VELS

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)

(DEEMED TO BE UNIVERSITY Estd. u/s 3 OF THE UGC ACT, 1956)

NAAC ACCREDITED

PALLAVARAM - CHENNAI - INDIA

SCHOOL OF LIFE SCIENCES

DEPARTMENT OF MICROBIOLOGY

M. Sc.
IMMUNOLOGY AND MICROBIOLOGY

Program Specific Outcomes (PSO)

Students who graduate with a Master of Science in Immunology and Microbiology will :

PSO1: Obtain a significant knowledge on fundamental and advanced aspects of Microbiology

PSO2: Gain in-depth knowledge on different antibiotics from the viewpoint of targets, resistance mechanisms and spectrum evaluation methods.

PSO3: Gain proficiency in laboratory techniques of basic microbiology, microbial genetics, molecular biology, medical and applied microbiology.

PSO4: Grasp the fundamental concepts of immunity and the contribution of organs and cells in the development of immune response.

PSO5: Gain insight into the various aspects of immunogenetics, molecular immunology and clinical immunology.

PSO6: Assimilate technical skills on immunotechnology and biotechnology.

PSO7: Acquire research skills- plan & execute experimental techniques independently as well as to analyse & interpret data.

SCHOOL OF LIFE SCIENCES
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BOARD OF STUDIES MEMBERS

S. No	Name and Address	Designation
1.	**Dr. R. Dinakaran Micheal** Dean School of Life Sciences Vels University, Chennai – 600 117.	Chairperson
2.	**Dr. A.K.Kathireshan** Professor and Head Department of Microbiology School of Life Sciences Vels University, Chennai – 600 117.	Internal Member
3.	**Mr. Allen John Henry** Assistant Professor Department of Microbiology School of Life Sciences Vels University, Chennai – 600 117.	Internal Member
4.	**Mrs. G. Gayathri** Assistant Professor Department of Microbiology School of Life Sciences Vels University, Chennai – 600 117.	Internal Member
5.	**Dr. M. Elanchezhiyan** Professor and Head Department of Microbiology University of Madras Dr. ALM PGIBMS Taramani Campus Chennai – 600 113.	External Member
6.	**Dr. Rajkumar Samuel** Managing Director HUBERT ENVIRO LABS Ashok Nagar, Chennai.	External Member
7.	**Ms. Sanchita Nath** Research Scholar Department of Microbiology School of Life Sciences Vels University Chennai – 600 117.	Alumni (M.Sc., Immunology and Microbiology, 2013 – 2015 Batch)

M. Sc.
IMMUNOLOGY AND MICROBIOLOGY

Curriculum and Syllabus
(Based on Choice Based Credit System)
Effective from the Academic year
2015 - 2016

M.Sc. – IMMUNOLOGY and MICROBIOLOGY

CURRICULUM

Total number of Credits: 90

Category	Code	Title of the Course	Hours/ week			Credit
			Lecture	Tutorial	Practical	
		Semester I				
Core	15MIM001	Microbiology	4	0	0	4
Core	15MIM002	Immunology	4	0	0	4
Core	15MIM003	Practical I - Microbiology	0	0	6	3
Core	15MIM004	Practical II - Immunology	0	0	6	3
DSE		Discipline Specific Elective 1	4	0	0	4
DSE		Discipline Specific Elective 2	4	0	0	4
GE		Generic Elective 1	2	0	0	2
		TOTAL	18	0	12	24
		Semester II				
Core	15MIM005	Microbial Genetics and Molecular Biology	4	0	0	4
Core	15MIM006	Molecular Immunology and Immunogenetics	4	0	0	4
Core	15MIM007	Practical-III Molecular Biology	0	0	6	3
Core	15MIM008	Practical IV - Immunotechnology	0	0	6	3
DSE		Discipline Specific Elective 3	4	0	0	4
DSE		Discipline Specific Elective 4	4	0	0	4
GE		Generic Elective 2	2	0	0	2
		TOTAL	18	0	12	24

Category	Code	Title of the Course	Hours/ week			Credit
			Lecture	Tutorial	Practical	
		Semester III				
Core	15MIM009	Clinical Immunology and Vaccinology	4	0	0	4
Core	15MIM010	Applied Microbiology	4	0	0	4
Core	15MIM011	Practical V - Vaccines Technology	0	0	6	3
Core	15MIM012	Practical VI - Applied Microbiology	0	0	6	3
DSE		Discipline Specific Elective 5	4	0	0	4
DSE		Discipline Specific Elective 6	4	0	0	4
GE		Generic Elective 3	2	0	0	4
		TOTAL	18	0	12	24
		Semester IV				
Core	15MIM13	Project	0	8	22	18
		TOTAL		90		90

List of Discipline Specific Electives (Any 6 papers) **4 0 0 4**

DSE1: 15MIM101 - Microbial Biochemistry

DSE2: 15MIM102 - Medical Parasitology

DSE3: 15MIM103 – Immunotechnology (II sem)

DSE4: 15MIM104 - Research methodology

DSE5: 15MIM105 - Cloning strategies and Nanomicrobiology (II sem)

DSE6: 15MIM106 - Biostatistics

DSE7: 15MIM107 – Biofertilizers (III sem)

DSE8: 15MIM108 - Animal Cell culture

DSE9: 15MIM109 - Good Manufacturing Practice (GMP)

DSE10: 15MIM110 - Medical Microbiology (I sem)

DSE11: 15MIM104 - Industrial and Pharmaceutical Microbiology (I sem)

DSE12: 15MIM112 - Cell Culture and Fermentation Technology (III sem)

List of Generic Electives (Any 3 papers) **4 0 0 4**

GE 1: 15MIM151 - Introduction and Scope of Microbiology

GE 2: 15MIM152 - Bacteriology and Virology

GE 3: 15MIM153 - Microbial Metabolism

GE 4: 15MIM154 - Industrial and Food Microbiology

GE 5: 15MIM155 - Microbes in Environment

GE 6: 15MIM156 - Medical Microbiology and Immunology

GE 7: 15MIM157 - Genetic Engineering and Biotechnology

GE 8: 15MIM158 - Microbial Genetics and Molecular Biology

Syllabus Core Courses

15MIM001 Microbiology (Theory) 4 0 0 4

Course Objective: The candidates undertaking this course will gain knowledge about the structure of bacteria; types of microscopes and microscopy; sterilization methods and quality control; disinfection, antibiotics – testing and quality control; alga structure and life-cycle patterns.

