FACULTY OF SCIENCE

SYLLABI

FOR

B.Sc. (HONOUR SCHOOL) MICROBIOLOGY
1\(^{st}\) TO 6\(^{th}\) SEMESTER

AND

M.Sc. (HONOUR SCHOOL) MICROBIOLOGY
1\(^{st}\) TO 4\(^{th}\) SEMESTER

EXAMINATIONS
2015-2016

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## PANJAB UNIVERSITY, CHANDIGARH

OUTLINES OF TESTS, SYLLABI AND COURSES OF READING IN THE SUBJECT OF MICROBIOLOGY FOR B.Sc. (HONS. SCHOOL) (SEMESTER SYSTEM) (MAJOR/SUBSIDIARY) 1ST TO 6TH SEMESTER EXAMINATIONS 2015-2016

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course No.</th>
<th>Course</th>
<th>Credits</th>
<th>Marks</th>
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<tbody>
<tr>
<td><strong>B.Sc (H.S.) Ist year (Major)</strong></td>
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<tr>
<td>1st semester</td>
<td>BMI 1101</td>
<td>Introduction to General Microbiology &amp; Bacterial Systematics</td>
<td>6</td>
<td>150</td>
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<tr>
<td></td>
<td>BMI 1151</td>
<td>Practical</td>
<td>2</td>
<td>50</td>
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<tr>
<td>2nd semester</td>
<td>BMI 1201</td>
<td>Introduction to Applied Microbiology &amp; Pathology</td>
<td>6</td>
<td>150</td>
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<tr>
<td></td>
<td>BMI 1251</td>
<td>Practical</td>
<td>2</td>
<td>50</td>
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<tr>
<td><strong>Subsidiary courses for B.Sc (HS) Ist year in Microbiology</strong></td>
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<tr>
<td></td>
<td>English</td>
<td>8</td>
<td>200</td>
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<td></td>
<td>Physics</td>
<td>8</td>
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<td>Chemistry</td>
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<td>Mathematics</td>
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<td></td>
<td>Total Credits</td>
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<td></td>
<td>Total Marks</td>
<td>1200</td>
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| **B.Sc (H.S.) 2nd year (Major)** | | | | |
| 3rd semester | BMI 2301 | Phycology | 3 | 75 |
| | BMI 2302 | Parasitology | 3 | 75 |
| | BMI 2303 | Environmental Microbiology | 3 | 75 |
| | BMI 2351 | Practical (Combined) | 3 | 75 |
| 4th semester | BMI 2401 | Mycology | 3 | 75 |
| | BMI 2402 | Industrial Microbiology | 3 | 75 |
| | BMI 2403 | Soil Microbiology & Bioremediation | 3 | 75 |
| | BMI 2451 | Practical (Combined) | 3 | 75 |
| **Subsidiary courses for B.Sc (HS) 2nd year in Microbiology** | | | | |
| | Biophysics | 8 | 200 |
| | Biochemistry | 8 | 200 |
| | Statistics | 8 | 200 |
| | Total Credits | 48 |
| | Total Marks | 1200 |

<p>| <strong>B.Sc (H.S.) 2nd year (Subsidiary) for Biochemistry &amp; Biophysics students</strong> | | | | |
| 3rd semester | BMIS 2371 | Introduction to General Microbiology | 3 | 75 |
| | BMIS 2372 | Practical | 1 | 25 |
| 4th semester | BMIS 2471 | Introduction to Applied Microbiology | 3 | 75 |
| | BMIS 2472 | Practical | 1 | 25 |
| | Total credits | 8 |
| | Total Marks | 200 |</p>
<table>
<thead>
<tr>
<th><strong>B.Sc (H.S.) 3rd year</strong></th>
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<tr>
<td><strong>5th semester</strong></td>
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<tr>
<td>BMI 3501</td>
<td>Medical Bacteriology – I</td>
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<tr>
<td>BMI 3502</td>
<td>Microbial &amp; Molecular Genetics</td>
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<tr>
<td>BMI 3503</td>
<td>Food Microbiology</td>
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<tr>
<td>BMI 3504</td>
<td>Immunochemistry</td>
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<td>BMI 3551</td>
<td>Practical (Combined)</td>
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<td><strong>6th semester</strong></td>
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<tr>
<td>BMI 3601</td>
<td>Medical Bacteriology – II</td>
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<tr>
<td>BMI 3602</td>
<td>Virology</td>
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<tr>
<td>BMI 3603</td>
<td>Microbial Physiology &amp; Metabolism</td>
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<tr>
<td>BMI 3604</td>
<td>Immunopathology</td>
</tr>
<tr>
<td>BMI 3651</td>
<td>Practical (Combined)</td>
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</table>

Total credits = 40
Total Marks = 1000

**GRANT TOTAL**

| Total Credits | = 136 |
| Total Marks   | = 3400 |

**IMPORTANT NOTE:**

The Environment & Road Safety Education is a compulsory qualifying paper, which the students have to study in the B.Sc. 1st year (2nd Semester). If the student/s failed to qualify the paper during the 2nd Semester, he/she/they be allowed to appear/qualify the same in the 4th or 6th Semester/s.
ENVIRONMENT AND ROAD SAFETY EDUCATION (SEMESTER – II)

Note: The syllabus has 15 topics to be covered in 25 hour lectures in total, with 2 lectures in each topic from 2 to 11 and one each for the topics 1 and 12 to 15.

1. Environment Concept:
   Introduction, concept of biosphere – lithosphere, hydrosphere, atmosphere; Natural resources – their need and types; Principles and scope of Ecology; concepts of ecosystem, population, community, biotic interactions, biomes, ecological succession.

2. Atmosphere:
   Parts of atmosphere, components of air; pollution, pollutants, their sources, permissible limits, risks and possible control measures.

3. Hydrosphere:
   Types of aquatic systems; Major sources (including ground water) and uses of water, problems of the hydrosphere, fresh water shortage; pollution and pollutants of water, permissible limits, risks and possible control measures.

4. Lithosphere:
   Earth crust, soil – a life support system, its texture, types, components, pollution and pollutants, reasons of soil erosion and possible control measures.

5. Forests:
   Concept of forests and plantations, types of vegetation and forests, factors governing vegetation, role of trees and forests in environment, various forestry programmes of the Govt. of India, Urban Forests, Chipko Andolan.

6. Conservation of Environment:
   The concepts of conservation and sustainable development, why to conserve, aims and objectives of conservation, policies of conservation; conservation of life support systems – soil, water, air, wildlife, forests.

7. Management of Solid Waste:
   Merits and demerits of different ways of solid waste management– open dumping, landfill, incineration, resource reduction, recycling and reuse, vermicomposting and vermiculture, organic farming.

8. Indoor Environment:
   Pollutants and contaminants of the in-house environment; problems of the environment linked to urban and rural lifestyles; possible adulterants of the food; uses and harms of plastics and polythene; hazardous chemicals, solvents and cosmetics.

9. Global Environmental Issues:
   Global concern, creation of UNEP; Conventions on climate change, Convention on biodiversity; Stratospheric ozone depletion, dangers associated and possible solutions.

10. Indian Laws on Environment:
    Indian laws pertaining to Environmental protection: Environment (Protection) Act, 1986; General information about laws relating to control of air, water and noise pollution. What to do to seek redressal.

11. Biodiversity:
    What is biodiversity, levels and types of biodiversity, importance of biodiversity, causes of its loss, how to check its loss; Hotspot zones of the world and India, Biodiversity Act, 2002.
12. Noise and Microbial Pollution:
Pollution due to noise and microbes and their effects.

13. Human Population and Environment:

14. Social Issues:
Environmental Ethics: Issues and possible solutions, problems related to lifestyle, sustainable development; Consumerisms and waste generation.

15. Local Environmental Issues:
Environmental problems in rural and urban areas. Problem of Congress Grass & other weeds, problems arising from the use of pesticides and weedicides, smoking etc.

Practical
Depending on the available facility in the college, a visit to vermicomposting units or any other such non-polluting eco-friendly site or planting/caring of vegetation/trees could be taken.

Examination Pattern:
A qualifying paper of 50 marks comprising of fifty multiple choice questions (with one correct and three incorrect alternatives and no deduction for wrong answer or un-attempted question), and of 1 hour duration.

The students have to obtain 33% marks to qualify the paper. The marks are not added / included in the final mark sheet.

UNIT II (ROAD SAFETY)

1. Concept and Significance of Road Safety.
2. Role of Traffic Police in Road Safety.
3. Traffic Engineering – Concept & Significance.
5. How to obtain Driving License.
7. Common Driving mistakes.
8. Significance of First-aid in Road Safety.
9. Role of Civil Society in Road Safety.

Note: Examination Pattern :

- The Environment and Road Safety paper is 70 marks.
- Seventy multiple choice questions (with one correct and three incorrect alternatives and no deduction for wrong or un-attempted questions).
- The paper shall have two units: Unit I (Environment) and Unit II (Road Safety).
- Unit II shall comprise of 20 questions with minimum of 1 question from each topics 1 to 10.
- The entire syllabus of Unit II is to be covered in 10 hours.
• All the questions are to be attempted.
• Qualifying Marks 33 per cent i.e. 23 marks out of 70.
• Duration of examination: 90 minutes.
• The paper setter is requested to set the questions strictly according to the syllabus.

Suggested Readings
2. Road Safety Signage and Signs (2011), Ministry of Road Transport and Highways, Government of India.

Websites:
(a) www.chandigarhpolice.nic.in
(b) www.punjabpolice.gov.in
(c) www.haryanapolice.gov.in
(d) www.hppolice.nic.in
Syllabus and Courses of Reading for B.Sc. (Hons. School) (courses where English is taught as a subsidiary subject) for the session 2015-2016.

FIRST SEMESTER

Objectives:
The objective of teaching English to the science students is to create general awareness among them about literature and its impact on their lives. At the same time, it is expected that the students, on reading this course, shall develop proficiency in reading and writing skills, while acquiring a sensitive and analytical attitude towards literature in particular, and life in general. It is with this aim in mind that the new text has been selected and it is hoped that the objectives of the course will not only be reflected but also realized through necessary shift in the teaching practices, design of the question paper and mode of evaluation.

Note:
(i) There will be one paper of 80 marks, 10 marks are reserved for the Internal Assessment and 10 for the Practical Work. Total is 100.
(ii) The paper shall consist of Two Units. Unit I will be text specific and Unit II shall deal with different aspects of communications and language learning skills.
(iii) For Unit I, the prescribed text is Varieties of Expression, Ed. A. H. Tak, Foundation Books, which shall replace the existing text Patterns in Prose by Jagdish Chander, P.U., Chandigarh. It may be pointed out here that only certain sections of this text i.e prose and drama are prescribed. Poetry has been deleted completely. Only five prose and five plays have been recommended for the study. The relevant sections, however, are as follows:

Prose:
I. The Judgement Seat of Vikramaditya, Sister Nivedita
II. Engine Trouble, R. K. Narayan
III. The Conjurer’s Revenge, Stephen Leacock

Drama:
I. The Rising of the Moon, Lady Gregory
II. Waterloo, Arthur Conan Doyle

(iv) No text book is recommended for Unit II, but a few books that may be used for this

Communication: It shall focus on different aspects of communication, types of communication, and significance of positive attitude in improving communication.

Writing Skills: This section shall focus on précis-writing, letters of all kinds; curriculum vitae, short, formal reports (not exceeding 200 words); public notices and advertisements relating to product promotion etc.,

Modern Forms of Communication: Here special emphasis shall be given to teaching the format of e-mails, fax messages, telegrams, audio-visual aids and power-point presentations. Apart from this, the students shall also be given basic lessons in effective listening, non-verbal communication, how to prepare for an interview and group discussion etc.
Practical work:-
Teacher should assign some project or practical work to the students. This should be in the nature of guided activity, which the students shall have to complete under the direct supervision of the teacher. The students may be given projects on a variety of subjects relating to their discipline i.e. science in general or a specific area of science they are specializing in. Preferably, they should be given minor projects (to be completed within less than two weeks, and length not exceeding 20 pages) in consultation with teachers of science. However, the evaluation of the projects should be done only by the Language Teachers, who must keep all the basic criteria of good writing in mind while doing so.

Note: In case of private candidates and students of School of Open Learning, the marks obtained by them out of 80 will be proportionately increased out of 100).

Testing Scheme:
The examination paper shall be divided into two sections, corresponding to two units already proposed in the syllabus. The distribution of questions and marks in Section I shall be as follows:

Section I (It is text-based and corresponds to unit I in the syllabus)
Q1. It shall consist of five short questions (not exceeding 100-120 words) out of which a student will be expected to attempt any three. This question shall be based upon the prescribed text Varieties of Expression and cover a wide range of issues, topics and problems. It shall consist of 12 marks.

Q2. It shall consist of two long questions (not exceeding 300-350 words) out of which a student will be expected to attempt only one. This question shall have internal choice, be based upon the prescribed text Varieties of Expression. This shall carry 10 marks.

Note: The question 1 & 2 should be so designed as to cover all the chapters prescribed, as well as the major issues and problems listed therein.

Q3. It shall consist of an Unseen Passage for Comprehension (not more than 800 words), with minimum six questions at the end. These questions should be designed in such a way that we are able to test a student's comprehension ability, language/presentation skills and vocabulary etc. This question shall be of 12 marks.

