



Department of Microbiology
Faculty of Allied Health Sciences

SGT UNIVERSITY

Shree Guru Gobind Singh Tricentenary University

Gurgaon-122505

Syllabus

M.Sc. Microbiology

Duration: 2 years (4 Semester)

W.e.f. Academic Session 2020-21

SEMESTER I

GENERAL MICROBIOLOGY

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

UNIT I: Introduction to Microbiology: Historical background and scope of Microbiology. Structure of prokaryotic and eukaryotic cell. Differences between Eubacteria, Archaeobacteria and Eukaryotes. Salient features of different groups of microorganisms - bacteria, fungi, protozoa, virus and algae including mode of reproduction. Nutrition and Classification: Principles of microbial nutrition- Chemoautotrophs, chemoheterotrophs, photoautotrophs and photoheterotrophs.

UNIT II: Bacteria and Viruses: Isolation, culture, identification and preservation of bacteria. Gram positive and gram-negative organisms. Structure and functions of peptidoglycan in gram positive and gram-negative organisms. General characteristics, structure, and classification of viruses, Replication of viruses. Lytic and lysogenic cycle in bacteriophages. A Brief account of Retroviruses, Viroids, Prions

UNIT III: Microbial Growth: Culture media and its types. Microbial growth: definition and different phases of growth. Measurement of microbial growth. Bacterial growth curve. Factors affecting microbial growth. Culture collection and maintenance of microbial cultures.

UNIT IV: Control of Microorganism: Control of Microorganism by physical and chemical agents. Antiseptics and disinfectants. Narrow and broad spectrum antibiotics. Antifungal antibiotics, Mode of action of antimicrobial agents.

UNIT V: Microbial Ecology: Microbial flora of soil, Interaction among microorganisms in environment. Symbiotic associations, commensalism, mutualism, amensalism. Brief account of biological nitrogen fixation.

Practical

L T P -- CREDITS

– 2

EXAMINATION: 30 MARKS

INT ASSESSMENT: 20 MARKS

TOTAL MARKS: 50 MARKS

1. Isolation of microorganism: Serial dilution, pure culture techniques

2. Perform gram's staining procedure
3. Preparation of important microbiological media
4. Isolation of fungi from soil sample
5. Perform antibiotic sensitivity test
6. Study of important viruses (photographic demo)
7. Study of important protozoa (photographic demo)

Suggested readings:

1. The Prokaryotes. A handbook on the biology of bacteria: ecophysiology, isolation, identification, applications. Volumes I-IV by Balows, A., Truper, H. G., Dworkin, M., Harder, W., Schleifer, K. H. Springer-Verlag, New York; 1992
2. Bacterial Systematics, by Logan, A., Niall A. Logan, Wiley-blackwell; 1994
3. Principles of Microbiology by R.M. Atlas, Mosby publishers, St. Louis; 1995
4. Madigan, M.T., Martinko, J.M., Bender, K., and Buckley, D. (2011) Brock Biology of Microorganisms, 13th Ed., Pearson Education, USA
5. Tauro, P., Kapoor, K.K. and Yadav, K.S. (1996). Introduction to Microbiology, New Age Pub., New Delhi
6. Pelczar, M.J. *et. al* (2001), Microbiology- Concepts and Applications, International Ed. McGraw Hill Publication, New York
7. Prescott's Microbiology, Revised edition, McGraw Hill Higher Education, New York

SEMESTER I

VIROLOGY

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

Unit I: General Virology

Brief outline on discovery of viruses, nomenclature and classification of viruses; distinctive properties of viruses; morphology & ultra structure; virus related agents (viroids, prions). Cultivation of viruses in embryonated eggs, experimental animals, and cell culture.

Unit II: Bacteriophages

Bacteriophage structural organization; life cycle: lysogenic cycle; bacteriophage typing; application in bacterial genetics. Assay of viruses – physical and chemical method (protein, nucleic acid, radioactivity tracers, electron microscopy)- infectivity assay (plaque method, end point method).

Unit III:

Plant viruses: Effects of viruses on plant; appearance of plants; historical, physiology and cytology of plants. Plant viruses like TMV, Cauliflower Mosaic Virus; transmission of plant viruses with vectors (insects, nematodes, fungi) and without vectors (contact, seed and pollens).

Unit VI: Animal Viruses

Introduction to animal human viruses; Epidemiology, lifecycle, pathogenicity of :

RNA Viruses: Picorna, Ortho myxo, Paramyxo, other arthropod viruses, Rhabdo, Rota and HIV. **DNA viruses:** Pox, Herpes, Adeno, Hepatitis viruses. **Viral vaccines** (conventional vaccines, genetic recombinant vaccines used in national immunization programmes with examples, newer generation vaccines including DNA Vaccines with examples) interferons, and antiviral drugs.

