communities in aquatic and terrestrial habitats, Microorganisms as components of ecosystem–as producers and decomposers.

MODULE II 14 hrs
Microbes in aquatic environments: The nature of aquatic habitats, Methods used in the study of aquatic (fresh and marine water) microbial community, Pollution of aquatic habitats, Water quality criteria, Water-borne diseases, Microbiological analysis of water purity, Indicator organisms, ground water quality and home treatment system.

MODULE III 10 hrs
Microbes in air: Composition of Air; Number and kinds of organisms in air; Distribution and sources of air borne organisms; Droplet and droplet nuclei; Assessment of air quality; Air sanitation; Air-borne diseases.

MODULE IV 15 hrs
Microbial life in extreme environments: Effect of temperature, pH, Pressure, salt and heavy metals such as As, Sb, Hg, Pb and Cd, Microbial life in conditions of high irradiation, Radiosensitivity; mechanism of damage and recovery, Growth in nutrient limited environment – mechanism of adaptations, Microbes in space.

MODULE V 15 hrs
Environmental application: Waste –types; Treatment of solid wastes –composting, Vermiform composting, silage, Pyrolysis and scarification; Treatment of liquid wastes, degradation of liquid industrial wastes; Degradation of pesticides and detergents; Degradation of lignin; synthetic polymers; Xenobiotic compounds; Alkyl benzyl sulphonates; Petroleum and hydrocarbon degradation.

Practical 54 hrs
2. Quantification of microorganisms in air by settle plate and air sampler methods.
3. Detection of aflatoxin B1 from moldy grains using thin layer chromatography.
4. Isolation and identification of E. coli from water samples and its identifications.
5. Environmental distribution of microorganisms -Examination of microbial flora of the available soil and water samples

REFERENCES
MEDICAL MICROBIOLOGY

Course code: MB1543  
Number of credits: 4  
Number of contact hours: 90 hrs (Lecture); 36 hrs (Practical) Total: 126 hrs

MODULE I  
Classification and general properties of medically important bacteria. Recommendation for collection, transport of specimens, isolation of bacteria from clinical specimens. Primary media for isolation and their quality control – Antibiotic sensitivity discs, testing procedures and their quality control.

MODULE II  

MODULE III  

MODULE IV  

MODULE V  

MODULE VI  
Practical

36 hrs

1. General requirements of collections, transport of clinical Specimens – Methods of enriched, selective and enrichment culture techniques used to isolate organisms from clinical materials. Simple, differential and special staining of clinical materials viz: throat swab, pus, urine, sputum, stool etc. Enumeration of bacteria in urine, quantitative urine culture.

2. Isolation and identification of bacterial pathogens from clinical specimens their biological reactions. Antimicrobial Sensitivity testing by disc-diffusion technique and determination of MIC.


4. KOH and Lactophenol preparations for skin scrapings for dermatophytes. Microscopic identification and cultural characteristics of medically important fungi and lab contaminants. Germ tube, carbohydrate assimilation and fermentation tests for yeasts.


REFERENCES


INDUSTRIAL MICROBIOLOGY

Course code: MB1641  
Number of credits: 4  
Number of contact hours: 72 hrs (Lecture); 54 hrs (Practical) Total: 126 hrs

MODULE-I  
15 hrs
Introduction to fermentation process. Microbial growth kinetics-batch, continuous and fed batch culture. Large scale cultivation of industrially important microbes. Fermentation media design, desired qualities of fermentation media and formulation strategies- carbon, nitrogen, vitamin, mineral sources, role of buffers, precursors, inhibitors, inducers and antifoams.

MODULE-II  
15 hrs
Types of fermentation process-(submerged and solid state) different types of fermentors, basic functions, design and components. Specifications of fomenters- sterilization of fomenters- aseptic inoculation methods. Brief idea on monitoring and control of variables such as temperature, aeration, agitation, pressure, pH, foaming.

MODULE-III  
7 hrs
Microbial products of commercial use: penicillin, xanthan gum, ethanol, vitamin B 12, protease, citric acid, glutamic acid and L- lysine. SCP and microbial enzymes.

MODULE-IV  
15 hrs
Scale up and down stream processing of biologicals. Separation of cells, cell disruption and recovery. Direct extraction of products and metabolites. Large scale separation techniques like chromatographic and affinity techniques, membrane filtration – ultra filtration and reverse osmosis. Spray drying, drum drying & freeze drying.