Q.4. It shall exclusively be a test of vocabulary, but designed strictly on the lines of various exercises given at the end of each chapter in the prescribed text. The candidate shall be given six words in one column and asked to match them with words/meanings in the next column, This shall carry 6 marks.

Section II (Based upon Unit II)
Q.5 (a) The students shall be asked to write a short survey report on a situation, incident, problem of science or the possibility of starting a new scientific venture (in about 150-200 words). The students shall be given an internal choice in this question. This question shall carry 8 marks.
Q.5 (b) This question shall be on notices/advertisements of various types (as mentioned in the syllabus). It’ll carry 4 marks.

Q.6. This question shall test a student’s ability to write letters of various kinds (in not more than 250 words). Again, there will be internal choice here and the question will be of 8 marks.

Q.7 There will test a student’s ability to write a Précis, A passage of about 200 words shall be given and the students shall have to write a précis of about 70 words (including the title). This question shall carry 10 marks.

Q.8 This question shall test a student’s understanding of various aspects of communication and modern forms of communication. It shall be divided into two parts:

(a) Two short questions to be attempted (in not more than 100-120 words each) on different aspects of communication. It’ll carry 6 marks.
(b) Definitions/format of modern forms of communication to be tested. This shall again carry 4 marks.

Suggested Reading:
SECOND SEMESTER

Objectives:
The objective of teaching English to the science students is to create general awareness among them about literature and its impact on their lives. At the same time, it is expected that the students, on reading this course, shall develop proficiency in reading and writing skills, while acquiring a sensitive and analytical attitude towards literature in particular, and life in general. It is with this aim in mind that the new text has been selected and it is hoped that the objectives of the course will not only be reflected but also realized through necessary shift in the teaching practices, design of the question paper and mode of evaluation.

Note:
(i) There will be one paper of 80 marks, 10 marks are reserved for the Internal Assessment and 10 for the Practical Work. Total is 100.
(ii) The paper shall consist of Two Units. Unit I will be text specific and Unit II shall deal with different aspects of communications and language learning skills.
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Prose:
I J. C. Bose, Aldous Huxley
II The Position of Women in Ancient India, Padmini Sen Gupta

Drama:
I The Proposal, Anton Chekhov
II Riders to the Sea, J. M. Synge
III Lithuania, Rupert Brooke

(iv) No text book is recommended for Unit II, but a few books that may be used for this Unit are listed towards the end.

Unit II shall consist of the following:

Communication: It shall focus on different aspects of communication, types of communication, and significance of positive attitude in improving communication.

Writing Skills: This section shall focus on précis-writing, letters of all kinds; curriculum vitae, short, formal reports (not exceeding 200 words); public notices and advertisements relating to product promotion etc.,

Modern Forms of Communication: Here special emphasis shall be given to teaching the format of e-mails, fax messages, telegrams, audio-visual aids and power-point presentations. Apart from this, the students shall also be given basic lessons in effective listening, non-verbal communication, how to prepare for an interview and group discussion etc.

Practical work:-
Teacher should assign some project or practical work to the students. This should be in the nature of guided activity, which the students shall have to complete under the direct supervision of the teacher. The students may be given projects on a variety of subjects.
relating to their discipline i.e. science in general or a specific area of science they are specializing in. Preferably, they should be given minor projects (to be completed within less than two weeks, and length not exceeding 20 pages) in consultation with teachers of science. However, the evaluation of the projects should be done only by the Language Teachers, who must keep all the basic criteria of good writing in mind while doing so.

**Note:** In case of private candidates and students of School of Open Learning, the marks obtained by them out of 80 will be proportionately increased out of 100).

**Testing Scheme:**
The examination paper shall be divided into two sections, corresponding to two units already proposed in the syllabus. The distribution of questions and marks in Section I shall be as follows:

Section I (It is text-based and corresponds to unit I in the syllabus)
Q1. It shall consist of five short questions (not exceeding 100-120 words) out of which a student will be expected to attempt any three. This question shall be based upon the prescribed text *Varieties of Expression* and cover a wide range of issues, topics and problems. It shall consist of **12 marks.**

Q2. It shall consist of two long questions (not exceeding 300-350 words) out of which a student will be expected to attempt only one. This question shall have internal choice, be based upon the prescribed text *Varieties of Expression.* This shall carry **10 marks.**

**Note:** The question 1 & 2 should be so designed as to cover all the chapters prescribed, as well as the major issues and problems listed therein.

Q3. It shall consist of an *Unseen Passage for Comprehension* (not more than 800 words), with minimum six questions at the end. These questions should be designed in such a way that we are able to test a student’s comprehension ability, language/presentation skills and vocabulary etc. This question shall be of **12 marks.**

Q4. It shall exclusively be a test of vocabulary, but designed strictly on the lines of various exercises given at the end of each chapter in the prescribed text. The candidate shall be given six words in one column and asked to match them with words/meanings in the next column, This shall carry **6 marks.**

**Section II (Based upon Unit II)**
Q.5 (a) The students shall be asked to write a short survey report on a situation, incident, problem of science or the possibility of starting a new scientific venture (in about 150-200 words). The students shall be given an internal choice in this question. This question shall carry **8 marks.**

(b) This question shall be on notices/advertisements of various types (as mentioned in the syllabus). It’ll carry **4 marks.**

Q.6. This question shall test a student’s ability to write letters of various kinds (in not more than 250 words). Again, there will be internal choice here and the question will be of **8 marks.**
Q.7 There will test a student’s ability to write a Précis. A passage of about 200 words shall be given and the students shall have to write a précis of about 70 words (including the title). This question shall carry **10 marks.**

Q.8 This question shall test a student’s understanding of various aspects of communication and modern forms of communication. It shall be divided into two parts:

(a) Two short questions to be attempted (in not more than 100-120 words each) on different aspects of communication. It'll carry **6 marks.**

(b) Definitions/format of modern forms of communication to be tested. This shall again carry **4 marks.**

**Suggested Reading:**


Pattern of instructions for Paper Setter:

Question papers will have FOUR sections. Examiner will set a total of NINE questions comprising TWO questions from each PART and ONE compulsory question of short answer types covering the whole syllabus. Students will attempt FIVE questions in all including ONE question from each PART and the compulsory question. All Questions will carry equal marks, unless specified.

B. Sc (H.S.) 1st year in MICROBIOLOGY
FIRST SEMESTER

BMI 1101: INTRODUCTION TO GENERAL MICROBIOLOGY AND BACTERIAL SYSTEMATICS

Objective: To give an overview of various aspects of microbiology viz. history, microbial world, taxonomy nomenclature, growth kinetics, metabolism, microbial genetics, antimicrobial agents and microbial ecology.

UNIT – I

Microbiology: definition, history and development of Microbiology, scope and relevance of microbiology, composition of microbial world and its applications. Distinguishing features of major groups of microorganisms: bacteria, fungi, algae, protozoa, viruses.


Characteristics of microorganisms: Prokaryotic cell structure and function, size, shape, capsule and slime layer, spore, cell wall, cell membrane, outer membrane, ribosome, motility organelle, fimbriae, nuclear region and cellular differentiation.

Cultivation of microorganisms: nutrition, cultivation methods and environmental factors affecting microbial growth.


UNIT-II

Microbial growth and metabolism: Bacterial growth curve, cell division, genes in cell division, maintenance of cells in exponential phase, synchronous growth, continuous culture, fed batch culture and measurement of growth.

Transport and Metabolism:- Mechanisms of transport of nutrients in bacteria: Simple diffusion, Facilitated diffusion, Active transport (ABC transport, Symport, Antiport, Uniport), Group translocation. Metabolic pathways of carbohydrate metabolism common (Embden Meyerhof pathway, direct oxidation pathway, pyruvate decarboxylation, TCA cycle) and unique to heterotrophic and phototrophic microorganisms (Entner- Doudoroff pathway, β
Keto adipate pathway), Calvin cycle, patterns of energy yielding metabolism in microorganisms (respiration and fermentation), generation of energy and its use in biosynthesis of carbohydrates, nucleic acids, proteins and regulation of metabolism: regulation of RNA synthesis and DNA synthesis and cell division.

**UNIT-III**

**Control of microorganisms:** control of microorganisms by physical and chemical agents, patterns of microbial death, factors affecting effectiveness of antimicrobial agents activity.

**Antimicrobial chemotherapy:** Development of chemotherapy, general characteristics of antimicrobial drugs, and mechanisms of action of antimicrobial agents. Origin of drug resistance and its transmission in microorganisms.

**Bacterial systematics:** classification systems, major characteristics used, nucleic acid, serology, chemical composition and phylogenetic mode of classification. Use of catabolic and anabolic keys. Numerical Taxonomy, cluster analysis and construction of taxonomy group based on dendrograms and similarity matrix. International codes, rules, recommendations, construction of names in bacterial nomenclature and its role in taxonomy. Methods for isolation of pure culture of microorganisms. Diagnostic procedures, keys and schemes

**UNIT-IV**

**Microbial genetics:** general principles of bacterial genetics, DNA as genetic material, gene structure, mutations and their chemical basis. Detection and isolation of mutants and DNA repair mechanisms. Intercellular transfer and genetic recombination in bacteria (transformation, transduction and conjugation), bacterial plasmids, transposable elements, genome mapping. Recombinant DNA technology: historical perspectives, preparation of recombinant DNA, cloning vectors, expression of foreign genes in bacteria and application of genetic engineering.

**Microbial ecology:** Microbial flora of soil microflora, factors affecting soil microflora, interactions among soil microorganisms, Biogeochemical role of soil microorganisms: Role of microorganisms in cycling process of carbon, sulphur, nitrogen and mining, lichens, normal flora of animals, germ free animals, rumen symbiosis, and microbial symbiosis with insects, algae and invertebrates.

**Water Microbiology:** Factors affecting microorganism in aquatic environment, water borne diseases; microbiological assay of water pollution, sewage treatment systems.

**BOOKS FOR READING**


LIST OF PRACTICALS: –

1. General Introduction and familiarization to important microbiological instruments in the laboratories.
2. Introduction to microscopes and their working.
3. Microorganisms are ubiquitous: Finger printing.
4. Introduction to sterilization: Dry heat and moist heat and filtration.
5. Simple staining, Gram staining, Negative staining, Cell wall staining, Capsule staining, Flagellar staining, Acid Fast staining, Spore staining.
6. Preparation of media (nutrient broth and nutrient agar) for the growth of microorganisms.
7. General Methods: Pour plating, Spread plating, streaking and dilutions.
8. Determine the size of bacteria.
9. Motility of bacteria: Hanging Drop and Soft Agar
10. Isolation of microorganisms from different sources: Soil, Curd, Root nodules, Sore throat.
11. Bacterial CFUs in mineral water bottle.
12. Phenol Coefficient: To study the antibacterial effect of various chemical compounds.
13. To study the antibacterial effect of antibiotics.
SECOND SEMESTER

BMI 1201: INTRODUCTION TO APPLIED MICROBIOLOGY AND PATHOLOGY.

Objective: The course provides basic knowledge of various aspects of applied microbiology including food & industrial microbiology, environmental microbiology, pathogenesis of microbial diseases.

UNIT – I

Host parasite relationship of infectious diseases: determinants of infectious diseases, attributes of pathogens and offending host (physical, chemical barriers and biological barriers), specific and non-specific immune defense mechanisms of host, autoimmune diseases and allergic reactions. Introduction to pathogenic microbiology.

Epidemiology of infectious diseases: infectious disease cycle, transmission of infectious agent, surveillance, recognition, study and control of epidemics and nosocomial infections.


UNIT – II

Introduction to soil and agriculture microbiology: Agriculture and soil microbiology, pesticides, microbial insecticides, ruminants and microorganisms, introduction to infectious diseases of domestic animals and agricultural plants.

Food Microbiology: Food spoilage, food borne diseases, assessing microbial contents of food, food preservation, food sanitation and microbiology of milk and dairy products.

Industrial microbiology: Industrial fermentation of alcohol and alcoholic beverages antibiotic fermentation, vitamins and amino-acids, microbial bioconversions, enzyme production by microorganisms, food from microorganism.

UNIT – III

Microbial diseases: In humans caused by Chlamydia, Rickettsiae, Gram positive and Gram negative organisms, Human mycotic and parasitic protozoan infections.

Viral diseases: Characteristics of causal agents and disease course of selected diseases such as influenza, measles, yellow fever, rabies, poliomyelitis, and AIDS.

UNIT – IV

Disturbances of growth of cell: atrophy, hypertrophy, aplasia, hyperplasia.

**Neoplasia**: benign and malignant tumors, possible routes of spread, grading and staging, types of carcinogenesis, diagnosis, therapeutic approaches.
BOOKS FOR READING

2. Review of Medical microbiology by Jawetz, Melnick and Adelberg. Lange Medical Publications.
5. Current Medical Diagnosis and Treatment – M.A. Krupp & M.J. Chatton
10. Fundamental of Microbiology IE Alcamo, Publisher. An imprint of Addison Wesley Longman Inc.

