

PANJAB UNIVERSITY CHANDIGARH- 160 014 (INDIA)

(Estd. under the Panjab University Act VII of 1947-enacted by the Govt. of India)



FACULTY OF SCIENCE

SYLLABI

FOR

**B.Sc. (HONOUR SCHOOL) MICROBIOLOGY
1ST TO 6TH SEMESTER**

AND

**M.Sc. (HONOUR SCHOOL) MICROBIOLOGY
1ST TO 4TH 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

Semester	Course No.	Course	Credits	Marks
B.Sc (H.S.) 1st year (Major)				
1st semester	BMI 1101	Introduction to General Microbiology & Bacterial Systematics	6	150
	BMI 1151	Practical	2	50
2nd semester	BMI 1201	Introduction to Applied Microbiology & Pathology	6	150
	BMI 1251	Practical	2	50

<u>Subsidiary courses for B.Sc (HS) 1st year in Microbiology</u>		Credits	Marks
English		8	200
Physics		8	200
Chemistry		8	200
Mathematics		8	200
		Total Credits = 48	
		Total Marks =	1200

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

<u>Subsidiary courses for B.Sc (HS) 2nd year in Microbiology</u>		Credits	Marks
Biophysics		8	200
Biochemistry		8	200
Statistics		8	200
		Total Credits = 48	
		Total Marks =	1200

B.Sc (H.S.) 2nd year (Subsidiary) for Biochemistry & Biophysics students				
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

B.Sc (H.S.) 3rd year				
5th semester	BMI 3501	Medical Bacteriology – I	4	100
	BMI 3502	Microbial & Molecular Genetics	4	100
	BMI 3503	Food Microbiology	4	100
	BMI 3504	Immunochemistry	4	100
	BMI 3551	Practical (Combined)	4	100
6th semester	BMI 3601	Medical Bacteriology – II	4	100
	BMI 3602	Virology	4	100
	BMI 3603	Microbial Physiology & Metabolism	4	100
	BMI 3604	Immunopathology	4	100
	BMI 3651	Practical (Combined)	4	100

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:

Population growth and family welfare programme, Human Health. HIV-AIDS. Human Rights.

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.
4. Traffic Rules & Traffic Signs.
5. How to obtain Driving License.
6. Traffic Offences, Penalties and Procedures.
7. Common Driving mistakes.
8. Significance of First-aid in Road Safety.
9. Role of Civil Society in Road Safety.
10. Traffic Police-Public Relationship.

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

1. The Motor Vehicle Act, 1988 (2010), Universal Law Publishing Co. Pvt. Ltd., New Delhi.
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 Conjuror'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

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**.

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:

1. *Business Communication*, Ed. Om. P. Juneja & Aarti Mujumdar, Hyderabad: Orient Blackswan, 2010.
2. *Textbook of Business Communication*, Anjali Kalkasr, R.B. Suryawanshi, Amlanjyoti Sengupta, Hyderabad: Orient Blackswan, 2010.

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.

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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:

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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.**
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SYLLABI AND 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.

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.

Microscopy and observation of microbes: Light microscopy: bright field microscope, dark field microscope, phase contrast microscope, fluorescence microscope. Electron microscopy: The transmission electron microscope, Scanning electron microscope.

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.

Viruses: Origin & evaluation of viruses, viruses of bacteria, plants and insects, virus host cell interactions, quantification and replication of viruses. Classification of animal viruses.

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

1. Microbiology by Prescott, Harley and Klein 7th Edition, WCB Publishers (2007).
2. Microbiology by Pelczar. MJ; Chan ECS and Kreig NR, 5th Edition, Mcgraw Hill.Inc 2007.

3. Text book of Microbiology (8th Edition) by R. Ananthanarayan & C. K. Panikar, Publisher: Orient Longman Limited (2010)
4. Microbiology by Jacquelyn G. Balck, 7th Edition, John Wiley and Sons, Inc (2008)
5. Microbiology General Microbiology by Stanier, Ingraham, Wheelish and Painter, Macmillan Edu. Ltd (1987).
6. Review of Medical microbiology by Jawetz, Melnick and Adelberg. Lange Medical publications 26th Edn (2013).
7. Molecular biology & Genetic Engineering 2005 by P.K. Gupta. Rastogi Publications.
8. Bergey's Manual of Systematic Bacteriology. 9th Edn. Lippincott Williams, Wilkin Bacteriology, Vol. I, II, III (1994).
9. Brock Biology of Microorganisms by Madigan, Martinko and Parker Prentice Hall International Inc. 13th Edition, 2011.

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.

Introduction to Pathology (Part-I):- History, development, and its relevance in relation to study of homeostasis, febrile reaction, intra and extra cellular environment of cells and factors affecting the constancy of environment, Degenerations: cloudy swelling, fatty acid degeneration, glycogen infiltration, hyaline degeneration and amyloidosis. Odema and its pathogenesis. Necrosis: Its pathogenesis and role of ischaemia in necrosis.