Practical

L T P -- CREDITS

– 2

EXAMINATION: 30 MARKS

INT ASSESSMENT: 20 MARKS

TOTAL MARKS: 50 MARKS

Demonstration of:

1. To study structure of important animal viruses (rhabdo, influenza, paramyxo, Hepatitis B & retroviruses) using electron micrographs/photographs
2. To study structure of important plant viruses (caulimo, gemini, tobacco ring spot, cucumber mosaic & alpha-alpha mosaic viruses) using electron micrographs/photographs
3. Study of cytopathic effects using photographs
4. Viral vaccines and their applications

Recommended Books:

1. Morang C and Timbury M.C (1994) medical virology-X- Edition. Churchill Livingstone, London.
2. Dimmock NJ, Primrose SB (1994). Introduction to modern Virology, IV Edition, Blackwell Scientific Publication, Oxford.
3. Topley and Wilson's (1995) Text Book on Principles of Bacteriology, Virology and immunology. Edward Arnold, London.

SEMESTER I BIOCHEMISTRY AND BIOCHEMICAL TECHNIQUES

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

UNIT I

Carbohydrates: Structure and function, classification: mono-, di- and polysaccharides, glycoproteins. Metabolism of carbohydrates- Glycolysis, Citric acid cycle, Gluconeogenesis and Pentose phosphate pathways and their regulations.

UNIT II

Lipids: Structure of fatty acids, Classification of lipids, essential fatty acids, Structure and functions of major lipids, subclasses- Acylglycerols, Phospholipids, Glycolipids, lipoproteins, Sphingolipids, and Steroids. Fatty acids: oxidation.

Unit III

Proteins: Structure and classification of amino acids, non-protein and rare amino acids. Metabolism of amino acids, urea cycle. Structural organization of proteins, Protein secondary structure, tertiary structure, quaternary structure with examples, protein denaturing and renaturing. Role of chaperons in protein folding.

Unit IV

pH, buffers and Nucleic acids: pH, buffers, Henderson-Hasselbalch equation. Nucleic Acids: Structure and properties of nucleic acid bases, nucleosides and nucleotides. Biosynthesis and regulation of purines and pyrimidines.

Unit V:

BIOCHEMICAL TECHNIQUES: Principle and applications of spectrophotometer-UV/visible, fluorescence. **Spectroscopy:** Principle and applications, Mass spectroscopy **Chromatography:** Principles and applications of Chromatography: Thin layer chromatography (TLC), Gel filtration chromatography, Ion exchange chromatography, Affinity chromatography, Gas chromatography (GC) and [(HPLC). **Electrophoresis:** Definition, principles and applications; different types of Electrophoresis- PAGE, SDS-PAGE, Agarose gel electrophoresis.

Suggested readings:

1. Biochemistry by Geoffrey L. Zubay. Fourth Edition, Addison-Wesley educational publishers Inc., 2008
2. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox. Fifth Edition, W.H. Freeman and Company; 2008.

SEMESTER I MOLECULAR BIOLOGY

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

UNIT I: DNA Structure: DNA as genetic material, Chemical structure and base composition of nucleic acids, Double helical structures, Different forms of DNA, Properties of DNA, Renaturation and denaturation of DNA.

UNIT II: DNA Replication: General features of DNA replication, Enzymes and proteins of DNA replication, Models of replication, Prokaryotic and eukaryotic replication mechanism. Fidelity of DNA replication.

UNIT III: Transcription: Mechanism of transcription in prokaryotes and eukaryotes, RNA polymerases and promoters, Post-transcriptional processing of tRNA, rRNA and mRNA (5' capping, 3' polyadenylation and splicing).

UNIT IV :Translation: Types of RNA, tRNA structure, RNA splicing and RNA editing. General features of the genetic code; Ribosome as the site of protein synthesis; Activation of amino acids; Initiation, elongation and termination of protein synthesis in prokaryotes and eukaryotes. Post-translational processing of the polypeptide chains; Acylation, methylation, sulfation, phosphorylation and glycosylation

UNIT V: Regulation of Gene Expression: Operon concept, Positive and negative control, lac and trp operon.

PRACTICAL

L T P -- CREDITS

- 2

EXAMINATION: 30 MARKS

INT ASSESSMENT: 20 MARKS

TOTAL MARKS: 50 MARKS

1. Plasmid DNA isolation technique
2. Isolation of bacterial phages
3. Genomic DNA isolation technique
4. Electrophoresis technique
5. PCR: demonstration
6. Subculturing of cells and cytotoxicity assays.

Suggested readings:

1. Lewin, B. Gene X, Oxford University Press.
2. Brown, T.A. Genomes, John Wiley and Sons Inc.
3. Brown. T.A. Molecular Biology LabFax, Bios Scientific Ltd. Oxford.
4. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. Molecular Biology of the Cell, Garland Publishing.
5. Lodish, H., Berk, A., Zipursky, S., Matsudaira, P., Baltimore, D. and Darnell, J.E Molecular Cell Biology, W.H. Freeman and Company.

