Undergraduate Department of Microbiology (SF)
Programme for B.Sc Microbiology from 2015 series

SEM	PART	COURSE NO	COURSE TITLE	HRS	CREDITS	MARKS
I	I	XXX 0000	Tamil/French/Hindi	3	2	30
I	II	ENG 0000	Functional English I	3	2	30
I	III-C	MIC 1531	General Microbiology	5	5	75
I	III-C	MIC 1433	Lab in General Microbiology	4	4	60
I	III-C	MIC 1435	Microbial Taxonomy and Diversity	4	4	60
I	III-S	MIC 1401	Biochemistry	5	4	60
I	IV-E	XXX 0000	Non Major Elective -I	3	2	30
I	IV-LS	XXX 0000	Life Skill -I	3	2	30
I	V	XXX 0000	Extension Activity (NSS/PED)	-	-	-
Total				**30**	**25**	**375**

SEM	PART	COURSE NO	COURSE TITLE	HRS	CREDITS	MARKS
II	I	XXX 0000	Tamil/French/Hindi	3	2	30
II	II	ENG 0000	Functional English II	3	2	30
II	III-C	MIC 1532	Food and Dairy Microbiology	5	5	75
II	III-C	MIC 1434	Lab in Food and Dairy Microbiology	4	4	60
II	III-C	MIC 1436	Microbial Genetics	4	4	60
II	III-S	MIC 1402	Microbial Physiology and Metabolism	5	4	60
II	IV-E	XXX 0000	Non Major Elective -II	3	2	30
II	IV-LS	XXX 0000	Life Skill -II	3	2	30
II	V	XXX 0000	Extension Activity - NSS/PED	-	**1**	**15**
Total				**30**	**25+1**	**375/390**

SEM	PART	COURSE NO	COURSE TITLE	HRS	CREDITS	MARKS
III	I	XXX 0000	Tamil/French/Hindi	3	2	30
III	II	ENG 0000	Functional English II	3	2	30
III	III-C	MIC 2531	Clinical Bacteriology and Mycology	5	5	75
III	III-C	MIC 2433	Lab in Clinical Microbiology	4	4	60
III	III-C	MIC 2535	Molecular Biology	5	5	75
III	III-C	MIC 2537	Bioinstrumentation	5	5	75
III	III-S	MIC 2403	Fundamentals of Pharmacology	5	4	60
III	V	XXX 0000	Extension Activity - NSS/PED	-	-	-
Total				**30**	**27**	**405**

SEM	PART	COURSE NO	COURSE TITLE	HRS	CREDITS	MARKS
IV	I	XXX 0000	Tamil/French/Hindi	3	2	30
IV	II	ENG 0000	Functional English II	3	2	30
IV	III-C	MIC 2532	Immunology	5	5	75
IV	III-C	MIC 2434	Lab in Immunology	4	4	60
IV	III-C	MIC 2536	Industrial Microbiology	5	5	75
IV	III-C	MIC 2538	Clinical Virology and Parasitology	5	5	75
IV	III-S	MAS XXXX	Biostatistics	5	4	60
IV	V	XXX 0000	Extension Activity - NSS/PED	-	**1**	**15**
Total				**30**	**27+1**	**405/420**

SEM	PART	COURSE NO	COURSE TITLE	HRS	CREDITS	MARKS
V	III-C	MIC 3731	Genetic Engineering	7	7	105
V	III-C	MIC 3533	Lab in Genetic Engineering	5	5	75
V	III-C	MIC 3635	Plant and Animal Cell Culture	6	6	90
V	III-C	MIC 3537	Lab in Plant and Animal Cell Culture	5	5	75
V	IV-LS	XXX 0000	Life Skill -III	3	2	30
V	ES	MIC 3200	Environmental Studies	4	2	30
Total				**30**	**27**	**405**

SEM	PART	COURSE NO	COURSE TITLE	HRS	CREDITS	MARKS
VI	III-C	MIC 3732	Environmental and Agricultural Microbiology	7	7	105
VI	III-C	MIC 3534	Lab in Environmental and Agricultural Microbiology	5	5	75
VI	III-C	MIC 3636	Medical Laboratory Technology	6	6	90
VI	III-C	MIC 3538	Lab in Medical Laboratory Technology	5	5	75
VI	IV-LS	XXX 0000	Life Skill - IV	3	2	30
VI	VE	XXX 0000	Value Education	4	2	30
Total				**30**	**27**	**405**
GRAND TOTAL				**180**	**158+2**	**2370/2400**

C-Core Courses NME - Non -Major Elective LS-Life Skill
S – Supportive Courses VE- Value Education ES- Environmental Studies

SUPPORTIVE COURSES (5 Hrs/Wk- 4 Cr)

SEMESTER	COURSE CODE	NAME OF THE COURSES
I	MIC 1401	1. Biochemistry
II	MIC 1402	2. Microbial Physiology and Metabolism
III	MIC 2403	3. Fundamentals of Pharmacology
IV	MAS XXXX	4. Biostatistics

LIFE SKILL COURSES (3 Hrs/Wk- 2Cr)

SEMESTER	COURSE CODE	NAME OF THE COURSES
I	MIC 1241	1. Infectious Diseases
II	MIC 1242	2. Health Awareness
V	MIC 3243	3. Bioinformatics
VI	MIC 3244	4. Pollution and Waste Management

NON MAJOR ELECTIVE COURSES (3 Hrs/Wk- 2Cr)

SEMESTER	COURSE CODE	NAME OF THE COURSES
I	MIC 1231	1. Health and Hygiene
II	MIC 1232	2. Nutritive Value of Food

MIC 2531 CLINICAL BACTERIOLOGY AND MYCOLOGY5Hrs/Wk –5Cr

The course aims to provide students with the foundations in Clinical Bacteriology and Mycology and enhance their understanding about the importance of epidemiology, concept of normal flora and its importance, mechanisms for transmission, virulence and pathogenicity of microorganism of medical importance. (Bacteria &Fungi) It also emphasizes prophylactic and therapeutic strategies.

Specific Learning Outcome (SLO):

Upon Successful completion of this course, student will be able to,

- Understand the importance of Medical epidemiology.
- Describe the concepts of normal microflora and its importance in human health.
- Acquire knowledge on mechanism of pathogenesis(Bacteria & Fungi) with medical importance.
- Learn about the Modern laboratory diagnosis.
- Able to explore the Significance of prophylaxis and therapeutic management.

UNIT - I Concepts of pathogenicity Epidemiology- scope and applications , Normal Microbial flora of human body .Infection- stages and transmission . Factors predisposing to microbial pathogenicity- mechanism of adhesion, colonization and invasionof mucous membranes.Nosocomial infection.

UNIT–II Bacterial Pathogens I: Study of Morphology, cultural characteristics, pathogenesis/disease caused & laboratorydiagnosis , Prophylaxis and Chemotherapy for *Staphylococcus, Streptococcus, Neisseiragonorrhoea,Cornybacteriumdiptheriae, Mycobacterium.*

UNIT –III Bacterial Pathogens II: Study of Morphology, cultural characteristics, pathogenesis s& lab diagnosis, Prophylaxis and Chemotherapy for*E.coli, Salmonella,Vibrio, Mycoplasma*&*Spirochaetes.*

UNIT–IVFungal Pathogens I: General characteristics, Tissue reactions to fungi, pathogenicity, Laboratory diagnosis, prophylaxis and chemotherapy Cutaneous, Sub cutaneous, superficial and Systemic Mycosis, Opportunistic fungal infections and yeast like fungi including *Candida, Cryptococcusand Malassezia*.

UNIT -V Fungal pathogens II: Pathogenicity, Pathogenesis, Laboratory diagnosis, Prophylaxis and Chemotherapy of Mycelial fungi including *Aspergillus, Fusarium,* &Dimorphic fungi -*Histoplasma, Blastomyces.*

TEXT BOOK

Ananthanarayanan and JayaramPanikkar (1922) Text book of Medical Microbiology, 4th edn, Orient Longman Ltd. Madras.

REFERENCES

1. Cruickshank (1975) Medical Microbiology, Vol II ELBS, Churchill Livingstone Pub.
2. Jawetz E Melnic J. L and Adelberg E. A (1998), Review of Medical Microbiology Lange Medical Publications, USA.
3. Pelczar M. J, Chan E. C. S., Kreig N. R (1986) Microbiology, McGraw Hill, New Delhi.

MIC 2433 LAB IN CLINICAL MICROBIOLOGY 4Hrs/Wk – 4Cr

Exercises will be on the methods of collecting body fluids, culture and identification of clinical specimens of anaerobic, food poisoning and fastidious bacteria. Efficacy of disinfectants and antibiotic sensitivity tests, will also be covered.

Specific Learning Outcome (SLO)

Upon Successful completion of this course, student will be able to

- An understanding of the common pathogens and the disease they cause.
- Understand the methods of sample collection and transport of biological specimen
- Promote technical ability in culturing of microbes of medical importance
- Demonstrate isolation and microscopic examination of Fungi

Laboratory exercises include,

1. Screening of normal flora in human body.
2. Screening of blood borne pathogens.
3. Nosocomial infection – isolation screening and characterization
4. Determination of susceptibility to dental caries.
5. Screening for Ocular Infection
6. Screening of upper respiratory tract infection.
7. Screening and identification of urine samples.
8. Screening of Dermatophytic infection
9. Microscopic screening of fungal pathogens
10. Antagonistic and synergistic effects of drugs.
11. Anti-microbial activity of body fluids.

REFERENCES:

1. Cappucino R. (2001) Microbiology – A Laboratory Manual 6th edn. Benjamin/Cummin Pub Co. California.
2. Gunasekaran P (1995) Laboratory Manual in Microbiology New Age International Pvt. Ltd, Madras.
3. Collins C. H., Patricia M. Lyne (2001) Microbiological Methods, 7th edn. London, Co Published in USA.

MIC 2535 MOLECULAR BIOLOGY 5Hrs/Wk-5Cr

This course deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division, and development. It provides insights on molecular mechanisms of DNA replication, repair, transcription, splicing, protein synthesis, and gene regulation in different organisms. Emphasis given on prokaryotic and eukaryotic gene regulation studies.

Specific Learning Outcomes (SLO)

Upon successful completion of this course, the student will be able to:

- Understand the connection between genes and DNA
- Explain how DNA replicates by its enzymatic machinery
- Articulate the flow of genetic information from DNA to RNA
- Elaborate the mechanism of protein synthesis
- Illustrate how genes are being regulated

UNIT I Molecular Biology of the Gene: Introduction to gene structure and function.Nucleic acids-structure-DNA double helix and alternative forms- denaturation and melting curves-renaturation.RNA- types- structure. Genetic code and Wobble hypothesis

UNIT II DNA Replication: DNA the central dogma-models of replication –semi conservative, conservative and dispersive. Modes of replication - bidirectional and unidirectional.Molecular mechanism and enzymatic apparatus for DNA replication in prokaryotes and eukaryotes.DNAdamage and repair mechanism.

UNIT III Transcription: Transcription in prokaryotes–RNA Polymerase-initiation, elongation and termination. Eukaryotic RNA polymerases – general transcriptional factors of eukaryotes – initiation, elongation and termination. Post transcriptional modifications– RNA editing.

UNIT IV Translation: Protein synthesis in prokaryotes and eukaryotes – initiation, elongation and termination– post translational modifications of proteins.

UNIT-V: Regulation of gene expression: Gene regulation in prokaryotes– Operon concept-inducible and repressible operon. Gene regulation in eukaryotes-Britten-Davidson model–homeobox in gene regulation.

TEXTBOOKS

Freifelder D (2007), Molecular Biology, 2nd Edn.Narosa Pub, New Delhi.India.
Watson JD, Hopkins NK, Roberts JW, Stertz JA and Weiner AM (1994), Molecular Biology of the Gene.Benjamin and Cummings Pub. Co., California, USA.

REFERENCES

1. AlbertsB,WilsonJ,Hunt T, (2008) Molecular biology of the cell . 5 Edn , Garland Science, New York ,USA.
2. Lodish H, Berk H, Zipursky S L, Matsudaira P, Baltimore D, and James Darnell (2000) Molecular Cell Biology, 4th edition. W. H. Freeman, New York, USA.

MIC 2537 BIOINSTRUMENTATION 5Hrs/Wk-5Cr

This course will introduce the students with the basic principles of techniques that are used routinely in modern biochemistry and molecular biology. The course focuses on separation techniques includes electrophoresis, chromatography and centrifugation. It deals with measurement of light absorption of colored substances in solutions using colorimeter and spectrophotometer. The last section is to provide knowledge on radioactivity and their applications in modern research field.

Specific learning outcomes (SLO):

At the completion of the course, the student will be able to,

- Explain the separation of molecule using electrophoresis and chromatography.
- To gain knowledge on centrifugation.
- Acquire knowledge on colorimeter and spectrophotometer.
- Understanding the radioisotope techniques and application in modern research.

UNIT-I Chromatographic techniques: General principles- Types- Paper, Adsorption, TLC, gel filtration, Ion-exchange, GC-MS, GLC and HPLC- Applications.

