FACULTY OF SCIENCE

SYLLABI

FOR

B.Sc. (HONOUR SCHOOL) MICROBIOLOGY
3\textsuperscript{rd} TO 6\textsuperscript{th} SEMESTER

EXAMINATIONS
2016-2017

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## OUTLINES OF TESTS, SYLLABI AND COURSES OF READING IN THE SUBJECT OF MICROBIOLOGY FOR B.Sc. (HONS. SCHOOL) (SEMESTER SYSTEM) (MAJOR/SUBSIDIARY) 3rd TO 6th SEMESTER EXAMINATIONS 2016-2017

### B.Sc (H.S.) 2nd year (Major)

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Marks</th>
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<tbody>
<tr>
<td>3rd</td>
<td>BMI 2301</td>
<td>Phycology</td>
<td>3</td>
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<tr>
<td></td>
<td>BMI 2302</td>
<td>Parasitology</td>
<td>3</td>
<td>75</td>
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<tr>
<td></td>
<td>BMI 2303</td>
<td>Environmental Microbiology</td>
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<td>4th</td>
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<td>Industrial Microbiology</td>
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<tr>
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<td>Soil Microbiology &amp; Bioremediation</td>
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<td></td>
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### Subsidiary courses for B.Sc (HS) 2nd year in Microbiology

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<tr>
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<tr>
<td>Biochemistry</td>
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<tr>
<td>Statistics</td>
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Total Credits = 48  
Total Marks = 1200

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

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<tr>
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<td>Introduction to General Microbiology</td>
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<td>BMIS 2372</td>
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<td>4th</td>
<td>BMIS 2471</td>
<td>Introduction to Applied Microbiology</td>
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Total credits = 8  
Total Marks = 200

### B.Sc (H.S.) 3rd year

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<td></td>
<td>BMI 3502</td>
<td>Microbial &amp; Molecular Genetics</td>
<td>4</td>
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<td>BMI 3503</td>
<td>Food Microbiology</td>
<td>4</td>
<td>100</td>
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<td></td>
<td>BMI 3504</td>
<td>Immunochemistry</td>
<td>4</td>
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<td>Medical Bacteriology – II</td>
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<td></td>
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<td>Microbial Physiology &amp; Metabolism</td>
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<tr>
<td></td>
<td>BMI 3604</td>
<td>Immunopathology</td>
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Total credits = 40  
Total Marks = 1000

### GRANT TOTAL

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<td>= 3400</td>
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B.Sc (H.S.) 2nd year in MICROBIOLOGY

THIRD SEMESTER

BMI 2301: PHYCOLOGY

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

UNIT-I

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

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

UNIT-II


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

UNIT-III

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

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

UNIT-IV

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

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

BOOKS FOR READING

1. Algal Culturing Techniques by Robert A. Andersen, Elsevier Academic Press, 2005
LIST OF PRACTICALS:-

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

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

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

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

**UNIT-I**

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

**UNIT-II**

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

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

**UNIT-III**

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

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

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

**UNIT-IV**

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

**BOOKS FOR READING**

LIST OF PRACTICAL:-

1. Demonstration of various protozoa/intestinal helminthes in stool samples;
   a) *Entamoeba histolytica* (Cyst)
   b) *Entamoeba coli* (Cyst)
   c) *Giardia lamblia*
   d) *Enterobius vermicularis*
   e) *Taenia* species
   f) *Ascaris lumbricoides*
   g) *Ancylostoma duodenale*

2. To examine the stool samples for the presence of protozoa/helminthes by simple/concentration techniques

3. To examine the auxenic culture of *Giardia* and *Entamoeba*.

4. To examine malarial parasite in peripheral blood.

5. To examine morphology of microfilarae in permanent slide.
**BMI 2303: ENVIRONMENTAL MICROBIOLOGY**

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

**UNIT-I**

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

**UNIT-II**

Microbial biodegradation of petroleum products in terrestrial, aquatic environment. Problems related to SO₄, reducing bacteria in petroleum industries and their metabolism, ecology and physiology. Treatment and disposal of petroleum refinery waste. Heavy crude and oil shale. Recovery of petroleum from oil bearing rocks.