Course Outcome

At the end of the course, learners will be able to:

CO1: Significant knowledge will be obtained about various microbes including cell structure.

CO2: Complete information about cell cycles, reproduction in bacteria and aspects of bacterial growth.

CO3: A firm grasp of the basics of microscopy and the principles, working and applications of bright field microscopes and electron microscopes.

CO4: A thorough understanding of the various physical and chemical methods for the control of microbial growth and evaluation of the methods.

CO5: An in-depth study of different antibiotics from the viewpoint of targets, resistance mechanisms and spectrum evaluation methods.

CO6: Full understanding of alga – including life cycles and reproduction and few important protozoa.

UNIT I INTRODUCTION 15

Evolution and scope of microbiology. Description of various groups of microorganisms with typical example. Cell cycle and reproduction of bacteria. Bacterial cell structure and components, bacterial growth curve in batch culture.

UNIT II MICROSCOPY 12

Microscopy – principles of microscopy- bright-field microscopy – PCM, FM CSLM, ICM, TEM, SEM and STEM – description, principle and use.

UNIT III STERILIZATION 12

Sterilization – High temperature- Tyndallization, Pasteurization, inspissation, incineration, moist heat under pressure; low temperature – preservation; filtration- membrane filters, depth filters; centrifugation; radiation- principle, use and Quality control. Disinfection- Mode of action and Evaluation.

UNIT IV ANTIBIOTICS 12

Antibiotics – Classification, Mode of Action, mechanism of resistance, Evaluation – Disc Diffusion; MIC – Broth dilution, agar dilution; MBC; E- test with Quality control for each method.

UNIT V ALGAE 09

Structure of algal cell with example; Life-cycle patterns of Algae. Reproduction in algae.Structure of Paramecium, Amoeba, Euglena, Giardia.

Total: 60 hours

TEXTBOOK:

Michael T. Madigan, John M Martinko, Brock's Biology of Microorganisms, Pearson-Prentice Hall. Ed. 11; 2006.

REFERENCE BOOKS:

1. Ananthanarayanan R & C.K.Jeyaram Paniker; Textbook of Microbiology; Orient Longman. Ed.7; 2005.
2. Michael T. Madigan, John M Martinko; Brock's Biology of Microorganisms, Pearson-Prentice Hall. Ed. 11; 2006
3. Ronald M.Atlas; Principles of Microbiology, WCB Publishers. Ed. 2; 1997
4. Roger Y. Stanier, John L. Ingraham, Mark L. Wheelis,Page R. Painter, Generall Microbiology, MacMillan Press. Ed. 5; 2004.
5. Topley & Wilson's: Principles of Bacteriology, Virology & Immunology,Edward Arnold. Ed. 9; 2002.
6. Lansing M. Prescott, John P Harley, Donald A. Klein; Microbiology, McGraw Hill. Ed. 6; 2005.

15MIM003 Microbiology (Practical) 0 0 6 2

Course Objective: The candidate will gain hands-on knowledge and acquire adequate skill required to stain and observe microbes, identify pathogens and other bacteria based on biochemical reactions.

Course Outcome

At the end of the course, learners will be able to:

CO1: Acquire technical skills on staining methods.

CO2: Know how to perform sterilization and antibiotics sensitivity tests

CO3: Gain the basic skill on identification of bacteria and culture methods

CO4: Skilled in identification pathogenic bacteria, fungi and protozoa

CO5: Gain the knowledge on collection & transport specimens

1. Staining – Simple, Gram's Staining, Acid fast Staining, Metachromatic granule staining, Staining of lipid, Endospore staining, Staining of flagella, Capsule staining. Observation of motility – Wet mount; Hanging drop
2. Sterilization of antibiotic solution. Methods for testing effectiveness of antibacterial antibiotics – Kirby-Bauer method.
3. Biochemical tests: IMViC test, O-F Test, Sugar fermentation test.
4. Preservation of bacterial cultures. Cultivation of anaerobes.
5. Collection and transport of specimens- Faeces, pus, sputum, throat/ ear/ nasal/ wound swab, CSF and other body fluids.
6. Bacterial typing methods- Serotyping, phage typing and bacteriocin typing methods.
7. Identification of medically important pathogenic bacteria- *Staphylococci, Streptococci, E. coli, Klebsiella, Shigella, Salmonella, Vibrio.*
8. KOH examination of skin, hair and nail infections.LPCB examination of fungi.Isolation and identification of fungi- *Mucor, Rhizopus, Aspergillus, Penicillium,* Dermatophytes and Yeasts - SDA/ Corn meal agar - Slide culture technique - Germ tube test – Capsular and Gram stain – Sugar assimilation and fermentation tests for yeasts.
9. Examination of parasites in clinical specimens- Ova/ cyst in faeces by Lugol's iodine wet mount method.Concentration methods- Formol ether and Zinc sulphate methods, Salt saturation methods.
10. Blood smear examination for malarial parasites.
11. Cultivation of viruses by egg inoculation methods.Observation and interpretation of CPE.
12. Detection of HBs Ag by ELISA

Total: 90hours

15MIM002 Immunology (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about immunity, organs of immunity and cells involved; Types of antigens and properties; immunoglobulin – types; MHC and its significance; hypersensitivity reactions.

Course Outcome

At the end of the course, learners will be able to:

CO1: Understand the fundamental concepts of immunity, contributions of the organs and cells in immune responses.

CO2: Realize how the MHC molecules function and host encounters an immune insult.

