

PANJAB UNIVERSITY CHANDIGARH- 160 014 (INDIA)

(Estd. under the Panjab Univerasity 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 2011-2012

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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 to be held in
December 2011 & May 2012

Semester	Course No.	Course	Credits	Marks
B.Sc (H.S.) Ist 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) Ist year in Microbiology</u>		Credits	Marks
English		8	200
Physics		8	200
Chemistry		8	200
Mathematics		8	200
Total Credits =		48	
Total Marks =			1200

IMPORTANT NOTE: The compulsory subject of ENVIRONMENT EDUCATION would be offered to the students in the First Year of Undergraduate classes in all streams (Arts, Commerce, Science, Computer Applications, Biotechnology, Education etc.)

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

ENVIRONMENT EDUCATION

(25 Hrs. course)

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, 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.

Practicals:

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

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

• Examination Pattern:

Fifty multiple choice questions (with one correct and three incorrect alternatives and no marks deduction for wrong answer or un-attempted question)

- All questions compulsory i.e. no choice.
- Qualifying marks 33 per cent i.e. 17 marks out of 50.
- Total marks : 50
- Duration of Examination: 60 minutes.
- Spread of questions: Minimum of 2 questions from each of the topics 1 and 12 to 15. Minimum of 4 questions from topics 2 to 11.

Outlines of tests syllabi and courses of reading for B.Sc. (Honours School) First Year English Subsidiary (Semester System)

FIRST SEMESTER

SECTION A

- | | | |
|----|--|----------|
| 1. | Fluency in English
Units-I, II,III,IV | 20 Marks |
| 2. | Shorts Stories
Unit I to VI | 10 Marks |
| 3. | Poems
Unit I to IX | 20 Marks |

SECTION B

Writing and Grammar

- | | | | |
|----|---|----------|---------|
| 1. | Paragraph Writing | 12 marks | |
| 2. | Formal Letters and E-mails | 10 marks | 8 marks |
| 3. | Applied Grammar:
-Types of Sentences
-Sentence Linkers
- Correction of Sentences | 20 marks | |

SECOND SEMESTER

SECTION A

- | | | |
|----|--|----------|
| 1. | Fluency in English
Units-VIII,IX,XIV, XVI | 20 Marks |
| 2. | Short Stories
Unit to VII to XII | 10 Marks |
| 3. | Poem
Unit X to XVIII | 20 Marks |

SECTION B

Writing and Grammar

- | | | |
|----|-----------------|----------|
| 1. | Resume Writing | 10 Marks |
| 2. | Precis Writing | 8 Marks |
| 3. | Report Writing | 12 Marks |
| 4. | Applied Grammar | 20 Marks |

- same word as different part of speech
- Formation of words
- One Word substitution
- Idioms & Phrases

TEXTS PRESCRIBED:

1. Fluency in English Eds. Mukti Sanyal & Tulika Prasad
Macmillam Publishers
2. Twelve Contemporary Shorts Stories O.U.P.
3. The Silver Lute Macmillam Publishers

NOTE:

1. The book 'Twelve contemporary Short Stories' is meant for discussion and evaluation purposes.
2. Mode of Testing: All the questions of Section A would have Internal choice. Question 1 and 2 Essay type. Question 3 and 4 from poems based on central idea or summary.

RECOMMENDED READING:

1. A textbook of grammar and composition Eds. S.C. Sharma, Pankaj Sharma et al Mcmillan.
2. A Practical Eng Grammar Ed. Thomsan Martinet, Oxford, India.

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.) Ist year in MICROBIOLOGY FIRST SEMESTER

BMI 1101: INTRODUCTION TO GENERAL MICROBIOLOGY AND BACTERIAL SYSTEMATICS

Objective: Introduction to General Microbiology (BMI-1101)

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.

PART – A

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.

PART – B

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. 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.

PART – C

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

PART – D

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, 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. 2005. WCB Publishers.
2. General Microbiology by Stanier, Ingraham, Wheelish and Painter, Macmillan Edu. Ltd.
3. Review of Medical microbiology by Jawetz, Melnick and Adelberg. Lange Medical publications 20th Edn..
4. Microbiology by Pelczar. 2006. MJ; Chan ECS and Kreig NR, Mcgraw Hill.Inc.
5. Molecular biology & Genetic Engineering 2005 by P.K. Gupta. Rastogi Publications.
6. Bergey's Manual of Systematic Bacteriology. 9th Edn. Lippincott Williams, Wilkin Bacteriology, Vol. I, II, III.
7. Brock Biology of Microorganisms by Madigan, Martinko and Parker. 2005. Prentice Hall International Inc.

SECOND SEMESTER

BMI 1201: INRODUCTION TO APPLIED MICROBIOLOGY AND PATHOLOGY.

Objective: Introduction to Applied Microbiology and Pathology (BMI 1201)

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

PART – A

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.

History, development, and its relevance in relation to study of homoeostasis, 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,

PART - B

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.

Introductory food and industrial 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.

PART- C

Microbial diseases of 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.