MODULE-V  
20 hrs

Practical  
54 hrs
1. Enumeration and isolation of Lactobacillus from curd
2. Enumeration and isolation of Bacteria and mold from fermented foods
3. Production of Alcohol from Cashew Apple
4. Mushroom cultivation
5. Wine Production from grapes
6. Immobilization of yeast cells
REFERENCES

BIOINFORMATICS AND BIOSTATISTICS

Course code: MB1642  
Number of credits: 4  
Number of contact hours: 72 hrs (Lecture); 36 hrs (Practical) Total: 108 hrs

MODULE I  
8 hrs  
Overview of information Technology: Features of the modern personal Computer and peripherals, computer network and internet, introduction to mobile phone technology, purchase of technology, license, guarantee, overview of operating system and major application softwares.

MODULE II  
15 hrs  
Bioinformatics: Introduction: Definition, Origin of concept of Bioinformatics; Brief history, Importance of bioinformatics; Web lab and Wet lab. Biological databases: Brief account on Model/organism databases, Biodiversity databases and Biomolecular databases - Nucleic acid databases Eg: EMBL, Gen Bank - Protein sequence databases. Eg: PIR, SWISS PROT. Bioinformatics in relation to Biomolecular structure • Protein structure databank- PDB - Molecular visualization- use of Rasmol- Molecular modeling (Brief account only). Molecular docking and computer aided drug design (Brief account only)

MODULE III  
14 hrs  

MODULE IV  
10 hrs  
Science and Tools of Science:Types of knowledge: practical, theoretical and scientific knowledge. Basis for Scientific laws and factual truths.Revolutions in Science and Technology.Hypothesis; theories and laws in Science; observations, evidences and proofs.Significance of peer Review.

MODULE V  
15 hrs  
Experimentation in Science and Data Handling.Design of an experiment; experimentation; observation; data collection; interpretation and deduction.Necessity of units and dimensions; repeatability and replication.Documentation of experiments, Record keeping.Connection between measurements and underlying theory.Documentation of experiments.Nature and types of data -typical examples; data acquisition; treatment of data; data interpretation. Significance of
statistical tools in data interpretation: graphs, tables, histograms and pi diagrams. Statistical
testing of hypothesis, null hypothesis. Significance test - Statistics based acceptance or rejection
of a hypothesis. Deduction of scientific correlation, patterns and trends.

**MODULE VI**

**10 hrs**

Nature and scope of statistical methods and their limitation. Compilation, classification,
tabulation, and application in life science. Graphical representation, Measure of average and
dispersion mean, medium, mode. Sampling methods - simple random, stratified, systematic and
cluster sampling procedures. Sampling distribution, Probability, Tests of significance based on
T, Chi-square and F Test Designing and methodology of experiment.

**Practical**

**36 hrs**

1. Students are expected to work with at least any one of the scientific packages, to
explore the WEB and able to find, recognize, download, install and use software
in various areas useful to the research in Biology.
2. Familiarization of academic data bases INFLIBNET, NICNET, and BRNET.
3. Nucleic acid databases Eg: EMBL, Gen Bank
4. Blast Search, Protein structure databank- PDB, Molecular visualization tools-
Rasmol, Molecular modeling, Molecular docking and computer aided drug
design.
5. Collection of data, sampling designs, tabulation and graphic representation using
biological materials.
6. To find mean, mode, meridian, coefficient of variance using biological materials.
8. t TEST, chi square, statistical error, standard deviation also, to be practically done
through SPSS [statistical Package for Social Sciences] programme.

**REFERENCES**

1. Debbie Holmes, Peter Moody, Diana Dine. Research methods for the biosciences,
   International student edition, Oxford University Press Inc. New York
FOOD AND DAIRY MICROBIOLOGY

Course code: MB1643  
Number of credits: 4  
Number of contact hours: 72 hrs (Lecture); 36 hrs (Practical) Total: 108 hrs

MODULE I  
7 hrs  
Food as a substrate for microorganisms. Microorganisms important in food microbiology; Molds, yeasts and bacteria, General Characteristics. Classification and importance.

MODULE II  
15 hrs  
Food fermentation: wine, bread, cheese, vinegar, fermented vegetables and fermented dairy products. Spoilage and defects of fermented dairy products and fermented foods.

MODULE III  
10 hrs  

MODULE IV  
20 hrs  
Food spoilage-Types of microorganisms in food and source of contamination. Factors influencing microbial growth in food. Contamination and spoilage of cereals, sugar products, vegetables and fruits, meat and meat products, milk and milk products, fish and sea foods, poultry and spoilage of canned foods.

MODULE V  
20 hrs  

Practical
1. Detection of number of Bacteria in milk by breed count. Detection of number of bacteria in milk by standard plant count.  
2. Determination of quality of milk sample by methylene blue reductase test and Resorzin method.  
3. Isolation of yeast and molds from spoiled nuts, fruits, and vegetables. Bacteriological examination of specific food a) Curd b) Raw meat c) Fish d) Ice cream.