CO3: Understand the antibodies and complement system

CO4: Understand the mechanisms involved in initiation of specific immune responses

CO5: Differentiate the humoral and cell mediated immune mechanisms

CO6: Comprehend the overreaction by our immune system leading to hypersensitive conditions and its consequences

CO7: Know how autoimmunity develops in a host

CO8: Gain knowledge about immunologic processes governing graft rejection and therapeutic modalities for immunesuppression in transplantation

CO9: Understand unique properties of cancer cells, immune recognition of tumors, immune evasion of cancers

UNIT I INTRODUCTION 12

Introduction- immunity- types-innate, acquired. Ontogeny and Physiology of immune system- Primary and Secondary lymphoid organs, lymphoid tissues. Immunoreactive cells- structure and functions-macrophages, granulocytes, NK cells, T and B lymphocytes – origin, development, differentiation, lymphocyte subpopulation in humans.

UNIT II ANTIGENS 12

Antigens and immunogenicity- terminologies and definition- antigen, immunogen, haptens, super antigen, tolerates, epitope, paratope. Features associated with antigenicity and immunogenicity. Basis of antigen specificity. MHC – types and importance- distribution and function. Antigen processing and presentation to T- lymphocytes.

UNIT III IMMUNOGLOBULINS 12

Immunoglobulin- structure, types, distribution, biological and chemical properties - Theories of antibody production- its regulation and diversity. Monoclonal and polyclonal antibodies. Complement system – mode of activation- Classical, Alternate and Lectin pathways, biological functions.

UNIT IV IMMUNE RESPONSE 12

Antigen recognition – TCR, BCR, MHC restriction, lymphocyte activation, clonal proliferation and differentiation. Physiology of acquired immune response – various phases of HI, CMI – cell mediated cytotoxicity, DTH response.

UNIT V HYPERSENSITIVITY 12

Hypersensitivity – types and mechanisms, Autoimmunity, Tumor and Transplantation immunology. Immune regulation mechanisms – brief account on immuno-induction, immuno-suppression, immuno-tolerance, immuno-potentiation. Role of cytokines, lymphokines and chemokines.

Total: 60hours

TEXTBOOK:

1. Richard Coico, Geoffrey Sunshine, Eli Benjamini. Immunology – A Short Course. Wiley-Liss, New York. 5th ed., 2003.

REFERENCE BOOKS:

1. Ivan M. Roitt, J. Brostoff and D. K. Male, Immunology, Gower Medical Publishing, London.1993.
2. Clark WR, The experimental foundations of modern immunology. John Wiley and Sons Inc. New York. 1991.
3. Janis Kuby, Immunology, II edition. W. H. Freeman and Company, New York. 1993.
4. Janeway Travers, Immunobiology- the immune system in health and disease. Current Biology Ltd. London, New York. 3rd ed.,1997.
5. Peter J. Delves, Ivan M. Roitt, Encyclopedia of Immunology; Academic Press. 2nd Ed., 1998.
6. Chapel H and Halbey M, Essentials of Clinical Immunology. ELBS. 1986.
7. Leslie Hudson and Frank C. Hay. Practical Immunology. Blackwell Scientific Publication. 3rd ed., 1989.
8. Pravash Sen. Gupta, Clinical Immunology. Oxford University Press. 2003.
9. Noel R. Rose, Herman Friedman, John L. Fahey. Manual of Clinical Laboratory Immunology. ASM. 3rd ed., 1986.

15MIM004 Immunology (Practical) 0 0 4 2

Course Objective: The candidate will gain hands-on knowledge and acquire adequate skill required to identify and enumerate immune cells and also perform agglutination reactions.

Course Outcome

At the end of the course, learners will be able to:

CO1: Identify various immune cells and enumerate them

CO2: Competently perform serological diagnostic tests such as RF, ASO, CRP.

CO3: Identify blood groups and types

CO4: Diagnose syphilis by performing TPHA test

CO5: Analyze the components of human sera by performing agarose and polyacrylamide gel electrophoresis

1. Identification of various immune cells by morphology – Leishman staining, Giemsa staining.
2. Differential counts.
3. Total counts.
4. Agglutination Reactions- Latex Agglutination reactions- RF, ASO, CRP.
5. Heamagglutination Reactions- Blood Grouping – forward and reverse, Rh Typing, Coomb's test, TPHA.
6. Visit to blood bank.
7. Serum electrophoresis.
8. PAGE of serum proteins.

Total: 90 hours

15MIM005 Microbial Genetics and Molecular Biology (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about chromosomes, nucleic acids; DNA damage and repair; RNA and transcription; genetic code and recombination; Plasmids and cloning vectors; methods in molecular analysis.

Course Outcome

At the end of the course, learners will be able to:

CO1: Significant knowledge will be obtained about gene transfer mechanisms in bacteria.

CO2: Complete information about structure, replication, damage and repair of nucleic acids.

CO3: A firm grasp of the process of transcription and its control.

CO4: A thorough understanding of the process of translation and operons along with recombination of DNA.

CO5: An in-depth study of mutagenesis and genetic analysis with gene mapping.

CO6: Full understanding of all aspects of all important techniques used for the study of biomolecules.

UNIT I MICROBIAL GENETICS 18

Transformation, conjugation and transduction. Nucleic acid as genetic material – DNA and RNA structure. Melting of DNA. DNA replication – general principles, modes of replication, DNA polymerases – structure and function. Superhelicity in DNA, topology of DNA and topoisomerases, chromosome structure and organisation. Replication of ssDNA, retroviral replication. Inhibitors of replication. DNA damage and repair – Types of DNA damage, mechanism of repair - methyl directed, excision, recombinational, SOS.

UNIT II TRANSCRIPTION 10

Transcription – general principles, basic apparatus, RNA polymerases and steps involved, inhibitors of RNA synthesis. Monocistronic and polycistronic mRNAs. Regulation of transcription – attenuation and antitermination, heat shock proteins. Structure of tRNA.