LIST OF PRACTICAL:

1. To carry out Total Leucocyte Count of a given blood sample.
2. To perform Differential Leucocyte Count of your own blood sample.
3. To assess haemoglobin count by Sahli’s method.
4. To carry out Erythrocyte Sedimentation Rate & Packed Cell Volume of a given blood sample.
5. To assess creatinin, urea, and uric acid content in the given sample.
6. To study the microflora of air
7. Isolation of bacteria from soil a) Saccharolytic b) Proteolytic c) Lipolytic microorganisms
8. Microbiological testing of water for its portability
10. Stormy clot fermentation test
11. Phosphatase test for milk.
12. Determination of thermal death point (TDP) of an organism.
13. Determination of thermal death time (TDT) of an organism.
B.Sc (H.S.) 2nd year in MICROBIOLOGY

THIRD SEMESTER

BMI 2301: PHYCOLOGY

Objective: The objective of the course is to teach general, ecological, metabolic and economic aspects of algae so as to understand how the algae can be applied for various useful purposes.

UNIT-I

An introduction to algae: The position of algae in continuation of life; General classification; Algal cell structure and nutrition; Reproduction in algae.

Ecological aspects of algae: Soil algae, Fresh water algae, marine algae (seaweeds), aerial algae and algae as symbionts; Adaptation of algae to extreme temperatures; Nature of extracellular products formed by algae and their ecological effects.

UNIT-II

Economic importance: Algae as bio fertilizer, reclamation of saline and acidic soil by algae. Algae as food, including single cell protein. Use of algae to fisheries and malaria control. Use of algae to fisheries and malaria control. Source of agar-agar, alginate, diatomite and iodine etc, antibiotics from algae and uptake of radioactive waste by algae. Role of algae in indicating pollution (water pollution). Algal photosynthesis in sewage treatment.

Phycovirus: Classification, structure and multiplication of phyco viruses (mainly Cyanophages), environmental impact of phyco viruses

UNIT-III

Nutrition and metabolism: Photosynthesis: The physical nature of light, pigments in systems of photosynthesis, the photosynthetic apparatus; path of electron in photosynthesis, factors affecting the rate of photosynthesis and carbon fixation. Respiration, Photorespiration.

Nitrogen Fixation: Distribution of the capacity to fix nitrogen among algae, Site of nitrogen fixation, heterocyst, ultrastructure of heterocyst, factors controlling heterocyst formation, genetic control of heterocyst formation, nitrogenase and biochemistry of nitrogen fixation, physiology of nitrogen fixation in blue green algae.

UNIT-IV

Genetics: Algal transgenics and transformation. Molecular genetics of dinitrogen – fixation and nitrite and nitrate utilization, challenges in algal transformation. Eyespot mutants, their isolation and characterization, cytoplasmic inheritance

Laboratory cultures: Growth characteristics, preparation of experimental material, methods of cultures, physical and chemical conditions for algal growth, pond and
bioreactor cultivation, harvesting and oil extraction methods, cultivation for biofuels: cost, energy balance, environmental impacts and future prospects

**BOOKS FOR READING**

1. Algal Culturing Techniques by Robert A. Andersen, Elsevier Academic Press, 2005
8. Seaweed Ecology and Physiology by Christopher S. Lobban, Paul J. Harrison Cambridge University Press, 2000

**Journals:**

1. Biotechnology Letters
2. Annual Reviews of Microbiology
3. Microbiology and Molecular Biology Reviews
4. International Journal of algal Research
5. Algologia
6. The Journal of Phycology

**LIST OF PRACTICALS:**

1. To study the morphological characteristics of different algal samples
   (a) Chara (b) Halimeda (c) Codium
   (d) Gracillaria (e) Batrachospermum

2. To study the microscopic features of different algal samples
   (a) Nostoc (b) Oscillatoria (c) Volvox (d) Anabaena (e) Wucheria
   (f) Chlorella (g) Spirogyra

3. To study the preparation of Beneck’s broth medium for algal cultivation
4. To isolate algal samples from different aquatic environment
5. To cultivate the different algal samples in Beneck’s broth and study their growth characteristics.
6. To study the ultrastructure of heterocyst and calculate heterocyst frequency
7. To isolate cyanobacteria from soil/water from paddy field
8. To quantify chlorophyll content in green algae by hot extraction method
9. To quantify chlorophyll content in green algae by cold extraction method
10. To quantify carotene pigment content in green algae
BMI 2302: PARASITOLOGY

Objective: To provide theoretical and practical information pertaining various parasitic diseases, and preventive measures.

UNIT-I

Protozology: Brief history of protozology, ecology and host parasite relationship (parasitism and symbiosis): Basis of host cell parasite interactions with special reference to autoimmune response and pathogenesis of protozoan diseases in general, zoonotic potentiality of protozoa.

UNIT-II

Morphology, life cycle, pathology, Symptomatology, laboratory diagnosis and treatment of following:

(a) Amoeba: Non pathogenic and pathogen amoebae
(b) Giardia (G. lamblia)
(c) Blood flagellates: Leishmaniasis, Post kala-azar dermal leishmaniasis and Trypanosomiasis.
(d) Flagellates of genital tract: Trichomonas (T. tenax, T. hominis T. vaginalis).
(e) Malaria parasite (Plasmodium falciparum, P. malariae, P. Ovale, P. knowlesi) general sequelae of malaria.
(f) Toxoplasma gondii,
(g) The emerging pathogen; Cryptosporidium parvum

UNIT-III

Helminthology: General introduction of helminths and classification, medically important heminths, immunity in Taenia saginata, T. solium. Echinococcus granulosus

Trematodes: Classification, morphology, life cycle, pathogenesis, laboratory diagnosis and treatment of Schistosoma haematobium, S. japonicum and S. mansoni.

Helminths: Classification, morphology, life cycle, pathogenesis, laboratory diagnosis and treatment of Ascaris lumbricoides, Ancylostoma duodenale, Strongyloides stercoralis, Enterobius vermicularis, Wuchereria bancrofti, Brugia malayi.

UNIT-IV

Medical entomology: - Classification and general characteristics of important insect vectors. Mode of transmission of various diseases. Role of arthropods in the spread and causation of parasitic disease.

BOOKS FOR READING

LIST OF PRACTICAL:-

1. Demonstration of various protozoa/intestinal helminthes in stool samples;
   a) *Entamoeba histolytica* (Cyst)
   b) *Entamoeba coli* (Cyst)
   c) *Giardia lamblia*
   d) *Enterobius vermicularis*
   e) *Taenia* species
   f) *Ascaris lumbricoides*
   g) *Ancylostoma duodenale*
2. To examine the stool samples for the presence of protozoa/helminthes by simple/concentration techniques
3. To examine the auxenic culture of *Giardia* and *Entamoeba*.
4. To examine malarial parasite in peripheral blood.
5. To examine morphology of microfilarae in permanent slide.
BMI 2303: ENVIRONMENTAL MICROBIOLOGY

**Objective:** The objective of the course is to teach the various microbial environments encountered in the area of soil water and air microbiology and how they affect the cycling of nutrients, various methods available for identification and enumeration of microbes in these environments.

**UNIT-I**

**Petroleum Microbiology:** Effect of hydrocarbon on microorganisms. Evidence regarding biogenesis of petroleum. Bacterial products as indicators of petroleum biodegradation. Role of methanotrophic bacteria, methanogens, their physiology, ecology, global carbon cycling and bio-degradation of toxic chemicals. Bio synthesis of surface active agent and methane production.

**UNIT-II**

Microbial biodegradation of petroleum products in terrestrial, aquatic environment. Problems related to $\text{SO}_4$, reducing bacteria in petroleum industries and their metabolism, ecology and physiology. Treatment and disposal of petroleum refinery waste. Heavy crude and oil shale. Recovery of petroleum from oil bearing rocks.

**UNIT-III**

**Microbiology of air:** Exhaust gas purification, Methods of waste gas treatment, aerosols monitoring, Bioreactors for Volatile organic compounds and odours. Sewage & water treatment: Significance of microorganisms present in sewage & water BOD mechanisms & kinetics, BOD in design and operation of biological treatment. BOD as an aid in regulation of water quality

**UNIT-IV**

**Analysis of water:** Quantitative and qualitative methods, coliform organisms in sewage, waterborne diseases. Qualitative and quantitative standards of water. Purification of water for industrial, municipal and domestic supply. Recycling & treatment of domestic & industrial water.

**BOOKS FOR READING**

2. Environmental Microbiology by Ian Papper and Charles Gerba, Elsevier Press 2008
3. Environmental Microbiology by P.D.Sharma, Alpha Science International, 2005
4. Environmental microbiology: Principles and applications by Patrick K. Jjemba,
Science Publisher 2004.
5. Environmental microbiology by A.H. Varnam and M. Evans Blackwill Publisher 2000
6. Comprehensive Biotechnology, by Moo Young. 1995

JOURNALS

2. Applied and Environmental Microbiology.
5. Environmental Microbiology Reports

LIST OF PRACTICAL:

1. Presumptive test for coliform group of bacteria.
2. Confirmed test of coliform bacteria.
3. To study the micro-flora of air (indoor and outdoor.
4. Isolation of anaerobic bacteria by candle jar method.
5. To study the micro-flora of soil by slide buried technique.
6. Isolation of phosphate solubilizing micro-organism from soil and water.
7. Water analysis for total bacterial population by standard plate count (SPC) method.
10. Determination of biological oxygen demand (BOD) of water (raw/treated sewage).
11. Determination of chemical oxygen demand (COD) of water (raw/treated sewage).
12. Determination of total alkalinity of water.
FOURTH SEMESTER
BMI 2401: MYCOLOGY

Objective: The course provides insight into the classification and general characteristics of fungi, fundamental processes of fungi e.g. growth, reproduction and genetics, the industrial significance of fungi and their role in causing diseases along with diagnostic measures and treatment.

UNIT-I

Major taxonomic groups of fungi: Brief classification systems and distinguishing characteristics of Slime moulds & organisms distantly related to fungi, Oomycota, Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota & Deuteromycota.

Fungal structures: General structure of hypha, differentiation along the hypha, hypha as part of colony, mycelial modifications, general structure of yeasts, fungal walls, plasma membrane, septa, nuclei & associated structures, cytoplasmic components, Golgi, endoplasmic reticulum & vesicles, vacuoles, cytoskeleton.

Fungal growth and development: Apical growth, assembly of the wall at the apex, steady state model of wall growth, driving force for apical growth, spore germination, spore germination tropisms, hyphal tropisms, yeast cell cycles, cell cycle in mycelial fungi, colony branching & branch behaviour, kinetics of growth.

UNIT-II

Fungal nutrition: Mode of nutrition, fungal adaptations for nutrient capture (apical growth, enzyme secretion, defence of territory), nutrient requirements of fungi, carbon & energy sources.

Fungal metabolism: Energy production, energy from non-sugar substrates, coordination of metabolism, translocation & storage of compounds, chitin synthesis, Lysine synthesis, secondary metabolism.

Fungal reproduction: Vegetative reproduction- fragmentation, fission, budding, spawns, sclerotia, rhizomorphs; Asexual reproduction- endospores, conidia, oidia, chlamydospores, pycniospores, ascospores, basidiospores, uredospores & telutospores; Sexual reproductionplanogametic copulation, gametangial contact, gametangial copulation, spermatogamy, somatogamy; reduction of sex in fungi.

UNIT-III

Fungal genetics: Structure & organization of fungal genome, genetic variation in fungi- Nonsexual variation (heterokaryosis & parasexuality), Sexual variation (Tetrad analysis), applied molecular genetics of fungi.

Medical Mycology: Superficial mycoses, systemic mycoses, fungal infections of skin, nail and hairs, opportunistic fungal infections, antifungal drugs.

Fungal Interactions: Mycorrhizal associations-ectomycorrhiza, endomycorrhiza & ectendotrophic mycorrhiza; Lichens- distribution, mycobiont, phycobiont, morphology & anatomy, economic significance.
UNIT-IV

**Plant Mycology:** Fungal diseases of plants- characteristics of plant pathogenic fungi, classification of plant pathogenic fungi, symptoms caused by fungi on plants; diseases caused by fungal like organisms (Myxomycota, Plasmodiophoromycetes & Oomycetes), diseases caused by True fungi (Chytridiomycetes, Zygomycetes, Ascomycetes, Deuteromycetes & Basidiomycetes); Post harvest diseases of plant products, caused by Ascomycetes & Deuteromycetes.

**Mycotechnology:** Fungi in production of traditional fermented foods, single cell proteins, edible mushrooms and mushroom food poisoning, mushroom nutraceuticals, organic acids, vitamins, antibiotics, fungal antibiotics, mycoherbicides, fungal insecticides, mycorrhizal inoculants, mycotoxins.

**BOOKS FOR READING**

2. 21st Century Guidebook to Fungi author: Moore, David, Robson Geoff, Trinci Tony, Publisher: Cambridge University Press 2011.