PART – D

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 hemorrhage

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. Benjamin 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. 5th Edition, 2005
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 Lippincott Williams & Wilkins.
10. Fundamental of Microbiology IE Alcamo, Publisher. An imprint of Addison Wesley Longman Inc.

B.Sc (H.S.) 2nd year in MICROBIOLOGY

THIRD SEMESTER

BMI 2301: PHYCOLOGY

Objective: Phycology (BMI-2301)

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.

PART – A

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.

PART-B

Economic importance : Algae as bio fertilizer, reclamation of saline and sodic soil by algae. Algae as food, including single cell protein. Use of algae to fisheries and malaria control. Source of agar-agar, alginates, 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

PART – C

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, nitrogenase and biochemistry of nitrogen fixation, physiology of nitrogen fixation in blue green algae.

PART-D

Genetics : Recombination, transformation and transduction. Molecular genetics of dinitrogen – fixation and nitrite and nitrate utilization.

Carbon source mutants, pigment mutants, vitamin and amino acids mutants, flagella mutants, eyespot mutants, their isolation and characterization, cytoplasmic inheritance

Laboratory cultures: Growth characteristics, preparation of experimental material, methods of cultures.

BOOKS FOR READING

1. **Algal Culturing Techniques** by Robert A. Andersen (Editor), Elsevier Academic Press, 2005
2. **Algae: Anatomy, Biochemistry, and Biotechnology**, by Laura Barsanti (Author), Paolo Gualtieri (Author), CRC Press, 2006
3. **Algae**, by Linda E. Graham (Author), Lee W. Wilcox (Author), Cambridge University Press, 2004
4. **Microalgae: Biotechnology and Microbiology** by E. W. Becker (Author) Cambridge University Press, 1995
5. **Freshwater Algae of North America: Ecology and Classification (Aquatic Ecology)**, by John D. Wehr (Author), Robert G. Sheath (Author), James H. Thorp (Series Editor) Academic Press, 2003
6. **Seaweed Ecology and Physiology** by Christopher S. Lobban (Author), Paul J. Harrison (Author), Cambridge University Press, 2000
7. **Algal Physiology and Biochemistry** by WDF Stewart, Academic Press, 1989
8. **Algae: An Introduction to Phycology**, by Christiaan van den Hoek (Author), David Mann (Author), H. M. Jahns (Author), Cambridge University Press, 1997

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

BMI 2302: PARASITOLOGY

Objective: Parasitology (BMI-2302)

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

PART – A

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.

PART – B

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: Lishmania, Post kala-azar dermal leishmaniasis and Trypanosomes.
- (d) Flagellates of genital tract: Trichomonas (*T. tenax*, *T. hominis* *T. vaginalis*).
- (e) Malaria parasite (*Plasmodium*, *P. falciparum*, *P. malariae*, *P. ovale*) general life cycle of malarial parasite in man and anopheles mosquito, sequelae of malaria.
- (f) Toxoplasma gondi, life cycle, symptomatology. Transmission and lab. Diagnosis of toxoplasmosis.
- (g) *Cryptosporidium parvum*

PART – C

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

Trematodes: Schistosoma haematobium, japonicum and mansoni.

Helminths : Ascaris lumbricoides, Ancylostome duodenale, Strongyloides stercoralis, Enterobius, Wuchereria bancrofti, Brugia malayi, Dracanculus medinensis.

PART – D

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

BOOKS FOR READING

1. Chatterjee, K.D. (2007) Parasitology, 12th 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 (1993) Text book of Parasitology, 3rd edition, Jaypee Brothers Medical Publishers, New Delhi.
5. Sehgal, R. (2003) Practical and viva in Medical Parasitology, 1st edition, Elsevier Publishers, India.

BMI 2303: ENVIRONMENTAL MICROBIOLOGY

Objective: Environmental Microbiology (BMI-2303)

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.

PART – A

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.

PART - B

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 oilshale. Recovery of petroleum from oil bearing rocks.

PART – C

Microbiology of air

Organism of fermentation in the air, Exhaust gas purification, Methods of waste gas treatment, aerosols monitoring

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

PART - D

Analysis of water. Quantitative and qualitative methods, coliform organisms in sewage, water-borne 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 by Raina Mair, Ian Papper and Charles Gerba, Elsevir Press 2007
2. Environmental microbiology by A.H. Varnam and M. Evans Blackwill Publisher 2000
3. Microbial Biochemistry, Zagic, 1994
4. Comprehensive Biotechnology, Moo Young. 1995
5. Environmental Microbiology, Rose Vol. III-V, 1999

FOURTH SEMESTER

BMI 2401: MYCOLOGY

Objective: Mycology (BMI-2401)

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.

PART-A

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.

PART-B

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

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

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

PART-C

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

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

PART-D

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.