REFERENCES
<table>
<thead>
<tr>
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<th>Title of the Course</th>
<th>Contact hrs/week</th>
<th>Credits</th>
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<tr>
<td>II</td>
<td>MB1221</td>
<td>General Informatics and Bioinformatics</td>
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MB 1221: GENERAL INFORMATICS AND BIOINFORMATICS

Course code : MB1221
Number of credits : 3
Number of contact hours : 54 hrs (Lecture); 18 hrs (Practical)

MODULE- I 6 hrs
Overview of information Technology: Features of the modern personal Computer and peripherals, computer network and internet, introduction to mobile phone technology, purchase of technology, license, guarantee, overview of operating system and major application softwares.

MODULE- II 8 hrs
Knowledge skill for Higher Education: Data information and knowledge, knowledge management- Internet as a knowledge repository, academic search techniques, creating your cyber presence, open access initiatives, open access publishing models, basic concepts of IPR, copy rights and patents, plagiarism, introduction to use of IT in teaching and learning, case study of educational software, Academic services-INFLIBNET, NICNET and BRNET.

MODULE- III 10 hrs
Social Informatics: IT and Society- issues and concerns- digital divide, IT and development, new opportunities and new threats, Cyber ethics, Cyber crime, Security, privacy issues, cyber addictions, Information overload, Health issues, guidelines for proper usage of computers, internet and mobile phones. Localization issues-IT and Regional languages-IT for the disabled, the free software debate.

MODULE-IV 15 hrs
Bioinformatics
1. Introduction: Definition, Origin of concept of Bioinformatics; Brief history, importance of bioinformatics; Web lab and Wetlab.
2. Biological databases: Brief account on Model/organism databases, Biodiversity databases and Biomolecular databases
   - Nucleic acid databases Eg: EMBL, Gen Bank
   - Protein sequence databases. Eg: PIR, SWISS PROT
3. Bioinformatics in relation to Biomolecular structure
   • Protein structure databank- PDB
   • Molecular visualization- use of Ras mol
   • Molecular modeling (Brief account only)
   • Molecular docking and computer aided drug design (Brief account only)

MODULE-V 15 hrs
1. Basics of Genomics and Proteomics, Comparative genomics and Pharmacogenomics
2. Sequence analysis and alignment (brief account only)
   • Pair wise sequence alignment
• Multiple sequence alignment
3. Molecular Phylogeny and Phylogenetic trees
Advantages of Molecular phylogeny and phylogenetic analysis
4. Bioinformation Tools: BLAST, CLUSTAL X

Practical 18 hrs
1. Create, Copy and Save a document with Header, Footer, Page Number, Date and Time using Word processing
2. Insert a table in the above Document
3. Prepare the mark list of students in a class using Excel
4. Prepare five slides each using power point with different design templates
5. Students are expected to work with at least any one of the commercial / scientific packages, to explore the WEB and able to find, recognize, download, install and use software in various areas useful to the research in Biology.
6. Blast Search
7. Molecular visualization using Rasmol

REFERENCES
2. Ingvar Eidhammer, Inge Jonassen,William R Tailor 2009, Protein Bioinformatics, Wiley India Edition
11. Higgs (2005), Bioinformatics and Molecular evolution. Ane Books India Pvt. Ltd

WEB RESOURCES
• www.fgcu.edu/support/office2000
• www.openoffice.org Open office official website
• www.microsoft.com/office MS Office website
• www.lgta.org Office online lessons
• www.learntheneth.com Web Primer
• www.computer.org/history/timeline
• www.computerhistory.org
• http://computer.howstuffworks.com
• http://vmoc.museophile.org Computer history
• www.dell.com Dell Computers
• www.intel.com Intel
• www.ibm.com IBM
• www.keralaitmission.org Kerala Govt. IT Dept.
• www.technopark.org
• http://www.studentworkzone.com/question.php?ID=139
• http://www.scribd.com/doc/259538/All-about-mobile-phones
# OPEN COURSES

## OPEN COURSE 1
Offered to the students from other disciplines

<table>
<thead>
<tr>
<th>Semester</th>
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<td>V</td>
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<td>Mushroom Culture</td>
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<td></td>
<td>MB1551.2</td>
<td>Microbial Waste Management</td>
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<td></td>
<td>MB1551.3</td>
<td>Biofertilizer Technology</td>
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## OPEN COURSE-II
Offered to the students of Microbiology

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<td>Biosafety in Microbiology</td>
<td>3</td>
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</table>
OPEN COURSE –I (a)
MUSHROOM CULTURE

Course Code : MB1551.1
Number of credits: 2
Number of contact hours: Lecture: 54 hrs

MODULE I 9 hrs
Introduction: history & scope of edible mushroom cultivation. Types of edible mushroom available in India: *Calocybe indica*, *Volvariella Volvacea*, *Pleurotus* sp. and *Agaricus bisporus*.