**Journals**

a. Mycologist
b. Mycological Research
c. Indian Journal of Mycology and Plant Pathology
d. Mycologia
e) Mycoses

**LIST OF PRACTICAL:**

1. To study the cultural characteristics of fungal colonies.
2. To study the preparation of Potato Dextrose Agar, the general growth medium of fungi
3. To study the microscopic features in permanent mount of different fungal organisms.
4. To perform the staining of different fungal organisms by lactophenol-cotton blue stains to observe various microscopic features.
5. To study the size measurement of various cell organelles and cells of fungal organisms by micrometry.
6. To study various useful taxonomic terms to describe the fungi.
7. To study the writing of taxonomic description of fungal organisms.
8. To perform the isolation of fungi from soil by serial dilution method.
9. To perform the isolation of fungi from soil by Warcup method.
10. To study the diversity of fungi from various environmental locations/substrates.
11. To study the sections ectomycorrhizal and endomycorrhizal fungi through permanent mount.
12. To study the long term preservation of fungi in glycerol solution.
13. To study the macroscopic and microscopic features of mushrooms for taxonomic description.
14. To study the microscopic features of yeast.
BMI 2402: INDUSTRIAL MICROBIOLOGY

Objective: The course has been designed to make the students understand the commercial exploitation of microorganisms, their processes and product in various industries, techniques to harness microbial products by the process of fermentation and its economic feasibility. The course also deals with the treatment of various industrial effluents, strain improvement, isolation, acquisition, maintenance & long and short term preservation of industrially important microbial cultures and various issues related to intellectual property rights especially for the safe guard of industrial products, techniques & microorganisms.

UNIT-I

Introduction to Industrial Microbiology: Characteristics of Industrial microbiology, its relation with industrial biotechnology, Industrial fermentation, definition; types of Fermentation- Submerged, Surface and Solid-State fermentation; Range and Component parts of fermentation processes, development of Industrial fermentation and fermentation Industry. Stirred tank fermenter; fermenters used in solid state fermentation.

Biological basis of Productivity in Industrial Microbiology: Microorganisms commonly used in microbiology and biotechnology, Basic nature of cells, classification of living things, taxonomic groupings of industrial microorganisms.

Aspects of Molecular Biology & Bioinformatics of Relevance in Industrial Microbiology: Protein synthesis, Polymerase chain reaction; Microarrays, Sequencing of DNA, Metagenomics; Nature of Bioinformatics

UNIT-II

Microbial Transformations & Production Media: Types of bioconversion reactions; ideal production medium, raw materials, saccharine, starchy, cellulosic materials, hydrocarbons and vegetable oils, nitrogenous materials, screening for production media.

Microbiological Assay: Microbiological assay of vitamins, amino acids, antibiotics, trace elements etc., advantages & disadvantages of microbiological assay, automation of microbiological assay.

Sterility in Industrial Fermentation Processes: basis of loss by contamination, methods of achieving sterility, aspects of sterilization in industry, Viruses (Phages) in industrial microbiology.

UNIT-III

Basic Operations in Industrial Fermentation : Modes of operation- Batch, Continuous & Fed Batch fermentations; Inoculum preservation and growth Fermenter preculture, Production fermenter-fermenter size, temperature, aeration, agitation and pressure; Process monitoring and control; Product isolation from fermentation broth, product purification.
**Industrial Productions:** Citric acid, Beer, Penicillin, Baker's Yeast, Beta Carotene, amino acids, enzymes & important fermented products.

**Economics of Industrial Fermentation:** Isolation of microorganisms of potential interest, strain improvement, market potential, plant & equipments, media, air sterilization, heating & cooling, aeration & agitation, batch process cycle times, continuous culture, Recovery costs, water usage & recycling, effluent treatment.

**Industrial Effluent Treatment:** Introduction, DO concentration as an indicator of water quality, site surveys, strength of fermentation effluents, treatment and disposal of effluents, disposal, treatment processes, by products.

**UNIT-IV**

**Screening for Industrial Productive Strains & Microbial Resource Collections:** Sources of Microorganisms, Literature search and Industrial microbes, collection management, acquisition of strains, accessions, culture properties, distribution, information isolation de novo of organisms producing metabolites of economic importance.

**Strain Improvement for Various Industrial Purposes:** Isolation and Selection from naturally occurring variants, conventional and genetic methods of strain improvement.

**Preservation of industrially important microorganisms:** Selection of preservation techniques, Serial sub-culturing, preservation by overlaying cultures with mineral oil, lyophilization or freeze drying, cryopreservation, special techniques and procedures.

**Patents and Intellectual Property Rights in Industrial Microbiology & Biotechnology.**

**BOOKS FOR READING**

**a) Essential**

8. Industrial biotransformation by Lieshe, Seelbach & Wandrey, Wiley VCH publications
b) Further Readings

2. Applications of Microbiology- J. Riviere

Journals

6. Journal of Industrial Microbiology and Biotechnology
7. International Journal of Applied Microbiology and Biotechnology
8. International Journal of Research in Pure and Applied Microbiology

LIST OF PRACTICALS:

1. To perform the submerged fermentation.
2. To perform the solid state fermentation.
3. To perform the microbiological assay of vitamins.
4. To perform the microbiological assay of amino acids.
5. To perform the microbiological assay of antibiotics.
6. To study the maintenance & preservation of bacterial and fungal culture by freeze drying (Lyophilization).
7. To study the maintenance & preservation of bacterial and fungal culture in glycerol.
8. Maintenance of mold cultures on distilled water.
9. Isolation of industrially important bacterial & fungal cultures from different biotopes.
10. To study the catabolism of carbohydrate by microorganisms (oxidation & fermentation of glucose).
11. To study the fermentation of carbohydrates.
12. To study the screening and evaluation of industrially important metabolites from different bacterial and fungal cultures.
13. To study the production of citric acid by Aspergillus niger.
14. To study the production of chitosan by Aspergillus species.
15. To study the production of mycomeat in submerged & solid state fermentation.
16. Screening and Isolation of industrially important microorganisms including amylase producers, cellulase producers, xylanase producers, mannanase producers, pectinase producers, protease producers, lipase producers, acid producers.
17. To study various parts of a typical stirred tank and a solid state fermenter.
18. Production of alpha-amylase by submerged, surface culture and solid state fermentations and comparing its yields in different fermentation processes.
19. Studying the kinetics of typical ethanol fermentation using molasses and sugar cane juice in terms of the rate of sugar utilization, rate of ethanol production, rate of yeast multiplication and determination of fermentation efficiency and product yield.
20. Immobilization of alpha-amylase and yeast cells and their evaluation of their activities in suitable biochemical process.
21. Production of white and red wines and qualitative and quantitative determination of their important functional components.
BMI 2403: SOIL MICROBIOLOGY & BIOREMEDIATION

Objective: The objective of the course is to teach the role of microbes and their products in various environmental processes and their interaction with pollutants. This will be helpful in the application of microbes in various processes e.g. nitrogen fixation and bioremediation.

UNIT-I

Introduction of soil microbiology: Nature of soil, types of microorganisms in soil. Functions of microorganisms in soil.

Role of microbes in biogeochemical cycles: Carbon cycle, Nitrogen cycle, Sulphur cycle. Detrimental impacts of diverted biogeochemical cycles.

Factors affecting the movement of microorganisms in soil: Adsorption to soil particles, soil physical properties, plant roots, soil animals and human beings in relation to microbial movement in soil.

UNIT-II

Soil enzymes as indicator of ecosystem: Soil enzymes properties, principles of enzyme assay distribution of enzyme in soil organic components, ecology of extracellular enzymes.


UNIT-III

Nitrogen fixation: Biochemistry of N₂ fixation, properties of terrestrial nitrogen fixing organisms, free living diazotrophs.

Symbiotic nitrogen fixation: Rhizobium-Legume association, Actinorhizal associations, contribution of symbiotic nitrogen fixation.

Denitrification: Biochemical properties of denitrification, Microbiology of denitrification, quantification of N₂ losses from ecosystem via denitrification, environmental factors controlling the denitrification.

UNIT-IV

Microbial interaction with metal pollutants: Sources of metal pollution, effects of metal pollution on microbes, metal corrosion, biotransformation and bio-removal of heavy metals from polluted environments. Beneficial effects of metal microbial interactions.

Microbial bioremediation: What is bioremediation, biodegradation of major groups of environmental pollutants, mechanisms of metabolizing different classes of organic pollutants, prospects of microbial application to toxic waste treatment, recent trends in bioremediation
BOOKS FOR READING

2. Environmental microbiology by A.H. Varnam and M. Evans Blackwill Publisher 2000.
5. Soil Microbiology by Waksman, 2011.
7. Microbial Communities, Insam, H, Rangger, A, 1997

LIST OF PRACTICALS:

1. To enumerate the number of organisms in rhizospheric soil and to study their diversity.
2. To enumerate the number of organisms in non-rhizospheric soil and to study their diversity.
3. To quantify the nitrate in given soil sample.
4. To quantify the nitrite in given soil sample.
5. To quantify the carbonate in given soil sample.
6. To perform contact slide assay.
7. To quantify the available phosphorus in the soil.
8. To isolate symbiotic nitrogen fixing organism (Rhizobium) and to coat the soyabean seeds with the isolated rhizobium.
9. To isolate the free living diazotrophores (Azotobacter) from the soil.
10. To isolate the microorganisms from air by plate settling method.
11. To isolate the microorganisms from air by using air sampler.
SYLLABUS FOR B.SC. (HONS SCHOOL) SECOND YEAR (SUBSIDIARY COURSES FOR BIOCHEMISTRY AND BIOPHYSICS STUDENTS)
FOR THE EXAMINATIONS OF 2015-2016

Note: The pattern of Question paper set by the Examiner should be as below:

“The examiner should set nine questions in total including one question with sub-parts representing the entire syllabus that will be compulsory. Apart from the compulsory question, students have to attempt four other questions i.e. the students will be asked to attempt five questions at least one question from Part A, B, C and D including the compulsory question.

THIRD SEMESTER
BMIS 2371: INTRODUCTION TO GENERAL MICROBIOLOGY

Objective: To provide an overview of various aspects of microbiology like growth, metabolism, reproduction, nutrition and beneficial and harmful roles of microorganisms in food and milk microbiology.

UNIT-I

Science of Microbiology: Definition, Scope- microbes & microbiologists, History of Microbiology-theory of spontaneous generation, the germ theory of disease, work towards controlling infections, emergence of special fields of microbiology-immunology, virology, chemotherapy, genetics & molecular biology; Sub-disciplines of microbiology; Prokaryotic and Eukaryotic microorganisms; The Scientific method; Classification systems.

Microscopy: Historical microscopy, Principles of Microscopy-metric units, properties of lights (wavelength & resolution, light & objects), Light microscopy-the compound light microscope, dark-field microscopy, Nomarsky (differential interface contrast) microscopy, fluorescence microscopy, confocal microscopy & digital microscopy; Electron Microscopy-Transmission electron microscopy (TEM), Scanning electron microscopy (SEM), Scanning tunneling microscopy (STM), Stains and principles of staining.

UNIT-II

Major Groups of Microorganisms: Bacteria- cell ultra-structure, nutrition, reproduction & function; Fungi- cell ultra-structure, nutrition, reproduction & function; Algae- cell ultra-structure, nutrition, reproduction & function; Viruses-origin & evolution, classification of animal, insect, bacterial & plant viruses, structure of viruses, quantification & replication, virus host interactions and Actinomycetes-classification, structure & important characteristics.

UNIT-III

**Microbial Nutrition & Biosynthesis:** preliminary discussion on the metabolism in heterotrophic & autotrophic organisms; transformation of energy by fermentation, respiration & anaerobic respiration.

**Culturing of Microorganisms:** Isolation methods of Microorganisms; Microbial media, genetic modification & preservation of industrial microorganisms.

**Control of Microorganisms:** Antimicrobial agents, such as growth factors analogs, antibiotics, germicides, disinfectants and antiseptics; Quantifications of antimicrobial action.

UNIT-IV

**Food Microbiology:** Microbial spoilage of food; Food borne diseases; Assessing microbial contents of food; Food preservation methods; Food from microorganisms.

**Milk Microbiology:** Microorganisms commonly found in milk and milk products, Microbiology of milk and milk products; Preparation of starters and Microbiological aspects of dairy sanitation.

**BOOKS FOR READING**


**LIST OF PRACTICALS:**

1) General Introduction to important microbiological instruments in the laboratories.
2) Introduction to sterilization, techniques and preparation of sterilizable materials.
3) Preparation of nutrient media for the growth of microorganisms.
4) Demonstration of omnipresent microorganisms.
5) Staining of microorganisms to study the morphology i.e shape and arrangement.
6) Differential staining to identify Gram +ve and Gram –ve bacteria.
7) To measure the cell size of the bacteria.
8) To study the motility of the microorganisms.
9) To study the negative staining.
10) To study the cell wall.
11) To study the antibacterial effect of various chemical compounds/antibiotics.
12) Enzymatic test of milk by methylene blue dye reductase test method.
**FOURTH SEMESTER**

**BMIS 2471: INTRODUCTION TO APPLIED MICROBIOLOGY**

**Objective:** The course provides basic knowledge of various aspects of applied microbiology including industrial microbiology, genetic engineering, environmental microbiology, host-parasite relationships and pathogenesis of microbial diseases.

**UNIT-I**

**Host parasite relationships:** Microbial factors, invasion and pathogen city, mechanisms of resistances. Host factors, Innate immune response, acquired immune response (types of antibodies, role of antibodies, T cells, B cells, natural killer cells)

**UNIT-II**

**Introduction to pathogenic microbiology**, chemotherapy and epidemiology, pathogenesis, diagnosis and treatment of infectious diseases caused by various micro-organisms like bacteria (*Streptococci, Staphylococci, Corynebacterium, Mycobacterium, Clostridium, E. coli, Salmonella, Shigella, Haemophilus, Vibrio, Klebsiella, Bordetella, Meningococci, Gonococci*), Parasites (*Giardia, Entamoeba, Plasmodium, Toxoplasma, Trypanosoma Leishmania*) and Viruses (*Entero viruses, Rhinoviruses, Rubella, Measles, Rabies, Influenza, Rota, Herpes, Small Pox, Hepatitis, Adenovirus, HIV*).