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

Introduction to Pathology (Part-II): Inflammations: acute and chronic inflammatory reactions, pathogenesis, morphological varieties of inflammation.

Regeneration and repair, types of wounds healing and the mechanism involved.

Factors affecting wounds healing allergic.

Thrombosis and embolism. Shock and haemorrhage

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

1. Microbiology an introduction 6th Edn. Tortora, Funke & Case. Publisher. Benzamin Cummings publishing Co. Inc. NY.
2. Review of Medical microbiology by Jawetz, Melnick and Adelberg. Lange Medical Publications.
3. Brock Biology of Microorganisms by Madigan, Martinko and Parker. Prentice Hall International Inc.
4. Microbiology by Prescott, Harley and Klein. WCB Wm C Brown Publishers
5. Current Medical Diagnosis and Treatment – M.A. Krupp & M.J. Chatton
6. Textbook of Pathology by Harsh Mohan. J.P. publishers, New Delhi India. 6th Edition
7. Textbook of Histology by William B Loom and Don W Fawcett.
8. A text book of Microbiology by Dubey R.C. & Maheshwari D.K 2005. S. Chand & Co. Ltd., New Delhi
9. Bergey's Manual of Determinative Bacteriology 9th Edn. By JG Holt, NR Krieg, PHA Sneath, JT Staley & ST Williams Publisher Lippin Colt Williams & Walkins.
10. Fundamental of Microbiology IE Alcamo, Publisher. An imprint of Addison Wesley Longman Inc.
11. Guyton – Text book of Medical Physiology, 12th Edition.

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
9. Sterility test for milk.
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. 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 phycoviruses (mainly Cyanophages), environmental impact of phycoviruses

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
2. Terrestrial Photosynthesis in a Changing Environment: A Molecular, Physiological, and Ecological Approach by Jaume Flexas, Francesco Loreto, Hipolito, Medrano. Cambridge University Press, 2012.
3. Phycology, Fourth edition, by Robert Edward Lee, Cambridge University Press, 2008
4. Algae: Anatomy, Biochemistry, and Biotechnology, Second edition, by Laura Barsanti, Paolo Gualtieri, CRC Press, 2014
5. Algae, by Linda E. Graham, Lee W. Wilcox , Cambridge University Press, 2004
6. Microalgae: Biotechnology and Microbiology by E. W. Becker, Cambridge University Press, 2008
7. Freshwater Algae of North America: Ecology and Classification (Aquatic), by John D. Wehr , Robert G. Sheath, James H. Thorp, Academic Press, 2003
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

Protozoology: Brief history of protozoology, 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 gondi*,
- (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

1. Chatterjee, K.D. (2009) Parasitology, 13th edition , Chatterjee Medical publishers India.
2. Arora, D.R. and Arora B (2004) Medical Parasitology, 2nd edition, CBS Publishers, New Delhi,
3. Cox, F.E.G (1993) Modern Parasitology, 2nd edition, Blackwell Scientific Publications, London.
4. Paniker, J (2007) Text book of Medical Parasitology, 6th edition, Jaypee Brothers Medical Publishers, New Delhi.
5. Sehgal, R. (2003) Practical and viva in Medical Parasitology, 1st edition, Elsevier Publishers, India.

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 SO₄, 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

1. Environmental Microbiology, Second Edition, by Ralph, Ji Doug Gu, Wiley Blackwell, 2009.
2. Environmental Microbiology by Ian Papper and Charles Gerba, Elsevir 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
7. Environmental Microbiology by Rose Vol. III-V, 1999
8. Practical Microbiology, third edition, by R.C. Dubey ,D.K.Maheshwari, S.Chand Publishers, 2012.

JOURNALS

1. Journal of Environmental Management.
2. Applied and Environmental Microbiology.
3. Journal of Bioremediation & Biodegradation.
4. Biodegradation.
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.
8. Demonstration of biological sewage treatment.
9. Estimation of dissolved oxygen of water.
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.
13. Determination of chlorine in 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 & teliospores; Sexual reproduction planogametic 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

1. Fundamental Medical Mycology by Errol Reiss, H. Jean Shadomy, G. Marshall Lyon, Publisher: Wiley-Blackwell 2011
2. 21st Century Guidebook to Fungi author: Moore, David, Robson Geoff, Trinci Tony, Publisher: Cambridge University Press 2011.
3. Clinical Mycology, Second edition by Michael R. McGinnis, Michael A. Pfaller, Publisher: Churchill Livingstone 2009.
4. Introduction to Fungi Author: Second edition by Webster, John, Weber, Roland W. 2007.
5. Introductory mycology, 4th edition by Alexopoulos, C.J., Mims, C.W., Blackwell, M. New York, Wiley-Liss, 2005.
6. Fungi: Biology and Applications by Kevin Kavanagh, Jhon Wiley, 2005.
7. Mushrooms: Cultivation, nutritional value, medicinal effect and environmental impact, Second Edition by Shu-Ting Chang, Philip G Miles, CRC Press, 2004.
8. Microbiology by Pelczar, M.J., Chan, E.C.S., Krieg, N.R. Publisher: Tata McGraw-Hill, 2008.
9. Fungal Associations by B Hock, Springer Verlag, 2001.