SEMESTER I

RESEARCH METHODOLOGY AND BIostatISTICS AND HOSPITAL MANAGEMENT

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

UNIT 1: Introduction of Research Methodology

Research – Definition, concept, purpose and approaches.

Variable in research, reliability & validity in research.

Scales of measurement.

Steps in the Research Process

- Identifying interest areas and prioritizing
- Selection of the topic and considerations in selection
- Review of related literature and research
- Concepts, hypotheses and theories
- Research Design
- Research questions, objectives and assumptions (with examples to be brought by students as exercise)

UNIT 2:Types of Research

- Basic and applied research, Qualitative and Quantitative research (brief review of differences)
- Descriptive research methods – survey, case study, correlation study, causal-comparative research
- Analytic studies- pre-experimental, experimental research, quasi experimental research
- Evaluative research- general characteristics, use of qualitative methods in enquiry (Exercise to be based on actual research papers published in accredited journals)
Results, Discussion, Conclusion, Summary, Abstract, Bibliography and Appendices

UNIT 3:Introduction of Biostatistics

Definition: biostatistics, concept and scope in research

Collection & presentation of data.

Methods of scaling: nominal, ordinal, ratio and interval scale.
Measures of central tendency-mean, median, mode and its uses, measures of dispersion /variability- range, variance, standard deviation, standard error, coefficient of variation, Kurtosis, Skewness (practical aspects of grouped data-frequency distribution, histogram, frequency polygons, percentiles

UNIT 4: Data Management

Sampling

Concept of population and sample.

- . Types of sampling methods and generalizability of results
- Probability sampling- simple random sample, systematic random sample, stratified random sampling etc.-random and non-random samples, random numbers and use
- Non-probability sampling-purposive samples, quota samples, snowball samples (Based on Journal contents discuss types of Research with Examples)
- General consideration in determination of sample size.

UNIT 5: Analysis and Evaluation

Correlation and Regression, its interpretation and practical approach, concept of probability distribution : discrete and continuous, Normal distribution.

Chi square test and its interpretation practical approach General features of Chi-square tests, goodness of fit, Test for Independence of attributes.

Parametric and non- parametric tests- t-test for single sample, paired t-test, unpaired t-test, Z-test and F-test, Mann-Whitney U test, Wilcoxon signed rank test, repeated measures ANOVA, Friedman test, kruskal Wallis test.

Software used in Statistical Analysis and research.

Unit 6 : Hospital Management

Functions of Hospital administration

Modern technique in hospital management.

Challenges and strategies of Hospital management.

Designing of Health Care, Medical records, Housekeeping services

Laboratory performance, Management of bio-medical waste

Evaluation of hospital services.

SEMESTER I

M.Sc. Dissertation

Critical research appraisal

The student is expected to read and critically evaluate minimum of 5 papers and present the inference of every part in a clear and precise manner in the form of a report and short seminar at the end of semester based on which the student will be evaluated.

SEMESTER II

MICROBIAL GENETICS

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

Unit 1

Prokaryotic Genome: *E.coli* chromosome- coiled, supercoiled. Eukaryotic Genome: Structure of nucleus and chromosome, lamp brush chromosome, nucleosomes, Histones: types and their role, histone chaperons, solenoid model, Packaging of DNA, role of N-terminal tails, nuclear scaffold, role of proteins involved, nucleosome assembly.

Unit 2

Mutation: Mutagenesis: definition, types of mutations, Molecular mechanism of mutations, Physical and chemical mutagenic agents. DNA repair mechanism - excision, mismatch, SOS, photo-reactivation, recombination repair and glycocylase system, site-directed mutagenesis, application of mutagenesis in strain improvement.

Unit 3

Genetic recombination: Genetic recombination in bacteriophages and *E. coli*, synopsis of homologous duplexes, breakages and re-union role of RecA and other recombinases, generalized & specialized transduction, transformation and conjugation.

Unit 4

Gene transfer mechanisms: Bacterial transformation; Host cell restriction; Transduction; complementation; conjugation and transfection, mechanisms and applications.

Unit 5

Plasmids and Bacteriophages: Gene mapping of Plasmids: types, purification and application, Phage genetics, genetic organization, Life cycle and their uses in microbial genetics, Lytic phages and Lysogenic phages.