MODULE II 10 hrs
Pure culture technique: preparation of media & sterilization – Preparation of test tube slants to store mother culture – culturing of *Pleurotus* mycelium on petri plates – Preparation of mother spawn in saline bottle and polypropylene bags and their multiplication.

MODULE III 15 hrs

MODULE IV 10 hrs

MODULE V 10 hrs
Economics of mushroom cultivation (fixed assets, recurring expenditure, labour, economics of cultivation throughout the year and seasonal growing formulation of project report for getting finance from funding agencies). Precautions in mushroom cultivation (precaution to be taken while selecting the area, spawn preparation, spawn run, during cropping harvesting etc.). Mushroom recipes.

Field study: Visit to a mushroom cultivating laboratory

REFERENCES
OPEN COURSE-I (b)
MICROBIAL WASTE MANAGEMENT

Course Code  : MB1551.1
Number of credits: 2
Number of contact hours: Lecture: 54 hrs

MODULE I
20 hrs
General concept of sanitation and disinfection. Sanitation of industrial and food processing units. Air sanitation. Safe location of animal houses, hospitals, industrial fermentation units etc based on air sanitation. Air borne diseases and preventive measures.

MODULE II
20 hrs
Microbiology of municipal sewage and sewage treatment BOD and COD Concept. Treatment of Industrial effluent- Waste water treatment-Mechanical and biological. Aerobic and anaerobic treatments. Domestic septic tank. Treatment of municipal water supplies. Water borne diseases

MODULE III
14 hrs
Solid waste disposal-sanitary landfills, composting, vermin compost. Disposal of animal and agricultural waste. Methanogenesis and biogas production
OPEN COURSE-I (c)  
BIOFERTILIZER TECHNOLOGY

Course Code : MB1551.3  
Number of credits: 2  
Number of contact hours: Lecture: 54 hrs

MODULE – I  
15 hrs  
General account of the microbes used as biofertilizers for crop plants and their advantages.  
Symbiotic N2 fixer: *Rhizobium* - Isolation, characterization, identification, Classification, inoculum production and field application.  

MODULE – II  
8 hrs  
Non – Symbiotic N2 fixers – *Azospirillum* – Free living - *Azotobacter* – free isolation, characterization, mass inoculum production and field application.

MODULE – III  
8 hrs  

MODULE – IV  
8 hrs  
Phosphate solubilizers – Phosphate solubilizing microbes – Isolation, characterization, mass inoculum production, field application – Phosphate solubilization mechanism.

MODULE – V  
15 hrs  
Mycorrhizal bioinoculants – classification – importance of mycorrhizal association  

Field study: Visit to a biofertilizer production unit

REFERENCES
OPEN COURSE-II

BIOSAFETY IN MICROBIOLOGY

Course Code   : MB1661
Number of credits: 2
Number of contact hours: Lecture: 54 hrs

MODULE I         12 hrs
Concept of biosafety: Historical background, principles of biosafety, introduction to biological
safety cabinets, selection, installation and use of biological safety cabinets, primary containment
for biohazards, biosafety levels, biocontainment, biosafety levels of specific microorganisms,
recommended biosafety levels for infectious agents and infected animals.

MODULE II         12 hrs
Biosafety guidelines - Government of India, definition of Genetically Modified Organisms
(GMOs) and Living Modified Organisms (LMOs), Roles of Institutional Biosafety Committee,
RCGM, GEAC etc. for GMO applications in food and agriculture, Environmental release of GMOs.

MODULE III         10 hrs
Risk Analysis, Risk Assessment, Risk management and communication. Overview of national
regulations and relevant international agreements including Cartagena Protocol.

MODULE IV         10 hrs
Plant biosafety, risk assessment, laboratory standard operating procedures, safety of laboratory
personnel, environmental safety, regulated biosafety and biosecurity. Biosafety regulations and
assessment of biotechnology products, drugs/vaccines and GMOs.

MODULE V         10 hrs
Biosafety protocols, biological weapons, biosecurity, components of biosecurity program and
bioethical issues. Occupational health and immunoprophylaxis, decontamination and
disinfection, transportation of infectious substances and, agriculture pathogen biosafety.

REFERENCES
1. Social issues in Science and Technology: An Encyclopedia, David E. Newton (ABC-
   CLIO, Santa Barbara), 1999.
   The truth of science, Newton R.G.,
3. Biotechnology: Issues, Ethics and Regulations, Tina M. Prow, Communications Specialist, Office of Agricultural Communications and Education.