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

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. Introduction to Fungi By Alexopolus and Mims, CRC Press, 2005
2. Fungi: Biology and Applications, Edited by Kevin Kavanagh , Jhon Wiley, 2005
3. Dictionary of Plant Pathology (2nd Edition) By Paul Holiday, Cambridge University Press 2001
4. Advances in Food Mycology Edited by Hocking, A.D.; Pitt, J.I.; Samson, R.A.; Thrane, U. Springer , 2006
5. Advances in Fungal Biotechnology for Industry, Agriculture, and Medicine Edited by Tkacz, Jan S.; Lange, Lene , Springer 2004
6. Biological Control - Benefits and Risks Edited by Heikki M. T. Hokkanen, James M. Lynch , Cambridge University Press ,1996
7. Fungal Associations Edited by B Hock, Springer Verlag, 2001
8. Fungal Biotechnology in Agricultural, Food, and Environmental Applications, By Dilip K. Arora , Marcel Dekker, 2003
9. Fungal Pathogenesis - Principles and Clinical Applications, Edited by Richard A Calderone and Ronald L Cihlar ,Marcel Dekker , 2001
10. Mushrooms: Cultivation, Nutritional Value, Medicinal Effect, and Environmental Impact, Second Edition, Shu-Ting Chang, Philip G Miles , CRC Press, 2004
11. Mycorrhiza - Structure, Function, Molecular Biology and Biotechnology (Second Edition) Edited by A Varma and B Hock , Springer Verlag, 1999 Protocols in Lichenology - Culturing, Biochemistry, Ecophysiology and Use in Biomonitoring, Edited by Kranner, I., Beckett, R., Varma, A. ,Springer Verlag 2002
12. The Mycota Volume X - Industrial Applications, Edited by Osiewacz, H.D., Springer 2002

Journals

1. Mycologist
2. Mycological Research
3. Indian Journal of Mycology and Plant Pathology
4. Mycologia

BMI 2402: INDUSTRIAL MICROBIOLOGY

Objective: Industrial Microbiology (BMI-2402)

To study the commercial exploitation of microorganisms for the production of valuable microbial products via fermentation processes. Another aspect is the role of microorganisms in detoxification of industrial wastes, degradation of petroleum in oil spills and production of biocontrol agents to be used as biofertilizers.

PART-A

Introduction to Industrial Microbiology: Fermentation, definition; Industrial microbes; Development of Industrial fermentation and fermentation Industry.

Strain improvement for various Industrial purposes: Isolation, conventional and genetic methods of strain improvement and preservation of industrially important microorganisms.

Types of Fermentation: Submerged, Surface and Solid-State fermentation; Range and Component parts of fermentation processes.

PART-B

Fermenter Configurations:

(1) **Submerged fermenter systems:** Stirred tank fermenter, Air lift fermenter, Fluidized Bed fermenter, Microcarrier bioreactor, Membrane bioreactor, Photobioreactor, Innovative and Special fermenters;

(2) **Solid-State Fermenter Systems:** Laboratory and Industrial Scale SSF Fermenter.

Design of fermenter: Design criteria-mechanical aspects and process aspects; Standard dimensions, Jackets & coils, Safety codes, Material of construction, baffles, Sparger, Nozzles & Manways, Piping & Valves, Steam locks, Welds & Joints, Surface treatment and Finish, Cleanability, sterility aspects, agitation system design-impeller design, drive location, seals, power requirements.

PART-C

Stages in Industrial Fermentation Process :

(1) **Upstream Processing:** design preparation, substrates, and sterilization of fermentation media; Optimization of fermentation media and inoculation.

(2) **Fermentation process:** Modes of operation- Batch fermentation, Continuous fermentation process, Fed Batch fermentation; Inoculum preservation, Growth of the inoculum, Fermenter preculture, Production fermenter-fermenter size, temperature, aeration, agitation and pressure; Process monitoring and control.

(3) **Down stream processing:** Removal of insolubles, product isolation, product purification, product polishing.

(4) **Scale Up of fermentation processes**

(5) **Asepsis in fermentation processes.**

PART-D

Production of Industrial Food Grade Products: Bakers Yeast, Single cell proteins, Amino acids, Vitamins, Enzymes, Beer, Wine, Acetic acid (Vinegar), Citric acid, Lactic acid.

Production of Industrial Health Care Products: Antibiotics & Vaccines.

Production of industrial Biochemicals and Biofuels: Ethanol, Acetone and Butanol.

BOOKS FOR READING

1. Biotechnology: A textbook of industrial microbiology. Crueger, W |Crueger, A SCIENCE TECH, INC., MADISON, WI (USA). 1984.
2. Industrial Microbiology- Prescott & Dunn, 2004
3. Comprehensive Biotechnology. Vol. I, III Ed.- Moo Young.
4. Industrial Applications of Microbiology- J. Riviere
5. Industrial Microbiology- Casida., 2007
6. Industrial biotransformation by Lieshe, Seelbach & Wandrey, Wiley VCH publications
7. .Methods in industrial microbiology. Sikyta, BELLIS HORWOOD, CHICHESTER (UK). 1983.
8. Industrial microbiology: an introduction By Michael J. Waites, Neil L. Morgan, Gary Higton, John S. Rockey Edition: 3, illustrated Published by Blackwell Science, 2001.
9. Biotechnology of antibiotics By W. R. Strohl Edition: 2, illustrated Published by Informa Health Care, 1997

BMI 2403: SOIL MICROBIOLOGY & BIOREMEDIATION

Objective: Soil Microbiology and Bioremediation (BMI-2403)

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.