**UNIT-III**

**Microbiology of soil**, physical characteristics, microbial flora, Bio-geochemical activities of micro-organisms, transformation of nitrogen, Carbon and Sulfur. Aquatic Microbiology, micro-organisms in aquatic environment and techniques employed for their study. Microbiology of domestic water and waste water, bacteriological techniques, sewage treatment and disposal, municipal treatment processes.

**Petroleum microbiology:** Formation, exploration, recovery and oil spills.

**Air Microbiology:** Indoor and outdoor air, microbiological techniques for measurement of air contamination, control of airborne infections.

**UNIT-IV**


**LIST OF PRACTICALS:**

1. To study the microflora of air
2. Isolation of bacteria from soil a) Sacccharolytic b) Proteolytic c) Lipolytic microorganisms
3. Microbiological testing of water for its potability
4. Sterility test for milk.
5. Stormy clot fermentation test
6. Phosphatase test for milk.
7. Determination of thermal death point (TDP) of an organism.
8. Determination of thermal death time (TDT) of an organism.
10. To study the microflora of soil/water by buried slide technique

**BOOKS FOR READING**

4. General Microbiology- Stanier, Ingrahm, wheelish and Painter, Macmillan Edu. Ltd
BMI 3501: MEDICAL BACTERIOLOGY-I

Objective: The course is designed to introduce the students a broad view of diseases caused by various groups of bacteria, the laboratory diagnosis and preventive measures. Accordingly, the students are given practical training for identification of Gram positive and Gram negative common pathogens encountered in clinical specimens.

UNIT-I

- History of medical microbiology; abiogenesis and biogenesis controversy, germ theory of disease; and microbiological techniques etc
- Mechanisms of bacterial pathogenicity; types of pathogens, role of microbial virulence factors; invasins, toxins; superficial structures – adhesins, fimbriae, capsules and enzymes.
- Epidemiology: Study development, investigation and control of epidemics. Nosocomial infections and control of community infections.
- Normal microbial flora of the human body (Skin, ear, eyes, nose, respiratory tract, gastrointestinal tract and urogenital tract) and its importance in host immunity.
- Salient features of laboratory diagnosis of common bacterial infections. Specimen collection, transportation and processing (direct examination, media selection, inoculation and isolation; culture examination, identification: characterization using biochemical, serological typing, bacteriophage typing and using molecular methods, antimicrobial sensitivity tests, drugs.

UNIT-II

- Epidemiology, morphology and physiological characteristics, antigenic structure, virulence determining factors, pathogenicity clinical manifestation and laboratory diagnosis of infections caused in humans by the following bacterial pathogens;
- Staphylococcal infections caused by S. aureus, CNS group (S. epidermidis, S. saprophyticus.
- Streptococcus infection caused by S. pyogenes, S. agalactiae, S. equisimilis, S. pneumoniae, Streptococcus viridans and Enterococcus faecalis
- Corynebacterium diphtheriae infections: pathogenicity, clinical significance, diagnostic, therapy.

UNIT-III

- Listeria monocytogenes infections in humans
- Mycobacterium tuberculosis and M. leprae and other mycobacteria.
- Bacillus anthracis and Bacillus cereus
- Clostridium: Infections agents associated with tetanus, botulinum, gas gangrene diseases and pseudomembranous colitis.
UNIT-IV

- Spirochetes: morphology, physiology, pathogenesis and lab diagnosis;
  a) Syphilis; *Treponema pallidum, T. pertenue, T. carateum*
  b) leptospirosis (*Leptospira interrogans* – serotypes: *L. icterohaemorrhagiae, L. grippotyphosa, L. canicola*),
  c) Lyme disease (*Borrelia burgdorferi*), recurrent fever (*Borrelia recurrentis*),
  d) cat scratch disease (*Bartonella henselae*)

BOOKS FOR READING

5. Mackie and McCartney Practical Medical Microbiology Ed Collee JG, Fraser AG, Marmion BP and Simmons A. Churchill Livingstone publication
6. Medical Microbiology by Mims and others. Elsevier Mosby Spain
7. Medical Microbiology Samuel Baron Publisher. University of Texas Medical Branch, Addison Wesley Publishing Co.
8. Textbook of Microbiology: Ananthanaryan and Panikar
9. Mandell, Douglas and Bennett's; Principles and Practice of Infectious diseases: GL Mandell R. Dolin and JE Bennett's, Publisher Churchill Livingstone. NY
10. Kenneth Todar; Todar's Online Textbook of Bacteriology, University of Wisconsin 2008

PRACTICAL LIST:

- Observation and structure of bacteria;
  1. Smear making, Gram staining, study of morphology of bacteria.
  2. Examination of capsule, spore, motility (hanging drop technique, semi solid media)
  3. Study of different types of media for isolation and identification
  4. Culturing and isolation and antibiotic sensitivity testing
  6. Examination of bacterial colonial characteristics; smell and odor etc
  7. Specimen collection and study of micro flora of throat.
  8. Study of characteristics of Streptococci associated with human infections
  9. Study of morphological, colonial and biochemical characteristics of *Staphylococcus* species.
10. Study of morphological, colonial and biochemical characteristics of *Micrococcus* species
11. Study of characteristics of family Enterobacteriaceae and grouping the isolates on the basis of IMViC tests.

- Introduction to identification schemes

12. Study of morphological, colonial and biochemical characteristics and differentiation of members of family enterobacteriaceae and other enteric for example
   a. *Escherichia coli, Edwardsiella tarda, Shigella* species
   b. *Citrobacter* species, *Salmonella* species
   c. *Klebsiella* species, *Enterobacter* species, *Serratia sp*
   d. *Proteus* species, *Morganella morganii, Providencia* species
   e. *Yersinia enterocolitica*
   f. *Vibrio cholerae, Aeromonas* species, *Pleisomonas shigelloides, Flavobacterium*
   g. *Achromobacter, Acinetobacter* species
   h. *Moraxella, Alkaligenes faecalis*
   i. *Burkholderia* Species
   ii. *Stenotrophomonas* Species
**BMI 3502: MICROBIAL AND MOLECULAR GENETICS**

**Objective:** The objective of the course is to introduce the students to basic and applied aspects of microbial genetics. The students are given a thorough understanding of recombinant DNA technology and guidelines. This prepares them for further advances courses.

**UNIT-I**


**UNIT-II**

Vectors- plasmids, lambda phage structure, biology and derivatives as vectors, in vitro packaging, cosmids, phagemids, P1, PAC, BAC, YAC and M13 vectors, restriction enzymes, types, restriction and modification systems of bacteria, restriction and generalized mapping, RFLP

**UNIT-III**

Gene technology & implications: Gene cloning: genomic and cDNA library construction, subtractive cDNA library, PCR, RT-PCR, Real time PCR, ligation theory, transformation by CaCl₂, electroporation, biolistics; screening of cloned transformants – autoradiography, hybridization, non-radioactive methods; in vitro protein synthesis.

**UNIT-IV**

Oligonucleotide mediated site directed mutagenesis.; DNA sequencing- Sanger, Maxam-Gilbert, capillary, on chip, pyrosequencing, streptomycetes genetics; NIH guidelines on the genetic engineering experiments, fungal (yeast) genetic, protoplast fusion.

**BOOKS FOR READING**


LIST OF PRACTICALS:

1. Isolation and purification of plasmid DNA using alkaline lysis method.
2. Isolation and purification of plasmid DNA using boiling prep method.
3. Isolation of bacterial chromosomal DNA
4. To check the purity and the quantification of DNA by using spectrophotometric method.
5. Transformation of *E.coli* with plasmid using calcium chloride treatment
6. Transformation of *E.coli* by electroporation.
7. To induce the mutations by (a) chemical mutagens like EMS (b) Physical agents like U.V light
8. Hfr x F- conjugation to map genes.
**BMI 3503: FOOD MICROBIOLOGY**

**Objective:** This course has been designed with objectives to impart knowledge to the students on significance of food in providing nutrition to human beings, involvement of various microorganisms in causing diseases, spoilage, fermentation and their role as source of food. Besides, it also gives the knowledge in depth regarding various food preservation and analysis methods and various rules, regulations and standards to assure the quality control for food safety.

**UNIT-I**

**Food & Nutrition:** Definition & Significance of food, Composition foods, Nutrients in foods- Proteins, carbohydrates fats, vitamins & minerals, Enzymes Foods, Flavour & Aroma of foods, Balanced diet, Factors affecting microbial activity in foods, Proximate analysis of different foods, Non-nutritional components of food, Food Allergies.

**UNIT-II**

**Microorganisms & Food:** Ecology & food microbiology, Diversity of microorganisms in food, Microbial foods- food value of mushrooms, single cell proteins-bacterial & fungal, Fermented foods of Indian origin, Manufacturing processes of important milk based, soybean based fermented products and manufacturing process of important beverages

**UNIT-III**

**Microbiology of different Foods:** Microbiology of milk & milk products, Microbiology of meat & meat products, Microbiology of eggs & egg products, Microbiology of fruits & vegetables, Microbiology of flour, bread & cereals, Microbiology of spices; Food borne diseases-caused by bacteria, fungi, viruses & protozoa; Food poisoning, infections & intoxications.

**UNIT-IV**

**Food Preservation, Safety & Regulation:** Preservation methods of different foods-physical, chemical, radiation, temperature, cold preservation, Role of microorganisms in preserving foods, Quality assurance-microbiological quality standards of food, Biosensors in food industry, Government regulatory practices and policies. FDA, EPA, HACCP, FPA, ISI etc.

**BOOKS FOR READING**

a) **Essential**
7. Fundamentals Food Microbiology, 4e Ray 2011
11. Food Bio-deterioration And Preservation Tucker S. Gary 2013

b) Further readings

Journals
5. International Journal of Food Microbiology
6. Food Microbiology and Safety
7. Journal of Food Safety
8. Food Microbiology and Food Safety
9. International Journal of Nutrition and Food Sciences

LIST OF PRACTICAL:

1. To study the major groups of food and respective nutritional constituents.
2. To study the structure of different food groups.
3. To perform the proximate analysis of various food groups (mushrooms, vegetables, fruits, meats).
4. To study the microbial flora associated with different food types.
5. To study the role of yeasts in bread making.
6. To study the production of sauerkraut by microorganisms.
7. To study the rope causing bacteria in bread & flour.
8. To isolate and study the food spoilage causing microorganisms from various food commodities.
9. To study the effect of temperature on the shelf life of various food commodities.
10. To study the nutrient contents present in various food commodities.
11. To detect the adulterations in various food types.
12. To determine the mastitic condition of milk by Hotis test, clot on boiling &
alcohol test.
13. To study the effect of moisture on the shelf life of various food commodities.
14. To check the bacteriological quality of raw milk on the basis of MBRT,
resazurin reduction test, SPC & DMC.
15. To assess the quality of raw milk on the basis of rapid platform tests.
16. To assess the bacteriological quality of potable water on the basis of MPN.
17. To assess the bacteriological quality of powdered milk products on the basis of
SPC, coliform count, yeasts and moulds.
18. To assess the bacteriological quality of ice cream on the basis of SPC and
coliform count.
19. To assess the microbiological quality of butter on the basis of yeasts and
moulds.
20. To determine lactose content in milk by Lane Eynon’s method.
21. To determine total, reducing and non reducing sugars in fruit juices.
22. To quantify total carbohydrates in solid food samples by Lane Eynon, and
anthrone methods.
23. To determine fat content in oil seeds by Soxhlet method.
24. To determine moisture content in various foods.
Objective: The immunology section will introduce the student to immunologic concepts and their relationship to medicine. The cellular and molecular basis of the immune system and its function in host-parasite interactions are covered.

UNIT-I


Acquired immunity:- Active and passive immunity, cells involved in immune system viz. B-cells, T-cells and antigen presenting cells.

Organs of the immune system:- Primary lymphoid organs, secondary lymphoid organs, mucosal associated lymphoid tissue, cutaneous associated lymphoid tissue.

UNIT-II

Antibodies:- Basic structure of immunoglobulin, immunoglobulin domains, folds, hinge region. Antigenic determinants on immunoglobulins. Immunoglobulin classes and biological activities. B-cell receptor, immunoglobulin superfamily.

Organisation and expression of immunoglobulin genes:- Genetic model for immunoglobulin structure, organisation of immunoglobulin genes, Gene rearrangement in variable region. Mechanism of variable region DNA rearrangements, class switching among constant region genes.

UNIT-III

Molecular basis of immunogenicity and antigenicity, Haptens, Mitogens, B cell epitope, T-cell epitopes. Affinity of antigen antibody interactions, antibody acidity and its biological significance, precipitation reactions, passive, bacterial and haemagglutination, Radioimmunoassay, Enzyme Linked Immunosorbent Assay, Immune Fluorescence assay.


UNIT-IV

Adjuvants, their chemical nature and mode of action. Compliment and its components, functions of complement, complement activation by classical,
Alternative and lectin pathway and its biological consequences, Regulation of complement system, diseases associated with complement deficiencies.