UNIT III TRANSLATION 10

Genetic Code.Translation – maturation and processing of RNA, RNA polymerase, Sigma-factor switching, post translational modifications, operon concept – *lac*, *trp* and *ara* operon, riboswitches. Recombination – Generalized, Site-specific; Models of recombination.

UNIT IV MUTATION 12

Biology of plasmids, structure of F1, Col E1. pSC 101, Ti plasmid – their replication. Transposons – structure, types and functions. Gene as a unit of mutation and recombination – mutagens, mutagenesis – biochemical basis of mutations – spontaneous and induced. Reversion, suppression, genetic analysis of mutants. Fine structure and genetic analysis of phage T4 using rII locus. Genetic mapping of *E. coli* and yeast.

UNIT V MOLECULAR ANALYSIS 10

Methods to study biomolecules – Gel electrophoresis, 2D- Gel electrophoresis, Ion-exchange Chromatography, Gel filtration Chromatography, Affinity Chromatography, Autoradiography, Southern Blot, DNA Fingerprinting and Typing, Western Blot, Restriction mapping, Site-directed mutagenesis, Northern Blot, S1 Mapping, Nuclear Run-on Transcription, Reporter Gene Transcription, Filter binding assay, Gel Mobility Shift, DNase Footprinting.

Total: 60 hours

TEXT BOOK:

1**.** Freifelder, D; Molecular Biology. Narosa Publishing House, New Delhi. 2008.

REFERENCE BOOKS:

1. Maloy S.R, Cronan JR, JE. Freifelder, D; Microbial Genetics. Jones and Barlette publishers. 1994.
2. Lodish H, Baltimore O, Berk A, Zipursky SL, MAtsudaira P, Darnell, J.; Molecular Cell Biology. Scientific American Books. 1995.
3. Lewin B; Genes VIII. Oxford University Press. 2004.

4. William Haynes; The Genetics of Bacteria and Their Viruses. Blackwell Scientific Publishers, Oxford. 1985.
5. E.D.P. De Robertis, E.M.F. De Robertis,Jr., Cell And Molecular Biology, Lippincott Williams and Wilkins. Ed. 8; 2001.
6. B.Alberts, A,Johnson, J.Lewis, M.Roff, K.Roberts, P.Walter, Mol;ecular Biology of The Cell, Garland science,NY. Ed. 4; 2002.
7. Robert F.Weaver, Molecular Biology, McGraw – Hill. Ed.4; 2008.

15MIM006 Molecular Immunology and Immunogenetics (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about genes that control properties of immunoglobulin, complement proteins; TCR and other similar markers; MHC/ HLA genes and antigenic structure; ABO and other grouping systems; tumor antigens.

Course Outcome

At the end of the course, learners will be able to:

CO1: Understand the genetic basis of immune cell receptors, proteins involved in humoral and cell mediated immune response

CO2: Learn MHC genes and products.

CO3: Know the genetics of human blood groups and types and their clinical / forensic significance.

CO4: Comprehend cancer genetics and expression of tumor antigens.

CO5: Discern the immune responses against tumor antigens in humans

UNIT I IMMUNOGLOBULINS 12

Genetics of Immunoglobulins – isotypes, class switching, Molecular biology of immunoglobulin - biosynthesis, generation of antibody diversity, allotypes, and idiotypes and Immunoglobulin purification techniques. Genetics of complement components.

UNIT II LYMPHOCYTES 12

Genetics of T – lymphocytes – Surface receptors, Antigens – Diversity of TCR, T cell surface alloantigens, other markers of Human T and B lymphocytes.

UNIT III MAJOR HISTOCOMPATIBILITY COMPLEX 12

Major Histocompatibility antigens – MHC genes and products, Structure of MHC molecules, Genetics of HLA Systems – Antigens and HLA typing.

UNIT IV IMMUNOHEMATOLOGY 12

Genetics of Immunohematology – Genetic basis and significance of ABO and other minor blood groups in humans, Bombay blood groups, Secretors and Non-secretors, Rh System and genetic basis of D- antigens. Clinical and forensic relevance of ABO and minor blood groups.

UNIT V TUMOR ANTIGENS 12

Genetics of neoplastic cell antigens – TL antigens, CEA and others in humans, expression of tumor antigens and humoral and cell – mediated immune responses against tumor antigens in humans.

Total: 60hours

TEXTBOOK:

Christiansen, Frank T., **Tait**, Brian D.; Immunogenetics: Methods and Applications; Springer. 2012.

REFERENCE BOOKS:

1. Benacerraf B, Immunogenetics and Immunodefeciency; William Clowes and Sons ltd. London. 1975.
2. Zaleski MB, Dubiski S, Niles EG and Cunningham RK, Immunogenetics; Pitman, Toronto. 1983.
3. Hugh Fudenberg H, Pink JRL, Wang A and Ferrera GB, Basic Immunogenetics; Oxford University Press , NY. 1984.
4. Williamson AR and Turner MN, Essential Immunogenetics; Blackwell Scientific Pulications, London. 1987.
5. K.S.N. Reddy, The Essentials of Forensic Medicine and Toxicology, Ed. 26; 2007.

15MIM007 Molecular Biology (Practical) 0 0 6 2

Course Objective: The candidate will gain hands-on knowledge and acquire adequate skill required to isolate, demonstrate and quantitate nucleic acids, transfer DNA to bacteria and separate biomolecules by electrophoresis.