Part-A

Introduction to types of soil microbes.

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 moment in soil.

Part-B

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

Ecophysiological interactions in microbes & higher plants: Interaction with plant roots, interaction with aerial plant structures microbial diseases of plant.

Part-C

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

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

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

Part-D

Microbial interaction with metal pollutants: Sources of metal pollution, effects of metal pollution on microbes, metal corrosion, biotransformation and bioremoval 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 Raina Mair, Ian Papper and Charles Gerba Elsevir Press 2007
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, 1996
5. Soil Microbiology by Waksman, 1994
6. Soil Biochemistry, Vol. I,II by Paul, Meclaren Vol. I, 1995
7. Microbial Communities, Insam, H, Rangger, A, 1997
8. Environmental and Microbial Relationship Wicklow D.T. & Soders from B.E. 1997.
9. Methods in Soil Biology Schinner, F., 1996
10. Soil Microbiology by Robert, L. Tate, John Wiley & Son. 1999.

**SYLLABUS FOR B.SC. (HONS SCHOOL) SECOND YEAR (SUBSIDIARY COURSES
FOR BIOCHEMISTRY AND BIOPHYSICS STUDENTS)
FOR THE EXAMINATIONS OF 2011 & 2012**

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 MICOBIOLGY

Objective: Introduction to General Microbiology (BMIS-2371)

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.

PART-A

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), defect of lenses & their corrections, 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.

PART-B

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.

PART-C

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.

PART-D

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. WCB Publishers.
2. General Microbiology by Stanier, Ingraham, Wheelish and Painter, Macmillan Edu. Ltd.
3. Microbiology by Pelczar. MJ; Chan ECS and Kreig NR, Mcgraw Hill.Inc.
Bergey's Manual of determinative Bacteriology 9th Edn. Lippincott Williams, Wilkin Bacteriology, Vol. I.
4. Textbook of Microbiology (5th Edition) by R. Ananthanarayan & C.K. Panikar, Publisher: Orient Longman Limited.
5. Dairy Microbiology by K.C. Mahanta, Omsons Publications, New Delhi.
6. Industrial Microbiology (4th Edition) by Prescott & Dunn (Editor: Gerald Reed), CBS Publishers, Delhi.
7. Microbiology : A Laboratory Manual (7th Edition) by James Cappuccino, Natalie Sherman, Publisher: Benjamin Cummings.

FOURTH SEMESTER

BMIS 2471: INTRODUCTION TO APPLIED MICROBIOLOGY

Objective: Introduction to Applied Microbiology (BMIS 2471)

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.

PART –A

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)

PART - B

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*, *Entamoaba*, *Plasmodium*, *Toxoplasma*, *Trypanosoma* *Leishmania*) and Viruses (Entroviruses, Rhinoviruses, Rubella, Measles, Maps, Rabies, Influenza, Rota, Herpes, Small Pox, Hepatitis, Adenovirus, HIV).

PART – C

Microbiology of soil, physical characteristics, microbial flora, Biogeo chemical 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.

PART - D

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.

BOOKS FOR READING

1. General Microbiology- Pelzar, Ried and Chan, 16th Edition (2001)
2. Review of Medical Microbiology- Jawetz. And Meinick., 20th Edition
3. General Microbiology- Stanier, Ingrahm, 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.

PART – A

- History and development of medical microbiology.
- Biological properties of etiological agents of diseases, Pathogenic Mechanisms Specific Virulence Factors, Nature of damage to the tissues caused by infectious agents. Biologic Activities of microbial toxins.
- Epidemiology: Epidemiology and control of community infections.
- Study of normal flora of human body and its importance to host.

PART – B

- Salient features of laboratory diagnosis of common clinical bacterial infections. Principles of Diagnosis, Introduction, Manifestations of Infection Microbial Causes of Infection Specimen Selection, Collection and Processing Microbiologic Examination Microbial Identification, Serodiagnosis, Antimicrobial Susceptibility
- Study of morphological and physiological characteristics and pathogenesis of infections and diseases and clinical manifestations of following microorganisms.
- *Staphylococcus*: aureus and *S. epidermidis*.
- *Streptococcus pyogenes*, *S. agalactiae*, *S. pneumoniae* and *S. mutans*

PART – C

- *Bacillus anthracis* and *Bacillus cereus*
- *Clostridium*: Infections agents associated with tetanus botulinum, gas gangrene diseases and pseudomembranous colitis.
- *Listeria*: monocytogenes
- *Corynebacterium*: *Corynebacterium diphtheriae*

PART – D

- *Mycobacterium tuberculosis* and *M. leprae* and other mycobacteria.
- *Neisseria meningitidis* and *N. gonorrhoeae*
- *Haemophilus influenzae* and *H. ducreyi*
- *Bordetella pertussis*, *B. parapertussis* and *B. bronchiseptica*
- *Francisella tularensis*
- *Yersinia pestis*, *Y. enterocolitica* and *Y. pseudotuberculosis*