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

1. Modern Industrial Microbiology and Biotechnology by Nduka Okafor. Published by Science Publishers, Enfield, NH, USA , 2007.
2. Practical Fermentation Technology Edited by Brian McNeil and Linda M. Harvey, John Wiley & Sons, Ltd. ISBN: 978-0-470-01434-9, 2008.
3. Industrial Microbiology: An Introduction by Michael J. Waites, Neil L. Morgan, John S. Rockey & Gary Higton, 2001.
4. Modern Industrial Microbiology and Biotechnology by Nduka Okafor. Published (16) 14 by Science Publishers, Enfield, NH, USA, 2007.
5. Stanbury P.F., and Whitaker A., Principles of Fermentation Technology, Pergamon Press, 1984.
6. Biotechnology: A textbook of industrial microbiology. Crueger, W. Crueger, SCIENCE TECH, INC., MADISON, WI (USA). 1984.
7. Industrial Microbiology-Prescott & Dunn, Comprehensive Biotechnology. Vol. I, III Ed.-Moo Young. Industria, 2004.

8. Industrial biotransformation by Lieshe, Seelbach & Wandrey, Wiley VCH publications
9. Methods in industrial microbiology. Sikyta, BELLIS HORWOOD, CHICHESTER (UK). 1983.
10. Industrial microbiology: An introduction By Michael J. Waites, Neil L. Morgan, Gary John S. Rockey Edition: 3, illustrated Published by Blackwell Science, 2001.

b) Further Readings

1. Biotechnology of antibiotics By W. R. Strohl Edition: 2, illustrated Published by Informa Health Care, 1997.
2. Applications of Microbiology- J. Riviere
3. Zubay G., Biochemistry, Macmillan Publishers, 1989.
4. Basic Biotechnology, 2nd Ed. Colin Ratledge and Bjorn Kristiansen. Cambridge University Press, UK, 2001.
5. Wang.D.I.C Cooney C.L., Demain A.L., Dunnill.P. Humphrey A.E. Lilly M.D. Fermentation and Enzyme Technology, John Wiley and sons 1980.

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.

Plant-microbe Interactions: Interaction with plant roots, interaction with aerial plant parts. Microbial diseases of plant.

UNIT-III

Nitrogen fixation: Biochemistry of N_2 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 N_2 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

1. Environmental Microbiology by Ian Papper and Charles Gerba Elsevir Press. 3rd edition, 2014..
2. Environmental microbiology by A.H. Varnam and M. Evans Blackwill Publisher 2000.
3. Environmental Microbiology, Rose, Vol. I, II, III, 1995
4. Soil Microbiology by Martin Alexander, 2nd Edition, 2011
5. Soil Microbiology by Waksman, 2011.
6. Soil Biochemistry, Vol. I,II by Paul, Meclaren Vol. I, 1995
7. Microbial Communities, Insam, H, Rangger, A, 1997
8. Methods in Soil Biology by Schinner, F., 2005.
9. Soil Microbiology by Robert, L. Tate, John Wiley & Son. 2nd edition, 2000.
10. Soil Microbiology, Ecology and Biochemistry by Eldor A. Paul. 4th Edition 2014.
11. Methods in Applied Soil Microbiology and Biochemistry by Alef Kassem et.al., 2013.

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 diazotophores (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: INTRODUCTICION 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.

Microbial Growth: Measurement of microbial growth, Growth kinetics, Growth cycle of the macromolecular synthesis & cellular differentiation Effect of environmental factors on microbial growth-temperature, moisture, salts, pH, oxidation reduction & radiation.

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

1. Microbiology by Prescott, Harley and Klein. 7th Edition, WCB Publishers (2007).
2. Microbiology by Pelczar. MJ; Chan ECS and Kreig NR. 5th Edition, Mcgraw Hill.Inc. 2007.
3. Bergey's Manual of determinative Bacteriology 9th Edn. Lippincott Williams, Wilkin Bacteriology, Vol. I.
4. Textbook of Microbiology (8th Edition) by R. Ananthanarayan & C.K. Panikar, Publisher: Orient Longman Limited (2010).
5. Dairy Microbiology by K.C. Mahanta, Omsons Publications, New Delhi. 2nd Edition (1984).
6. Industrial Microbiology (4th Edition) by Prescott & Dunn (Editor: Gerald Reed), CBS Publishers, Delhi (2004).
7. Microbiology : A Laboratory Manual (7th Edition) by James Cappuccino, Natalie Sherman, Publisher: Benjamin Cummings (10th Edition, 2013).
8. Microbiology by Jacquelyn G. Black, 7th Edition. John Wiley and Sons, Inc (2008)

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 (Enteroviruses, Rhinoviruses, Rubella, Measles, Mumps, Rabies, Influenza, Rota, Herpes, Small Pox, Hepatitis, Adenovirus, HIV).