PRACTICAL

L T P -- CREDITS

– 2

EXAMINATION: 30 MARKS

INT ASSESSMENT: 20 MARKS

TOTAL MARKS: 50 MARKS

1. Isolation and electrophoretic analysis of genomic DNA (from bacteria, fungi and algae)
2. Isolation and electrophoretic analysis of plasmid DNA from bacteria
3. Mutagenesis: Identification and isolation of fungal mutants [physical (UV) and chemical (EMS)].
4. Study of replica plating techniques
5. Bacterial transformation by CaCl₂ method

Suggested readings:

1. Snyder L. and Chapness W. Molecular Genetics of Bacteria 2007.
2. Birge EA. 1981. Bacterial and Bacteriophage Genetics. Springer Verlag.
3. Gardner JE, Simmons MJ & Snustad DP. 1991. Principles of Genetics. John Wiley & Sons.
4. Lewin B. 1999. Gene. Vols. VI, IX. John Wiley & Sons.
5. Maloy A & Friedfelder D. 1994. Microbial Genetics. Narosa.
6. Scaife J, Leach D & Galizzi A 1985. Genetics of Bacteria. Academic Press.
7. William Hayes 1981. Genetics of Bacteria. Academic Press.
8. Microbial Genetics. Maloy et. al. 1994. Jones & Bartlett Publishers.
9. Dale J.W., Molecular genetics of bacteria. 1994. John Wiley & Sons.
10. Streips & Yasbin. Modern microbial genetics. 1991. Niley. Ltd.

SEMESTER II

FOOD MICROBIOLOGY

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

UNIT I:

Introduction: Development of food microbiology as a science, scope of food microbiology. Food as substrate for microorganisms, intrinsic and extrinsic factors affecting the growth of microbes, important microorganisms in food (molds, yeasts and bacteria) and their source (air, soil, water, plants and animals).

Unit 2

Food contamination and spoilage: Sources of food contamination. Principles of food spoilage; spoilage of cereals, sugar products, vegetables, fruits, meat and meat products, milk and milk products, fish and sea foods, poultry; spoilage of canned foods.

Unit 3

Food-borne infections and intoxication: Bacterial- *Brucella*, *Bacillus*, *Clostridium*, *Escherichia*, *Listeria*; Food intoxication- *Botulism*, *Staphylococcal*. Mycotoxins & their types – aflatoxins, ochratoxins, fumonisins, trichothecenes, zearalenone, ergot alkaloids; food borne outbreaks and lab testing procedures and Preventive measures. Brief account on diseases of Molds, Algae, Protozoa, Viruses.

Unit 4

Food preservation: Principles and methods of food preservation- Physical (temperature, irradiation, drying, canning, Chemical (Organic acids, food additives. Class I and Class II preservatives), Biopreservation (Lactic acid bacteria). Food Packaging- Types of packaging materials, properties and benefits.

Unit 5

Microbial and Fermented foods: SCP- Nutritional & therapeutic importance, Fermented Vegetables (olives, cucumbers), Meat (sausages), Beverage (cocoa and coffee); Bread, Idli, Dairy foods (cheese). Production methods of Kefir, Yogurt, Acidophilus milk; Probiotics, Prebiotics and Synbiotics, Nutraceuticals, functional foods.

Unit 6

Food and sanitation: Good Hygiene Practices, Sanitation in manufacture and retail trade; food control agencies and their regulation, hazard analysis and critical control points (HACCP); GMP, plant sanitation – employees' health standard, waste treatment, disposal, quality control. Recent trends and development in food technologies in India.

PRACTICAL

L T P -- CREDITS

- 2

EXAMINATION: 30 MARKS

INT ASSESSMENT: 20 MARKS

TOTAL MARKS: 50 MARKS

1. Study culture characteristics of important microorganisms in food (molds, yeasts and bacteria)
2. Isolation and identification of common food borne pathogens (*Enterobacteriaceae*, *Pseudomonas*, *Staphylococcus*, *Salmonella*, *Listeria*, *Vibrio*)
3. Study of fermented foods- Isolation and identification of microbes from yogurt, sauerkraut, idli batter, sausages
4. Role of yeast in bread making
5. Dahi preparation technique
6. Perform shelf life analysis of any food product.
7. MBRT test for determining the quality of milk

Suggested readings:

1. Ray, B. and Bhunia, A. (2013). Fundamental Food Microbiology, 5th Revised edition. CRC Press Inc
2. Frazier, W.C. and Westhoff, D.C. (1991). Food Microbiology. 3rd Ed. Tata McGraw Hill.
3. Banwart, G. J, (1989.) Basic Food Microbiology. AVI.
4. Jay, J.M., Loessner, M.J. and Golden, D.A. (2005) Modern Food Microbiology, 7th edn. Springer-Verlag New York
5. Lee, B.H. (1996), Fundamental of Food Biotechnology, VCH Publishers.

SEMESTER II

RECOMBINANT DNA TECHNOLOGY AND BIOTECHNOLOGY

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

UNIT I:

Introduction: Principle of gene cloning, vectors: Plasmids: basis features, size and copy number, conjugation and compatibility, classification, Bacteriophage: basic feature, lysogeny, Restriction Enzymes: Types, Restriction Endonuclease, Blunt ends and Sticky ends, Ligation, Linkers and Adaptors.