UNIT-II Centrifugation techniques: Basic principles of sedimentation-relative centrifugal force-conversion of G to rpm- rotors -types of centrifuges (clinical, high speed, refrigerated and ultra)- - Applications.

UNIT-III Colorimetry- Beer-Lambert's law- complementary color- standard graph preparation.Spectrophotometer- UV and Visible- IR, X-ray crystallography and atomic absorption spectrophotometry- applications.

UNIT-IV Electrophoretic techniques: General principles- types of electrophoresis- AGE, PAGE, 2-D, Iso-electric focusing, and immunoelectrophoresis.

UNIT-V Radio isotopic techniques: Radioactive substance- radioactivity- Detection and measurement of radioactivity- GM counter, Scintillation counter, Autoradiography- Applications- safety aspects.

TEXT BOOKS

Wilson.K and J. Walker, (1994) Practical Biochemistry – Principles and Techniques, Cambridge Press, New York.
Palanivelu.P (2001) Analytical Biochemistry and Separation Techniques.A Laboratory Manual 2nd edn. Published by Tulsi Book Centre, Madurai, Tamil Nadu.

REFERENCES

1. Voet D and G Voet (1995) Biochemistry II edn. John Wiley and sons, New York.
2. John G. Webster (2004) Bioinstrumentation, Student Edition. John Wiley & Sons Ltd.

MIC 2403 FUNDAMENTALS OF PHARMACOLOGY 5Hrs/Wk-4Cr

This course will familiarize students with general concepts of drugs and drug action in man at the level of molecules, cells, and tissues. It provides ample understanding about the battle against diseases at the cellular and molecular level. The students will explore the pharmacological effect of drugs, the specific biochemical processes with which they affect the molecular target and interactions. Emphasis will also given to the Pharmaceutical regulations, clinical trials, marketing and patenting. This would help the students with an awareness of the wide scope of applications of microorganisms in industry; the applications of fermentation technology and potentials for future development.

Specific Learning Outcomes (SLO)

Upon successful completion of this course, the student will be able to:

- Understand the fundamentals of pharmacology.
- Integrate and evaluate the properties of drugs.
- Know the competency of drugs and their action
- Explore on pharmacopoeial standards.
- Discover the use of microorganisms in production of useful products.

UNIT I Introduction to Pharmacology: History and scope of pharmacology- Drug and Classification, sources of drugs-plant, animal, microbial and synthetic drugs. Discovery of drugs, Drugs and Diseases- control measures.

UNIT II Drug targets: Introduction-structure, function, and cellular location of ligand-gated channels, enzymes, nuclear hormone receptors, Carrier Proteins, Structural proteins, G-protein receptors, Nucleic Acids, Lipids and Carbohydrates. Agonists, Antagonists and partial agonists.

UNIT III Pharmacodynamics and Pharmacokinetics: Drug absorption, distribution, metabolism-biotransformation of drugs, Drug excretion-. Drug dosage-Routes of drug Administration- Mechanism of drug action- drug assay- Drug toxicity and side effects.

UNIT IV Pharmacology and Pharmaceutical Regulations: Drug Formulations- Dosage Preparation, Drug load- Stability. Clinical trials- phases; Regulatory bodies- FDA, IDA, NDA, Fast Tracking, Orphan Drugs, Labeling; Scientific code regulations- GLP and GMP. Marketing- Patenting of drugs.

UNIT V Microbial Aspects of Pharmaceutical Processing: Ecology of microorganisms in pharmaceutical industry-Sterile pharmaceutical products-Production of antibiotics, immunological products- Quality control-Bioassays.

TEXT BOOK

Patrick, G (2002), Medicinal Chemistry, First Edition, Viva Books Private Limited, (ISBN-81-7649-271-X).

REFERENCES

1. Stephen P. Denyer, Norman A. Hodge and Sean P. Gorman (2004), Hugo and Russell's Pharmaceutical Microbiology, Seventh Edition, Black Well Publishers, UK.
2. Prescott L.M, Cecil G. Dunn (2004) Industrial Microbiology, 4th edn, CBS Publishers & Distributors, New Delhi.
3. Vyas, S.P., (2002) Pharmaceutical Biotechnology CBS Publishers &Distributors, Ne4w Delhi.

MIC 2532 IMMUNOLOGY 5Hrs/Wk -5Cr

This course attempts to provide a basic understanding in Immunology. The course covers cells and organs of the immune system, antigens, antibody structure, antibody diversity, antigen-antibody interactions, cell mediated and humoral immune response and complement. In the section on disorders of immune system, autoimmunity, hypersensitivity reactions, immunodeficiency disorders that include AIDS are dealt.

Specific Learning Outcome (SLO):

Upon successful completion of this course, student will be able to

- Understand basic concepts in Immunology such as cells, organs of immune system.
- Antigen & antibody and their interactions and humoral & cell mediated immunity.
- Regulation of immune response and disorders of the immune system.

UNIT – I Cells and organs of the immune system: Introduction –historical perspectives – innate (non-specific) and acquired (specific) immunity – cells involved – primary & secondary lymphoid organs – tertiary lymphoid tissues.

UNIT – II Antigen, antibody and their interactions: Epitopes, haptens – immunogenicity-adjuvants - antibody structure-Deducing- structure of IgG, IgM & IgA. Biological properties of various Ig classes. Primary interactions-affinity and avidity-secondary interaction-agglutination-precipitation

UNIT – III Antibody diversity and humoral response: Multigene organization of Ig genes – generation of antibody diversity- Role of T_H cells in humoral response-primary and secondary response-affinity maturation-class switching-generation of plasma cells and memory cells.

UNIT – IVCell mediated immunity: Structure and functions of MHC- Antigen processing and presentation- Activation of cytotoxic T cells-NK cells-antibody dependent cell mediated cytotoxicity (ADCC) – delayed type hypersensitivity (DTH).

UNIT – VRegulation of immune response, complement and disorders of immune system: Immune tolerance-regulation of immune response-complement. Classical and alternative pathways – biological properties of complement components. Auto-immunity-hypersensitivity reactions- Immunodeficiency disorders – AIDS.

TEXTBOOK

Goldsby RA *et al*., (2000). Kuby, Immunology, WH Freeman and Co, New York, 4th edn.

REFERENCES

1. Coico R, Sunshine G (2009). Immunology – a short course, Wiley Blackwell, New York, 6th edn.
2. Roitt IM, Brostoff J, Male D (2001). Immunology, 6th edn, Mosby, London.

MIC 2434 LAB IN IMMUNOLOGY 4Hrs/Wk 4Cr

The laboratory component includes identification and enumeration of blood cells, location of lymphoid organs in selected vertebrates, preparation of antigens. Immunization techniques, methods of raising polyclonal antibodies, repetitive bleeding methods, antibody titration, complement mediated hemolysis, ELISA test for AIDS and skin test for allergy reactions.

Specific Learning Outcome (SLO):

Upon successful completion of this course, student will be able to

- Steps involved in raising polyclonal antibodies
- Diagnostic tests based on antigen-antibody interactions
- Immunology of ABO blood grouping and skin test for allergy reactions.

The Laboratory component includes exercises as follows:

1. Total and differential count of blood cells
2. Lymphoid organs in vertebrates I – fish and amphibians
3. Lymphoid organs in vertebrates II-reptiles, birds and mammals
4. Raising polyclonal antibodies I-preparation of antigens
5. Raising polyclonal antibodies II-routes of immunization
6. Raising polyclonal antibodies III- bleeding techniques and separation of serum
7. Raising polyclonal antibodies IV-antibody titration
8. Complement mediated hemolysis

9. Ouchterlony double immunodiffusion (ODI)
10. Mancini's single radial immunodiffusion (SRID)
11. Immunology of ABO blood grouping
12. ELISA test for AIDS
13. Skin test for allergy reactions

REFERENCES:

1. Garvey JS, Cremer NE and Sussadorf DH (1977). Methods in Immunology, The Benjamin Cummings Pub co., Massachusetts, pp 345, 3rd edn.
2. Hudson L and Hay F (1989). Practical Immunology, Blackwell Sci Pub, Oxford, PP 507, 3rd edn.

MIC 2536 INDUSTRIAL MICROBIOLOGY 5 Hrs/Wk – 5 Cr

This course deals with the development of industrial Microbiology and role of Microbiologist in industries. This course also explains the screening, development and preservation of industrially important strains and also emphasizes the formulation of media. The other part elucidates the types of fermentations, bioreactors, downstream process and the production of various fermented products.

Specific Learning Outcome (SLO):

Upon successful completion of this course, student will be able to

- understand the source for microorganisms of industrial importance from the environment
- Manipulate the microorganisms to produce more of these useful products
- understand the types of fermentation and bioreactors
- summarize the recovery of products
- know that microorganisms are important in the production of many useful products

UNIT – I History and Scope: Development – Contributions of Louis Pasteur and fermentation – discovery of antibiotics – growth of industrial fermentations – Applied branches of Industrial Microbiology and role of Microbiologist in industries.

UNIT – II Screening and development of strains: Isolation – crowed plate, auxanography and other methods – development and improvement – Mutation and Genetic engineering techniques. Preservation of cultures – Storage – agar slants, lyophilization and liquid nitrogen.

UNIT – III Formulation of media: Preparation of media – source and components – Agricultural and industrial waste – saccharide, starch, cellulose, nitrogen, enhancers and precursors - Medium sterilization.

UNIT – IV Fermentation and Bioreactors: Fermentation process - surface, solid state, submerged, batch and continuous fermentation – Fermentors – components of basic fermentor – pH, temperature, foam controlling device – shaft, baffle, impeller and sparger – Types of fermentors – batch and continuous fermentors, aerated and agitated fermenters and air lift fermenter.

UNIT – V Downstream processing and fermented products: Recovery of intracellular and extracellular products – removal of insoluble components – product isolation – purification – polishing. Fermented products – production of alcohol – beverages –industrially important enzymes – foods – organic acids – antibiotics and other medically important products.

TEXT BOOK

Patel A. H., (2012) Industrial Microbiology, 1st Edition, Macmillan Publishers, India.

Crueger, W., Crueger, A., and Brock, T. D. (2005) Biotechnology: A Textbook of Industrial Microbiology, 3rd Edn, Panima Publishing Corporation, New Delhi.

El – Mansi E.M.T and C.F.A. Bryce (2005) Fermentation Microbiology and Biotechnology, Replika Press Pvt. Limited, India.

REFERENCES

1. Peter F. Stanbury, Allan Whitaker, Stephen J. (2009) Principles of Fermentation Technology, 2nd Edition Hall Elsevier Science Ltd.
2. Prescott L.M, Reed G. Dunn (2004) Industrial Microbiology, 4th Edition, CBS Publishers & Distributors, New Delhi.

MIC 2538 CLINICAL VIROLOGY AND PARASITOLOGY 5Hrs/Wk-5Cr

This course aims to provide students about general properties of viruses and parasites their mechanism of pathogenesis, clinical conditions and therapeutic management. Emphasis also given on specimen collection, identification, prophylaxis and treatment.

Specific Learning Outcomes (SLO):

Upon successful completion of this course, student will able to

- Explain the general characteristics and pathogenesis of viruses
- Understand the challenges faced by DNA and RNA viruses during their replication in the host cell and causing diseases.
- Ensure an understanding of the general and specific life cycles of the medically important parasites.
- Understand the diagnosis and treatment.

UNIT - ICharacteristic of virus: History- General Properties - Classification and replications of viruses - Epidemiology and Pathogenesis of viral infections.

UNIT - IIDNA viruses & RNA viruses: Properties- life cycle and pathogenesis of Pox virus- Herpes virus - Papilloma virus- Hepatitis B. Polio- Rabies – Influenza – Ebola – Dengue - Human Immunodeficiency Virus.

UNIT - IIIProtozoan parasites: Introduction to medical parasitology – morphology, classification, life cycle and pathogenesis of Protozoa – Entamoeba- Plasmodium, Leishmania - Trypanosoma – Giardia – Trichomonas.

UNIT - IVHelminths parasites: Properties - life cycle and pathogenesis ofPlatyhelminthes – Taenia–Schistosoma and Nemathelminthes – Ascaris – Trichuris – Wuchereria.

UNIT - VLaboratory diagnosis & Treatment: Isolation & identification of viruses - Cultivation of viruses - Serological diagnosis of virus infections. Examination of faeces for ova and cysts – concentration methods. Blood smear examination for parasites. Vaccines and interferon - Antiviral - antiparasitic agents.

TEXT BOOK

Flint SJ, Enquist LW, Krug RM, Racaniello VR and AM Skalka (2000) Principles of Virology, ASM Press, USA.
Cheng C.G (2006). General parasitology, 2nd edn, Academic press (An imprint in Elsevier).

REFERENCES

1. Cruickshank (1975) Medical Microbiology, Vol II ELBS, Churchill Livingstone Pub.
2. Ananthanarayanan and Panikkar J (1922). Text book of Medical Microbiology, 4th edition, Orient Longman Ltd. Madras.