Cytokines & their properties, cytokine receptors, their families and subfamilies. Cytokine antagonists, diseases related to cytokines. General organization for Major Histocompatibility complex, Major classes of MHC antigen, Class I, Class II and Class III. MHC, disease susceptibility and immune responsiveness. Generation of monoclonal antibodies, hybridoma technology and various applications of monoclonal antibodies.

**BOOKS FOR READING**


**LIST OF PRACTICALS:-**

1. Radial immunodiffusion (Mancini Method)
2. Double immunodiffusion: Ouchterlony technique
3. Ouchterlony technique
4. Rocket Immuno Electrophoresis
5. Two dimensional Immuno Electrophoresis
7. Handling, maintenance and usage of experimental animals for immunological experiments
8. To study various routes of immunization
9. To study various routes of collection of blood
10. To study different anticoagulants, methods of anesthesia
11. To separate serum and plasma from blood
12. To observe different immune organs in mice
13. To separate lymphocytes from spleen and to check their viability
14. Separation of lymphocytes from plasma by gradient centrifugation
15. To perform TLC and adjust the lymphocyte count
16. To separate and count T & B lymphocytes by Rosette method
Objective: The course is designed to introduce the students a broad view of diseases caused by various groups of bacteria, the laboratory diagnosis and preventive measures. Accordingly, the students are given practical training for identification of Gram positive and Gram negative common pathogens encountered in clinical specimens.

UNIT-I

Morphology, physiological characteristics, antigenic structure, virulence determining factors, pathogenicity clinical manifestation and laboratory diagnosis of infections caused in humans by the following by Gram-negative bacterial pathogens;

- Diseases caused facultatively anaerobes of family enterobacteriaceae
  - *Escherichia coli*; intestinal and extra intestinal infections
  - *Klebsiella pneumoniae*
  - *Shigella: Shigella dysenteriae*, *S. sonnei*, *S. flexneri* and *S. boydii*
  - *Salmonella:* Causal agents of enteric fever, *septicemia* and *enteritis.*
  - *Proteus, Morganella* and *Providencia* group
  - *Serratia marcescens*
  - *Yersinia pestis, Y. enterocolitica* and *Y.pseudotuberculosis*

- Diseases caused by *enterics* other than family enterobacteriaceae
  - *Campylobacter jejuni* and *Helicobacter pylori*
  - *Vibrio cholerae; V parahaemolyticus* etc
  - *Aeromonas* species

UNIT-II

- Non fermentative Gram-negative aerobic
  - *Pseudomonas*,
  - *Stenotrophomonas*,
  - *Burkholderia*,
  - *Acinetobacter, Alcaligenes, Moraxella, and Flavobacterium.*

- Diseases caused by Gram-negative anaerobes
  - *Bacteroides fragilis* and *Fusobacterium* sp

UNIT-III

- Diseases caused by the following Gram-negative fastidious organisms
  - *Neisseria meningitidis* and *N. gonorrhoeae*
  - *Haemophilus influenzae* and *H. ducreyi*
  - *Bordetella pertussis, B. parapertussis* and *B. bronchiseptica*
  - *Francisella tularensis*
UNIT-IV

- *Mycoplasma* and L. forms bacteria
- General description and biological properties of *Rickettsiae* and *Chlamydiae*. Epidemiology and pathogenesis of diseases caused by these organisms in humans.

**BOOKS FOR READING**

5. Mackie and McCartney Practical Medical Microbiology Ed Collee JG, Fraser AG, Marmion BP and Simmons A. Churchill Livingstone publication
6. Medical Microbiology by Mims and others. Elsevier Mosby Spain
7. Medical Microbiology Samuel Baron Publisher. University of Texas Medical Branch, Addison Wesley Publishing Co.
8. Textbook of Microbiology: Ananthanaryan and Panikar
9. Mandell, Douglas and Bennett’s; Principles and Practice of Infectious diseases: GL Mandell R. Dolin and JE Bannett;s, Publisher Churchill Livingstone. NY
10. Kenneth Todar; Todar’s Online Textbook of Bacteriology, University of Wisconsin 2008

**LIST OF PRACTICALS:**

1. Observation and structure of bacteria; Smear making, Gram staining, study of morphology of bacteria.
2. Examination of capsule, spore, motility (hanging drop technique, semi solid media)
3. Study of different types of media for isolation and identification
4. Culturing and isolation and antibiotic sensitivity testing
6. Examination of bacterial colonial characteristics; smell and odour etc.
7. Specimen collection and study of micro flora of throat.
8. Study of characteristics of Streptococci associated with human infections
9. Study of morphological, colonial and biochemical characteristics of *Staphylococcus* species.
10. Study of morphological, colonial and biochemical characteristics of *Micrococcus* species
11. Study of characteristics of family “Enterobacteriaceae and grouping the isolates on the basis of IMViC tests.
12. Introduction to identification schemes
13. Study of morphological, colonial and biochemical characteristics and differentiation of members of family enterobacteriaceae and other enteric for example;
   a. *Escherichia coli, Edwardsiella tarda, Shigella* species
   b. *Citrobacter* species, *Salmonella* species
   c. *Klebsiella* species, *Enterobacter* species, *Serratia sp*
   d. *Proteus* species, *Morganella morganii, Providencia* species
   e. *Yersinia enterocolitica*
   f. *Vibrio cholerae, Aeromonas* species, *Pleismonas shigelloides, Flavobacterium*
   g. *Achromobacter , Acinatobacter* species
   h. *Moraxella, Alkaligenes feacalis*
   i. *Burkholderia*
   ii. *Stenotrophomonas*
BMI : 3602: VIROLOGY

Objective: The objective of this course is to give an exhaustive account of viruses, their structure, classification and diseases associated with them to the B.Sc. (H.S.) final year students. This course will prepare them for further studies and research in virology.

UNIT-I

Introduction and general characteristics: Discovery of viruses, General morphology of viruses, viral genomes. Chemical properties of viruses, Isolation and purification of viruses.

Virus assays: Physical and chemical methods and assays based on infectivity. Comparison of different types of assays.

Classification and Nomenclature of viruses: Conventional and Baltimore classification.

Virus Multiplication: Virus multiplication and one step growth experiment. Host induced restriction and modifications.

UNIT-II

Cultivation of viruses: Animal inoculation, inoculation in embryonated eggs and different types of cell cultures. Detection of virus growth in cell cultures.

Unconventional Agents: Satellites, viroids, prions and diseases caused by them.

Oncogenic viruses: Mechanism of viral oncogenesis and oncogenic RNA and DNA viruses.

UNIT-III


Prevention and control measures of virus diseases: Immuno prophylaxis and chemotherapy.

UNIT-IV

Detailed study of important groups of viruses causing diseases in man including the following groups:

Poxviruses, Herpesviruses, Picornaviruses, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Hepatitis viruses, AIDS viruses, miscellaneous viruses.
BOOKS FOR READING


LIST OF PRACTICALS:

1. Isolation of bacteriophage from sewage samples.
2. Demonstration of spot assay and turbidity method for detection of lytic bacteriophage.
3. Purification and preparation of high titre of bacteriophage.
4. Enumeration of bacteriophage in a sample by Plaque forming unit method.
6. Demonstration of various tissue culture methods.
7. Demonstration of various egg inoculation techniques.
Objective: The objective of the course is to teach the various aspects of microbial metabolism, growth kinetics and cell thermodynamics so as to understand the microbial physiology. This knowledge will be helpful to students for the research and industrial applications of microorganisms.

UNIT-I

Introduction and scope of microbial physiology studies.

Microbial Growth: Trophophase and Idophase, Primary and secondary metabolites, growth kinetics, Effect of environmental changes on microbial growth.

Types of growth: Batch, Fed-Batch, and Continuous and their industrial applications. Transport of nutrients in microbes.

Microbial nutrition: classification of microorganisms on the basis of their nutrition requirements. Uptake of nutrients

Reproduction: Modes of bacterial cell division, synthesis of bacterial peptidoglycan.

UNIT-II

Regulation of bacterial metabolism: Concepts of operons and regulons, enzyme induction, catabolite repression, feed-back inhibition and repression.

Allosteric enzymes: properties of allosteric enzymes and their role in controlling central metabolic pathways, covalent modification of enzymes.

Principles to study enzymes, different enzyme preparations and practical assay conditions, enzyme kinetics.

UNIT-III

Cell thermodynamics: Concept of thermodynamics of biological systems, modes of energy production, principles of electron transport & Chemiosmotic theory, photosynthesis, aerobic/anaerobic respiration, fermentation, modes of energy conservation

Ageing & death in microorganism, Stress response: Tolerance to extremes and starvation.

UNIT-IV

Carbohydrate metabolism in bacteria & yeast: Glycolysis phosphogluconate pathway, hetero-lactic fermentation, Entner-Duoderoff pathway, Neuberg’s scheme of
fermentation, mixed acid fermentation, Kreb’s cycle, Methyl glyoxal, gluconeogenesis, teichoic acid and lipopolysaccharide synthesis

**Metabolism** of nitrogen compounds, anaerobic amino acid catabolism, paired degradation of amino acid (Stickland reaction), aromatic amino acid synthesis.

**BOOKS FOR READING**


**LIST OF PRACTICALS:**

1. Preparation of various buffers
2. To plot the bacterial growth curve
3. To perform the shake flask fermentation and to study the enzyme production at different time intervals.
4. To study the functioning of lac operon.
5. To find the optimum pH of given enzyme.
6. To find the optimum temperature of given enzyme.
7. To find the temperature stability of given enzyme
8. To find the pH stability of given enzyme.
9. To study the catabolite repression
10. To study the effect of various agents like metal ions, detergents on enzymes.
11. To calculate $K_m$ and $V_{\text{max}}$ of given enzyme.
12. To check the isoelectric point of protein.
**BMI 3604: IMMUNOPATHOLOGY**

**Objective:** The objective of teaching of this course is the application of basic immunology/immunochemistry in various clinical manifestations/pathologies.

**UNIT-I**

Hypersensitivity reaction and Gell and Coomb classification.

**Type I hypersensitivity** reaction components of IgE mediated hypersensitivity, intracellular events in mast cells degranulation, Pharmacologic agents mediating reaction, late phase reactions, localized and systemic anaphylaxis atop ic and anaphylactic disorders, detection and control.

**Immune complex mediated Type III hypersensitivity:** Localized and generalized reactions, Arthus reaction and serum sickness, Diagnostic and therapeutic approaches.

**UNIT-II**

**Type II Hypersensitivity:** Mechanism of Type II hypersensitivity, Roles of different cells in causing Type II hypersensitivity reaction, Incompatible Blood Transfusion (immediate and delayed reactions) Hemolytic Disease of New borns, Drug Hypersensitivity. Diagnosis of Type II hypersensitivity reactions. Prevention/Treatment.

**Basis for cell mediated immune response. Type IV Hypersensitivity:** Tuberculin and hypersensitivities to other agents, contact dermatitis, phases of DTH response, cytokines participating in DTH response, in vivo & in vitro diagnostic tests.

**UNIT-III**

**Role of phagocytes in health and disease:** Origin of phagocytic cells, Immune and non immune receptors present on macrophage membrane, Oxidative and non oxidative phagocytic functions, Secretary product of macrophages, Role of macrophages in regulating immune response, Functions of macrophages in vivo, Role of phagocytes in variety of human disorders,

**Immunological tolerance:** Basis of immunological tolerance, T cell tolerance to thymic and extra thymic antigens (clonal deletion and clonal anergy), Role of apoptosis, B cell tolerance (clonal abortion and clonal anergy), Factors affecting the induction and duration of tolerance, Failure of tolerance leading to auto immunity.

**Physiological and pathological auto immune response. Autoimmune diseases:** possible factors contributing to the diseases. Classification: organs specific autoimmune diseases (diseases mediated by direct cellular damage and by stimulating or blocking auto-antibodies) and systemic autoimmune diseases including auto immune thyroiditis, multiple sclerosis. Myasthenia gravis, systemic lupus erythematosus, rheumatoid arthritis. Their diagnosis as well as conventional and recent therapeutic approaches.

**HIV / AIDS infection:** History / spread, structure of HIV, pathogenesis, opportunistic infections, diagnosis and preventive / therapeutic approaches for AIDS.
UNIT-IV

Classification of immunodeficiency diseases:- Primary deficiencies, immune deficiencies of myeloid lineage, phagocytic number, adherence, chemotactic and killing defects. Humoral deficiencies, Agammaglobulinemia, hypergammaglobulinemia, hypogammaglobulinemia, selective immune deficiencies, Ataxia telangiectasia.

Cell mediated immune deficiencies, Di George syndrome. Combined immunodeficiencies, SCID and Wiscott Aldrich Syndrome, Experimental models of immunodeficiency, nude and SCID mouse.