UNIT II

Isolation Sequencing and Synthesis of Genes: Methods of gene isolation, cloning of specific gene, application of gene cloning: DNA sequencing methods: Maxam Gilbert's and Sanger's dideoxy method, PCR: Polymerase Chain Reaction-Basic Principle , types and application of PCR in Biotechnology, Blotting techniques- Southern Blotting.

Unit III

Proteins identification and characterization: Methods/strategies, protein isolation and purification, stability, SDS PAGE, 2-Dimensional gel electrophoresis: Methods including immobilized pH gradients (IPGs), western blotting.

Unit IV

Application of RDT: Production of regulatory proteins (Interferon, Interleukins), vaccines (Hepatitis-B), hormones (insulin, somatostatin).

PRACTICAL

L T P -- CREDITS

- 2

EXAMINATION: 30 MARKS

INT ASSESSMENT: 20 MARKS

TOTAL MARKS: 50 MARKS

1. Demonstration of DNA amplification by PCR technique
2. Western blotting technique (demo)
3. Southern and northern blotting technique.(demo)
4. Construction of growth curve and determination of specific growth rate and doubling time.
5. PCR
6. Agarose gel electrophoresis.

Suggested readings

1. Brown T.A., Gene Cloning and DNA Analysis ,Blackwell Publishing.
2. Dale J.W. & von Schantz M. 2002. From Genes to Genomes: Concepts and Applications of DNA Technology. John Wiley & Sons.
3. Gupta P.K. 2008. Biotechnology and Genomics. Rastogi Publications.

4. Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.

5. Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.

SEMESTER II MEDICAL MICROBIOLOGY

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

Unit 1

Discovery and introduction to pathogenic microorganisms, medically important flora and organisms; Normal microbial flora of human body; role of the resident flora; normal flora and the human host. Establishment, spreading, tissue damage and anti – phagocytic factor; mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts. Role of aggressions, depolymerising enzymes, organotropisms, variation and virulence.

UNIT II:

Pathogenic Bacteria and Virus: Morphological characteristics, pathogenesis and laboratory diagnosis of following pathogenic bacteria; *Staphylococcus*, *Streptococcus*, *Klebsiella*, *Salmonella*, *Vibrio*, *Pseudomonas*, *Acinetobacter*, *Haemophilus*, *Bacillus*, *Clostridium*, *Mycobacterium*, *Mycoplasma*, *Rickettsiae*, *Chlamydiae*, *Spirochetes*. Common types of hospital infection and their diagnosis and control. Viral Pathogens: Brief account of viral diseases- Hepatitis, Herpes, Measles, Rabies, Polio, Rubella, HIV, SARS, Rotaviruses.

UNIT III:

Medical Mycology: Fungi: definition and Morphology, diseases caused and lab diagnosis of:- Opportunistic fungi - Cryptococcus, Candidiasis, Aspergillus, Zygomycetes. Fungi causing superficial mycoses- Ptyriasisversicolor, TineaNigra, Piedra. Dermatophytes. Subcutaneous mycoses, Dimorphic fungi –Anti-mycotic agents

Unit IV

Protozoa & Helminthology

Morphology, life cycle, laboratory diagnosis of: *Entamoeba*, *Giardia*, *Trichomonas*, *Leishmania*, *Trypanosoma*, *Plasmodium*, *Toxoplasma*, *Taenia*, *Wuchereriabancrofti*

PRACTICAL

L T P -- CREDITS

- 2

EXAMINATION: 30 MARKS

INT ASSESSMENT: 20 MARKS

TOTAL MARKS: 50 MARKS

1. Case study for epidemiology of the diseases taught in theory: students have to collect data and interpret.
2. Isolation and identification of clinically important microbes from clinical specimens(throat swab, sputum, nasal swab, urine, blood, stool)
3. Demonstration of ELIZA
4. Drug susceptibility test
5. Determination of MIC by Kirby-Bauer method
6. To study composition and use of important differential media for identification of pathogenic bacteria
7. To study symptoms of the diseases with the help of photographs - Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis, kaposi's sarcoma), dermatomycoses (ring worms), kala-azar

Suggested readings:

1. Ananthanarayanan R. and C.K. JayaramPanicker Orient Longman Text of Microbiology, 1997.
2. Mackie and McCartney Medical Microbiology Vol.1: Microbial Infection. Vol.2: Practical Medical Microbiology Churchill Livingstone, 1996.
3. Shanson D.C., Wright PSG, Microbiology in Clinical Practice., 1982.
4. Baron EJ, Peterson LR and Finegold SM Mosby, Bailey and Scott's Diagnostic Microbiology, 1990.
5. Smith, C.G.C. "Epidemiology and Infections" (1976): Medowfief Press Ltd., Shildon, England.