BOOKS FOR READING

1. Topley & Wilson's: Principles of Bacteriology, Virology and Immunology, Vol. I-VIII.
2. Mackie and McCartney Practical Medical Microbiology Ed Collee JG, Fraser AG, Marmion BP and Simmons A. Churchill Livingstone publication
3. Textbook of Microbiology: Ananthanaryan and Panikar
4. Bacterial Pathogenesis; A Molecular Approach by Slayters AA and Whitt DD, ASM Press Washington DC.
5. Medical Microbiology by Greenwood D, Slack RCB and Peutherer. Churchill Livingstone publication
6. Medical Microbiology by Mims and others. Elsevier Mosby Spain
7. Medical Microbiology Samuel Baron Publisher. Addison Wesley Publishing Co.
8. Mandell, Douglas and Bennett's; Principles and Practice of Infectious diseases: GL Mandell R.Dolin and JE Bannett;s, Publisher Churchill Livingstone. NY
9. Medical Microbiology by Murray PR, Rosenthal KS, Kobayashi GS and Pfaller MA. Mosby Inc. St Louis Missouri.
10. Review of Medical Microbiology by Jawetz, Melnick and Adelberg. Lange Medical Publications.

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.

PART – A

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

PART- B

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

PART - C

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;

PART – D

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.

BMI 3503: FOOD MICROBIOLOGY

Objective: This course has been designed with the objective of relating interactions of microorganisms and food in relation to food bioprocessing, food spoilage and food borne diseases.

PART – A

Microbiology of Milk and Milk products:

Composition of milk, sources of microorganisms in milk and their control. Number and type of microorganisms present in milk. Microbiological examination of milk and milk products.

Legal standards for milk and milk products, grading of milk and certified milk, microbiology of lactic cultures, dairy products manufactured with the aid of microorganisms, cheese, fermented milks,

PART – B

Food Chemistry

Moisture in foods, hydrogen bonding, bound water, determination of moisture in foods.

Nutritive value of food stuffs. Proteins, carbohydrates fats, vitamins and minerals present in food and their importance in diet. Flavour changes in fats and oils. Changes of carbohydrates on cooking, browning reactions, effects of heat treatment on proteins. Flavour and aromas of foods. Balanced diet. Qualitative and quantitative analysis of different foods for their proteins, fats, carbohydrates and minerals, Food Allergies.

PART – C

Food microbiology

Contamination of foods from natural sources, Conventional and Rapid methods for microbiological examination of foods, Spoilage of different foods. Role of microorganisms in preserving foods. Fermented foods of Indian origin, Fermented soyabean products.

PART-D

Food preservation & Food poisoning:

Preservation methods: physical agents of preservation, chemical agents of preservation. Food poisoning: Intoxications and food infections, investigation of food borne disease outbreaks.

BOOKS FOR READING

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. MJ Loessner and DA Golden/ Springer, Printed by Rashtrya Printers Delhi, 2005
4. Food Chemistry by H.-D. Belitz , W. Grosch, P. Schieberle and M.M. Burghagen, Springer Verlag , 2007
5. Food Microbiology by Adams, MR and Moss, MO, New age International (P) Ltd, Publishers. 2006
6. Food Science by Srilakshmi, New Age International Publishers, 2006

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

PART – A

Overview of the immune system: Innate and adaptive immunity. Anatomical Barriers. Soluble molecules and cell types and membrane associated receptors of innate immunity. Collaboration between innate and adaptive immunity.

Cells of the immune system: Lymphoid cells, Mononuclear phagocytes, Granulocytic cells, Dendritic cells.

Organs of the immune system: Primary lymphoid organs, Secondary lymphoid organs, Mucosa associated lymphoid tissues.

Markers: Markers on T-Cells, B-Cells, Natural killer cells, macrophages and antigen presenting cells

PART-B

Structure of antibodies and antibody classes: Basic structure of antibodies as revealed by chemical and enzymatic methods. Antibody binding site. Domains and immunoglobulin folds. Five major classes of immunoglobulins and their biological activities. The B-Cell receptor and the immunoglobulin super family.

Organisation and Expression of Immunoglobulin genes: Germ line and somatic variation models to explain antibody diversity. Dreyer and Bennett two gene one-polypeptide model, Multi gene organization of immunoglobulin genes. Gene rearrangement in light and heavy chain and its mechanism. Generation of antibody diversity. Class switching among constant region genes.

PART – C

Molecular basis of immunogenicity and antigenicity Haptens, Mitogens, B cell epitope, T- cell epitopes. Affinity of antigen antibody interactions, antibody avidity and its biological significance, precipitation reactions, passive, bacterial and haemagglutination Radioimmunoassay, Enzyme linked immunosorbent assay, immunofluorescent 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.