MIC 3731 GENETIC ENGINEERING 7Hrs/Wk-7Cr

This course aims to acquaint the students to versatile tools and techniques employed in genetic engineering and recombinant DNA technology. It provides theoretical basis to DNA modifying enzymes, cloning vector types, host genotype specificities for selection and screening of recombinants. Current experimentation and progress in these fields as well as ethical considerations of this research will be discussed.

Specific Learning Outcomes (SLO):
Upon successful completion of this course, the student will be able to:

- Describe the function of most common enzymes used in molecular biology
- Recognize the importance of cloning vectors
- Understand and articulate different libraries
- Illustrate creative use of modern tools and techniques and when they could be applied
- Explore the principle behind gene therapy

UNIT I Tools for Genetic Engineering: Principles and techniques– historical development in gene technology – Restriction endonucleases and DNA modifying enzymes used in cloning. Preparation and purification of DNA from living cells.

UNIT II Vectors for gene cloning: –Cloning vectors for *E.coli*- plasmids- properties- pBR322- Bacteriophage vectors-cosmids, phagemids, insertion and replacement vectors. Yeast plasmid vectors- Artificial chromosome vectors -BAC, YAC– vectors for cloning in higher plants– vectors for animal cells. Expression vectors and properties. Introduction of

DNA into living cells- transformation- transfection and *in vitro* packaging- Alternative DNA delivery systems.

UNIT III Gene cloning Strategies and techniques: Cloning from DNA, mRNA-Genomic libraries, cDNA libraries. Techniques used in genetic engineering: nucleic acid hybridization, blotting techniques, Polymerase chain reaction, Methods ofDNA sequencing

UNIT IV Selection and Screening of recombinants: Direct selection through marker rescue- methods of screening – genetic methods, immunological methods, plus and minus screening, HRT and HART.

UNIT V Applications of genetic engineering: Production of recombinant pharmaceuticals – recombinant insulin, human growth hormone- somatotropin, Recombinant vaccines-DNA vaccines. Disease diagnosis and gene therapy. Production of transgenic plants, animals – methods involved - limitations and obstacles and its applications. Recombinant DNA debate and Bioethics

TEXT BOOK

Brown TA, (2001) Gene cloning and DNA analysis- an Introduction 4th edn. Blackwell, Oxford.

REFERENCES

1. Old, R.S. and Primrose, S.B. (1995) Principles of Gene manipulation. An Introduction to genetic Engineering. 5th Edition. Blackwell Scientific Publication, London.
2. Glick BR and Pasternak JJ (1996) Molecular Biotechnology – Principles and Applications of Recombinant DNA, Panima Publishing Co, New Delhi.
3. Desmond S.T. Nicholl (1994) An Introduction to Genetic Engineering, Cambridge University, Oxford.

MIC 3533 LAB IN GENETIC ENGINEERING 5Hrs/Wk – 5Cr

This laboratory course is focused on genetic engineering methods and their underlying molecular biology.

Specific Learning Outcomes (SLO):

Upon successful completion of this lab course, the student will able to:

- Describe the principles and techniques of genetic engineering methods
- Explain which biological hosts are best choice for producing certain protein
- Translate their teaching and learning concepts in genetic engineering to their own research

Laboratory exercises include,

1. Isolation of genomic DNA from bacteria.
2. Isolation of genomic DNA from plants.
3. Isolation of genomic DNA from animal tissue.
4. Isolation and purification of plasmid.
5. Estimation of DNA (Spectrophotometric method).
6. Analysis of DNA on Agarose Gel Electrophoresis.
7. Restriction digestion of genomic DNA.
8. Isolation of RNA from Mammalian tissue and yeast.

9. Estimation of molecular weight of proteins using SDS – PAGE.
10. Silver staining of protein gel.

REFERENCES

1. Sambrook J and Russell D.W (2001) Molecular Cloning: A Laboratory Manual, Volume 1, CSHL Press.
2. Robertson D. Shore A. S. and Miller D. M (1997) Manipulation and Expression of Recombinant DNA – A Laboratory Manual, Academic Press, San Diego.
3. Scheppler J. A. Cassin P. E and Gambier R. M (2000) Biotechnology Explorations – Applying the fundamentals, ASM Press, Washington DC.

MIC 3635 PLANT AND ANIMAL CELL CULTURE 6Hrs/Wk-6Cr

This course provides students an overview of plant and animal cell culture. First section emphasizes on the basic requirements of plant tissue culture, callus culture, protoplast culture, and somatic hybridization. It also focuses on Micro propagation, organogenesis, embryogenesis and in-vitro conservation. Next section focuses on animal cell culture lab requirements, culture media, primary explants, and characterization of cultured cells. The last section provides insights on organotypic models, hybridoma technology and stem cells.

Specific learning outcomes (SLO):

Upon successful completion of this course, student will be able to

- Gain knowledge on the requirement and techniques of plant cell & tissue culture.
- Understand the micro propagation and in-vitro conservation process.
- Explore basic concepts of animal cell culture and importance of serum free media.
- Demonstrate the techniques of primary explants, monolayer culture, and cell line characterization,
- Acquire knowledge on the wide applications of animal cell culture.

UNIT I Basics of Plant tissue culture: Historical perspective - containments –culture types – tissue culture media – callus culture initiation – cell culture – plant regeneration – scale up process –single cell isolation – protoplast culture – fusion – somatic hybridization – haploid plant production – diploidization.

UNIT II Micro propagation and Germplasm conservation: Somoclonal variants – isolation method –micro propagation – techniques – multiplication by axillary buds, apical and adventitious shoots – organogenesis –embryogenesis –embryo culture. Germplasm conservation – cryopreservation –genetically modified crops.

UNIT III Basics of Animal Cell Culture: History- types- scope- requirements- equipments- culture vessels – contamination – aseptic condition – sterilization –advantages and limitations – applications. Culture media – Physico-chemical properties – serum and serum free media.

UNIT IV Primary cell culture & Characterization: Primary culture – tissue isolation technique –primary explants – cell lines – selection and maintenance; subculture – monolayer and suspension – scale up process –culture system. Characterization of cultured cells – cell line identification – growth parameters – cell viability.

UNIT VOrganotypic models & Tissue engineering – Organ culture techniques –histotypic – 3D culture – organotypic culture. Tissue engineering –Hybridoma technology –monoclonal antibody production. Stem cells - applications.

TEXT BOOKS

Gambora O.L, and G.C. Phillips, (1995) Plant cell, tissue and organ culture – Fundamental methods, Narosa Publication.

Freshney I, (2005), Culture of Animal cells, A manual of Basic technique, 5th edition, A. John Wiley & Sons, INC, Publication.

REFERENCES

1. Satyanarayana U, (2011) Biotechnology, Books & Allied publication Ltd.
2. Dubey C.R, (2006) Textbook of Biotechnology, 4th edition, S.Chand & Company Ltd.
3. S.M Bhatt (2011) Animal Cell Culture – Concepts and Applications, Narosa Publishing House Private Limited, New Delhi.

MIC 3537 LAB IN PLANT AND ANIMAL CELL CULTURE 5Hrs/Wk-5Cr

This lab course is designed to provide students a technical skill on plant and animal cell culture. Students will familiarize in media preparation, development of shoot and root and preparation of synthetic seeds. Techniques like tissue explant preparation; monolayer culturing and cell viability test will be done.

Specific Learning Outcomes (SLO):

Upon successful completion of this course, student will be able to

- Acquire knowledge in preparing plant and animal cell culture media,
- Establish, maintain and sub culturing of callus, shoot & root culture.
- Gain hands on practice in primary explants and cell culture preparation,
- Identify the monolayer & suspension culture and their viability.

Laboratory exercises include,

Plant cell and tissue culture

1. Preparation of Tissue Culture Media.
2. Callus Induction.
3. Shoot and root induction.
4. Isolation of protoplasts.
5. Synthetic seed preparation.
6. Cell suspension culture.

Animal cell and tissue culture

7. Sterilization &Preparation of Tissue and Cell Culture Media.
8. Primary explants culture from chick embryo.
9. Disaggregation of tissue – Physical method.
10. Disaggregation of tissue – Enzymatic method.
11. Primary cell culture – Monolayer Cells.
12. Primary cell culture – Suspension Cells.
13. Sub culturing technique/Secondary cell culture method.
14. Cell counting and viability – Trypan blue dye exclusion test.

TEXT BOOKS

Aneja K R (1996) Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom production technology, New Age International Publications, India.
Freshney I, (2005), Culture of Animal cells, A manual of Basic technique, 5th edition, A. John Wiley & Sons, INC, Publication.

REFERENCE

Bhatt S.M (2011) Animal Cell Culture – Concepts and Applications, Narosa Publishing House Private Limited, New Delhi.

MIC 3243 BIOINFORMATICS 3Hrs/Wk – 2Cr

Generation of abundant molecular biological information, especially the genetic and protein sequences, would made the human mind to exhaust when if tried to compare and contrast so as to find out the links or homology between sequences. Fortunately, at this juncture a perfect blend of molecular biology and computer evolved the discipline bioinformatics making molecular biologists to explore extensively. In this course, data generation, biological databases, data storage, data retrieval, sequence alignment and application of bioinformatics were given emphasis.

Specific Learning Outcomes (SLO):

Upon successful completion of this course, the student will be able to:

- Understand and work with computational tools of bioinformatics
- Perform biological sequence (DNA, RNA, Protein)analytical studies
- Undertake phylogenetic relation analysis

UNIT I Fundamentals of Computer: Introduction to Computers: – Characteristics of Computers. Classification of Computers – Programming Languages: Machine Language – Assembly Language – Features of commonly used operating systems e.g. DOS, Windows, UNIX, and LINUX. Input Devices- Keyboard – Mouse - Trackball – Output Devices – Dot Matrix Printer – Inkjet – Laser Printer – LCD & LED Printers: Hard Disk – CD –DVD – primary memory, Introduction to Internet.

UNIT II Basics of Internet Use and Search Engines: Fundamentals of Internet, WWW, HTML, URLs Browsers, Netscape/Opera/Explorer Search Engines: Google, PUBMED, NCBI EMBL, GENBANK, Entrez, Unigene, PDB, SwissProt, And TrEMBL. Introduction to search; Indices, Boolean, Fuzzy and neighbouring search.

Unit III Bio-informatics Basics: Bio-informatics- Its Definitions, Introduction, History - Objectives, Applications, Its need, Scope, Opportunities in Bioinformatics. Emerging areas of Bioinformatics - Bioinforrnatics scenario in India and the rest of the world.Origin of Bioinformatics, Overview of available Bioinformatics resources on the web NCBI/ /EBI/EXPASY etc.

UNIT IV Sequences used in Bioinformatics: Central dogma - DNA, RNA,Protein. Dawn of sequencing.Features of the DNA, Protein, and RNA molecules.

UNIT VBiological Databases: Introduction to data types and Source. Population and sample, Classification and Presentation of Data.Quality of data, private and public data sources.General Introduction of Biological Databases; Types of Biological Databases, Nucleic acid databases (NCBI, GenBank, DDBJ, and EMBL). Protein databases (Primary, Composite, and Secondary). Specialized Genome databases: (SGD, TIGR, and ACeDB).

TEXT BOOK

Lesk, A.M. (2002) Introduction to Bioinformatics. Oxford University Press.
Atwood T K, Parry Smith D J and Phukan S. Introduction to bioinformatics, Pearson Education, Ltd. & Dorling Kindersley Publishing Inc., 2013 - New Delhi, India.

REFERENCES

1. Zoe Lacroix and Terence Critchlow (2003) Bioinformatics – Managing Scientific Data, Morgan Kaufmann Publishers, New Delhi.
2. Andreas D. Baxevanis and Francis B. F. Francis Ouellette (2006) Bioinformatics – A Practical Guide to the Analysis of Genes and Proteins, Wiley – Interscience, Inc, Publications, USA.
3. Setubal, J. and Meidanis, J. (1996) Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.

MIC 3200 ENVIRONMENTAL STUDIES 4Hrs/Wk-2Cr

This course is designed to introduce students the importance, scope and problems in environment. It focuses on the natural resources, energy flow and types of ecosystems. Values of biodiversity, hotspots, endangered species and conservation are emphasized. It also highlights the social issues and population explosion in the environment.

Specific Learning Outcomes (SLO):

Upon successful completion of this course, student will be able to

- Explore the values of renewable and non-renewable resources.
- Understand the concepts, function and types of ecosystem.
- Acquire knowledge on values, location and conservation of biodiversity.
- Demonstrate different types of pollution and waste management.
- Critically analyse impact of technology development and population on environment.

UNIT I Natural Resources: Ecology –scope – importance- components –awareness – renewable resources – forest, water, mineral, food, land and energy resources – renewable and non-renewable energy –conservation.

UNIT II Ecosystems: Concepts –structure and function – food chain & web and ecological pyramids –energy flow in the ecosystem –ecological niche –ecological succession. Types of ecosystems - Forest, grassland, desert and aquatic ecosystems.

UNIT III Biodiversity: Introduction – levels – values of biodiversity – Global, National and local biodiversity – hotspots – major threats –endangered species. Conservation of biodiversity –*In situ* and *Ex situ* conservation.