Immunology of tumors:- Malignant transformation of cells, tumor antigen, tumor specific and non specific antigens, humoral & cell mediated immune responses to tumor antigens, Immunological surveillance and evasion of immune response by tumors. Role of immunotherapy. Immunization, adoptive cellular therapy, passive therapy with monoclonal antibodies. Cytokines in tumor therapy


BOOKS FOR READING


Journals:

1. Immunology
2. Infection and Immunity
3. Journal of Immunology
4. Internet sites for advanced immunology

LIST OF PRACTICALS:-

1. To determine Bleeding and Clotting time of blood.
2. To observe the histopathology slides of liver, kidney and lung tissue for inflammation.
3. To perform CRP test.
4. To perform VDRL test.
5. To perform RPR test for Syphilis.
6. To perform pregnancy test using the principle of latex agglutination inhibition.
7. To perform Visipreg strip test.
8. To perform Mantoux/Tuberculin Test.
9. To perform the test for detection of typhoid fever (Widal test).
10. To separate lymphocytes by perfusion technique.
11. To analyze the glass adhering property of monocytes.
12. To check the viability and count of the monocytes isolated in the previous experiment.
13. To assess passive haemagglutination by Rheumatoid Arthritis Factor.
14. To determine liver function by assessing ALT, AST and ALP in serum samples.
15. To distinguish apoptotic cells from necrotic cells.
# OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR M.Sc. (HONS SCHOOL) (SEMESTER SYSTEM) (CORE/ELECTIVE) IN MICROBIOLOGY 1<sup>ST</sup> TO 4<sup>TH</sup> SEMESTER EXAMINATION 2015-2016

## M.Sc (H.S.) 1<sup>st</sup> Year

<table>
<thead>
<tr>
<th>Semester</th>
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<th>Credit</th>
<th>Marks</th>
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<tr>
<td>First semester</td>
<td>MMI 4101</td>
<td>Advances in Microbial Ecology</td>
<td>6</td>
<td>150</td>
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<tr>
<td></td>
<td>MMI 4102</td>
<td>Pathogenesis of Infectious diseases</td>
<td>6</td>
<td>150</td>
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<td></td>
<td>MMI 4103</td>
<td>Newer approaches in diagnostic Microbiology</td>
<td>6</td>
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<td>MMI 4151</td>
<td>*Combined Practical</td>
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<td>Second semester</td>
<td>MMI 4201</td>
<td>Fermentation Technology</td>
<td>6</td>
<td>150</td>
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<td>MMI 4202</td>
<td>Advances in Molecular Biology &amp; Biotechnology</td>
<td>6</td>
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<td>MMI 4203</td>
<td>Advances in Immunoprophylaxis &amp; Immunotherapy of infections</td>
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<td>MMI 4251</td>
<td>*Combined Practical</td>
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Total Credits = 46
Total Marks = 1150
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<td>MMI 5301</td>
<td>Fundamentals of Computer Programming and Applications</td>
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<td>80 (Theory) +20(Practical) =100</td>
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<td>MMI 5302</td>
<td>Advanced Topics in Microbiology –I (Seminar)</td>
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* The research work for thesis will start from third semester

Total Credits = 34
Total Marks = 850
SYLLABI OF CORE COURSES OF READING

Pattern of instructions for Paper Setter:

Question papers will have FOUR sections. Examiner will set a total of NINE questions comprising TWO questions from each PART and ONE compulsory question of short answer types covering the whole syllabus. Students will attempt FIVE questions in all including ONE question from each PART and the compulsory question. All Questions will carry equal marks, unless specified.

M.Sc (H.S.) 1st Year in MICROBIOLOGY
FIRST SEMESTER

MMI 4101: ADVANCES IN MICROBIAL ECOLOGY

Objective: The syllabus has been designed to make students aware of the microbial interactions with environment including their natural habitat and adaptations, the fundamental processes of extreme thermophiles along with their stress resistance mechanism. Also, the course deals with the application of various molecular techniques to study microbial ecology and effect of various biotechnological processes on microbes.

UNIT-I

Microbial Ecology: Introduction, scope, historical overview, its relation with general ecology, microbial diversity- bacterial, archaeal & eucaryal diversity; fungal diversity; cyanobacterial diversity.

Natural Environment of Microorganisms: Habitat and its microbial inhabitants; Atmoecosphere- characteristics & stratification, atmosphere as habitat and medium for microbial dispersal, microorganisms in atmosphere; Hydro-Ecosphere- (1) fresh water habitats, composition & activity of fresh water microbial communities (2) Marine habitats characteristics and stratification of the ocean, composition and activity of marine microbial communities; Litho-Ecosphere- microbiology of rocks & soils, deep subsurface microbiology.

Microbial Interactions: (1) Microbe-Microbe interactions- interaction within a single microbial population, positive & negative interactions, Interactions between diverse microbial populations-Neutralism, Commensalism, Mutualism, Synergism, Competition, amensalism, Parasitism & Predation ;

(2) Microbe-Plant interactions- Interactions with plant roots :Rhizosphere, Mycorrhizae, Nitrogen-fixation in nodules, nitrogen fixing associations between rhizobia and legumes, non-leguminous nitrogen-fixing mutualistic relationships, interactions with aerial plant structures, microbial disease of plants :plant pathogens, bacterial, fungal & viral diseases of plants ;
(3) **Microbe-Animal interactions** - Microbial contribution to animal nutrition, predation on microorganisms by animals, cultivation of microorganisms by animals, food & food processing, commensal & mutualistic intestinal symbionts, digestion within rumen

**UNIT-II**

**Microbial Communities & Ecosystem**: Structure & dynamics of microbial communities, diversity & stability of microbial communities; population selection within communities: r & K Strategies; Succession within microbial communities; microbial communities in nature microbes within Macro-communities, their structure & functions.

**Microbiology of Extremophiles**: Ecology of thermophiles, psychrophiles, halophiles, barophiles, osmophiles; effects of light, magnetic force, organic and inorganic compounds on microorganisms and defence strategies.

**Microbial adaptions**: Abiotic limitations to microbial growth - Liebig’s Law of the minimum, Shelford’s law of Tolerance, environmental determinants: temperature, radiation, pressure, salinity, water activity, movement, hydrogen ion concentration, redox potential, magnetic force, organic compounds, inorganic compounds.

**UNIT-III**

**Quantitative Microbial Ecology**: Modern and conventional methods used to study microorganisms, sampling procedures and devices, microbial enumeration, biomass determination, activity assessment.

**Anaerobic Microbiology**: Introduction to anaerobic techniques, measurement isolation and identification of methanogenic and other anaerobes.

**Application of molecular techniques to microbial ecology**: Nucleic acid extraction from soil and sediment, gene probe technology to study to soil microbiology and biochemistry.

**Molecular Approaches to Phylogeny**: DNA markers, RAPD, Molecular Phylogenetics, 16s rRNA technique, limitations of molecular microbial ecology.

**UNIT-IV**

**Microorganisms in Biological Control**: Microbial control of insects, pests, weeds and other disease causing organisms.

**Biodegradability testing and monitoring the bioremediation**: Biodegradability and ecological side effect testing, Bioremediation efficacy testing, approaches to bioremediation, Bioremediation of various ecosystems.
**Environmental assessment of biotechnological processes:** Ecological consequences of the release of genetically engineered microorganism, risk assessment and methods used to study the effect of genetically engineered microorganism on environment. Regulation of biotechnology processes.

**BOOKS FOR READING**


**JOURNALS**

1. Microbial Ecology
3. Biodegradation
4. FEMS Microbiology Ecology
5. Microbiology in Health and Disease

**LIST OF PRACTICALS:**

1. To enumerate microorganisms from different natural habitats.
2. To determine the microbial biomass from different natural habitats.
3. To study the bacterial ecology of fresh water environment.
4. To study the microbial diversity of soil.
5. To study the fungal diversity in soil and forest litter.
6. To study the microbial ecology of the rhizosphere and determination of rhospheric effect.
7. To study the microbial ecology of the phylosphere.
8. To study the methods of obtaining axenic culture of microorganisms from different natural habitats.
9. To study the methods of long and short term preservation of bacterial, fungal and actinomycetous culture.
10. To isolate mycophages from natural environment.
11. To isolate the culturable microbial endophytes from different plant species.
12. To study the effect of various salt concentrations on bacterial, actinomycetes and fungal growth.
13. To study the effect of various concentrations of dyes on bacterial, actinomycetes and fungal growth.
14. To study the effect of osmotic pressure on bacterial, actinomycetes and fungal growth.
15. To study of growth forms of lichens (crustose, foliose, fruticose) on different substrata. Study of thallus and reproductive structures (soredia, apothecium) through permanent slides.
16. To study the lethal effects of temperature on bacterial and fungal growth (Thermal Death Point, TDP)
17. To study the lethal effects of temperature on bacterial and fungal growth (Thermal Death Time, TDT)
18. To study the effect of different pH on bacterial and fungal growth.
MMI 4102: PATHOGENESIS OF INFECTIOUS DISEASES

Objectives: The course contents are designed to understand the disease process associated with various group of microorganisms collectively based on signs and symptomatology.

UNIT-I

- General principles of infectious diseases.
- **Entry of microorganisms into the body:** Role of host receptors and bacterial virulence traits. Organisms gaining entrance through skin, respiratory tract, intestinal tract, pharynx, urogenital tract, conjunctiva, interference by normal flora and exit of organisms from the body.
- Events occurring immediately after the entry of the microorganisms in host in relation to establishment of infections. Growth in epithelial cells spread of intracellular organisms & tissue tropism etc.

UNIT-II

- The encounter of the microbe with the phagocytes and cells of RE system of the body. Neutrophil kinetics, phagocytosis by phagocytic cells, microbial defenses/strategies in relation to phagocytosis, consequences of functional defects of phagocytic cells on pathogenesis and evaluation of phagocytic functions.
- **Immune responses to infections:** Mechanisms of lymphocyte activation, role of lymphokines and related factors in induction of humoral and cell mediated immune responses.

UNIT-III

- **The spread of microbes through the body:** direct and indirect spread, microbial factor promoting spread, spread via lymphatic, blood and via other pathways.
- **Recovery from infection:** Role of specific (immunological) and non-specific factors in (physical and physiological factors- complement, interferon, acute phase proteins, temperatures) in recovery, tissue repairs wound healing and resistance to reinfection.
- **Failure to eliminate microbes.** Various aspects of latency with and without shedding of infectious agents.

UNIT-IV

- **Microbial strategies in relation to immune responses:** Immune tolerance immune suppression, molecular mimicry, induction of ineffective antibodies antibody mopping, antigenic variation, avoidance of immune responses and interference to immune response induction.
• **Mechanisms of tissue injury in relation to bacterial infection:** infection with no cell or tissue damages, direct damage by micro-organisms, microbial toxins, extracellular enzymes, indirect damage via inflammation, immune responses and diarrheal etiologies.

• **Susceptibility and resistance:** Role of hosts and microbial genetic factors, hormonal and emotional stresses on host microbes’ interactions, environmental factors.

**BOOKS FOR READING**

6. Virulence mechanisms of bacterial pathogens edited by Brogdm KA, Roth JA, Stawton TB,
7. Bolin CA, Minion FC, & Wannemuehler, ASM Press Washington DC
8. Clinical Immunology By Catherine Sheelan Publisher: Lippincot NY

Apart from above books, further reading should be done from Journals & reviews like

1. Journal of Medical Microbiology
2. Journal of Infectious diseases
3. Infection and Immunity
4. Visit on line internet sites for advancements in the field of pathogenesis of various Infectious diseases.

**LIST OF PRACTICALS:**

• **Experiments on virulence traits of pathogens**

  1. Determination of hemolysin production
     • Determination of cytolytic activity
     • Quantification of hemolysin
  2. Cell surface hydrophobicity
  3. Hemagglutination
  4. Siderophore Production
  5. Adhesins; Bacterial Uroepithelial Cells (UECs) Adherence Assay
  6. Acid tolerance response
7. Non specific resistance: bactericidal activity of lysozyme and serum; Death kinetics of test strains; determination of serum bactericidal activity

- **Isolation and characterization of pathogens and non-pathogens**

8. Study of micro flora of skin
10. Isolation and differentiation of *Strep* species associated with dental carry and dental plaque.
11. Principles of laboratory diagnosis; Isolation and characterization of pathogens from sore throat and stool sample.
12. Identification of given unknown culture (encountered frequently in clinical specimens)
MMI 4103: NEWER APPROACHES IN DIAGNOSTIC MICROBIOLOGY

UNIT I

Enzyme Immunoassays:

UNIT II

Molecular methods in clinical microbiology:
Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology.

Laboratory tests in chemotherapy:

UNIT III

Mechanised and automated methods in clinical Microbiology for microbial identification:- Manual biochemical system, Mechanised automated systems, Immunological methods, Substrate profile systems.

Serological techniques & Immuno-mapping:- Agglutination, Counter Current Immuno Electrophoresis, Dot Blot Assay, Western Blot, Radioimmunoassay, Idiotypic Network (Classification, internal imaging and applications).

Chromatographic techniques: Size exclusion chromatography, ion exchange chromatography, affinity chromatography, GLC, HPLC.

UNIT IV

Cytodiagnostic techniques:- Flowcytometry and cell sorting, Immuno florescence, Electron Microscopy (Types of Electron Microscopy, concepts and operations with applications).

Transgenic animals:- Development, applications

Research methodology:- Planning, execution, analysis, paper writing and thesis writing.
**Ethics in Research:**-Ethical issues pertaining to animal study, handling and disposal of radioactive waste and pathogenic micro-organisms.