UNIT-III

Microbiology of soil, physical characteristics, microbial flora, Bio-geochemical activities of microorganisms, 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

Industrial microbiology: genetic engineering of microorganism, industrial fermentations, submerged, surface, batch wise and continuous. Industrial production of amino acids, lactic acid and acetic acid. Industrial yeast and its uses, alcohol fermentation and alcoholic beverages. Enzyme production and immobilized enzyme technology. Antibiotics and their uses, microorganisms producing antibiotics, industrial production of penicillin.

LIST OF PRACTICALS:

1. To study the microflora of air

2. Isolation of bacteria from soil a) Saccharolytic 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.
9. Antibiotic sensitivity test.
10. To study the microflora of soil/water by buried slide technique

BOOKS FOR READING

1. Microbiology by Pelczar, M.J.C, E.C.S., Krieg, N.R, Publisher: Tata McGraw-Hill, 2008.
2. Practical Microbiology, third edition, by R.C. Dubey, D.K. Maheshwari, S. Chand Publishers, 2012
3. Review of Medical Microbiology- Jawetz. And Meinick.
4. General Microbiology- Stanier, Ingraham, Wheelish and Painter, Macmillan Edu. Ltd

B.Sc (H.S.) 3rd year in MICROBIOLOGY
FIFTH SEMESTER

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. grippityphosa*, *L. canicola*),
 - c) Lyme disease (*Borrelia burgdorferi*), recurrent fever (*Borrelia recurrentis*),
 - d) cat scratch disease (*Bartonella henselae*)

BOOKS FOR READING

1. Topley & Wilson's: Principles of Bacteriology, Virology and Immunology, 8th Edition.
2. Medical Microbiology by Murray PR, Rosenthal KS, Kobayashi GS and Pfaller MA. Mosby Inc. St. Louis Missouri. 2014.
3. Bacterial Pathogenesis; A Molecular Approach by Slayers AA and Whitt DD, ASM Press Washington DC.
4. Medical Microbiology by Greenwood D, Slack RCB and Peutherer. Churchill Livingstone publication
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
11. Review of Medical Microbiology by Jawetz, Melnick and Adelberg. Lange Medical Publications.

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
 5. Characterization of unknown bacteria using metabolic activities of microbes.
 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, *Plesiomonas shigelloides*, *Flavobacterium*
 - g. *Achromobacter*, *Acinetobacter* species
 - h. *Moraxella*, *Alkaligenes feacalis*
 - 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 advanced courses.

UNIT-I

Nature of genetic material, genetic code, transformation, transduction conjugation, plasmid biology, Transposable elements, Molecular and biochemical aspects of gene regulation – promoter, enhancers.

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

1. Allis, D. Epigenetics. (2002). 1st Edition. CSH Lab. Press, New York, USA.
2. Benjamin, L. (2008). Genes IX. 2nd Edition. John Wiley and Sons, NY
3. Glick, B. R. and Pasternak, J. J. (1998). Molecular Biotechnology. 2nd Edition. ASM Press, Washington, D.C.
4. Glover, D. M. and Hames, B. D. (ed.) (1995). DNA cloning: A practical Approach. Vol. I – IV. I.R.L. Press, Oxford.
5. Lodge, J., Lund, P. & Minchin, S. (2007). Gene Cloning. Taylor & Francis Publishers.
6. Primorse, S. B., Twyman, R. M. and Old, R. W. (2009). Principles of Gene Manipulation & Genomics. 8th Edition. Blackwell Science, Oxford.
7. Puhler, A. L. and Timmis, K. B. (1984). Advanced Molecular Genetics. Springer-Verlag Berlin Heidelberg.
8. Reece, R. J. (2005). Analysis Genes & Genomes. John Wiley & Sons.

9. Sambrook, J. and Russel, D. W. (2001). Molecular Cloning: A Laboratory manual. 3rd Edition. Cold Spring Harbor Laboratory Press, Cold Spring Harbour, New York, U.S.A.
10. Watson, J.D. (2004). Molecular Biology of the Gene. 5th Edition. Benjamin Cummings, San Francisco, CA.
11. Watson, J.D. and Gilman, M. (1992). Recombinant DNA. 2nd Edition. Scientific American Books, W.H. Freeman Company, New York.
12. Winnacker, E. L. (1988). From Genes to Clones: Introduction to gene technology. Springer-Verlag Heidelberg.
13. Wu, R. (ed.) (1979). Methods in Enzymology: Recombinant DNA. Vol. 68. Academic Press, New York.