Course Outcome

At the end of the course, learners will be able to:

CO1: Acquire technical skills on isolation of DNA & Plasmid & their quantification

CO2: Know how to perform gene transfer, protein quantification & TLC

CO3: Gain the basic skill on blotting techniques & PCR

CO4: Skilled in production of microbial enzymes

CO5: Gain the knowledge on strain improvement and enzyme immobilization

1. Isolation of genomic DNA. Isolation of plasmid DNA – Alkaline lysis. Isolation of DNA from Fungi.
2. Quantitation of DNA and RNA by chemical methods-Dinitrophenol, orcinol, physical method – UV adsorption
3. Preparation of competent cells. Gene transfer by conjugation method.
4. Estimation of proteins – Lowry method; Bradford method
5. Electrophoretic methods – PAGE native PAGE.
6. TLC – Plant pigments, amino acids, lipids and vitamins. Protein separation by aqueous two phase partitioning.
7. Blotting techniques – Southern blotting and western blotting
8. Strain Improvement - Protoplast and spheroplast fusion, mutation.
9. PCR-standard amplification.
10. Isolation of antibiotic resistant microbes. Isolation of auxotrophic mutants.
11. Screening test for production of Cellulases, Amylases and Proteases, purification and assay.
12. Whole cell and enzyme immobilization. Biogas production. Mushroom cultivation. Wine preparation.

Total Hours: 90

15MIM008 Immunotechnology (Practical) 0 0 4 2

Course Objective: The candidate will gain hands-on knowledge and acquire adequate skill required to perform precipitation reactions and purify immunoglobulins and detect antigens via western blotting.

Course Outcome

At the end of the course, learners will be able to:

CO1: Antigen-antibody interactions demonstrated in gels and to visualize the bands

CO2: Isolating of lymphocytes from blood by density gradient centrifugation

CO3: Purifying and separating immunoglobulins using salt precipitation and affinity chromatography respectively

CO4: Molecular detection of infectious proteins by blotting techniques.

CO5: Serological and Molecular typing of tissues

1. Precipitation reactions in gels – SRID, ODD, RE, CIE, Immunoelectrophoresis and staining of precipitation lines.
2. Preparation of lymphocytes from peripheral blood by density gradient centrifugation.
3. Purification of immunoglobulin – Ammonium Sulphate Precipitation.
4. Separation of IgG by chromatography using DEAE cellulose or Sephadex.
5. Western Blotting.
6. Tissue typing – Microcytotoxicity Assay, Mixed Lymphocyte Reaction and Primed Lymphocyte Typing.
7. HLA – DNA Typing.

Total: 90hours

15MIM009 Clinical Immunology and Vaccinology (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about immunological against infections; humoral and cell mediated immunity; autoimmunity mechanisms and damage; immunodiagnostic tests and assays; Vaccines- preparations and use.

Course Outcome

At the end of the course, learners will be able to:

CO1: Learn the molecular basis of microbial pathogens.

CO2: Understand the Innate and Acquired immune responses against microbial pathogens

CO3: Learn various disease caused by immune response.

CO4: Learn immune diagnostic tests and assays against pathogens.

CO5: Understand the vaccines preparations and its clinical uses.

UNIT I MOLECULAR BASIS 12

Microbial pathogens – Bacterial, Viral and Fungal Pathogens and Parasitic diseases. Immune response vs infection. Immunity against bacterial infections – Innate and Acquired Immune responses – cellular involvement – Macrophages, Neutrophils, NK cells, Defensins, Humoral and Cell mediated Immune responses, Intracellular infections.

UNIT II INFECTION AND IMMUNITY 12

Immunity against bacterial and viral infections – Innate and Acquired immune responses – Effector mechanisms of HI and CMI – cytokine involvement. Immunodeficiency. Immunity to fungal and parasitic infections – overview of Humoral and Cell mediated immune responses against the pathogens. Immunomodulation in infections.

UNIT III CLINICAL IMMUNOLOGY 12

Clinical Immunology - Disease caused by immune response – hypersensitivity, immune tolerance and autoimmunity, mechanism of autoimmunity, therapy for immunological diseases - Immune complex disease, immunosuppression and immunomodulation.

UNIT IV IMMUNODIAGNOSIS 12

Diagnostic Immunology - Methods based on precipitation; ODD, CIE, IEP, immuno fixation and immunoblotting, RIA, RE, Immunonephlometry. Methods based on Agglutination - agglutination of whole cells, agglutination of inert particles coated with Ag/Ab. Haemagglutination – Direct, indirect, passive; CFT, labeled assays – ELISA, RIA, FISH, IFT-*in vivo* reactions- skin tests, immune complex demonstration. Diagnostic evaluation of lymphocytic haemagglutination inhibition, lymphocytic function and CMI, phagocytosis.

UNIT V VACCINES 12

Introduction to Vaccines and Adjuvants - Types of vaccines – Whole cell - Killed and Live Attenuated vaccines. Sub–unit vaccines – polysaccharides, proteins, Toxoids. Recombinant vector vaccines, DNA vaccines, Development of vaccines and antibodies in plants. Vaccines against AIDS and Tropical Infectious Diseases – Leprosy, malaria and TB. Vaccines for control of fertility , Anti – HCG Vaccines and Anti – sperm antigen vaccine. Immunization – Active and Passive. Therapy for immunological diseases. Immuno therapy for cancer. Strategies of vaccine production. Gene silencing.

Total: 60hours

TEXTBOOK:

Mark Peakman, Basic and Clinical Immunology; Churchill Livingstone. 2nd Ed., 2009.

REFERENCE BOOKS:

1. Talwar GP, Rao KVS and Chauhan VS, Recombinant and Synthetic Vaccines; Narosa, New Delhi. 1994.
2. Benjamini E, Coico R and Sunskise G,;Immunology – A short course, Wiley – Liss Publication, NY. Ed.4; 2000.
3. Kuby J, Immunology, WH Freeman and Co. NY. Ed.4; 1997.
4. Clark WR, The Experimental Foundations of Modern Immunology; John Wiley and Sons Inc. New York. 1991.
5. Leslie Hudson and Frank C. Hay., Practical Immunology. Wiley. Ed.3; 1989.
6. Noel R. Rose, Herman Friedman, John L. Fahey., Manual of Clinical Laboratory Immunology. ASM. Ed.3; 1986.

15MIM010 Applied Microbiology (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about the role of microorganisms in soil; plant pathology and biogeochemical cycles; microorganisms and foods – preservation, spoilage, canning, HACCP,GMP; microbiology of air and effluent treatment.