SEMESTER II

BIO- ETHICS AND SAFETY

L T P -- CREDITS

2 0 0 - 2

EXAMINATION: 30 MARKS

INT ASSESSMENT: 20 MARKS

TOTAL MARKS: 50 MARKS

UNIT 1:

Biosafety and Biosecurity - Introduction; historical background; introduction to biological safety cabinets; primary containment for biohazards; biosafety levels; GRAS organisms, biosafety levels of specific microorganisms; recommended biosafety levels for infectious agents and infected animals.

UNIT 2:

Definition of GMOs & LMOs; risk – environmental risk assessment and food and feed safety assessment; problem formulation – protection goals, compilation of relevant information, risk characterization and development of analysis plan

UNIT 3

An overview of Patent laws in India. Patent Practice & Problems : Review of case law, public & international depositories, patentability of microorganisms,

UNIT 4:

Genetic engineering. Social issues - public opinions against the microbial technologies. Ethical issues – ethical issues against the microbial technologies. Ethical issues in stem cell research.

UNIT 5: Ethics in genetic testing, cloning, GM foods and genetic therapy.

References:

1. Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press
2. Fundamentals of Environmental Chemistry, G.S. Sodhi, Narosa Publishers.
3. Introduction to Environmental Pollution, B.K. Sharma, H. Kaur, Goel Publishers.

SEMESTER II **M.Sc. Dissertation**

Project development (2 credit)

In this semester the student is expected to work on finalising the topic and methodology with a detailed review of literature work to be submitted in the form of a synopsis along with a seminar to be held. Allotment of guide will also be carried out. It will involve a comprehensive literature survey of the chosen research area. Through regular meetings, the student and advisor discuss this literature in detail and the topic for research project.

SEMESTER III

INDUSTRIAL MICROBIOLOGY

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

Unit 1

Introduction: Scope of Industrial Microbiology and fermentation technology. Study of industrially important micro-organisms and their preservation. Criteria for selection and strategies for strain improvement; maintenance and containment of recombinant organisms.

Unit 2

Fermentation process: Batch culture: growth kinetics; effect of environment: temperature, pH, nutrient concentration; monitoring microbial growth in culture. Continuous culture, apparent viscosities; anti-foam agents.

Unit 3

Fermentors: Basic features, design & components – Typical fermentor. Sterilization of fermentor, medium, air supply. Fermentation media: sources of carbon, nitrogen, vitamins and minerals; role of buffers, precursors, inhibitors and inducers. Specialized bioreactors (Photobioreactors)

Unit 4

Solid state fermentation (SSF): Estimation of growth in SSF, concept of sterility. Factors influencing SSF, design of fermentor in SSF (Koji fermentor). Production of commercially important products by SSF.

Unit 5

Downstream processing: Objectives and criteria, foam separation, precipitation methods, filtration, centrifugation, cell disruption methods, liquid extraction, membrane filtration, chromatography, drying devices, crystallization. Solvent recovery. Effluent treatment.

Quality control of fermented products.

PRACTICAL

L T P -- CREDITS

- 2

EXAMINATION: 30 MARKS

INT ASSESSMENT: 20 MARKS

TOTAL MARKS: 50 MARKS

1. Visit to any related industry
2. Report making and seminar in selected topic of interest

Suggested readings

1. Stanbury P. F., A. Whitaker, S. J. Hall. Principles of Fermentation Technology Publisher: Butterworth-Heinemann
2. Shuler M.L. and F. Kargi: Bioprocess Engineering Basic Concepts by Publisher Prentice Hall.
3. Prescott and Dunn's Industrial Microbiology. Publisher: Gerald Reed: Books.

SEMESTER III IMMUNOLOGY

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

Unit 1

Immune System and immunity: History of immunology; innate and acquired immunity. Cells and organs involved in immune system – T-cells, B-cells, lymphoid organ, spleen and bone marrow. Antigenic properties, T and B cell epitopes, chimeric peptides, macrophages, antigen-processing cells, eosinophils, neutrophils, mast cells and natural killer cells; immune responses – cell mediated and humoral, clonal selection and nature of immune response.

Unit 2

Antigen and antibodies: Types, structure and properties of antigens, haptens; adjuvant - antigen specificity. Immunoglobulins – structure, types and subtypes, properties, primary and secondary responses, Antibody diversity. Complement system – Structure, components, properties and functions, complement fixation and complement pathways, biological consequences. Inflammation- effector mechanisms.

Unit 3

Antigen-antibody reactions: Agglutination, precipitation, immunoelectrophoresis, immunofluorescence, ELISA, RIA; Flow cytometry, Montaux test. Applications of these methods in diagnosis of microbial infections, autoimmunity mechanisms, altered antigens, systemic lupus erythematosus, Graves's diseases, rheumatoid arthritis, myasthenia gravis, multiple sclerosis. Concept of Immunodeficiency.