**UNIT-III**

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

**UNIT-IV**

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

**BOOKS FOR READING**

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

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

**LIST OF PRACTICAL:**

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

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

UNIT-I

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

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

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

UNIT-II

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

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

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

UNIT-III

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

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

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

UNIT-IV

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

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

**BOOKS FOR READING**

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

**Journals**

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

**LIST OF PRACTICAL:**

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

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

UNIT-I

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

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

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

UNIT-II

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

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

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

UNIT-III

Basic Operations in Industrial Fermentation: Modes of operation- Batch, Continuous & Fed Batch fermentations; Inoculum preservation and growth Fermenter preculture, Production fermenter-fermenter size, temperature, aeration, agitation and pressure; Process monitoring and control; Product isolation from fermentation broth, product purification.

Industrial Productions: Citric acid, Beer, Penicillin, Baker’s Yeast, Beta Carotene, amino acids, enzymes & important fermented products.
**Economics of Industrial Fermentation:** Isolation of microorganisms of potential interest, strain improvement, market potential, plant & equipments, media, air sterilization, heating & cooling, aeration & agitation, batch process cycle times, continuous culture, Recovery costs, water usage & recycling, effluent treatment.

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

**UNIT-IV**

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

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

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

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

**BOOKS FOR READING**

**a) Essential**

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

2. Applications of Microbiology- J. Riviere

Journals

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

LIST OF PRACTICALS:

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

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

**UNIT-I**

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

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

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

**UNIT-II**

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

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

**UNIT-III**

**Nitrogen fixation:** Biochemistry of N\(_2\) fixation, properties of terrestrial nitrogen fixing organisms, free living diazotrophs.

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

**Denitrification:** Biochemical properties of denitrification, Microbiology of denitrification, quantification of N\(_2\) losses from ecosystem via denitrification, environmental factors controlling the denitrification.

**UNIT-IV**

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

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

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

LIST OF PRACTICALS:

1. To enumerate the number of organisms in rhizospheric soil and to study their diversity.
2. To enumerate the number of organisms in non-rhizospheric soil and to study their diversity.
3. To quantify the nitrate in given soil sample.
4. To quantify the nitrite in given soil sample.
5. To quantify the carbonate in given soil sample.
6. To perform contact slide assay.
7. To quantify the available phosphorus in the soil.
8. To isolate symbiotic nitrogen fixing organism (Rhizobium) and to coat the soyabean seeds with the isolated rhizobium.
9. To isolate the free living diazotrophes (Azotobacter) from the soil.
10. To isolate the microorganisms from air by plate settling method.
11. To isolate the microorganisms from air by using air sampler.
Note: The pattern of Question paper set by the Examiner should be as below:

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

THIRD SEMESTER
BMIS 2371: INTRODUCTION TO GENERAL MICROBIOLOGY

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

UNIT-I

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

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

UNIT-II

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


UNIT-III

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

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

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

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

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

BOOKS FOR READING


LIST OF PRACTICALS:

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

BMIS 2471: INTRODUCTION TO APPLIED MICROBIOLOGY

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

UNIT-I

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

UNIT-II

Introduction to pathogenic microbiology, chemotherapy and epidemiology, pathogenesis of infectious diseases caused by various micro-organisms like bacteria (Streptococci, Staphylococci, Corynebacterium, Mycobacterium, Clostridium, E. coli, Salmonella, Shigella, Vibrio, Klebsiella), Parasites (Giardia, Entamoaba, Plasmodium, Leishmania) and Viruses (Rhinoviruses, Rubella, Measles, Mumps, Rabies, Influenza, Rota, Herpes, Small Pox, Hepatitis, HIV).

UNIT-III

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

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

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

UNIT-IV


LIST OF PRACTICALS:

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

**BOOKS FOR READING**

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

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

UNIT-I

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

UNIT-II

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

UNIT-III

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

UNIT-IV

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

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

PRACTICAL LIST :

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

• Introduction to identification schemes

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

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

UNIT-I


UNIT-II

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

UNIT-III

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

UNIT-IV

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

BOOKS FOR READING


LIST OF PRACTICALS:

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

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

UNIT-I


UNIT-II

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

UNIT-III

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

UNIT-IV

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

BOOKS FOR READING

a) Essential
7. Fundamentals Food Microbiology, 4e Ray 2011
b) **Further readings**