UNIT IV Environmental pollution: Definition – source, types, effects and control measures of air, water, soil, marine, noise, thermal pollution – nuclear hazards – solid waste management –disaster management.

UNIT V Social issues and population: Sustainable development –water conservation - environmental ethics – global climate change problem –role of environmental legislation (acts). Human population growth – population explosion –human rights –value education.

TEXTBOOK

Kaushik A and C.P.Kaushik (2014), Perspectives in Environmental Studies, 4th multicolour edition, New Age International (P) Limited Publishers.

REFERENCES

1. Bharucha E (2013), Textbook of Environmental studies for Undergraduate courses, 2nd edition, Universities press (India) Private Ltd.
2. Thatheyus A.J (2011) Textbook of Environmental Studies, Narosa Publishing House, New Delhi.

MIC 3732 ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY 7Hrs/Wk-7Cr

The main objective of this course is to make the students familiar with microorganisms without which human could not survive as these microbes occur in large number in most natural environment and bring about many desirable and undesirable changes. Beside their role in evolution of life on this planet, the microbial activity is linked directly with processing and removal of dead bodies and sewage. Thus, their role as scavengers is encouragable. The study of this course will help the students to develop the sustainable environment.

Student learning outcomes (SLO):

At the conclusion of the course, the student will be able to,

- Recognize the basic concepts of ecosystem.
- Familiarize with the positive and negative roles of organisms.
- Understand the interactions between organisms and environment.
- Explore the basic needs in the field of agriculture.
- Summarize the traditional agricultural practice to be followed.

UNIT IMicrobiology of Air & Water: Atmospheric dispersal of microbes- Microbial diversity of thermophiles-Mesophiles-Psychrophiles - deep sea- hyper saline habitats and metal-contaminated environments. -Air-borne diseases-control of bio- aerosols- air sanitation. Microbial communities in pelagic & benthic habitats- biological analysis of water sampling - Microbial processes in waste water treatment.

UNIT IIMicrobial Interactions: Microbe–microbe Interactions – Mutualism, Commensalism, and Amensalism, Microbe–plant interactions – Phylloplane- Phyllosphere-Rhizosphere and Mycorrhizae.

UNIT IVSoil microbiology: Soil - general properties -soil microflora-microbes in soil surface and different zones of soil – role of microbes in soil fertility – soil and environmental influence on microbes - decomposition of plant and animal residues by microorganisms in soil.

UNIT IV Bioremediation & Biodegradation: Bioremediation and its types- Principles and application of Bioaccumulation- Xenobiotics- Microbial degradation of hydrocarbons. Biodegradation of pesticides.

UNIT VRole of microbes in sustainable agriculture: Traditional agricultural practice and organic farming. Applications of microbes in agriculture.Bio fertilizers- symbiotic and non-symbiotic microorganisms – vermicomposting - bio pesticides- bacterial, fungal and viral.

TEXT BOOKS

Atlas R and Bartha R (1998) Microbial Ecology 4th edn. Benjamin/Cummings Publishing Co,Inc.California.
SubbaRao NS (2000) Soil Microbiology 4th edn.Oxford & IBH, New Delhi.

REFERENCES

1. Alexander M (1977) Introduction to Soil Microbiology. Wiley, New York.
2.Rheinheimer G (1980) Aquatic Microbiology 2nd edn. Wiley New York.
3. Mitchell R (1992) Environmental Microbiology Wiley-John Wiley Sons, Inc Publications, New York.

MIC 3534 LAB IN ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY

5Hrs/Wk - 5Cr

In this laboratory course, students will be trained on isolation and identification of various microorganisms from soil, techniques to assess physico-chemical parameters of various organisms. It also helps them to identify eco-friendly organisms of our environment

Student learning outcomes (SLO):

At the conclusion of the course, the student will be able to,

- Identify beneficial organisms from our environment.
- Improve their skill based techniques in agricultural field.
- Recognize the importance of bio fertilizers.
- Implement new technologies for the betterment of our environment.

Laboratory exercises include,

Environmental Microbiology

1. Enumeration of bacteria present in different types of soil.
2. Isolation of rhizobium from leguminous plant.
3. Isolation and identification of Azotobacter.
4. Isolation and identification of Phosphobacter.
5. Isolation and Enumeration of fungi from soil.

Agricultural Microbiology

6. Isolation and enumeration of major groups of microorganisms from rhizosphere and Non-rhizosphere soil.
7. Isolation and identification of microorganisms from phylloplane region.
8. Isolation and identification of microorganisms from phyllosphere region.
9. Isolation of microflora from different industrial effluents.
10. Determination of BOD and COD.
11. Vermicomposting.
12. Cultivation of plants using biofertilizers – Pot culture technique.

REFERENCES

1. Cappucino R (2001) Microbiology - A laboratory manual 6th edn. Benjamin/Cummings, California.
2. Gunasekaran P (1995) Lab manual in Microbiology, New Age International Pvt Ltd. Madras.
3. Motsana MR, Bhattacharya and BeenaSrivastava (1995) Biofertilizers Technology, Marketing and usage. Publication Division, Ministry of Agriculture, New Delhi.

MIC 3636 MEDICAL LABORATORY TECHNOLOGY 6Hr/Wk-6Cr

This course is meant for developing the knowledge and technical skills necessary to perform basic laboratory tests. Emphasis is given on use and maintenance of laboratory equipment, quality control and biosafety techniques. Collection of samples inclinical biochemistry, clinical pathology, haematology and blood banking analysis and interpretation of results will be dealt with.

Specific Learning Outcomes (SLO):

Upon successful completion of this course, student will able to

- understand the infrastructure of the laboratory
- perform the biochemical tests
- perform the haematological tests
- explain the preparation of biopsy slides
- understand the diagnosis of body fluids

UNIT IOrganization of the laboratory: Safety precautions in laboratory - personal cleanliness and care with regard to infected materials and chemical burns — Maintenance and applications of biomedical instruments – haemocytometer, Gluco meter, Sphygmomanometer - Disposal of bio-medical wastes.

UNITIIClinical Biochemistry: Disorders and diagnosis of carbohydrate metabolism – diabetes mellitus, lipids metabolism – hypercholesterolemia , Protein metabolism – phenylketonuriaand tyrosinemia.

UNITIIIClinical Pathology: Types of clinical specimens: urine, feces, sputum, CSF, Semen. Methods of collection –transportation- handling. Physical – chemical - microscopical and microbiological examination of clinical specimen.

UNIT IVHaematology: Laboratory preparation – Blood components, Collection of blood, Determination of Haemoglobin, blood cell count, bleeding time - clotting time – Prothrombin time, Estimation of ESR, Anemia and its types, Leukemia, blood banking.

UNIT VHistopathology: Preparation of specimen, paraffin section, embedding- frozen section, fixation, microtome –types, decalcification, deparaffinization, staining.

TEXT BOOK

Godkar, P. B. Godkar D. P (2002). A Text Book for Medical Lab Technology, 2nd edition, Bhalami Publishing House, Mumbai.

REFERENCES

1. Mukherjee, K.L (1989). Medical Laboratory Technology (Vol –I to III) Tata McGraw Hill, New Delhi.
2. Sood, R (1996). Laboratory Technology (Methods and interpretation) 4th Ed. J.P. Bros, New Delhi

MIC 3538 LAB IN MEDICAL LABORATORY TECHNOLOGY 5Hr/Wk-5Cr

This laboratory course focuses on the techniques in the examination various body fluids. The student is trained to analysis physical and chemical properties of biological fluids as well as microscopic examination.

Specific Learning Outcomes (SLO):

Upon successful completion of this course, student will able to

- collect the clinical samples
- Perform basic haematological investigation
- demonstrate the biochemical tests

Laboratory exercises include,

1. Sample collection, preservation and transportation of various clinical samples.
2. Determination of E.S.R., Packed cell volume in blood.
3. Estimation of Haemoglobin.
4. Bleeding Time, Clotting Time and Platelet count in Blood
5. Determination of Differential blood count.
6. Biochemical estimation of serum- total protein, albumin, globulin, sugar.
7. Biochemical estimation of serum - cholesterol, urea, Creatinine.
8. Biochemical estimation of Urine - urea, Uric acid and Creatinine.
9. Microscopic and macroscopic examination of urine.
10. Microscopic examination of Pus and Stool.
11. Visit to Hospital laboratory

TEXT BOOK

Mukherjee, K.L (1989). Medical Laboratory Technology (Vol –I to III) Tata McGraw Hill, New Delhi.

REFERENCES

1. Godkar, P. B. Godkar D. P (2002). A Text Book for Medical Lab Technology, 2nd edition, Bhalami Publishing House, Mumbai.
2. Sood, R (1996). Laboratory Technology (Methods and interpretation) 4th Ed. J.P. Bros, New Delhi

MIC 3244 POLLUTION & WASTE MANAGEMENT 3Hrs/Wk-2Cr

Environmental management is actively moving toward strategies of reduction andprevention of pollution and waste management. Planning for pollution prevention is recognized as a vital component of this process. The purpose of this course is to introduce students the basic aspects of air, soil water and soil pollution, its effects and preventive measures. In the last two units they will gain knowledge on waste and disaster management.

Student learning outcomes (SLO):

At the conclusion of the course, the student will be able to,

- Learn about the causes and types of pollution.
- Get familiarized with global environmental issues.
- Acquire knowledge regarding the control measures against pollution.
- Recognize the various types of wastes in existence.
- Implement the pollution and waste management technologies in action.

UNIT IAir and Soil Pollution: Definition-causes –sources-- air pollutants - particulates and gaseous pollutants - harmful Effects –prevention & control technologies of Air Pollution. Soil pollution-causes -sources –industrial waste effluents – heavy metals - degradation of soil quality- remediation ofContaminated Soil

UNIT II Water and Noise Pollution: Water Pollutants and their sources; Pollution of stream, lakes -Eutrophication- waste water treatments systems -water quality standards-prevention & control measures. Noise pollution-causes-sources-Decibel scale-noise instrumentation and monitoring procedure- impacts of noise pollution-control and preventive measures.

UNIT III Control of Environment Pollution: Monitoring of air and water quality parameters - methods, equipments, standards- control of soil pollution. Role of individuals in prevention of pollution - pollution case studies. Global and regional perspectives of environmental pollution.

UNIT IV Solid Wastes: Causes, sources and types-**Municipal solid waste- organic waste- commercial wastes-Toxic waste-Recyclable-Soiled-**Hazardous wastes- - Biomedical wastes- Animal wastes- Sewage Wastes- Urban and industrial wastes.

UNIT V Solid Waste & Disaster management: Basic aspects of solid waste management; Current practices in India; Volume and strength reduction – Recycle, reuse and by-product recovery – Applications. Combined treatment of industrial and municipal wastes – Residue management – Dewatering – Disposal. Disaster management- Floods, Earthquake, Cyclone and landslides.

TEXT BOOKS

Atlas R. and Bartha .M (1988) Microbiology Fundamentals & Applications.2nd edn.Maxwell Macmillan International edn. UK.

Mitchell R (1992) Environmental Microbiology, Wiley – John Wiley Sons, Inc Publications, New York.

REFERENCES

1. Dave P. K. Gupta S. Parmar N. K, Kant S. (2007) Emergency Medical Services and Disaster Management: A Holistic Approach. Jaypee Brothers Medical Publishers (P) Ltd, New Delhi.
2. Kumar A (2006) Disaster Management – Recent Approaches, Anmol Publications, New Delhi.
3. Eugene P. Odum (1990) Ecology – A Bridge between Science and Society.