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

1. Food Microbiology: Fundamentals and Frontiers by Michael P. Doyle Larry R. Beuchat, ASM Press, 2007

2. Food Microbiology by William C. Frazier, Dennis C. Westhoff, Tata McGraw Hill Publishing Co. Ltd. 2007
3. Modern Food Microbiology, 7th edn. J.M. Jay, M.J. Loessner and D.A. Golden/ Springer, Printed by Rashtrya Printers Delhi.
4. Food Microbiology by Adams, M.R. and Moss, M.O., New Age International (P) Ltd, Publishers. 2006
5. Food Science by Srilakshmi, New Age International Publishers, 2006
6. Food Microbiology By M. R. Adams 1st Edition, 1995.
7. Fundamentals Food Microbiology, 4e Ray 2011
8. Laboratory Methods in Food Microbiology Harrigan F.W 3rd edition, 2013
9. Microbiological analysis of food and water: guidelines for quality assurance By N.F Lightfoot. 2012
10. Applied Dairy Microbiology, 2nd Edition, Revised & Expanded (HB) By Marth, 2005.
11. Food Bio-deterioration And Preservation Tucker S. Gary 2013

b) Further readings

1. Food Chemistry by H.-D. Belitz, W. Grosch, P. Schieberle and M.M. Burghagen, Springer Verlag, 2007.
2. Food Microbiology : Fundamentals and Frontiers 2013. Food microbiology By Neelam Khetarpaul 2009.
3. Food Microbiology Protocols (HB) Doyle M. P Spencer 2007.
4. Applied Dairy and Food Microbiology Rameshwar Singh, S.K. Tomar & Gunjan Goel 2005.

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.

BMI 3504: IMMUNO CHEMISTRY

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

Innate Immunity:- Immunity at body surfaces, anatomical barriers, physiological barriers, Role of natural killer cells, mast cells and inflammatory cells in innate immunity. Mechanism of innate immunity recognition.

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.

Generation of humoral immune response, Primary and secondary B cell maturation, activation and proliferation. Cell mediated cytotoxic immune responses, Cytotoxic T lymphocyte and Natural Killer cell mediated killing, Antibody dependent cell mediated cytotoxicity, Method for evaluating cell mediated cytotoxicity. Immune responses and their regulation.

UNIT-IV

Adjuvants, their chemical nature and mode of action. Complement 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

1. Immunology, 2nd Edition, 2012. C. Vaman Rao Narosa Publishing House, New Delhi.
2. Kuby Immunology, 7th Edition 2013. Judy Owen, Jenni Punt, Sharon Stranford, W.H. Freeman and Company publishers.
3. Cellular and Molecular Immunology. 7th Ed. 2011. A.K. Abbas, A.H. Lichtman and S. Pillai. Saunders Company, Philadelphia
4. Immunology: An introduction, 4th Edition, 2009, Ian R. Tizard, Saunders College Publishing.
5. Roitt's Essential Immunology, 12th Edition 2014, Peter Delves, Seamus Martin, Dennis R. Burton, Ivan Roitt.

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
6. Passive agglutination test.
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

SIXTH SEMESTER
BMI 3601: MEDICAL BACTERIOLOGY –II

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*

- *Brucellae* species and *Bartonella* species
- *Legionella pneumophilla*
- *Calymmatobacterium* species

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

1. Topley & Wilson's: Principles of Bacteriology, Virology and Immunology, 8th Edition.
2. Medical microbiology by Patrick R Murray; Rosenthal KS, Kobayashi GS and Pfaller MA. Mosby Inc. St Louis Missouri. 2012.
3. Bacterial Pathogenesis; A Molecular Approach by Slayters AA and Whitt DD, ASM Press Washington DC.
4. Medical Microbiology by Greenwood D, Slack RCB and Peutherer. Churchill Livingstone publication
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
11. Review of Medical Microbiology by Jawetz, Melnick and Adelberg. Lange Medical Publications.

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

5. Characterization of unknown bacteria using metabolic activities of microbes.
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*, *Pleisomonas 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

Virus host interactions: Pathogenesis and immune mechanism of viral infections. Transmission of viruses and epidemiology of viral infections. Laboratory diagnosis of viral diseases.