**Books for Reading**


**LIST OF PRACTICALS:**

1. Thin Layer Chromatography
2. Paper chromatography
3. Molecular sieve chromatography
4. Polyacrylamide gel electrophoresis
5. Extraction of Outer Membrane Proteins and the estimation of Protein content.
6. Enzyme Linked Immunosorbent Assay
7. Dot Blotting
8. Visit to CIL for Electron Microscopy and High Pressure Liquid Chromatography
9. Visit to PGI for demonstration of Flow Cytometry
SECOND SEMESTER

MMI 4201: FERMENTATION TECHNOLOGY

Objective: This course aims to provide fundamentals of fermentation technology and microbial process development for the production and recovery of various value-added products including the industrial chemicals, whole cells, bio-fuels, metabolites for use in food and medical industry.

UNIT-I

Microbial Process Development: Microbial types & technology; Process development strategies, Metabolic pathways for the biosynthesis of primary and secondary metabolites-nature of metabolic pathways, Trophophase-Idiophase relationship in production of secondary products, Role of secondary metabolites in the physiology of organisms producing them, Over production of microbial metabolites.

Types of Fermentations: Batch, continuous & fed batch fermentation.

Growth Kinetics: Growth curve, Algebra of microbial growth, kinetic model of growth, Scale up principle and different methods of scaling up.

Down stream Processing: Separation of cells & insoluble products, cell disruption, separation of soluble products, Purification techniques, product polishing.

UNIT-II

Fermenter Configurations:

Design of Fermenters: components of fermenter, body construction, sealing, baffles, aeration system (sparger), exit gas cooler, agitation, stirrer glands & bearings, valves & steam traps,

Types of Fermenters: i) Submerged fermenter systems: stirred tank fermenter, air lift fermenter, fluidised bed bioreactor, packed bed bioreactor, bubble column fermenter; ii) Solid-State Fermenter Systems: Laboratory and Industrial Scale SSF Fermenter.

Control & Monitoring of Fermentation system: temperature monitoring & controlling, gas flow rate & controlling, Liquid flow & controlling, pressure measuring & controlling, agitation measuring & controlling, foam sensing & controlling, dissolved oxygen monitoring, pH monitoring, PID (Proportional-Integral-Derivative Controller) control system.

UNIT-III

Alcohol-Based Fermentation Industries: Production of Beer, Wines, Spirits & Vinegar.
Production of Metabolites as bulk Chemicals or as inputs in other Processes:

*Production of organic acids & Industrial Alcohol*—Production of lactic acid, propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, ethanol butanol, hydrogen, microbial electricity, starch conversion processes. *Production of amino acids*—Production of Glutamic acid, etc; *Production of Biocatalysts*—Immobilized enzymes & cells.

**Production of Whole Cells for Food related purposes:** Single cell Proteins, Production of Yeasts (food, feed, alcohol yeasts & Yeast products), Microbial insecticides, *Rhizobium* Inoculants, Fermented foods from wheat, corn, milk, vegetables, derived from legumes & oil seeds.

**UNIT-IV**

**Production of Commodities of Pharmacological Importance:** *Production of antibiotics*—Beta-Lactam antibiotics, search for new antibiotics, antitumor antibiotics; *Ergot alkaloids*; Steroids—Types and fermentation conditions of microbial transformations in steroids & sterols, *Vaccines*—virus vaccines, bacterial toxoids, killed bacterial vaccines.

**Drug discovery in microbial metabolites:** Search for microbial products with bioactive properties: Conventional & newer methods of drug discovery.

**BOOKS FOR READING**

**a) Essential**

4. Industrial Microbiology by Casida.
5. Industrial Microbiology by Prescott.
b) Further readings

2. Microbial Biotechnology-Fundamentals of applied Microbiology by A.N. Glazer
   and H. Nikaido. W.H Freeman and company.

LIST OF PRACTICALS:

1. To study the effect of substrate concentration (Glucose) on growth of E. coli
   cells, and to estimate Monod’s kinetic parameters.
2. To demonstrate different phases of a batch culture to estimate the Monod’s
   parameters, growth yield and productivity of E. coli.
3. To immobilize E. Coli cells in calcium alginate.
4. To immobilize conidia of Aspergillus niger in sodium alginate.
5. To study the alcoholic fermentation.
6. To produce the wine from grapes etc.
7. To produce the fungal & bacterial exopolysaccharides.
8. To perform the surface and solid fermentation.
9. To perform the primary and secondary screening of microbial enzymes.
10. To perform the primary and secondary screening of penicillin.
11. To perform the screening and production of alkaloids.
12. To perform the screening and production of saponins.
13. To study the instrumentation & working of laboratory fermenters.
14. To study the process of fed batch fermentation.
15. Isolation of fermentative yeasts from natural biodiversity.
16. Evaluation of fermentability range of yeasts with respect to pentoses and
    hexoses.
17. Production of cellulases, xylanases, mannanases and pectinases by solid and
    liquid state fermentations.
18. Scale-up studies on the production of industrially important enzymes by solid
    as well as submerged state fermentations.
19. Determination of pH versus activity and temperature versus activity profiles of
    suitable industrially important enzymes.
20. Bioconversion of a corn grain, a typical starchy biomass residue into
    fermentable sugar formation, conversion efficiencies and yields.
21. Fermentation of sugars released from hydrolysis of corn biomass into ethanol
    and study of fermentation kinetics including the rate of sugar utilization, rate
    of ethanol production, rate of yeast multiplication and determination of
    fermentation efficiency and product yield.
**Objectives:** To apprise the students with advanced techniques and applications of Molecular Biology and recombinant DNA Technology. This course will help the students in further research in this area.

**UNIT-I**

**Molecular genetics:** signal transduction and expression of genes including environmentally regulated genes; molecular basis of pathogenesis; Regulation of gene expression in prokaryotes and eukaryotes, Promoters, enhancers, methylation, acetylation.

**UNIT-II**

**Structural and functional genomics:** Proteomics, Plasmid stability and incompatibility; codon preferences, transposons; transposition, gene rearrangement, homologous recombination.

**UNIT-III**

**Molecular biological techniques:** PFGE, DNA microarray, antisense RNA, RNAi and microRNA, protein engineering, phage display, DNA sequencing, Ribozymes, Stem cell technology. DNA footprinting and oligonucleotide mediated site directed mutagenesis; use of computer programs in data analysis and interpretation;

**UNIT-IV**

**Application of molecular biology in Biotechnology:**

a. **Industry:** e.g. protein engineering; enzyme and polysaccharide synthesis, activity and secretions, alcohol and antibiotic formation.

b. **Agriculture:** e.g. N\textsubscript{2} fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of livestock.

c. **Environments:** e.g. chlorinated and non-chlorinated organ pollutant degradation; degradation of hydrocarbons and agricultural wastes, stress management, development of biodegradable polymers such as PHB.

d. **Forensic science:** e.g. solving violent crimes such as murder and rape; solving claims of paternity and theft etc. using various methods of DNA fingerprinting.

e. **Health:** e.g. development of non-toxic therapeutic agents, recombinant live vaccines, gene therapy, diagnostics, monoclonal in E.coli, human genome project.

**BOOKS FOR READING**


**Apart from above many other books, journal and reviews can be consulted such as:**

1. Various volumes of methods in Enzymology
2. Annual Reviews of Molecular Biology, Biochemistry, Genetics, and Microbiology, Microbiological reviews, Trends in Biotechnology.

Students are also advised to be online(various internet sites) for genomics/proteomics and other advancements in the field of Molecular Biology, Biotechnology.

**LIST OF PRACTICALS:**

1. To isolate and purify plasmid DNA
2. To isolate and purify chromosomal DNA
3. To perform the restriction digestion of plasmid DNA.
4. To perform the partial digestion of genomic DNA.
5. To perform the alkaline phosphatase treatment of plasmid DNA.
6. To perform the elution of DNA from agarose gel by various methods:
   a) Guanidium HCl method
   b) Electroelution method
   c) LMP (Low Melting Point) agarose method
   d) Commercial Kit method
7. To perform the ligation of partially digested genomic and plasmid DNA
8. To perform the transformation using electroporation
9. Screening of library
10. To perform nucleotide sequence analysis using various bioinformatic tools.
11. To perform PCR.
**Objectives:** To give insight into therapeutic and prophylactic measures of various human and animal diseases.

**UNIT-I**

Disease amenable to control by vaccination, rationale of immunization, controlled studies of vaccines, hazards of immunization, vaccination schedules.

Vaccines produced by conventional means to control major infectious disease: man and animals. Immune responses to vaccination.

**UNIT-II**

Bird flu vaccine, Yellow fever vaccine, Hib vaccine, Pneumococcal vaccine DNA vaccine, Edible Vaccine, Viral Vectored vaccine, Bacterial Vectored vaccine, Rabies Vaccine, Salmonella Vaccine, BCG Vaccine, Malarial Vaccine, Cholera Vaccine, DPT Vaccine, Hepatitis vaccine, Polio vaccine, MMR vaccine, Combinational Vaccine/Super vaccine, Anthrax vaccine.

**UNIT-III**

The development of biosynthesised vaccines. Infectious recombinant vectored virus vaccines. Modern approaches to live virus vaccines, live bacterial vaccines and their application against tumor antigens immune modifiers in vaccines.

AIDS : HIV testing: product development strategies, approaches to HIV, vaccine design.

Idiotype vaccines and immune toxins

**UNIT-IV**

Plant expression systems for the production of vaccines.

Recombinant DNA vaccines.

Adjuvants & their future development.

Contraceptive vaccine development: future prospects.

Commercial & regulatory aspects of vaccines production and distribution.

**BOOKS FOR READING**

LIST OF PRACTICALS:

1. Preparation of killed Vaccines and monitoring of its purity
2. Immunization of animal with killed vaccine. Assessment of antibody level by IHA/ELISA
3. Capsule as the subunit vaccine: its preparation and quantification.
4. Immunization of animals with capsular vaccine using Freund’s Complete Adjuvant and incomplete adjuvant as an adjuvant.
5. Outer cell membrane as the subunit vaccine: its preparation, quantification and monitoring its purity by SDSPAGE electrophoresis followed by immunization.
M.Sc (H.S.) 2nd Year in MICROBIOLOGY
THIRD SEMESTER

MMI 5301: FUNDAMENTALS OF COMPUTER PROGRAMMING & APPLICATIONS

Objective: The course provided basic introduction to computers, word processing tools, computing languages and computer programming operations.

UNIT-I

Introduction to computers: Block Diagram of a computer; Description of each block in detail; concept of input-output devices; Types of input-output devices; Concept of Memory: Types of Memory; Concept of Central processing Unit (CPU), Control Unit (CU), and Arithmetic Logic Unit (ALU).

Flowcharts and Algorithms: Algorithms-their use; Flowcharts; various slide boxes and symbols; examples.

Introduction to word processing spread sheets and slide presentation packages. Introduction to Bioinformatics.

UNIT-II

Introduction to C Language: C character set; Constants, variables, key words; Types of C Constants; Rules for constructing Integer Constants; Rules for constructing Real Constants; Rules for constructing Character Constants; Types of C variables; Rules for constructing variable Names: C keywords; C instruction classification; Type declaration instruction; Arithmetic; instruction; Integer and float conversion; Type conversion in assignments; Hierarchy operation; Basic C programme.

If Statement: The if statement; its syntax; Multiple statements within if, if-else statement; its syntax; Nested if else statement; its syntax; forms of If; Programs related to if, if-else statement.

Decision Control Structure; Conditional operator : Use of Logical operators; Conditional operators; its syntax; Nested conditional operator; Programs related to conditional operator

UNIT-III

While, D-While Loop: The while Loop; its syntax; Tips and traps More operators; Nesting of while loops; do-while statement; its syntax; Nesting of do-while loops; Difference between while and do-while; programs with the use of while, do-while loops.

For Loop: The for loop; its syntax; Nesting of for loops; Tips and traps: difference between while, do-while and for loops; Programs with the use of for loops.
The Case Control Structure: Case-switch statement; Decision using switch statement; syntax; break statement; syntax; Programs with the use of case-switch, break statement.

UNIT-IV

Functions: What is a function; Why use functions; Passing values between functions; Scope Rule of functions; Advanced Features of functions; Function declaration and prototypes; Call by value and call by reference. Programs with the use of functions.

Arrays: Array Definition and Syntax; Program related to arrays; array declaration; Accessing elements of array; entering data into an array; Reading data from an array; array initialization; array elements in memory. Two Dimensional Array. Programs with the use of Arrays.

Structures & Unions, their use:- Introduction to file handling. Reading and writing text as well as binary files.

BOOKS FOR READING

4. A simplified Text-cum-workbook on Application programming in C by R.S. Salaria, Khanna Booka Publishing Co. (P) Ltd.
7. Let Us C: Yashavant Kanetkar

MMI 5302: ADVANCED TOPICS IN MICROBIOLOGY-I

The students will be assigned various advanced topics in Microbiology and will be asked to deliver seminars on these.

MMI 5303: ADVANCED TOPICS IN MICROBIOLOGY-II

The students will be examined through a written test covering various advanced topics on which the students delivered seminars as part of MMI 5302
The students will be sent on 4-6 weeks summer training in various research institutes/industries for on the spot training and will be asked to submit a project report after the training which will be evaluated after making a presentation on the same.
FOURTH SEMESTER

MMI 5401: THESIS

The students will submit a thesis after undertaking a research which will start during the IIIrd semester under the supervision of faculty members.

MMI 5402: VIVA VOCE

The students will be evaluated for their research work on the basis of an oral examination by an external examiner.

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