PART-D

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 of 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. Kuby Immunology . 6th Edition 2007. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne. W.H. Freeman and Co. Publishers.
2. Janeway's Immunology. 7th Ed. 2008. Kenneth Murphy, Paul Trevers, Mark Walpart. Garland Science Publishers.
3. Introduction to Medical Immunology by Gabriel Virella et.al. (1996)
4. An advanced text book of Immunochemmistry by Glynn & Steward.
5. Cellular and Molecular Immunology. 6th Ed. 2007. A.K. Abbas, A.H. Lichtman and S. Pillai. W.B. Saunders Company, Philadelphia
6. Roitt's Essential Immunology. Peter J. Delves, Seamus, J. Martin, Dennis R. Burton, Ivan M. Roitt. 11th Ed. Blackwell Publishing Ltd. Oxford

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.

PART - A

Diseases caused by the following genera of family Enterobacteriaceae.

- *Escherichia coli*
- *Klebsiella pneumoniae*
- *Shigella: Shigella dysenteriae, S. sonnei, S. flexneri and S. boydii*
- *Salmonella:* Causal agents of enteric fever, septicemia and enteritis.

PART – B

- *Proteae group*
- *Serratia marcescens*
- *Campylobactor jejuni and Helicobactor pylori*

Diseases caused by

- *Vibrio cholerae*
- *Pseudomonas group*
- *Bacterocides: B. fragilis and Fusobacterium sp*

PART – C

Spirochetes:

Treponema:

Borrellia:

Leptospira:

Brucellae

Bartonella

PART-D

Legionella,

Calymmatobacterium sp

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, Vol. I-VIII
2. Mackie and McCartney Practical Medical Microbiology Ed Collee JG, Fraser AG, Marmion BP and Simmons A. Churchill Livingstone publication
3. Textbook of Microbiology: Ananthanaryan and Panikar
4. Bacterial Pathogenesis; A Molecular Approach by Slayters AA and Whitt DD, ASM Press Washington DC.
5. Medical Microbiology by Greenwood D, Slack RCB and Peutherer. Churchill Livingstone publication
6. Medical Microbiology by Mims and others. Elsevier Mosby Spain
7. Medical Microbiology Samuel Baron Publisher. Addison Wesley Publishing Co.
8. Mandell, Douglas and Bennett's; Principles and Practice of Infectious diseases: GL Mandell R.Dolin and JE Bannett;s, Publisher Churchill Livingstone. NY
9. Medical Microbiology by Murray PR, Rosenthal KS, Kobayashi GS and Pfaller MA. Mosby Inc. St Louis Missouri.
10. Review of Medical Microbiology-Jawetz et.al.

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.

PART – A

Introduction: Viruses as distinct living organisms. The origin of virology, classification and nomenclature of viruses. Isolation, purification and assay of viruses.

Structure of viruses: Capsid symmetry and architecture. Enveloped viruses, complex viruses, virus receptors, attachment, penetration and multiplication of viruses. The Baltimore classification.

PART –B

Cultivation of viruses: Cultivation in animals, embryonated eggs and cell culture. Detection of virus growth in cell culture.

Novel infectious agents : Satellites ,viroids and prions.Diseases caused by prions.

Virus and cancer: Mechanism of viral oncogenesis and Oncogenic RNA and DNA Viruses.

PART – C

Virus host interactions:

Pathogenesis of virus infection. Spread of virus in body. Non immunological and Immunological responses to viral infections. Laboratory diagnosis of viral diseases. Epidemiology of viral infections.

Prevention and control: Immunoprophylaxis and chemoprophylaxis of virus diseases

PART-D

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. Burrow's Textbook of Microbiology: William Freeman. 2003. W.B. Saunders Publishers
2. Ananthanarayan and Paniker's Text Book of Microbiology. R. Ananthanarayan and C.K.J. Paniker. 7th Ed. Orient Longman Publishers.
3. Introduction of Modern Virology. N.J. Dimmock, A.J. Easton and K.N. Leppard. 2007. 6th Ed. Blackwell Publishing Ltd. Main Street, Malden, USA.
4. Principles of Molecular Virology. Alan J. Conn. 2001. 3rd Ed. San Diego Academic Press

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.

PART - A

Introduction to Microbial Physiology in the Post Genomics era (Metabolomics).

Microbial growth: Trophophase & Idiosphase, Primary & Secondary metabolites, Growth kinetics, Types of growth: Batch, Fed-batch, continuous & their industrial applications. Transport of nutrients in bacteria

Bacterial Cell Division, Cell Wall Synthesis, Fungal differentiation & Physiological specialization, Microbial nutrition & structural modifications,

PART - B

Regulation of metabolism: Concept of operons and regulons, enzyme induction, catabolite repression, End product inhibition and repression, attenuation, feed-back inhibition & repression, 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.

PART - C

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.