**Journals**

1. International Journal of Food Microbiology
2. Food Microbiology and Safety
3. Journal of Food Safety
4. Food Microbiology and Food Safety
5. International Journal of Nutrition and Food Sciences

**LIST OF PRACTICAL:**

1. To study the major groups of food and respective nutritional constituents.
2. To study the structure of different food groups.
3. To perform the proximate analysis of various food groups (mushrooms, vegetables, fruits, meats).
4. To study the microbial flora associated with different food types.
5. To study the role of yeasts in bread making.
6. To study the production of sauerkraut by microorganisms.
7. To study the rope causing bacteria in bread & flour.
8. To isolate and study the food spoilage causing microorganisms from various food commodities.
9. To study the effect of temperature on the shelf life of various food commodities.
10. To study the nutrient contents present in various food commodities.
11. To detect the adulterations in various food types.
12. To determine the mastic condition of milk by Hotis test, clot on boiling & alcohol test.
13. To study the effect of moisture on the shelf life of various food commodities.
14. To check the bacteriological quality of raw milk on the basis of MBRT, resazurin reduction test, SPC & DMC.
15. To assess the quality of raw milk on the basis of rapid platform tests.
16. To assess the bacteriological quality of potable water on the basis of MPN.
17. To assess the bacteriological quality of powdered milk products on the basis of SPC, coliform count, yeasts and moulds.
18. To assess the bacteriological quality of ice cream on the basis of SPC and coliform count.
19. To assess the microbiological quality of butter on the basis of yeasts and moulds.
20. To determine lactose content in milk by Lane Eynon’s method.
21. To determine total, reducing and non reducing sugars in fruit juices.
22. To quantify total carbohydrates in solid food samples by Lane Eynon, and anthrone methods.
23. To determine fat content in oil seeds by Soxhlet method.
24. To determine moisture content in various foods.
BMI 3504: IMMUNO CHEMISTRY

**Objective:** The immunology section will introduce the student to immunologic concepts and their relationship to medicine. The cellular and molecular basis of the immune system and its function in host-parasite interactions are covered.

**UNIT-I**

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

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

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

**UNIT-II**

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

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

**UNIT-III**

**Molecular basis of immunogenicity and antigencity:** 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, Immune Fluorescence assay. Adjuvants, their chemical nature and mode of action.


**UNIT-IV**

**Immune Effector Mechanisms:** 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.
**MHC, Monoclonal Antibodies:**- General organization of Major Histocompatibility complex, Major classes of MHC Molecules, Class I, Class II and Class III. MHC, disease susceptibility and immune responsiveness. Generation of monoclonal antibodies, hybridoma technology and various applications of monoclonal antibodies.

**BOOKS FOR READING**


**LIST OF PRACTICALS:**-

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

UNIT-I

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

- Diseases caused facultatively anaerobes of family enterobacteriaceae
  - *Escherichia coli*; intestinal and extra intestinal infections
  - *Klebsiella pneumoniae*
  - *Shigella: Shigella dysenteriae, S. sonnei, S. flexneri and S. boydii*
  - *Salmonella: Causal agents of enteric fever, septicemia and enteritis.*
  - *Proteus, Morganella* and *Providencia* group
  - *Serratia marcescens*
  - *Yersinia pestis, Y. enterocolitica* and *Y.pseudotuberculosis*
- Diseases caused by *enterics* other than family *enterobacteriaceae*
  - *Campylobacter jejuni* and *Helicobacter pylori*
  - *Vibrio cholerae; V parahaemolyticus etc*
  - *Aeromonas* species

UNIT-II

- Non fermentative Gram-negative aerobic
  - *Pseudomonas,*
  - *Stenotrophomonas,*
  - *Burkholderia,*
  - *Acinetobacter, Alcaligenes, Moraxella, and Flavobacterium.*
- Diseases caused by Gram-negative anaerobes
  - *Bacteroides fragilis* and *Fusobacterium sp*

UNIT-III

- Diseases caused by the following Gram-negative fastidious organisms
  - *Neisseria meningitidis* and *N. gonorrhoeae*
  - *Haemophilus influenzae* and *H. ducreyi*
  - *Bordetella pertussis, B. parapertusis and B. bronchiseptica*
  - *Francisella tularensis*
  - *Brucella* species and *Bartonella* species
  - *Legionella pneumophilla*
  - *Calymmatobacterium* species
UNIT-IV