Unit 4

Hypersensitivity reactions: Allergy, Type I- Anaphylaxis; Type II- Antibody dependent cell cytotoxicity, Type III- Immune complex mediated reactions, Type IV- delayed type hypersensitivity. Symptoms and Immunological methods of diagnosis of hypersensitivity reactions. Lymphokines and cytokines

Unit 5

Major histocompatibility complex (MHC): Structure and functions of MHC and the HLA systems. Tissue typing methods for transplantations in humans; graft versus host reaction and rejection. **Tumor immunology:** tumor specific antigens, Immune response to tumors, immunodiagnosis of tumors – detection of tumor markers – alphafoetal proteins, carcinoembryonic antigen, Cancer therapeutics.

Unit 6

Immunization: Common immunization practice, types of vaccines and its application. Edible vaccines. Production of Polyclonal and monoclonal antibodies; antibody engineering. Plantibodies.

PRACTICAL

L T P -- CREDITS

- 2

EXAMINATION: 30 MARKS

INT ASSESSMENT: 20 MARKS

TOTAL MARKS: 50 MARKS

1. To separate serum from the blood sample (demonstration).
2. To perform DOT ELISA.
3. To perform immunoelectrophoresis.
4. Blood grouping

5.Precipitation and agglutination reaction

Suggested readings:

- 1.Clark, W.R., "The Experimental Foundations of Modern Immunology (1991): John Wiley and Sons.Inc.
2. Roitt, I.M: Essential Immunology (1995): Blackwell Scientific Publications, Oxford.
3. Roth, J.A. (1985): Virulence Mechanism of Bacterial Pathogens. American Society for Microbiology, Washington D.C.
- 4.Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne Immunology, 8th Edition, Freeman, 2012.

SEMESTER III INTRODUCTION TO BIOINFORMATICS

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

1. Introduction to Bioinformatics

Definition and History of Bioinformatics, Internet and Bioinformatics, Introduction to Data Mining, Technologies used in Data Mining, Applications of Data Mining to Bioinformatics.

2. Biological Databases

Types: primary, secondary, specialized, Gen bank, Database searches: sequence retrieval systems; Similarity searching: BLAST, FASTA, Protein and nucleic acid databases, Structural data bases.

3. Sequence Analysis

Collecting and storing the sequence, Sequence alignment, Pair wise alignment techniques, Dot matrix method, Multiple sequence alignment, CLUSTAL W and CLUSTAL X.

4. Applications of Bioinformatics

Phylogenetic analysis: phylogenetic tree: role in evolutionary studies and their types , Protein structure prediction: secondary structure, ExPASy, CFSSP, PSIPRED, Application tools: Motif and Domain prediction: PROSITE, Emotif, ProDom, Pfam, primer designing,

REFERENCES:

1. David W. Mount, Bioinformatics Sequence and Genome Analysis, CBS Publishers Distributors
2. S. C. Rastogi et. al. Bioinformatics- Concepts Skill and Applications, CBS Publishers and Distributors
3. T. E. Creighton, Protein Structure and Molecular Properties, W.H. Freeman and Company
4. Andreas D. Baxevanis, B. F. Francis Ouellette, Bioinformatics; A Practical Guide to the Analysis of Genes and Proteins, John Wiley & Sons, Inc.
5. Arthur M. Lesk, Introduction to Bioinformatics, Oxford University Press.

Practicals

L T P -- CREDITS

- 2

EXAMINATION: 30 MARKS

INT ASSESSMENT: 20 MARKS

TOTAL MARKS: 50 MARKS

1. Database searching

2. Phylogenetic analysis

3. Sequence analysis methods

4. Protein structure prediction

5. Primer design using softwares.

REFERENCES:

A practical guide to the analysis of genes and proteins, A.D. Baxevanis and B.F.F. Ouellette,

Database Annotation in Molecular Biology : Principles and Practice, Arthur M. Lesk

SEMESTER III PHARMACEUTICAL MICROBIOLOGY

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

Unit – 1

Antibiotics and synthetic antimicrobial agents (Aminoglycosides, β lactams, tetracyclines) Antifungal antibiotics, antitumor substances. Peptide antibiotics, Chloramphenicol, Sulphonamides and Quinolone antimicrobial agents. Chemical disinfectants, antiseptics and preservatives. Phenol coefficient test.

Unit – 2

Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis). Microbial resistance to antibiotics. Screening of antibiotic producing microbial strains; Microbial production of antibiotics (anti-bacterial & anti-fungal); spectrum of activity of antibiotics. Antibiotic assay- principle and procedures as per pharmacopeia.

Unit – 3

Microbial production and Spoilage of pharmaceutical products. Microbial contamination and spoilage of pharmaceutical products (sterile injectables, non-injectables, ophthalmic preparations and implants); sterilization of Pharmaceutical Products. Manufacturing procedures and in process control of Pharmaceuticals. Pharmacopeial test for sterility of pharmaceutical preparations. Test for pyrogen for parenteral products, Microbial production of vitamins, amino acids and therapeutic enzymes. Microbial biotransformation of steroids.