Sem	Part	Course No	Course Title	Hrs	Credits	Marks
I	I	XXX 0000	Tamil/French/Hindi	3	2	30
I	II	ENG 0000	Functional English I	3	2	30
I	III-C	MIC 1561	General Microbiology	5	5	75
I	III-C	MIC 1463	Lab in General Microbiology	4	4	60
I	III-S	MIC 1465	Biochemistry	4	4	60
I	III-C	MIC 1467	Lab in Biochemistry	5	4	60
I	IV-E	MIC 1269	Community Health – NME I	3	2	30
I	IV-LS	MIC 1271	Pollution and Waste Management – LS I	3	2	30
I	V	XXX 0000	Extension Activity (NSS/PED)	-	-	-
Total				**30**	**25**	**375**
II	I	XXX 0000	Tamil/French/Hindi	3	2	30
II	II	ENG 0000	Functional English II	3	2	30
II	III-S	MIC 1562	Cell Biology	5	5	75
II	III-C	MIC 1464	Immunology	4	4	60
II	III-C	MIC 1466	Lab in Immunology	4	4	60
II	III-C	MIC 1468	Microbial Physiology and Metabolism	5	4	60
II	IV-E	MIC 1270	Know About Microbes –NME II	3	2	30
II	IV-LS	MIC 1272	Bioproducts LS - II	3	2	30
II	V	XXX 0000	Extension Activity -NSS/PED	-	**1**	**15**
Total				**30**	**25+1**	**375/390**
III	I	XXX 0000	Tamil/French/Hindi	3	2	30
III	II	ENG 0000	Functional English II	3	2	30
III	III-C	MIC 2561	Microbial Ecology	5	5	75
III	III-C	MIC 2463	Molecular Biology	4	4	60
III	III-C	MIC 2565	Lab in Molecular Biology	5	5	75
III	III-C	MIC 2567	Analytical Microbiology	5	5	75
III	III-S	MIC 2469	Fundamentals of Pharmacology	5	4	60
III	V	XXX 0000	Extension Activity -NSS/PED	-	-	-
Total				**30**	**27**	**405**

Sem	Part	Course No	Course Title	Hrs	Credits	Marks
IV	I	XXX 0000	Tamil/French/Hindi	3	2	30
IV	II	ENG 0000	Functional English II	3	2	30
IV	III-C	MIC 2462	Microbial Genetics	4	4	60
IV	III-C	MIC 2564	Clinical Microbiology	5	5	75
IV	III-C	MIC 2566	Lab in Clinical Microbiology	5	5	75
IV	III-C	MIC 2568	Industrial Microbiology	5	5	75
IV	III- S	MIC 2570	Internship			
IV	III-S	MAS XXXX	Biostatistics	5	4	60
IV	V	XXX 0000	Extension Activity -NSS/PED	-	**1**	**15**
Total				**30**	**27+1**	**405/420**
Sem	**Part**	**Course No**	**Course Title**	**Hrs**	**Credits**	**Marks**
V	III-C	MIC 3761	Microbial Biotechnology	7	7	105
V	III-C	MIC 3563	Lab in Microbial Biotechnology	5	5	75
V	III-C	MIC 3665	Plant and Animal Cell Culture	6	6	90
V	III-C	MIC 3567	Lab in Plant and Animal Cell Culture	5	5	75
V	IV-LS	MIC 3269	Entrepreneurship in Microbiology – LS III	3	2	30
V	ES	MIC 3271	Environmental Studies	4	2	30
Total				**30**	**27**	**405**
VI	III-C	MIC 3762	Environmental and Agricultural Microbiology	7	7	105
VI	III-C	MIC 3564	Lab in Environmental and Agricultural Microbiology	5	5	75
VI	III-C	MIC 3666	Food and Dairy Microbiology	6	6	90
VI	III-C	MIC 3568	Lab in Food and Dairy Microbiology	5	5	75
VI	IV-LS	MIC 3270	Clinical Laboratory Technology - LS IV	3	2	30
VI	VE	XXX 0000	Value Education	4	2	30
Total				**30**	**27**	**405**
GRAND TOTAL				**180**	**158+2**	**2370/2400**

* *C-Core Courses*
* **NME - Non - Major Elective**
* **LS-Life Skill**
* **S – Supportive Courses**
* **VE- Value Education**
* **ES- Environmental Studies**

SUPPORTIVE COURSES (5 Hrs/W- 4 Cr)

Semester	Course Code	Course Title
I	MIC 1465	1. Microbial Biochemistry
II	MIC 1562	2. Cell Biology
III	MIC 2469	3. Fundamentals of Pharmacology
IV	MAS XXXX	4. Biostatistics

LIFE SKILL COURSES (3 Hrs/W- 2Cr)

Semester	Course Code	Course Title
I	MIC 1271	1. Pollution and Waste Management
II	MIC 1272	2. Bioproducts
V	MIC 3269	3. Entrepreneurship in Microbiology
VI	MIC 3270	4. Clinical Laboratory Technology

NON-MAJOR ELECTIVE COURSES (3 Hrs/W- 2Cr)

Semester	Course Code	Course Title
I	MIC 1269	Community Health
II	MIC 1270	Know about Microbes

VALUE ADDED COURSES (2Hrs/W-2Cr)

Semester	Course Code	Course Title
I	MIC 121V	Biocomposting
II	MIC 122V	Basics of Epidemiology
III	MIC 221V	Fundamentals of sanitation
IV	MIC 222V	Forensic Microbiology
V	MIC 321V	HACCP
VI	MIC 322V	Basics in Scientific Writing

Programme Specific Outcomes

PSO No	Upon completion of the BSc degree programme in Microbiology, the graduates will be able to
1	Formulate, articulate, retain and apply specialized language and knowledge relevant to the core concepts in microbiology.
2	Demonstrate competency in laboratory safety and in routine and specialized microbiological laboratory skills applicable to microbiological research or clinical methods
3	Communicate scientific concepts, experimental results and analytical arguments clearly and concisely, both verbally and in writing.
4	Apply the Microbiology discipline through involvement in research or internship activities
5	Assess how microorganisms are used as model systems to study basic biology, genetics, metabolism and ecology.
6	Explain why microorganisms are ubiquitous in nature; inhabiting a multitude of habitats and occupying a wide range of ecological habitats and play an integral role in disease, microbial and immunological methodologies are used in disease treatment and prevention
7	Evaluate examples of the vital role of microorganisms in biotechnology, fermentation, medicine, and other industries important to human wellbeing
8	Outline that microorganisms have an indispensable role in the environment, including biogeochemical cycles, bioremediation and others
9	Demonstrate the following laboratory skills: aseptic and pure culture techniques, preparation of and viewing samples for microscopy, use appropriate methods to identify microorganisms, estimate the number of microorganisms in a sample, and use common lab equipment.
10	Identify and discuss the ethical issues and responsibilities of doing science

Mapping of Programme Specific Outcomes (PSO) with Programme Outcomes (POs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
PSO1	X	X		X		X			X	X
PSO2		X	X	X	X	X	X		X	
PSO3	X	X		X	X	X	X		X	
PSO4	X	X	X	X	X		X	X		X
PSO5	X	X		X	X	X	X			
PSO6	X	X		X	X	X	X		X	
PSO7	X	X	X		X	X	X	X		
PSO8	X	X	X		X	X	X			X
PSO9				X		X	X	X	X	X
PSO10		X		X		X	X	X	X	X

Mapping of Courses with Programme Specific Outcomes (PSOs)

COURSE CODE	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10
MIC 1561										
MIC 1463			✓							
MIC 1465	✓									
MIC 1467	✓									
MIC 1269						✓				
MIC 1271						✓				
MIC 1562								✓		
MIC 1464								✓		
MIC 1466					✓					
MIC 1468					✓					
MIC 1270								✓		
MIC 1272						✓				

MIC1561 *General Microbiology* *5 Hrs / 5Cr*

This is an introductory course to microbiology for freshly enrolled undergraduates. The course aims to discuss how scientific community came together to debunk superstitions and discover the presence of microorganisms and their role in causing diseases. It gives insight into the possible theories of evolution, and the importance of microorganism in it. Current classifications, and the principles of taxonomy followed in microbiology as a field and their respective biological properties are discussed over three chapters. Also included are the basic tools and techniques necessary for an amateur microbiologist to study them.

Upon completion of this course, students will be able to

i. Compare theories on discovery of microorganisms and microbial evolution
ii. Use microscope to stain microorganisms with dyes for respective purpose
iii. Describe different methods of cultivation, counting and control of microorganisms
iv. Differentiate bacteria, archaea and virus based on their structure, taxonomy and characteristics
v. Categorize fungi and protists based on their structure, taxonomy and their characteristics

Unit I:Introduction to Microbiology (10Hrs)

Discovery of microorganisms – abiogenesis – Koch's postulates - Golden age of Microbiology; Microbial evolution – endosymbiosis, domains of life, scope of microbiology

Unit II: Basics of Microscopy (7Hrs)

Optics and properties of light, bright-field and dark-field, phase contrast, fluorescence, electron microscopy. Microbial size and shape. preparation and staining of microorganisms.

Unit III: Cultivation, counting and control of microbes (12Hrs)

Culturing microorganisms - sampling; Media- composition, types; techniques of pure culture isolation, inoculation; Counting bacteria; methods of microbial control - physical and chemical.

Unit IV: Prokaryotic diversity (14Hrs)

Bacteria – cell structure, classification, taxonomy, representative groups and characteristics;Archaea – diversity, taxonomy and general characteristics; Virus – properties, structure, classification and cultivation techniques.

UnitV: Eukaryotic diversity (8Hrs)

Classification, structure, reproduction and characteristics of fungi. Distribution, nutrition, classification, reproduction of protists

Textbook

Prescott L.M, Harley J. P and Klein D.A. (2016). Microbiology. 10 edn, McGraw Hill Book Co, New Delhi.

References

1. Slonczewski, J. L., & Foster, J. W. (2013). *Microbiology: An evolving science: Third international student edition*. WW Norton & Company.
2. Pommerville, J. C., & Alcamo, I. E. (2012). *Alcamo's Fundamentals of Microbiology: Body systems edition*. Jones & Bartlett Publishers.
3. Jacquelyn G. Black (2013), *Microbiology*, 8th edn, John Wiley & Sons International Publication.
4. Tortora, G. J., Funke, B. R., Case, C. L., & Johnson, T. R. (2018). *Microbiology: an introduction* (Vol. 13). San Francisco, CA: Benjamin Cummings.
5. Pelczar JM., Chan ECS., and Krieg NR. (1998). Microbiology. India: McGraw-Hill Education

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1	**1**	**2**			**5**	**1**
CO2		**2**	**3**	**4**	**5**	
CO3		**2**	**3**	**4**	**5**	
CO4	**1**	**2**			**5**	**1**
CO5	**1**	**2**			**5**	**1**

Mean: 3.1

MIC1463 *Lab in General Microbiology* *4Hrs/ 4Cr*

In this laboratory course, students will be trained to explore skill-based knowledge in aseptic maintenance, handling microscopes and glassware. This course aims to provide technical hands-on-training in preparation of selective and differential media, isolation and maintenance of pure culture. Students will also identify the morphological characteristics of microbes using various staining methods.

Upon completion of this course, students will be able to

i. Apply the aseptic techniques and proper handling of glassware and equipment
ii. Prepare various culture media for the cultivation of microbes.
iii. Demonstrate pure culture isolation and maintenance.
iv. Use various staining techniques for morphological characterization of microbes.
v. Utilize storage technique for bacteria and fungi

Laboratory exercises include

1. Orientation to the laboratory: rules of conduct and general safety
2. Aseptic techniques and culture transfer methods
    a. Serial dilution
3. Microbiological culture media preparation and sterilization
    a. Preparation of solid and liquid media
    b. Preparation of agar slant, and agar deep
4. Isolation and Maintenance of Pure Cultures
    a. Streaking techniques: pour, spread, streak methods
    b. Isolation of fungi by Warcup's method
    c. Pure culture storage and maintenance.
5. Identification of morphological and cultural characteristics of unknown bacteria and fungi
6. Examination of living microorganisms
7. Bright-field light microscope and microscopic measurement of organisms
8. Bacterial Morphology and Staining
    a. Smear preparation and simple staining
    b. Differential Gram staining
    c. Negative staining
    d. Spore and capsule staining
9. Observation of bacterial motility by Hanging drop slide
10. Slide culture technique and Lactophenol cotton blue staining for fungi

Textbook

James, C., & Natalie, S. (2019). Microbiology. A Laboratory Manual. Edition 12 Pearson Education.

References

1. Johnson, T. R., & Case, C. L. (2014). Laboratory experiments in microbiology. Edition 10. Pearson/Benjamin Cummings.
2. Harley JP., and Prescott LM. (2002). Laboratory Exercises in Microbiology Fifth Edition. The McGraw−Hill Companies.
3. Brown AE., and Smith H. (2014). Benson's Microbiological applications: a laboratory manual in general microbiology. Edition 13. McGraw-Hill Education.

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1				**4**	**5**	
CO2				**4**	**5**	
CO3				**4**	**5**	
CO4				**4**	**5**	
CO5				**4**	**5**	

Mean: 4.5

MIC 1465 *Biochemistry* *4Hrs / 4Cr*

The course Biochemistry is designed to give a comprehensive understanding of the chemical nature and chemical behavior of living systems. It includes the classification, structure and functions of various biomolecules such as carbohydrates, amino acids, proteins, lipids and nucleic acids. This course aims to deal with classification, mechanism of enzyme action, enzyme kinetics, regulation and inhibition

Upon completion of this course, students will be able to:

i. Assess the chemical nature and chemical behavior in living systems.
ii. Differentiate the types of carbohydrates and their biological significances.
iii. Analyze the structure of amino acids & proteins.
iv. Explain the chemistry, structure and significances of lipids and nucleic acids.
v. Discuss the structure, properties, mechanism of enzyme action and the regulation of enzyme activity.

Unit I: Biochemical interactions (10 hrs)

Atoms - types of chemical bonding - functional groups - structure and Properties of water - dissociation constant - Henderson and Hassel balch equation - acids and bases - pH scale - buffers - molarity and normality.

Unit II: Carbohydrates (10 hrs)

Monosaccharides - isomerism - structural forms and derivatives. Disaccharides - Oligosaccharides - Polysaccharides - simple and complex - Biological significances of carbohydrates.

Unit III: Amino acids and proteins (10 hrs)

Amino acids: Structure - classification - properties - Protein - classification - Structure: primary, secondary, tertiary and quaternary. Biological significances of amino acids and proteins.