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

1. Textbook of Microbiology (8th Edition) by R. Ananthanarayan & C.K. Panikar, Publisher: Orient Longman Limited (2010).
2. Topley and Wilson's principles of Bacteriology, Virology and Immunology by William Whiteman Carlton Topley, Sir Graham Selby Wilson. 8th edition. 1990.
3. Review of Medical microbiology by Jawetz, Melnick and Adelberg. Lange Medical publications 26th Edn. (2013).
4. Microbiology by Jacquelyn G. Black, 7th Edition. John Wiley and Sons, Inc (2008).
5. Practical Microbiology by D.K. Maheshwari & R.C. Dubey, S. Chand & Company Ltd. Fifth Edition, (2012).
6. Burrow's Textbook of Microbiology: William Freeman. 2003. W.B. Saunders Publishers 22nd edition,
7. Introduction of Modern Virology. N.J. Dimmock, A.J. Easton and K.N. Leppard. 2007. 6th Ed. Blackwell Publishing Ltd. Main Street, Malden, USA.
8. Principles of Molecular Virology. Alan J. Cann. 2012. 5th Ed. San Diego Academic Press.

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.
5. Demonstration of cross sensitivity of bacteriophage.
6. Demonstration of various tissue culture methods.
7. Demonstration of various egg inoculation techniques.

BMI 3603: MICROBIAL PHYSIOLOGY AND METABOLISM

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, Krebs'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

1. Bacterial Metabolism by Doelle, H. W. (2005). 2nd Edition. Academic Press.
2. Bacterial Metabolism by Gottschalk, G. (1986).. 2nd Edition. Springer-Verlag Heidelberg.
3. Principles of Biochemistry by Lehninger, A. L., Nelson, D. L. and Cox, M. M. (2008). 5th Edition. Worth Publishers Inc., U.S.A.
4. Microbial Physiology by Moat, A. G., Foster, J. W and Spector M. P. (2004). 4th Edition. Wiley-Liss, John Wiley and Sons Publications.
5. Comprehensive Biotechnology: The practice of biotechnology by Moo-Young, M. (1985). Vol. I-IV.
6. Methods for general and Molecular Microbiology by Reddy, C. A. and Beveridge, T. J. (2007). 3rd Edition. ASM press
7. Principles of Fermentation Technology by Stanbury, P. F., Whittakar, A. and Hall, S. J. (2009). 2nd Edition. Butterworth-Heinemann, Oxford, UK.

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_{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 atopic 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, Secretory 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

Transplantation its principles and immunologic basis:- Classification of grafts, immunology of graft rejection, first and second set of rejection reactions, Methods of graft rejection, lymphocyte mediated, humoral antibody mediated, hyper acute, acute early, acute late and late rejections. Mechanism of graft rejection, sensitization and effector phase. Immunosuppressive therapies during transplantation. Graft versus host disease. Tissue and organs transplantation.

BOOKS FOR READING

1. Manual of Clinical Immunology: Rose & Friedman 2009.
2. Clinical Aspects of Immunology: Gell, Coomba and Lachman, 3rd Edition.
3. Basic and Clinical Immunology: Edited by Daniel P. Stites, John D. Stobo, H. Hugh Fudenberg and J. Vivian Wells. Lange Medical Publication, U.S.A. 1994
4. Kuby Immunology. 7th edition. Thomas J. Kindt, Richard A Goldsby, Barbara A., Osborne, W.H. Freeman and Co. Publishers 2013.
5. Immunology by Tizard IR, Thomson, 9th edition, 2004.
6. Immunology 2nd Edition by CV Rao, 2006

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/Tuperculin 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 heam agglutination 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 SYSYSTEM) (CORE/ELECTIVE) IN
MICROBIOLOGY 1ST TO 4TH SEMESTER EXAMINATION 2015-2016**

M.Sc (H.S.) 1st Year				
Semester	Course No.	Course Title	Credit	Marks
First semester	MMI 4101	Advances in Microbial Ecology	6	150
	MMI 4102	Pathogenesis of Infectious diseases	6	150
	MMI 4103	Newer approaches in diagnostic Microbiology	6	150
	MMI 4151	*Combined Practical	5	125
Second semester	MMI 4201	Fermentation Technology	6	150
	MMI 4202	Advances in Molecular Biology & Biotechnology	6	150
	MMI 4203	Advances in Immunoprophylaxis & Immunotherapy of infections	6	150
	MMI 4251	*Combined Practical	5	125

Total Credits = 46

Total Marks = 1150

M.Sc (H.S.) 2nd Year						
Semester	Course No.	Course Title	Credit		Marks	
Third semester	MMI 5301	Fundamentals of Computer Programming and Applications	4		80 (Theory)	+20(Practical)
					=100	
	MMI 5302	Advanced Topics in Microbiology –I (Seminar)	4		100	
	MMI 5303	Advanced Topics in Microbiology –II (Paper)	4		100	
	MMI 5304	Project Training Report & Presentation	2		50	
Fourth semester	MMI 5401	Thesis*	16		400	
	MMI 5402	Viva Voce	4		100	

* 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 adaptations: 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