Course Outcome

At the end of the course, learners will be able to:

CO1: The students gain knowledge about the role and importance of soil microbes.

CO2: Students gain knowledge on complete study of plants.

CO3: Complete knowledge on plant pathogenic interaction.

CO4: Detailed view of Bio geochemical cycles.

CO5: Knowledge on beneficial and pathogenic microorganisms involved in food materials.

CO6: Knowledge on different methods of preservation of food.

CO7: Quality control knowledge in depth.

CO8: Detailed study on dairy products and its fermentation methods.

CO9: Clear approach on environmental issues - Pollution and control.

UNIT I SOIL MICROBIOLOGY 15

Various types of soil microbes and their importance. Organic matter – sources and decomposition. Soil enzymes and soil sickness. Plant microbes interaction – rhizosphere, phyllosphere, root nodules (*Rhizobium, Frankia),* stem nodules and mycorrhiza. Nitrogen fixation – symbiotic (*Rhizobium, Azolla, Anabena*) free living (*Azotobacter*, BGA) and associative (Azospirillum).Preparation, application and advantage of Biofertilizer – Nitrogen fixer –

Rhizobium, *Azotobacter*, *Azospirillum*, *Azolla-Anabena*, *Nostoc*, Phosphate solubilising – *Phosphobacterium* and mycorrhizal biofertilizer. Biopesticide-Bacterial, fungal and viral.

UNIT II NUTRIENT CYCLES 10

Plant pathology – Host - pathogen interaction. Transmission of plant pathogen. Various symptoms of plant diseases. Biogeochemical cycles. Importance of biogeochemical cycle in environment. A brief account of carbon cycle, sulphur cycle and iron cycle.

UNIT III FOOD MICROBIOLOGY 12

Microorganisms important in food microbiology- molds, yeasts and bacteria. Factors influencing microbial growth and survival in foods – intrinsic and extrinsic factors. Principles of food preservation – Asepsis, Removal of microbes, maintenance of anaerobic conditions. Methods – physical- heat-processing, low temperature- chilling, freezing, high pressure, controlled and modified atmosphere, drying, irradiation. Chemical methods- use of preservatives, food additives. Canning process. Food Sanitation- Controlling microbiological quality of foods- sampling schemes, control at source, GMPs, HACCP, Personal Hygiene. Quality Systems – BS 5750, ISO 9000 series.

UNIT IV DAIRY MICROBIOLOGY **11** Microbiology of milk and dairy products- contamination, spoilage and preservation of dairy products. Fermented dairy products – cheese and its types. Food safety and quality assurance. Food hazards, Significance of food-borne diseases, Incidence and Risk factors. Bacterial and non-bacterial food borne infections and intoxications. Methods of microbiological examination of foods- indicator organisms, direct examination, cultural techniques.

UNIT V ENVIRONMENTAL MICROBIOLOGY 12

Microbiology of air; droplet, droplet nuclei, aerosol, infectious dust. Assessment of air quality. Laboratory hazards of air microbes, air borne diseases, air sanitation. Aquatic Microbiology-aquatic ecosystems. Potability of water, assessment of water quality, purification of drinking water. Water borne diseases- pathogenesis, prevention and control.Waste treatment – BOD and COD. Biodegradation of xenobiotic compounds. Bioaccumulation of heavy metals, biomagnification, biocorrosion, bioleaching and biomining. Bioremediation.

Total: 60hours

TEXTBOOK:

Arumugam.N.; Microbiology – Basic and Applied. Saras Publication. 2014.

REFERENCE BOOKS:

1. Subba Rao N.S.; Soil Microorganisms and Plant Growth, Oxford and IBH publication Co. Pvt. Ltd. New Delhi. 2002.
2. Mitchell.R.; Introduction to Environmental Microbiology, Prentice – Hall. Inc. Cliffs - New Jersey. 2003.
3. N.S. Subba Rao, Biofertilizer in Agriculture and Forestry, Oxford and IBH publication. 3rd edn, 2005.
4. Lynch , J.M. and Poole, Microbial Ecology. A Concept Approach, BI scientific publication London. 2005.
5. Sivasankar, B, Food Processing and Preservation; Prentice Hall of India Pvt. Ltd. 2002.
6. Ananthakrishnan CP, Singh RB, Padmanabhan PN, Dairy Microbiology; Sri Lakshmi Publications, Chennai. 1994.
7. Robinson RK, Dairy Microbiology; Wiley and Sons. New York. 2002.
8. Salle, A.J., Fundamental Principles of Bacteriology, Tata-McGraw Hill Publishing Company Ltd. Ed.7; 2001.
9. Ronald. M. Atlas, Richard Bartha, Microbial Ecology. Fundamental and application, An imprint of Addison Wesley Longman Inc. 4th ed, 1998.
10. Mitchell.R., Introduction to Environmental Microbiology; Prentice Hall. Inc. Cliffs - New Jersey. 2003;
11. Rheinheimer, Aquatic Microbiology, John Wiley and sons, Chichester. Ed.2; 2003.

15MIM011 Vaccine Technology (Practical) 0 0 4 2

Course Objective: The candidate will gain hands-on knowledge and acquire adequate skill required to prepare bacterial antigens and raise antisera, evaluate the antisera.

Course Outcome

At the end of the course, learners will be able to:

CO1: Acquire technical skills on antigen preparation

CO2: Know how to prepare bacterial vaccines

CO3: Gain the basic skill on toxoid prepartion

CO4: Skilled in testing of efficacy of vaccines

CO5: Gain the knowledge on raising polyclonal Abs.

1. Crude preparation of bacterial antigens.
2. Crude preparation of bacterial vaccines.
3. Efficacy tests for vaccines.
4. Toxoid preparation
5. Raising polyclonal antisera.

6. Visit to Regional Vaccine Institutes

Total Hours: 90hours

15MIM012 Applied Microbiology (Practical) 0 0 6 2

Course Objective: The candidate will gain hands-on knowledge and acquire adequate skill required to observe the growth of microbes in various foods and environments. Requisite skills and basic knowledge about the use of microbes in fementation and product formation.