PART - D

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

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

BOOKS FOR READING

1. Doelle, H. W. (2005). Bacterial Metabolism. 2nd Edition. Academic Press.
2. Gottschalk, G. (1986). Bacterial Metabolism. 2nd Edition. Springer-Verlag Heidelberg.
3. Lehninger, A. L., Nelson, D. L. and Cox, M. M. (2008). Principles of Biochemistry. 5th Edition. Worth Publishers Inc., U.S.A.
4. Moat, A. G., Foster, J. W and Spector M. P. (2004). Microbial Physiology. 4th Edition. Wiley-Liss, John Wiley and Sons Publications.
5. Moat, A. G., Foster, J. W and Spector M. P. (2004). Microbial Physiology. 4th Edition. Wiley-Liss, John Wiley and Sons Publications.
6. Moo-Young, M. (1985). Comprehensive Biotechnology: The practice of biotechnology. Vol. I-IV.
7. Reddy, C. A. and Beveridge, T. J. (2007). Methods for general and molecular microbiology. 3rd Edition. ASM press
8. Rose, A. H. (1976). Chemical Microbiology. 3rd Edition. Plenum Press, New York.
9. Stanbury, P. F., Whittakar, A. and Hall, S. J. (2007). Principles of Fermentation Technology. Butterworth-Heinemann, Oxford, UK.

BMI 3604: IMMUNOPATHOLOGY

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

PART – A

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.

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.

PART – B

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

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.

PART – C

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

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

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

HIV / AIDS infection: history / spread, structure of HIV, pathogenesis, opportunistic infections, diagnosis and preventive / therapeutic approaches for AIDS.

PART – D

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 immunodeficiencies, 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, hyperacute, 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- 1995
2. Clinical Aspects of Immunology: Gell, Coomba and Lachman
3. Basic and Clinical Immunology: Edited by : Daniel P. Stites, John D. Stobo, H. Hugh Fudenberg and J. Vivian Wells. Lange Medical Publication, USA 1994.
4. Kuby Immunology. 6th edition. Thomas J. Kindt, Richard A Goldsby, Barbara A., Osborne, W.H. Freeman and Co. Publishers.
5. Immunology by Tizard IR, Thomson, 4th edition, 2004.
6. Immunology by CV Rao, 2005

Apart from books, further reading should be done from Journal like:

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

**OUTLINES OF TESTS, SYLLABI AND COURSES OF READING FOR M.Sc. (HONS SCHOOL) (SEMESTER SYSTEM) (CORE/ELECTIVE) IN MICROBIOLOGY
1ST TO 4TH SEMESTER
EXAMINATION 2011-2012**

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.

PART-A

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; Atmo ecosphere-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.

PART-B

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.

PART – C

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: Allozyme genotyping, DNA markers, RFLP, RAPD, 16s rRNA technique, limitations of molecular microbial ecology.

PART-D

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.

An 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. Microbial Ecology: Fundamentals and Applications (4th Edition) by Ronald M. Atlas (Author), Richard Bartha (Author), Academic Press, 2006
2. Techniques in Microbial Ecology by Robert S. Burlage (Editor), Ronald Atlas (Editor), David Stahl (Editor), Gill Geesey (Editor), Gary Saylor (Editor), ASM Press, 1998

3. Freshwater Microbiology: Biodiversity and Dynamic Interactions of Microorganisms in the Aquatic Environment by David Sigeo, 2004
4. Comprehensive Biotechnology By Murray Moo-Young (Editor in Chief) Vol I & Vol IV Pergamon Press.
5. Manual of Environmental Microbiology by Christon J. Hurst (Editor), Ronald L. Crawford (Editor), DAVID A. LIPSON (Editor), Jay L. Garland (Editor), Aaron L. Mills (Editor), American Society for Microbiology, 2007. Environmental Microbiology by Raina M. Maier, Ian L. Pepper, Charles P. Gerba Academic Press' 2000.
6. Microbiology and Biotechnology : A Laboratory Manual by PT Kalaichevan, MJP Publishers, 2005
7. Microbial Biofilms by M. Ghannoum and G.A. O'Toole (Editors), ASM Press Washington, DC, 2004.
8. Microbial Diversity : Current Perspectives and Potential Applications, By T. Sattyanarayana and BN Johri (Editors), I.K. International Pvt. Limited, 2005
9. Biodiversity of Microbial Life: Foundations of Earth's Biosphere by James T. Staley (Editor), James T. Staley, Anna-Louise Reysenbach, Anna-Louise Reysenbach (Editor), 2004
10. Microbial Ecology: An Evolutionary Approach by J. Vaun McArthur, Academic Press, 2006
11. Environmental Microbiology By Raina M Maier, Ian L Pepper Academic Press, 2000
12. Biological and Biotechnological Control of Insect Pests, By Jack E Rechcigl and Nancy A Rechcigl CRC Press ,1999

Journals

1. The ISME Journal: Multidisciplinary Journal of Microbial Ecology, Editors: Mark Bailey, John Heidelberg , George Kowalchuk
2. International Journal of Aquatic Microbial Ecology, Editors : Paul A. del. Giorgio, Fereidoun Rassoulzadegan
3. Springer Journal of Microbial Ecology editor-in-chief : James K. Fredrickson
4. Multidisciplinary Journal of Microbial Ecology
5. Applied and Environmental Microbiology
6. Annual Reviews of Microbiology

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.

PART – A

- 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.

PART B

- 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.

PART – C

- The spread of microbes through the body: direct and indirect spread, microbial factor promoting spread, spread via lymphatic, blood and via other pathways.
- 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.