Unit – 4

Design & layout of pharmaceutical microbiology quality control and assurance laboratory; Working principle of various instruments use in pharmaceutical microbiology laboratory. SOP Development & its maintenance, FDA Regulatory documentation.

Suggested readings:

1. Pharmaceutical microbiology- Elsevier- Tim Sandle
2. Pharmaceutical microbiology-Hugo and Russel's

SEMESTER III
M.Sc. Dissertation (4 credits)

Technical writing and seminar

In this semester the student will start working on their research proposal and evaluate the outcome of the project along with a detailed seminar presentation on progress made. Each student must submit to the university with the signed approval of the advisor, a thesis proposal defining the thesis project, the methods and design of the experiments needed for completion, the progress to date and plans for completion in the fourth semester.

SEMESTER IV
ENVIRONMENTAL MICROBIOLOGY

L T P -- CREDITS

3 1 0 – 4

EXAMINATION: 60 MARKS

INT ASSESSMENT: 40 MARKS

TOTAL MARKS: 100 MARKS

DURATION OF EXAM: 3 HOURS

UNIT I: Scope of Environmental Microbiology: An overview of microbial niches in global environment. Microbes in terrestrial, aquatic and aerial environments. Microbes in the extreme environments and their adaptations- Thermophiles, psychrophiles, acidophiles, alkalophiles, halophiles and barophiles. Dispersal of microorganism-role of physical and biological factors.

Microbial Degradation of Organic Pollutants: Degradation of xenobiotics-pesticides, Hydrocarbons. Bioremediation strategies for soils and waters polluted with heavy metals and organic pollutants. Phytoremediation of pollutants.

UNIT II: Microbiology of Wastewater and Solid Waste Treatment: Waste types-solid and liquid waste their characterization, physical, chemical, biological. Aerobic, anaerobic, primary, secondary and tertiary treatments. Treatment schemes for effluents of industries including microbes used, and types of effluent treatment plants. Management of solid wastes.sanitary landfills. Bioconversion of solid waste and utilization as fertilizer-Composting and vermicomposting.

UNIT III: Microbial Interaction in Rumen and Gastrointestinal Tract: Microbiology of silage making. Microbiology of termite and earthworm gut.Interaction of soil fauna and microflora in cycling of plant litter in forest ecosystem.

UNIT IV: Bio-fuels and Bio-mining: Bioethanol and future fuels-hydrogen, biodiesel. Biomining-Microbial leaching of low grade ores.

Suggested readings:

- 1.Johri B. N. 2000. Extremophiles. Springer Verlag. New York
2. Maier R. M. Pepper I. L. &Gerba C. P. 2000. Environmental Microbiology. Academic Press. USA.
3. Baker K. H. &Herson D. S. 1994. Bioremediation, MacGraw Hill Inc. N.Y.
4. Ralph M. A. 1997. Environmental Microbiology.John Wiley and Sons.Inc.
5. Forster C. F. & John D. A. 2000. Environmental Biotechnology, Ellis Horwood Ltd. Publication.
6. Christon J. H. 2001. A Manual of Environmental Microbiology, ASM Publications.

SEMESTER IV

Dissertation (12 credits)

After completion of dissertation lab work, this involves preparation of the thesis. The thesis must include a cover page, abstract, table of contents, introduction of the thesis topic with a comprehensive review of literature, appropriately organized methods, results and discussion section for the experiment performed and final conclusions section summarizing the outcome of the project. The student should submit a draft of the thesis along with a manuscript draft (submitted or prepared for publication in Scopus indexed Journal) to the advisor by the end of the fourth semester. Also a draft of the review/research paper (submitted or prepared to be submitted) must be submitted to respective guide before seminar presentation.

M.Sc Microbiology, 4th Semester

PHARMACOGENOMICS & IPR Credit: 4

UNIT I

Bioinformatics companies, Genomes, transcriptomes and proteomes – their applications in medicine and agriculture, disease monitoring, profile for therapeutic molecular targeting.

UNIT II

Diagnostic drug discovery and genomics. Pharmacogenomics and its application. SNPs and their applications. Microarray and genome wide expression analysis: Introduction to basic microarray technology, Bioinformatics in microarrays, Getting started – target selection.

UNIT III

Customised microarray design, Image processing and quantification, Normalization and filtering, Exploratory statistical analysis, Public Microarray data resources.

UNIT IV

Patenting and data generation from patent literature for commercial benefits. IPR, and bioinformatics. Bioinformatics patents.

Suggested Readings

Blalock EM. 2003. *A Beginner's Guide to Microarrays*. Springer.

Catania M. 2006. *An A-Z Guide to Pharmacogenomics*. American Association for Clinical Chemistry.

Chakraborty C & Bhattachary A. 2005. *Pharmacogenomics*. Biotech Books.

Stekel D. 2003. *Microarray Bioinformatics*. Cambridge University Press