Unit IV: Lipids and nucleic acids (10 hrs)

Lipids: Structure and biological significances offatty acids - triglycerides - phospholipids - sphingolipids - glycolipids - cholesterol - lipoproteins. Nucleic acids: Nucleotides - empirical structures - Structure, properties and types of DNA and RNA.

Unit V: Introduction to enzymes (10 hrs)

Classification - properties - enzyme kinetics - factors affecting rate of enzyme activity - mechanisms of enzyme action - regulation of enzyme activity - enzyme inhibition - coenzymes and cofactors.

Textbook

Moran LA, Horton HR, Scrimgeour KG and Perry MD (2012) Principles of Biochemistry. 5th Edition, Pearson Education, Inc., New York, USA.

References

Nelson DL and Cox MM (2017) Lehninger Principles of Biochemistry. 7th Edition, W.H. Freeman Company, USA.

Satyanarayana U and Chakrapani U (2013) Biochemistry. 4th Edition, Elsevier - a division of Reed Elsevier India Pvt. Ltd., New Delhi.

Murray RK, Granner DK, Mayes PA and Rodwell VA (2000) Harper's Biochemistry. 25th Edition. Appleton & Lange, USA.

Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry. 7th Edition, W.H. Freeman and Company, New York, USA.

Jain JL, Jain S and Jain N (2016) Fundamentals of Biochemistry. S. Chand & Company Ltd., New Delhi.

Ferrier DR (2017) Lippincott Illustrated Reviews Biochemistry. 7th Edition, Wolters Kluwer India Pvt., Ltd., Haryana.

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1	**1**			**4**	**5**	
CO2	**1**			**4**	**5**	
CO3	**1**			**4**	**5**	
CO4	**1**	**2**				
CO5	**1**	**2**				

Mean: 2.8

MIC 1467 *Lab in Biochemistry* *2Hrs/Wk – 2 Cr*

The lab course in Biological Chemistry includes pH metry, qualitative estimation of biomolecules, centrifugation, chromatographic separation of amino acids, and enzyme kinetics.

Upon completion of this course, students will be able to:

i. Use pH meter, colorimeter and centrifuge.
ii. Demonstrate paper and thin layer chromatography.
iii. Estimate the quantity of nucleic acids colorimetrically.
iv. Analyze biological samples for carbohydrates, protein and lipids qualitatively.
v. Evaluate the factors affecting enzyme activity.

Laboratory Exercises:

1. pH metry
2. Preparation of biological buffers
3. Acid *vs* Base titration
4. Estimation of sugar by colorimetry
5. Qualitative analysis of carbohydrates
6. Qualitative analysis of amino acids & proteins
7. Qualitative analysis of lipids
8. Quantitative estimation of DNA and RNA
9. Chromatography: Paper and Thin Layer
10. Centrifugation: separation of serum and milk proteins
11. Factors affecting enzyme activity on salivary and bacterial amylase

References

Plummer DT (1996) An introduction to Practical Biochemistry. Tata McGraw Hill, New Delhi.

Rajan S and Christy RS (2010) Experimental Procedures in Life Sciences. Anjanaa Book House Publishers and Distributors, Chennai.

Palanivelu P (2009) Analytical Biochemistry and Separation Techniques, 4th Edition, Twenty first Century Publications, Madurai

Bloom's Taxonomy	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
CO1				**4**	**5**	
CO2				**4**	**5**	
CO3				**4**	**5**	
CO4				**4**	**5**	
CO5				**4**	**5**	

Mean: 4.5

MIC 1269 Community Health 3Hrs / 2Cr

This course will encourage the students to understand the history, the need and the importance of community health and create awareness on the current scenario of the environmental and occupational community health problems present in India. This course aims to guide students to carryout community health planning and resource assessment and also will have the opportunity to gain volunteer community-based work experience and create a community experience portfolio.

Upon completion of this course, students will be able to

i. Explain the concepts and goals of community health in India.
ii. Appreciate the roles and significance of organization in ensuring health for all.
iii. Discuss the health planning objectives
iv. Critique the need for environmental safety towards public health.
v. Analyze the possible hazards of workplace and the necessity of preventive measures to ensure worker's safety.

Unit I: Community and public health (8 hours)

Introductions – definition – general concepts –history of public health – philosophy behind health for all, primary health care, millennium development goals –state of health profile in India – past, present, future.

Unit II: Adolescence and Occupational health (8 hours)

Adolescence: a special group - physiological and psychological needs – health problems – Global and Indian scenario –Alcohol & drug abuse - interventions- initiatives in India; Occupational health – definition - health hazards – health problems in various occupations – preventive measures – safe work environment – social security and labour laws.

Unit III: community health and the environment (8 hours)

Introduction – outdoor and indoor air pollutants – protecting the air – sources and types of water pollutants – ensuring the water safety – waste water treatment – food borne disease – regulating food safety - managing solid and hazardous waste – natural, psychological and sociological hazards

Unit IV: Community organizing and health promotion (8 hours)

Introduction – need – assumptions and methods – the process of community organizing – basics of health promotion programming.

UnitV:Organizations that shape community and public health (8 hours)

International health –definition –organizations involved –WHO, UNICEF, UNESCO, FAO, ILO, UNDP, UNFPA, UNAIDS, world bank – organization of health care in India

Textbooks

1. McKenzie, James F, Pinger, Robert R (2014) An Introduction to Community & Public Health. United States: Jones & Bartlett Learning.
2. Bhalwar R and Vaidhya R (2009) Text Book of Public Health and Community Medicine. India: Department of Community Medicine, Armed Forces Medical College, World Health Organization, Pune.

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1	**1**	**2**				
CO2	**2**	**2**				
CO3			**3**	**4**	**5**	**6**
CO4				**4**	**5**	
CO5				**4**	**5**	

Mean: 3.6

MIC 1271 *Pollution & Waste Management* *3Hrs / 2Cr*

Environmental management is actively moving toward strategies of reduction and prevention of pollution and waste management. Planning for pollution prevention is recognized as a vital component of this process. This course aims at introducing students the basic aspects of air, soil water and soil pollution, its effects and preventive measures. In the last two units they will gain knowledge on waste and disaster management.

Upon completion of this course, students will be able to

i. Outline information on air and soil pollutants and their control measures
ii. Assess standards and control measures for water and noise pollution
iii. Compare global and regional perspectives of environmental pollution
iv. Identify the sources, causes and types of solid wastes
v. Plan techniques for solid waste disposal and disaster management

Unit I: Air and Soil Pollution(8 hrs)

Definition-causes – sources - air pollutants - particulates and gaseous pollutants–prevention & control technologies of Air Pollution. Soil pollution-causes -sources –industrial waste effluents – heavy metals - degradation of soil quality- remediation of Contaminated Soil

Unit II: Water and Noise Pollution(8 hrs)

Water pollutants and their sources; Pollution of stream, lakes -Eutrophication- waste water treatments systems -water quality standards-prevention & control measures. Noise pollution- causes-sources-Decibel scale-noise instrumentation and monitoring procedure- impacts of noise pollution-control and preventive measures.

Unit III:Waste Management(8 hrs)

History of waste management, Waste – definition, types - Municipal solid waste- **o**rganic waste-commercial wastes-Toxic Waste-Recyclable-Soiled-Hazardous Wastes-Biomedical wastes- Animal wastes- Sewage Wastes- Urban and industrial wastes – e-waste.

Unit IV:Policy on Wastemanagement(8 hrs)

Environmental policy and law on waste management, Reduce-recycle-reuse policy; Current practices in India; worldwide waste management regimes

Unit V:Waste treatment(8 hrs)

Waste collection and transportation options, Chemical – physical – biological treatment methods – waste disposal and recycling methods, Landfills – wastewater treatment plants; Bioremediation

Textbooks

Atlas R. and Bartha .M (1988) Microbiology Fundamentals & Applications.2nd edn.Maxwell Macmillan International edn. UK.
Mitchell R (1992) Environmental Microbiology, Wiley – John Wiley Sons, Inc Publications, New York.

References

1. Bilitewski, B., Härdtle, G., Marek, K. (2013). Waste Management. Germany: Elsevier Science.
2. Vaughn, J. (2009). Waste Management: A Reference Handbook. United States: ABC-CLIO.
3. Eugene P. Odum (1990) Ecology – A Bridge between Science and Society.

Bloom's Taxonomy	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
CO1	1					
CO2		2				
CO3				4		
CO4			3			
CO5						5

Mean: 3

MIC1562 *Cell Biology* *5Hrs / 5Cr*

This course offers students the basic structure of prokaryotic and eukaryotic cells and the organization of cells and their organelles. It will help them understand the features common to all cells, from microbes to mammalian cells. Student will learn how cells interact with each other and the outer environment, the importance of cytoskeleton in various cellular processes such as intracellular transport, cell division etc. This course aims to help students to appreciate the various internal and external features of cells which allow them to perform diverse functions required of them for the proper functioning of an organism.

Upon completion of this course, students will be able to:

i. Outline various milestones in the discovery of the structure of diverse cells and their basic properties and functions
ii. Understand the fine structure of the plasma membrane, its functions and the various intercellular junctions and adhesion molecules that help cellular organization into tissues.
iii. Comprehend the structure and functions of organelles and the cytoskeleton.
iv. Discuss and compare various cell signaling strategies adapted by cells to convert external signals to various cellular responses.
v. Evaluate how cells divide, grow and die and the loss of cell cycle control leading to cancer.

Unit I: Introduction to cell biology *(10hrs)*

The discovery of cells- cell theory- basic properties of cells- characteristics that distinguish prokaryotic and eukaryotic cells- cellular organisation - types of prokaryotic cells- types of eukaryotic cells.

Unit II: Membranes and junctions *(12hrs)*

Structure of plasma membrane- Fluid mosaic model- Functions of plasma membrane. Transport across membrane- channels, pumps, carriers- absorption of glucose from the intestine. Endocytosis- exocytosis- membrane trafficking. Extracellular matrix- cell adhesion- intercellular junctions.

Unit III: CellularOrganelles and the cytoskeleton **(12hrs)**

Mitochondria, chloroplasts, peroxisomes, endoplasmic reticulum, secretory membrane system and golgi apparatus, nucleus. Cytoskeleton- major functions of the cytoskeleton. Actin fibres, microtubules, intermediate filaments- Centrioles and centrosomes- mechanism of muscle contraction and the role of cytoskeleton.

Unit IV: Cell communication *(14hrs)*

Cell signalling- local signalling and long-distancesignalling-Three stages of cell signalling- a preview of reception, transduction and response. Receptors in the plasma membrane- G protein coupled receptors, Receptor tyrosine kinases- ion channel receptors- intracellular receptors. Signal transduction pathways- Protein phosphorylation and dephosphorylation- second messengers. Responses- cellular and cytoplasmic responses. Mechanism of cholera toxin- stimulation of glycogen breakdown by epinephrine.

Unit V: The Cell Cycle *(10hrs)*

Key roles of cell division- Cell cycle- Phases of the cell cycle- Mitosis- Meiosis. Regulation of cell cycle. Apoptosis, Cancer as an example of loss of cell cycle controls.

Textbooks

1. Plopper, G. (2011). Principles of cell biology. First Edition. Jones and Bartlett Learning, MA, USA.
2. Reece, J. B., Urry, L. A., Cain, M. L., Wasserman, S. A., Minorsky, P. V., & Jackson, R. B. (2014). Campbell biology (No. s 1309). Boston: Pearson.

References

1. Karp, G., Iwasa, J., & Marshall, W. (2020). Karp's Cell and Molecular Biology. John Wiley & Sons.
2. Raven, P. H., Mason, K. A., Losos, J. B., Singer, S. R., & Johnson, G. B. (2014). Biology. 10th. AP, editor. Dubuque, Iowa: McGraw-Hill.

Bloom's Taxonomy	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
CO1	1	2			5	
CO2	1	2		4	5	
CO3	1	2	3		5	
CO4	1	2			5	
CO5	1	2	3		5	

Mean: 2.8

MIC1464 *Immunology* *5Hrs / 5Cr*

This course attempts to provide a basic understanding in Immunology. The course aims to discuss cells and organs of the immune system, complement, antigens, antibody structure, antibody diversity, antigen-antibody interactions, cell mediated and humoral immune response. In the section on disorders of immune system, autoimmunity, hypersensitivity reactions, immunodeficiency disorders that include AIDS are dealt.

Upon completion of this course, students will be able to

i. Identify the basic concepts in Immunology such as cells, organs, cytokines and complement system.
ii. Explain antigen, antibody and their interactions.
iii. Discuss the role of B, T cells and MHC in antigen recognition
iv. Assess humoral immune response and antibody diversity
v. Outline the regulation of immune response and disorders of the immune system

Unit I: Overview of the immune system (15hrs)

A historical perspective -– cells, tissues, organs and microenvironments of the immune system. Types of immunity: innate – anatomical barriers, chemical defenses, complement system, inflammation, Pattern recognition receptors, cytokines and adaptive – properties – humoral and cellular.Antigens-Types, Properties, Epitopes, Determinants of Immunogenicity

Unit II:Humoral immunity (10hrs)

Development of B-cells. Activation of B Lymphocytes and Production of Antibodies. B cell receptor structure and function. Effector Mechanisms of Humoral Immunity.