Course Outcome

At the end of the course, learners will be able to:

CO1: Acquire technical skills on isolation microbes from spoiled foods

CO2: Know how to perform quality checking of milk and dairy products

CO3: Gain the basic skill on microbial quality checking of air, water.

CO4: Skilled on study of microbes in Biofertilizers

CO5: Gain the knowledge on animal cell cultures.

1. Isolation and identification of bacteria and fungi from spoiled food. Enumeration of bacteria in spoiled foods.
2. Dye Reduction Tests for milk – MBRT and Resazurin tests. Litmus Milk Reactions.
3. Evaluation of quality of Dairy products (milk and curd) by SPC.Isolation of microorganisms from Dairy products (curd/ yoghurt) – *S. aureus, Lactobacillus* species and yeasts.
4. Production of Sauerkraut
5. Enumeration of microbes in air- settle plate method, air sampling methods.
6. Physical, chemical and microbial assessment of water- color, pH, alkalinity, acidity, BOD, COD, anions, cations. MPN analysis of water.
7. Enumeration of microbes using membrane filter.
8. Isolation of Bacteria, Fungi, Algae and Actinomycetes from soil.Isolation and study of *Rhizobium, Azotobacter, Azospirillum,* Phosphate solubilising organism, BGA – *Nostoc, Anabena.*
9. Isolation of plant pathogens – Bacteria – *Xanthomonas, Pseudomonas spp. Alcaligens spp,* Fungi- *Fusarium, Helminthosporium, Cercospora.*
10. Preparation of media for animal cell culture. Primary culture of chick embryo fibroblasts. Primary culture of chick organ - spleen and kidney cells. Demonstration of inclusion bodies.
11. Ethanol production.Cultivation of SCP – *Spirulina,* Fodder yeast.
12. Production of acetic acid. Production of lactic acid.

13. Visit to any Microbial / Biotech Industries.

Total: 90hrs

List of Discipline Specific Electives (Any 6 papers)

DSE1: 15MIM101 - Microbial Biochemistry

DSE2: 15MIM102 - Medical Parasitology

DSE3: 15MIM103 - Immunotechnology

DSE4: 15MIM104 - Research methodology

DSE5: 15MIM105 - Cloning strategies and Nanomicrobiology

DSE6: 15MIM106 - Biostatistics

DSE7: 15MIM107 - Biofertilizers

DSE8: 15MIM108 - Animal Cell culture

DSE9: 15MIM109 - Good Manufacturing Practice (GMP)

DSE10: 15MIM110 - Medical Microbiology

DSE11: 15MIM111 - Industrial and Pharmaceutical Microbiology

DSE12: 15MIM112 - Cell Culture and Fermentation Technology

15MIM101 Microbial Biochemistry (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about microbial ultrastructure and biomolecules, biochemical cycles; energy molecule formation; fermentations and transport mechanisms.

Course Outcome

At the end of the course, learners will be able to:

CO1: In depth knowledge about the ultrastructure of various groups of microbes and details related to biomolecules – carbohydrates, proteins and lipids plus mechanism of action of enzyme

CO2: A thorough understanding of different metabolic cycles related to photosynthesis, ETC, stress response and adaptations to different conditions by bacteria including the various methods of carbohydrate breakdown and utilization.

CO3: Fine understanding of the ways for formation of ATP as well as fatty acid synthesis.

CO4: Complete grasp of various fermentation cycles, N2 and Sulphur utilization; endospore formation and two life-cycles.

CO5: Knowledge regarding bacterial locomotion, homeostasis, cell division and transport of molecules.

UNIT I ULTRASTRUCTURE 13

Ultra structure of bacteria, algae, protozoa, fungi and virus. Types of Linkages in biomolecules; configuration and forms of sugars, amino acids (biologically active forms).Chemistry of Carbohydrates, Proteins and Lipids; Enzymes – factors affecting enzyme activity.

UNIT II CYCLES 14

Photosynthesis in bacteria, Cyanobacteria. Electron transport and respiration in bacteria - aerobic and anaerobic; and eukaryotes. Adaptive response in bacteria- metabolic stress, temperature, pH, oxygen. Osmotic stress, extremophiles. C1 metabolism. EMP, ED Pathway; HMP Shunt, TCA cycle.

UNIT III ENERGY PRODUCTION 10

Energy production–Substrate-level phosphorylation; oxidative phosphorlation. Membrane - potential – chemiosmotic theory, conformational change hypothesis; mechanisms to generate and maintain membrane potential. ATP Synthesis. Biosynthesis of fatty acids.

UNIT IV FERMENTATION 12

Fermentation – Propionate, Acetate, Lactate, Mixed Acid, Butyrate and Butanediol. Assimilation and dissimilation of nitrogen and sulphate. Nitrogen fixation – nitrogen fixation process; components of nitrogenase system. Endospore formation, Life cycle of *Myxobacteria*, Life cycle of *Caulobacter*.

UNIT V TRANSPORT 11

Mechanism of locomotion by bacteria, Homeostasis in bacteria, Transport across membranes – Chaperons, Leader Sequence. Bacterial cell division. Biosynthesis of nucleic acids. Exotoxins, endotoxins and quorum sensing.

Total: 60 hours

TEXTBOOK:

J.L. Jain, Fundamentals of Biochemistry; Chand Publications. 2006.