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

BOOKS FOR READING

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

LIST OF PRACTICALS:

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

a. *Escherichia coli, Edwardsiella tarda, Shigella* species
b. *Citrobacter* species, *Salmonella* species
d. *Proteus* species, *Morganella morganii, Providencia* species
e. *Yersinia enterocolitica*
f. *Vibrio cholerae, Aeromonas* species, *Pleisomonas shigelloides, Flavobacterium*
g. *Achromobacter, Acinetobacter* species
h. *Moraxella, Alkaligenes feacalis*
i. *Burkholderia*
j. *Stenotrophomonas*
**BMI : 3602: VIROLOGY**

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

**UNIT-I**

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

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

**Classification and Nomenclature of viruses:** Conventional and Baltimore classification.

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

**UNIT-II**

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

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

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

**UNIT-III**

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

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

**UNIT-IV**

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

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

**BOOKS FOR READING**

3. Review of Medical microbiology by Jawetz, Melnick and Adelberg. Lange Medical

LIST OF PRACTICALS:

1. Isolation of bacteriophage from sewage samples.
2. Demonstration of spot assay and turbidity method for detection of lytic bacteriophage.
3. Purification and preparation of high titre of bacteriophage.
4. Enumeration of bacteriophage in a sample by Plaque forming unit method.
6. Demonstration of various tissue culture methods.
7. Demonstration of various egg inoculation techniques.
**BMI 3603: MICROBIAL PHYSIOLOGY AND METABOLISM**

**Objective:** The objective of the course is to teach the various aspects of microbial metabolism, growth kinetics and cell thermodynamics so as to understand the microbial physiology. This knowledge will be helpful to students for the research and industrial applications of microorganisms.

**UNIT-I**

Introduction and scope of microbial physiology studies.

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

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

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

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

**UNIT-II**

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

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

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

**UNIT-III**

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

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

**UNIT-IV**

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

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


LIST OF PRACTICALS:

1. Preparation of various buffers
2. To plot the bacterial growth curve
3. To perform the shake flask fermentation and to study the enzyme production at different time intervals.
4. To study the functioning of lac operon.
5. To find the optimum pH of given enzyme.
6. To find the optimum temperature of given enzyme.
7. To find the temperature stability of given enzyme
8. To find the pH stability of given enzyme.
9. To study the catabolite repression
10. To study the effect of various agents like metal ions, detergents on enzymes.
11. To calculate $K_m$ and $V_{max}$ of given enzyme.
12. To check the isoelectric point of protein.
Objective: The objective of teaching of this course is the application of basic immunology /immunochemistry in various clinical manifestations/pathologies.

UNIT-I
Hypersensitivity reaction and Gell and Coomb classification.

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

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

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

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

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

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

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

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

UNIT-IV
Classification of immunodeficiency diseases:- Primary deficiencies, immune deficiencies of myeloid lineage, phagocytic number, adherence, chemotactic and killing defects. Humoral deficiencies, Agammaglobulinemia, hypergammaglobulinemia, hypogammaglobulinemia, selective immune deficiencies, Ataxia telangiectasia.
Cell mediated immune deficiencies, Di George syndrome. Combined immunodeficiencies, SCID and Wiscott Aldrich Syndrome, Experimental models of immunodeficiency, nude and SCID mouse.

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


BOOKS FOR READING

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

LIST OF PRACTICALS:-
1. To determine Bleeding and Clotting time of blood.
2. To observe the histopathology slides of liver, kidney and lung tissue for inflammation.
3. To perform CRP test.
4. To perform VDRL test.
5. To perform RPR test for Syphilis.
6. To perform pregnancy test using the principle of latex agglutination inhibition.
7. To perform Visipreg strip test.
8. To perform Mantoux/Tuberculin Test.
9. To perform the test for detection of typhoid fever (Widal test).
10. To separate lymphocytes by perfusion technique.
11. To analyze the glass adhering property of monocytes.
12. To check the viability and count of the monocytes isolated in the previous experiment.
13. To assess passive heam agglutination by Rheumatoid Arthritis Factor.
14. To determine liver function by assessing ALT, AST and ALP in serum samples.
15. To distinguish apoptotic cells from necrotic cells.