Unit III: Antibodies (10hrs)

Antibody structure, classes, functions,Generation of diversity, Allotypes and idiotypes, Monoclonal antibodies, Antigen–antibody complexes - Primary interactions-affinity and avidity-secondary interaction-agglutination-precipitation. Primary and secondary immune responses of antibodies - Immunological memory and vaccination - adjuvants

Unit IV: Cell-mediated immunity (10 hrs)

Types of T-lymphocytes. Development of T-cell. T-cell receptors. Role of Major Histocompatibility Complex. Antigen recognition, processing and presentation by T-cell. Effector mechanisms of cell-mediated immunity. NK cells – Antibody-dependent cell mediated cytotoxicity

Unit V: Dynamics of the immune response, in health and disease(10hrs)

Allergy and hypersensitivity – Transplantation – Autoimmunity - Immunodeficiency disorders – AIDS.

Textbooks

1. Owen JA., Punt J and Stranford SA. (2013). Kuby Immunology. 7 th Ed. WH Freeman and Company, New York.
2. Coico R. and Sunshine. G. (2015). Immunology – A Short Course. 7 thedn. Wiley Blackwell, UK.

References:

1. Pier GB., Lyczak JB and Wetzler LM. (2004). Immunology, Infection, and Immunity.ASM press.
2. Delves PJ, Martin SJ, Burton DR and Roitt IM (2006).Essential Immunology. 11 th Ed.Blackwell Pub Ltd, UK
3. Murphy K. and Weaver C. (2017). Janeway's Immunobiology. 9th edn. GarlandScience, New York and London.
4. Abbas, A. K., Lichtman, A. H., Pillai, S. (2016). Basic Immunology: Functions and Disorders of the Immune System. Netherlands: Elsevier.
5. Wood, P. J. (2006). Understanding Immunology. United Kingdom: Pearson Prentice Hall.

Bloom's Taxonomy	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
CO1		**2**				
CO2				**4**		
CO3					**5**	
CO4				**4**		
CO5			**3**			

Mean: 3.6

MIC1466 *Lab in Immunology* *4Hrs / 4Cr*

The laboratory component includes identification and enumeration of blood cells, location of lymphoid organs in selected vertebrates, preparation of antigens. Immunization techniques, methods of raising polyclonal antibodies, repetitive bleeding methods, antibody titration, complement mediated hemolysis, ELISA test for AIDS and skin test for allergy reactions.

Upon completion of this course, students will be able to

i. Identify the primary and secondary lymphoid organs.
ii. Assess the steps involved in raising polyclonal antibodies
iii. Demonstrate the diagnostic tests based on antigen-antibody interactions
iv. Perform ABO blood grouping and detection of HIV
v. Apply skin tests for allergy reactions.

The Laboratory component includes exercises as follows:

1. Total and differential count of blood cells
2. Lymphoid organs in vertebrates – fish
3. Raising polyclonal antibodies, I-preparation of antigens
4. Raising polyclonal antibodies II-routes of immunization
5. Raising polyclonal antibodies III- bleeding techniques and separation of serum
6. Raising polyclonal antibodies IV-antibody titration
7. Complement mediated hemolysis
8. Ouchterlony double immunodiffusion (ODI)
9. Mancini's single radial immunodiffusion (SRID)
10. Immunology of ABO blood grouping
12. ELISA test for AIDS
12. Skin test for allergy reactions

References:

1. Myers RL. (1989). *Immunology: A Laboratory Manual*. Wm. C. Brown, Dubuque, Iowa.
2. Hay FC and Westwood OMR (2003). *Practical Immunology*. 4th Ed. Blackwell Science UK.
3. Garvey JS., Cremer NE and Sussdof DH (1993).*Methods in Immunology – A Laboratory Text for Instruction and Research*. 3rd Ed. The Benjamin/Cummings Publisher, London.

Bloom's Taxonomy	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
CO1		2				
CO2				4		
CO3					3	
CO4			4			
CO5		2				

Mean: 3

MIC1468 *Microbial Physiology and Metabolism* *5Hrs/WK- 4Cr*

This course provides students the components of physiology and metabolism of microbes. This course aims to emphasize on the nutritional diversifications and uptake of nutrients by microbes and their growth. The students are exposed to the basic idea on nature of energy, concepts of thermodynamics and oxidation reduction reactions. It gives an opportunity to learn the basic principles and processes common to metabolism of all microbes.

Upon completion of this course, students will be able to:

i. Outline how the nutritional needs of microbes are diverse and compare the modes of transport microbes employ to uptake nutrients
ii. Identify the physiological changes in microbes during growth, the methods to measure microbial growth and to explain the role of environmental factors in influencing microbial growth
iii. Analyze and evaluate the laws governing biochemical reactions in microbes
iv. Discuss and compare how microbes catabolize carbohydrates aerobically and anaerobically for energy production
v. Evaluate how proteins and fats are utilized by microbes and how photoautotrophic microbes make food

Unit I: Microbial Nutrition (12h)

Categories of essential nutrients- forms, sources and functions of essential nutrients- nutritional types of microorganisms- transport of nutrients across the cell membrane- Diffusion- osmosis- active transport- passive transport

Unit II: Microbial growth (12h)

Bacterial cell cycle- binary fission- growth curve- methods of analysis of population growth- environmental factors that affect microbes - Ecological association among microbes- Mutualism- commensalism- parasitism- biofilms- quorum sensing -sporulation

Unit III: Microbial Metabolism (12h)

Enzymes- structure- Functions- Regulation of enzymatic activity- Factors affecting enzyme activity- thermodynamics- cell energetics- Biological oxidation and reduction- ATP as a source of energy- laws of thermodynamics- catabolism and anabolism

Unit IV: Carbohydrate metabolism (16h)

Aerobic respiration- Glycolysis- Krebs cycle- Electron transport chain. Anaerobic respiration- Fermentation- Metabolism of chemolithotrophs/ chemolithotrophic microbes

Unit V: Photoautotrophic bacteria, Protein, fat and nucleotide metabolism of chemorganotrophs (18h)

Bacterialphotosynthesis- Oxygenic and anoxygenic photosynthesis, rhodopsin-based phototrophy. Deamination- Amino acid biosynthesis- beta- oxidation of fats- lipid synthesis- synthesis of purines, pyrimidines and nucleotides.

Textbooks

1. Willey JM., Sherwood LM., and Woolverton CJ. (2011). Prescott's Microbiology, 8th ed., McGraw Hill International Publication.
2. Black JG. (2013). Microbiology. 8th ed. John Wiley & Sons International Publication

References

1. Talaro, K. P., Chess, B. (2017). Foundations in Microbiology. 10th Edition. United States: McGraw-Hill Education.
2. Foster, J. W., Slonczewski, J. (2017). Microbiology: An Evolving Science. United Kingdom: W.W. Norton.

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1	1	2				
CO2		2		4		
CO3			3		5	
CO4		2	3			
CO5		2			5	

Mean: 2.9

MIC 1270 *Know About Microbes* *3Hrs / 2Cr*

A comprehensive course that aims to give a basic understanding on the structure and characteristic features of wide range of microorganisms. This course aims to describe the role of these microorganisms in our daily life, agriculture, industries and medical fields.

Upon completion of this course, students will be able to:

i. Illustrate the structure and features of bacteria, viruses, algae, fungi and protozoa.
ii. Discuss the importance of microbes in our daily life.
iii. Identify the microbial agents that cause diseases.
iv. Explain the role of microorganisms in agriculture.
v. Evaluate the importance of microbes in the production of industrially important products.

Unit I: Introduction to microorganisms (8 hrs)

Structure and general characteristic features of bacteria - viruses - algae - fungi - protozoa.

Unit II: Microbes in our daily life (8 hrs)

Normal microflora of humans - microbiology of milk and dairy products - microorganisms in food spoilage and its control - edible mushrooms - SCP.

Unit III: Microbes of medical importance (8 hrs)

Biology and pathogenesis of*Salmonella typhi* - *Mycobacterium tuberculosis* - *Clostridium botulinum* - HIV - SARS CoV2 - *Hepatitis* - *Candida albicans* - *Plasmodium vivax* - *Entamoeba histolytica.*

Unit IV: Microbes of agricultural importance (8 hrs)

Nitrogen fixationby symbiotic and non-symbiotic microorganisms - Biofertilizers - Bacterial insecticides - Entomopathogenic fungi - Plant viruses (TMV and CMV).

Unit V: Microbes of Industrial importance (8 hrs)

Role of microorganisms in the production of industrially important products - wine - vinegar -lactic acid - citric acid - penicillin - vitamins.

Textbook

Dubey RC and Maheshwari DK (2013) A Textbook of Microbiology. S. Chand & Company Ltd., New Delhi.

References

Tortora GJ, Funke BR and Case CL (2016) Microbiology: An Introduction. 12th Edition, Pearson Education, Inc., New York, USA.

Pelczar MJ, Chan ECS and Kreigh NR (2000) Microbiology. 8th Edition, Tata McGraw Hill, New Delhi.

Kanungo R. ed. (2017) Ananthanarayan and Paniker's Textbook of Microbiology. 10th Edition, The Orient Blackswan, Hyderabad.

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1	1	**2**				
CO2	1	**2**				6
CO3	1	**2**	**3**			
CO4	1	**2**			**5**	
CO5	1	**2**		**4**	**5**	

Mean: 2.5

MIC 1272 *Bioproducts* *3 Hrs / 4Cr*

This course dealt the production of various products from microbes mainly through fermentation. The course will facilitate the students to became an entrepreneur by providing basic information about fermentation and the organisms used.

Upon completion of this course, students will be able to

i. Describe the production fermented dairy products
ii. Explains the applications of microbes in the field of pharmaceuticals.
iii. Discuss the production of beverages and other chemical compounds
iv. Explain the importance of alternative energy and the production of biofuels.
v. Demonstrate how microbes itself used as products.

Unit I: Foods (8 Hrs)

Dairy industry - organisms used, fermented dairy products and nutritive values of cheese, yogurt, acidified milk, kefir and koumiss.

Unit II:Pharmaceuticals (8 Hrs)

Antibiotics - organism used - fermentation - production of streptomycin and tetracycline. Production of insulin and interferon through cloned microbial cells.

Unit III: Beverages and other useful chemicals (8 Hrs)

Production of beer and wine; production of acetic acid, citric acid, lactic acid, vitamin and amino acids.

Unit IV: Biofuels (8 Hrs)

Biogas and bioethanol - definition - methods - raw materials (wastes) - collection and processing - role of microbes - fermentation - anaerobic digester - renewable natural gas - safety measures.

Unit V: Microbes as products (10 Hrs)

Single cell protein: microorganisms used; raw material used as substrate; condition for growth and production; nutritive value and uses of SCP. Mushroom production: cultivation of different types of mushroom; edible mushroom; Nutritive value of an edible mushroom. Microbial fertilizers- Production of *Rhizobium*, *Azotobacter*, *Azospirilla* and - Phosphate solubilizing bacteria; mycorrhiza.

Textbooks:

1. L. M. Prescott, J. P. Harley and D. A. Klein. Microbiology-, McGraw Hill
2. Frazier, Food microbiology. W.C. Tata McGraw Hill.

References:

1. Bergerson F J. 1980. Methods for Evaluating Biological Nitrogen Fixation. John Wiley & Sons.
2. Casida, Industrial microbiology-, L.E. New age international Ltd, Publishers. New Delhi:
3. N. J. Pelczar, S. Chand, R. Krieg. Microbiology- Tata McGraw Hill.

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1		**2**	**3**			
CO2	1	**2**	**3**			
CO3		**2**	**3**			
CO4		**2**	**3**		**5**	
CO5		**2**	**3**		**5**	

Mean: 2.8

VALUE ADDED COURSES

MIC 121V **Biocomposting** **2Hrs / 2Cr**

This course is designed to provides basics of composting, its various methods and applications. This course aims to infuse knowledge about the maximum utilization waste in to useful products by means of composting. By visiting industries students will be enlighten and acquire information to become an entrepreneur.

Upon completion of this course, students will be able to

i. Discuses various eco-friendly methods for waste management.
ii. Explain the energy production potential of natural wastes.
iii. Illustrate the utilization and nutritive value of agro-wastes.
iv. Explain the production of alternative energy and their importance.
v. Enlighten the students with field exposure

UnitI: Composting (6 Hrs)
Definition - History - fundamentals - microorganisms involved - phases of composting - methods - materials used - applications.

Unit II: Vermicomposting (6 Hrs)
Definition - collection - characterization - composting methods - factors involved - methods of vermicompost - maintenance - harvesting.

UnitIII:Agro-waste (6 Hrs)
Collection - role of microbes - fermentation - product recovery of products such as organic acids, vitamin and amino acids.