1. Bacterial biogeochemistry : The ecophysiology of mineral cycling by Tom Fenchel, Henry Blackburn, Gary M. King , Publisher-Academic Press, 2012.
2. Soil Microbiology, Ecology and Biochemistry, by Eldor A.Paul , Publisher-Academic Press 2006
3. Microbial Ecology an Evolutionary Approach by J.VaunMc Arthur, Publisher, Academic Press 2006.
4. Microbial Ecology by Larry L. Barton, Diana E. Northup, Publisher-John Wiley and Sons 2011.
5. Microbial Ecology: Fundamental and Applications by Ronald M. Atlas, Richard Bartha 2011.
6. Microbial Ecology of Oceans, second edition by David L. Kirchman 2009
7. Techniques in Microbial Ecology by Robert, S. Burlage Ronald Matlus, ASM Press,1998.
8. Genome 3, Third edition T.A.Brown ,2006.

JOURNALS

1. Microbial Ecology
2. Journal of Bioremediation & Biodegradation.
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 rhizospheric effect.
7. To study the microbial ecology of the phyllosphere.
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, extra cellular 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

1. Microbial determinants of virulence host response. Elia M. Ayoub ASM publications M. Ave. N.Y. Washington.
2. Medical Microbiology, An Introduction to Infectious Diseases. Elsevier Science Publishing Co. Inc. John C. Sherris.
3. MIMS Pathogenesis of infectious diseases by Mims C. Nash A and Stephen J, 2002 Academic Press.
4. Bacterial Pathogenesis; A Molecular Approach by Slayers AA and Whitt DD, ASM Press Washington DC.
5. Immunology by Tizard IR, Thomson, 4th Edition. 2009
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
9. Medical Immunology by Virella Gabriel. Publisher Marcel Dekker, Inc. New York and Basel.

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

9. Determination of susceptibility to dental carries by examining microbial flora of mouth.

10. Isolation and differentiation of *Strep* species associated with dental carry and dental plaque.

10. Principles of laboratory diagnosis; Isolation and characterization of pathogens from sore throat and stool sample.

11. Urinary tract infection diagnosis

12. Identification of given unknown culture (encountered frequently in clinical specimens)

MMI 4103: NEWER APPROACHES IN DIAGNOSTIC MICROBIOLOGY

UNIT I

Enzyme Immunoassays:

Comparison of enzymes available for enzyme immuno assays. Conjugation of enzymes
Solid phases used in enzyme immuno assays. Homogeneous and heterogeneous
enzyme immuno assays. Enzyme immuno assays after immuno blotting. Enzyme
immuno histochemical techniques. Use of polyclonal or monoclonal antibodies in
enzymes immuno assays. Applications of enzyme immuno assays in diagnostic
microbiology

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:

Susceptibility tests: Micro-dilution and macro-dilution broth procedures.
Susceptibility tests: Diffusion test procedures. Susceptibility tests: Tests for
bactericidal activity. Automated procedures for antimicrobial susceptibility tests.

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

1. Antimicrobial chemotherapy, January 5th, 2012 Finch, Davey, Welcox, Irving (6th Edition).
2. Rose, N. R. (2001). Manual of Clinical Laboratory Immunology.. American Society for Microbiology Press. Washington, D.C. 6th edition.
3. Murray, P.R; Baron, E.J; Jorgensen, J.H; Landry. M.L and Pfaller, M.A. (2007). Manual of Clinical Microbiology. American Society for Microbiology, Washington D.C. 9th edition.
4. Detrick, B; Hamilton, R.G and Folds, J.D. (2006)Manual of Molecular and Clinical Laboratory Immunology. American Society for Microbiology press. 7th edition

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*-L-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

1. Principles of Fermentation Technology, P.F. Stanbury & A. Whitaker, Pergamon Press.
2. Microbial Process Development by H.W Woelle, World Scientific.
3. Biotechnology Text book of Industrial Microbiology by W. Creuger and A Creuger.
4. Industrial Microbiology by Casida.
5. Industrial Microbiology by Prescott.
6. Biochemical Engineering Fundamentals (2nd Ed) by J.E Bailey and D.Ollis, McGraw-Hill Book Company..
7. Methods in Microbiology, Vol. I, II, Eds. J.R. Norris, D.W. Robbins, Academic Press London, New York.
8. Microbial Technology, Ed. H.J. Pepler, Reinhold Publishing Company, New York.
9. Biochemical Engineering: Fundamentals by Bailey & oila Mcgraw Hill.
10. Biochemical Engineering by Aibe, Humphry & others.
11. Industrial Applications of Microbiology, J. Riviere Surrey, University Press, London.
12. Manual of Industrial Microbiology & Biotechnology by Arnold Demian, JE Davies, AGM Press.
13. Bioprocess Technology Fermentation Process Development of Industrial Organisms, by J.O. Neway, T & F Publisher, 1989.

b) Further readings

1. Bioprocess Engineering Principles by Pauli.M 2009, Publisher-Elsevier.
2. Microbial Biotechnology-Fundamentals of applied Microbiology by A.N. Glazer and H.Nikaido. W.H Freeman and company.
3. Comprehensive Biotechnology, Vol. I to IV Ed. Moo Young, Pergaman Press, N. York.