PART D

- Recovery from infection: Role of specific (immunological) and non-specific factors (complement, interferon acute phase proteins, temperatures in recovery, tissue repairs and resistance to reinfection. Failure to eliminate microbes. Various aspects of latency with and without shedding of infectious agents.
- Susceptibility and resistance: Role of hosts and microbial genetic factors, hormonal and emotional stresses on host microbes' interactions.

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 Inf. Dis. 2nd Ed. 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. Immunology by Tizard IR, Thomson, 4th Edn. 2004
5. Virulence mechanisms of bacterial pathogens edited by Brogdm KA, Roth JA, Stawton TB, Bolin CA, Minion FC, & Wannemuehler, ASM Press Washington DC
6. Clinical Immunology 2nd Edn. By Catherine Sheelan Publisher: Lippincot NY
7. 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.

MMI 4103: NEWER APPROACHES IN DIAGNOSTIC MICROBIOLOGY

Objective : To provide information about latest techniques used for the diagnosis of various bacterial, viral, fungal and parasitic diseases.

PART – A

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

PART - B

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.

PART – C

Automation in microbial diagnosis, rapid diagnostic approach including technical purification and standardization of antigen and specific antibodies. Concepts and methods in idiotypes. Anti-idiotypes and molecular mimicry and receptors. Epitope design and applications. Immunodiagnostic tests. Immuno florescence. Radioimmunoassay.

PART - D

GLC, HPLC, Electronmicroscopy, flowcytometry and cell sorting.

Transgenic animals.

Methods and ethics of research.

BOOKS FOR READING

1. Greenwood, D. (2000). Antimicrobial chemotherapy. Oxford University Press, New York. 4th 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. Pfaller, M.A. (2007). Manual of Clinical Microbiology. American Society for Microbiology, Washington D.C. 9th edition
4. Hay, F. C. and West Wood, M.R. (2002). Practical Immunology. Wiley Blackwell Publishers. 4th edition.
5. Rao, C.V. (2005). Immunology. Alpha Science Intl Ltd. 2nd edition.

SECOND SEMESTER

MMI 4201: FERMENTATION TECHNOLOGY

Objective : This course aims to provide fundamentals of fermentation technology and biochemical engineering for the production and recovery of various value-added products including the industrial chemicals, biofuels, metabolites for use in food industry and chemotherapeutic products

PART – A

Production of industrial chemicals, biochemicals and chemotherapeutic products.

Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti cancer agents, amino acids.

PART – B

Microbial products of pharmacological interest, steriod fermentations and transformations. Over production of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity.

Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

PART - C

Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handlig. Distrupction of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations.

PART - D

Rate equations for enzyme kinetics, simple and complex reactions. Inhibition kinetics; effect of pH and temperature on rate of enzyme reactions. Mathematical derivation of growth kinetics, mathematical derivations of batch and continuous culture operations; single stage CSTR; mass transfer in aerobic fermentation ; resistances encountered; overall mass transfer co-efficient (K_a); determination, factors depending on; scale up principle and different methods of scaling up. Metabolic engineering of antibiotic biosynthetic pathways.

BOOKS FOR READING

1. Comprehensive Biotechnology, Vol. I to IV Ed. Moo Young, Pergaman Press, N. York.
2. Methods in Microbiology, Vol. I, II, Eds. J.R. Norris, D.W. Robbins, Academic Press London, New York.
3. Microbial Technology, Ed. H.J. Pepler, Reinhold Publishing Company, New York.
4. Biochemical Engineering: Fundamentals by Bailey & oila McGraw Hill.
5. Biochemical Engineering by Aibe, Humphry & others.
6. Industrial Applications of Microbiology, J. Riviere Surrey, University Press, London.
7. Manual of Industrial Microbiology & Biotechnology by Arnold Demian, JE Davies, AGM Press.

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.

PART – A

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,

PART – B

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

PART – C

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;

PART - D

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.

MMI 4203: ADVACNES IN IMMUNOPROPHYLAXIS AND IMMUNOTHERAPY OF INFECTIONS

Objectives: To give insight into therapeutic and prophylactic measures of various human and animal diseases.

PART – A

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.

PART – B

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.

PART – C

The development of biosynthesized vaccines. Infectious recombinant vectored virus vaccines.

Modern approaches to live virus vaccines, live bacterial vaccines and their application against tumor antigens immunomodifiers in vaccines.

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

Idiotypic vaccines and immunotoxins

PART – D

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. Dekker, Inc., New York - Ed. Richard E. Isaacson, Marce.
2. Vaccine Research and Development, 1992, Vol. I. 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

M.Sc (H.S.) 2nd Year in MICROBIOLOGY
THIRD SEMESTER

MMI 5301: FUNDAMENTALS OF COMPUTER PROGRAMMING & APPLICATIONS

Objective: Fundamentals of Computer Programming and Applications (MMI 5301)

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

PART - A

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.

PART – B

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; Hierachy operation; Basic C programe.

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

PART – C

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.

PART – D

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, ITL 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.