Unit IV: Biofuels (6 Hrs)
Biogas - Screening of waste (ligno-cellulose) - types of digester - factors - production of biogas; Bioethanol - raw materials - microbes involved - fermentation - product recovery.

UnitV: Field exposure (6 Hrs)
Visit to any one or two industries.

Textbook:

1. The Gardener's Guide to Composting, 3rd edition, by Stu Campbell. North Adams, Massachusetts: Storey Publishing, 1998.

References:

1. P.D. Grover and S.K. Mishra, Biomass Briquetting: Technology and Practices. Published by FAO Regional Wood Energy Development Programme in Asia, Bangkok, Thailand, 1996.
2. Magdalena Muradin and Zenon Foltynowicz, Potential for Producing Biogas from Agricultural Waste in Rural Plants in Poland. Sustainability, 2014, 6, 5065-5074.

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1		**2**	**3**			
CO2	1	**2**	**3**			
CO3		**2**	**3**		**5**	
CO4		**2**	**3**			
CO5		**2**	**3**			

Mean: 2.6

MIC 122V *Basics of Epidemiology* *2Hrs / 2Cr*

This course introduces the principles and basic methods of modern epidemiology. It covers the methods involved in surveillance of diseases and assessing and validating the reliability of screening and diagnostic tests. The course also covers the aspects of epidemiological approaches in identifying the cause of diseases and assessing the preventive and therapeutic measures of disease outbreak.

Upon completion of this course, students will be able to:

i. Explain the modes of transmission and outbreak of epidemiological diseases.
ii. Analyze and interpret the epidemiological data.
iii. Assess and validate the reliability of screening and diagnostic tests.
iv. Discuss the various epidemiological approaches in identifying the cause of disease.
v. Evaluate the methods in assessing preventive and therapeutic measures of disease outbreak.

Unit I: Dynamics of disease transmission (6 hrs)
Modes of transmission - clinical and sub-clinal diseases - disease outbreaks - immunity and susceptibility - incubation period - herd immunity - attack rate

Unit II: Measuring occurrence of disease(6 hrs)
Surveillance - stages of disease in population - measures of morbidity - incidence and prevalence rates - measures of mortality - mortality rate - case-fatality rate - proportionate mortality

Unit III: Assessing and validating reliability of screening and diagnostic tests (6 hrs)
Biologic variations in human population - validity of screening tests - tests with dichotomous results - tests of continuous variables - use of multiple tests - reliability of tests - kappa statistic

Unit IV: Epidemiological approach to identify the cause of disease(6 hrs)
Observational studies - Case reports and case series - Ecologic studies - Cross-sectional studies -Case control studies - Cohort studies

Unit V: Assessing preventive and therapeutic measures (6 hrs)
Randomized trials - selection of subjects - studies with and without comparison - factorial design - phases of testing drugs - multiple risk factor intervention trial - registration of clinical trials - ethical considerations

Textbook:
Celentano DD and Szklo M (2019) Gordis Epidemiology. Sixth Edition, Elsevier Inc., Canada.

References:
Beaglehole R, Bonita R and Kjellstrom T (1993) Epidemiology. World Health Organization,Geneva
Rothman KJ (1998) Modern epidemiology. Little Brown and Company, Boston/Toronto

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1	1	**2**				
CO2	1	**2**	**3**	**4**	**5**	
CO3		**2**	**3**	**4**	**5**	
CO4		**2**	**3**	**4**	**5**	
CO5		**2**	**3**	**4**	**5**	

Mean: 3.2

MIC221V *Fundamentals of Sanitation* *2Hrs / 2Cr*

This course helps students to understand the imperative of hygienic practices in reducing disease outbreaks associated with poor sanitation. To that end, the course provides insight into the various practices involved in maintaining sanitation in hospital, other healthcare facilities and food plants as these are some of the most important sources of deadly disease outbreaks. Students will learn about various disinfectants, detergents, sanitizers and cleaning equipment used to maintain hygiene in healthcare facilities and food plants.

Upon completion of this course, students will be able to:

i. Comprehend the importance of personal hygiene, nosocomial infections, infectious disease burden in India.
ii. Understand the hospital environment, chemicals and equipment used for maintaining hygiene in healthcare facilities (HCF).
iii. Discuss different disinfection and sterilization practices adapted by HCFs
iv. Realize the importance of food safety and various disease outbreaks related to poor handling of food
v. Comprehend the various food safety measures taken by diverse food industries to minimize contamination.

Unit I: Introduction to sanitation(6 hrs)

Nomenclature/terms- significance of sanitation- basic principles of personal hygiene- healthcare associated infections (HCAI)- anti-microbial resistance (AMR)- diseases associated with poor sanitation- infectious disease burden in India

Unit II: Hospital housekeeping I (6 hrs)

Hospital environment and different hazards- Detergents and disinfectants- Cleaning procedures for different areas of the hospital- Cleaning equipments- operation and maintenance- waste disposal and treatment.

UnitIII: HospitalhousekeepingII (6 hrs)

Infection control measures- disinfection and sterilization- types and practices- prevention and control of hospital infection- WASH in healthcare facilities- WHO guidelines.

Unit IV: Food safety I (6 hrs)

Biosecurity and sanitation- foodborne bioterrorism- food contamination sources- allergens in food- sanitizers- sanitary equipments- pest control

Unit V: Food Safety II (6 hrs)

Sanitation in different types of food industries- dairy processing plants- meat and poultry – seafood plant sanitation- fruit and vegetable processing plants- beverage plant sanitation.

Textbook:

1. Marriott, N. G., Schilling, M. W., &Gravani, R. B. (2018). *Principles of food sanitation*. Springer.
2. World Health Organization (2019). Water, Sanitation and Hygiene in Healthcare Facilities: Practical Steps to Achieve Universal Access to Quality Care. Geneva: World Health Organization.

References:

1. World Health Organization Staff, & World Health Organization. (2004). Laboratory Biosafety Manual. World Health Organization.

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1	1	**2**			**5**	
CO2		**2**		**4**	**5**	
CO3			**3**		**5**	
CO4		**2**			**5**	
CO5	1		**3**			

Mean: 3.2

MIC 222V *Forensic Microbiology* *2Hrs / 2Cr*

Microbes are involved in everything of human life. Criminalistics and forensics are not exceptions. This course is designed for the understanding the use of the microbes and microbiological methods for adding strength to the existing forensic investigation strategies.

Upon completion of this course, students will be able to

i. Relate microbiology for the advantage of forensics
ii. Collect and preserve microbes for the support of existing evidences
iii. Know the utility of biological material for forensic analysis
iv. Analyze and apply the molecular techniques for forensic investigation
v. Design experiment for developing evidences for investigations

Unit I: Introduction to Forensics and Microbiology (6 hrs)

Locard's exchange principle, Microbes and their ubiquitous nature, collection of samples from the crime scenes, basics of microbial culture techniques.

Unit II: Microbiome analysis in forensics (6 hrs)

Protection of the crime scene, Microbes as supporting evidences microscopic observation of the diatoms and planktons for support of evidences in deaths due to submergence, post- mortem microbiome.

Unit III: Forensic Serology (6 hrs)

Composition of blood, Blood grouping and typing for racial distinctions, Lewis antigen in genetics, secretors and non – secretors as evidences, serogenetic markers (HLA typing) in lineage analysis

Unit IV: Molecular techniques in forensic analysis (6 hrs)

Genetic markers from biological sample, methods of isolating DNA from the blood and body fluid) Blotting techniques, RAPD and RFLP, DNA fingerprinting, DNA sequencing and PCR in parental disputes,

Unit V: Microbial Forensics and critical analysis (6 hrs)

Microbes as the evidences for prosecution**,** case – dependant customization of the protocols, historical perspectives and the future prospect, Governance and regulations for monitoring vaccines, drugs and bio-weaponry.

Textbooks:

1. Microbiology: Lansing M Prescott & D Harley and Donald E Klein
2. Forensic Microbiology. David O. Carter, Jeffery K. Tomberlin, M. Eric Benbow, Jessica L. Metcalf, John Wiley & Sons, 21-Mar-2017

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1		2	3			
CO2			3	3	3	6
CO3		2	3	4		
CO4			3	4	5	6
CO5			3	4		6

Mean: 3.8

MIC 321V *Hazard Analysis and Critical Control Point System (HACCP)* *2Hrs / 2Cr*

This course focuses on the application on hazard analysis and risk-based preventive controls (HARPC) that align with the Food Safety Modernization Act (FSMA) regulations and HACCP principles. It includes the FDA-recognized "standardized curriculum" developed by the Food Safety Preventive Controls Alliance (FSPCA).

Upon completing the course, students will be able to:

i. Implement science-based HACCP Principles as a basis for food and food safety.
ii. Possess a working knowledge of how to meet FSMA regulatory requirements outlined in the Current Good Manufacturing Practice, Hazard Analysis, and Risk-Based Preventive Controls for Food.

Unit I: Introduction & Overview (6 hrs)

History and Introduction to HACCP, Principles and applications of HACCP. Prerequisite programs, Good manufacturing practices (GMP), Standard Operating Procedures (SOP), and Sanitation Standard Operating Procedures (SSOP). TACCP and VACCP, Codex Alimentarius Commission.

Unit II: Application of HACCP to control Food Hazards(6 hrs)

Definition of the terms: Hazard, Risk, Food business operation, Critical Control Point, Risk assessment, Hazard analysis, Control measure corrective action, critical limit, deviation, monitor, validation and verification.

Unit III: Critical Control Points (CCP) (6 hrs)

Application of CCP food business operation - methods of identifying CCP to ensure food safety, Critical limits specification.

Unit IV: Identification and Prevention of Hazard(6 hrs)

Identification of biological, chemical, and physical hazards - food (Food additives and adulterants),Allergens (Natural and Artificial residues) - Drugs (Veterinary drug residues). Preventive measures.

Unit V:HACCP plan and Legislations(6 hrs)

Monitoring procedures, Verification, and record-keeping procedures within a food manufacturing industry. Food Hygiene Regulations 2006 and the EU Regulations - Codes of Practice with regard to the system of HACCP. Implementation procedures based on HACCP principles. Labelling under the EU Consumer Information (Consumer Regulation 1169/2011, Food Information Regulations 2014).

Textbook

1. *HACCP: A Systematic Approach to Food Safety*, Jeffrey T. Barach and Melinda M. Hayman, Fifth Edition 2014.

2. Food Quality and Safety Systems - A Training Manual on Food Hygiene and the Hazard Analysis and Critical Control Point (HACCP) System, John R. Lupien(1998), Publishing Management Group, FAO Information Division ISBN 92-5-104115-6

Bloom's Taxonomy	**K1**	**K2**	**K3**	**K4**	**K5**	**K6**
CO1		2	3			
CO2			3	3	3	6
CO3		2	3	4		
CO4			3	4	5	6
CO5			3	4		6

Mean: 3.8

MIC 322V *BASICS OF SCIENTIFIC WRITING* *2Hrs / 2Cr*

This course aims to introduce the concept of academic writing in the field of biological sciences. It emphasizes on the precision, clarity and other technical skills necessary in writing a research article, a thesis, a review paper or while presenting an oral/poster presentation. The course will be dealt in writing exercises that will touch grammar, sentence construction, paragraph writing, components of research paper such as title, abstract, materials and methods, interpretation of results and its discussion. Do's and don'ts exercises on vocabulary and expressions related to science will also be provided. Students will become familiar with citing references, their formats, as well as the different types of plagiarism. On a final note, they will also engage in writing summarized scientific text to present in seminars, posters, as well as replying to emails and letters.

Upon completion of this course, students will be able to

i. Employ grammar properly in forming sentences and paragraphs
ii. Prepare a scientific report
iii. Identify reference formats and avoid plagiarism
iv. Recognize and apply diverse scientific terminologies and vocabulary
v. Construct emails, letters, oral as well as poster presentations

Unit I: Grammar for academic writing (6hrs)
Articles, Subject-verb agreement, Prepositions, Sentence construction, Participle clauses, Verb patterns, punctuation

UnitII: Organizing a scientific report (6hrs)
Writing Exerciseson Titles, Abstract, Materials and Methods**,** Results and Discussion

Unit III: Bibliography and Plagiarism (6hrs)
Reading exercises, Reference Formats, types of plagiarism, Plagiarism checker softwares

Unit IV: Expressions and Vocabulary in science (6hrs)
Exercises on words that are often confused, Unnecessarily complex words, Empty, wordy and redundant expressions

UnitV: Presentations, Emails and Cover Letters (6hrs)
Writing exercises on preparing oral and poster presentation, framing email and cover letters.

Textbook
Giba, J. (2014). *Developing skills in scientific writing*. Esteve Foundation.

References

1. Viallard, M. L. (2013). *Mastering scientific and medical writing. A self-help guide.* SM Rogers, Springer.
2. Wallwork, A. (2012). *English for academic research: writing exercises*. Springer Science & Business Media.

Bloom's Taxonomy	K1	K2	K3	K4	K5	K6
CO1		2	3			
CO2			3	4		6
CO3			3	4		6
CO4			3	4		6
CO5			3	4		6

Mean: 4.1