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.

MMI 4202: ADVANCES IN MOLECULAR BIOLOGY & BIOTECHNOLOGY

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 foot printing 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 secretion, alcohol and antibiotic formation.
- b. **Agriculture:** e.g. N₂ fixation: transfer of pest resistance genes to plants; interaction between plants and microbes; qualitative improvement of live stock.
- 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 finger printing.
- 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

1. Alcamo, I. E. (2001). DNA Technology. 2nd Edition. Academic Press.
2. Benjamin, L. (ed.) (2007). Genes IX. Jones & Bartlett Publishers, USA.
3. Freifelder, D. (1987). Molecular Biology. 2nd Edition. Jones and Bartlett Publishers.
4. Glover, D.M. and Hames, B. D. (ed.) (1995). DNA Cloning: A practical Approach. Vol. I – IV. I.R.L. Press, Oxford.
5. Grierson, D. and Covey, S. N. (1991). Plant Molecular Biology. 2nd Edition. Blackie, Chapman & Hall Publishers, New York.

6. Innis, M. A., Gelfand, D. H. and Sninsky, J. J. (eds.) (1995). PCR Strategies. Academic Press.
7. Neidhart, F. C. (1987). *Escherichia coli* and *Salmonella typhimurium* Cellular and Molecular Biology. 2nd Edition., Vol. II. American Society of Microbiology, Washington.
8. Primorse, S. B., Twyman, R. M. and Old, R. W. (2009). Principles of Gene Manipulation & Genomics. 8th Edition. Blackwell Science, Oxford.
9. Reece, R. J. (2005). Analysis Genes & Genomes. John Wiley & Sons.
10. Schuler, M. A. and Zielinski, R. E. (1989). Methods in Plant Molecular Biology. Academic Press, New York
11. Watson, J. D., Baker, T. A., Bell, S. T., Gann, A. (2007). Molecular Biology of the Gene. 6th Edition. Pearson/ Benjamin Cummings.
12. Wilkins, M. R. (1997). Proteome Research: New Frontiers in Functional genomics. Springer-Verlag Berlin Heidelberg
13. Winnacker, E. L. (1988). From Genes to Clones: Introduction to gene technology. Springer-Verlag Heidelberg.

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.
3. Journal of Bacteriology, Infection and Immunity, Nature, Science, Gene J. of Molecular Biology; Proc. Natl. Acad. Sciences (USA) and Molec. of Gen. Genetics and other related journals.

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.

4203: ADVACNES IN IMMUNOPROPHYLAXIS AND IMMUNOTHERAPY OF INFECTIONS

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.

Idiotypic 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

1. Recombinant DNA Vaccine –Rationale & Strategy, 1992. Dekkev, Inc., New York - Ed. Richard E. Isaacson, Marce.
2. Vaccine Research and Development, 1992, Vol. I. Six Marcel Dekker Inc., New York-Wayne C. Kuff & Richard R.
3. New Generation Vaccines, 2008. Marcel Inc., New York - Woodrow, G.C. & Levine, M.M.
4. Vaccines-Prospects & Perspectives, 1993. Forward Publishing Company, New Delhi - Harminder Singh & Rajesh Bhatia. .
5. Vaccines- 1999, 3rd Edition, WB Saunders Company - Stanley A. Plotkin & Walter a. Orenstein.
6. The Vaccine book, 2008, B.R. Bloom and P.H. Lambet. , Academic Press New Delhi

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

1. Fundamentals of computers by V. Rajaraman, Prentice Hall of India, Pvt. Ltd., Fourth Edition, 2007.
2. Introduction to Information Technology, IITL Education solutions Ltd. Pearson Education, 2007
3. Gottfried: Programming in ANSIC, Schaum Series, TM4 publications, Latest Edition.
4. A simplified Text-cum-workbook on Application programming in C by R.S. Salaria, Khanna Booka Publishing Co. (P) Ltd.
5. Fundamentals of computers & Programming in C: A practical approach by G.S. Baluja, G.K. Baluja, Dhanpat Rai & Co. (P) Ltd., 2007.
6. Herbert Schildt, C: The complete reference, latest edition, Tata McGraw Hill Publications.
7. Let Us C: Yashavant Kanetkar
8. Computer today, Donalk H. Sanders, Mc. Graw Hill International Editions.

MMI 5302: ADAVANCED 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: ADAVANCED 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

MMI 5304: PROJECT TRAINING REPORT & PRESENTATION

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.