REFERENCE BOOKS:

1. Albert G.Moat, John W. Foster, Michael P.Spector, Microbial Physiology, John Wiley and Sons. Ed. 4; 2006.
2. David White, The Physiology and Biochemistry of Prokaryotes; Oxford University Press. 1995.
3. Michael T. Madigan, John M Martinko, Brock's Biology of Microorganisms, Pearson-Prentice Hall. Ed. 11; 2006.
4. Alberts B.Dray, J Lewis, M Raff, K Roberts, JD Watson, Molecular Biology of The Cell, Garland Publishing. Ed. 3; 1994.
5. Gottschalk G, Bacterial Metabolism, Springer-Verlag. Ed. 2; 1996.
6. Kates M, D Kushner, AT Matthews, The Biochemistry of Archae; Elseiver. 1993.
7. Topley and Wilson's : Principles of Bacteriology, Virology, and Immunology, Edward Arnold. Ed. 9; 2002.
8. Harper's Biochemistry; Robert.K. Murray Lance International Publication, 26th edition, 2005.
9. M.N. Chatterjee, Text Book of Medical Biochemistry; Jaypee Publication. 6th edition, 2006
10. U. Sathyanarayana, Biochemistry; Books and Allied (P) Ltd. 3rd edition, 2006.

15MIM102 Medical Parasitology (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about the structure of protozoa and helminths; life-cycle patterns, pathogenesis, identification, and treatment.

Course Outcome

At the end of the course, learners will be able to:

CO1: Gain knowledge about the basic information of parasites

CO2: Acquire knowledge on complete study of protozoans

CO3: Complete knowledge on plant pathogenic interaction.

CO4: Get detailed view of haemoflagellates

CO5: Knowledge on cestodes and neamtodes.

UNIT I INTRODUCTION 11

Introduction to parasitology, Classification, Host – parasite relationship, Lab diagnosis of parasitic infections.

UNIT II PROTOZOOLOGY 12

Protozoology- pathogenic mechanism, transmission, life cycle, lab diagnosis of Protozoans – *Entamoeba, Giardia, Trichomonas, Balantidium.*

UNIT III HAEMOFLAGELLATES 12

Haemoflagellates- *Leishmania, Trypanosomes- Trypanosoma and Sporozoites-Plasmodium. Toxoplasma, Cryptosporidium.*

UNIT IV CESTODES 12

Helminthes – Cestodes – *Taenia solium and saginata, Echinococcus*. Trematodes – *Fasciola hepatica, Fasciolopsis buski, Paragonium, Trematodes- Schistosomes, Trichinella*.

UNIT V NEMATODES 13

Nematodes – *Ascaris, Ancylostoma, Trichuris, Strongyloides, Enterobius, Filarial worms- Wucheriria, Brugia, Loa Loa, Dracunculus, Onchocerca;* and other parasitic infections in immunocompromised hosts and AIDS associated parasites.

Total: 60hours

TEXTBOOK:

Chatterjee; Medical Parasitology. CBS Publishers. 2008.

REFERENCE BOOKS:

1. D.R. Arora & B.R. Arora Medical Parasitology, CBS Publishers & Distributors, New Delhi. 1st Edn., 2002.
2. Subhas Chandra Parija, Medical Parasitology, 2nd Edn., 2009.
3. Jayaram Panicker, Textbook of Parasitology, C.K. Jaypee Brothers, New Delhi. 2006.
4. Gerald D. Schmidt & Larry S. Roberts. Foundations of Parasitology, 6th Edn., 2008.

15MIM103 Immunotechnology (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about antigens, antiboby , Ag-Ab reactions; antigen preparation; antibody and genetic engineering in mmunology; immune cells and blood systems.

Course Outcome

At the end of the course, learners will be able to:

CO1: Basic Understanding of various immunological techniques

CO2: Understand the polyclonal, monoclonal and humanized antibodies and production of these.

CO3: Learn various types of molecular engineering methods and their applications for diagnosis and therapy.

CO4: Understand the evaluating effect of immune cells.

CO5: Understanding of the principles of immunohaematology methods and their use in diagnostics, medicine, biotechnology, and scientific research.

UNIT I ANTIGEN-ANTIBODY REACTIONS 12

Antigen-Antibody reactions- Precipitation- types-immunodiffusion methods-Agglutination-types-immunofluorescent techniques-principles- typical protocol -types- RIA-principles-typical protocol-ELISA-different types-Ag coating-Ab coating-linking of enzymes to Abs-substrates. Immunoelectrophoresis- immunoblotting.

UNIT II ANTIBODY 12

Preparation of antigens-bacterial, fungal, viral pathogens-different methods. Standardization of antigens-quantification. Raising of polyclonal antibodies in animals-different routes of inoculation-immunization protocol- purification of immunoglobulins of different classes-quantification.

UNIT III MOLECULAR ENGINEERING 12

Molecular engineering methods – improve and modify immunological specificities and reactions. Antigen engineering for better immunogenicity and use for vaccine development. Antibody engineering – development of monoclonal antibodies and fragments using cellular and molecular technologies- cloning methods, production, purification and characterization of mAbs. Production of human monoclonal antibodies and their applications. Antibodies for diagnosis and therapy.

UNIT IV IMMUNE CELLS 12

Separation of immune cells-T cells- B cells- Macrophages- density gradient-lymphocyte stimulation test- flow cytometry-T cell subset analysis- B cell analysis. Delayed Type Hypersensitivity estimation methods- macrophage migration inhibition assays- purification and assay of interleukins.

UNIT V IMMUNOHAEMATOLOGY 12

Immunohaematology-blood groups- methods of blood grouping- reverse grouping- uses in forensic science-coombs test- blood banking. HLA typing- Tissue typing.

Total: 60hours

TEXTBOOK:

D.P. Stites, JD Stobo, H.H. Fudenberg, J.V. Wells; Basic and Clinical Immunology. Lange Medical Publications. Ed.8; 2006.

REFERENCE BOOKS:

1. Pravash Sen. Gupta, Clinical Immunology; Oxford University Press. 2003.
2. Noel R. Rose, Herman Friedman, John L. Fahey, Manual of Clinical Laboratory Immunology. ASM. III edition; 1986.
3. Leslie Hudson and Frank C. Hay, Practical Immunology, Blackwell Scientific Publication. Ed.3; 1989.
4. Goding J.W., Monoclonal Antibodies: Principle and Practice; Academic Press. 2001.
5. Carl A. K. Borrebacck, Antibody Engineering, Oxford University Press. Ed.2; 1995.
6. Leonore A. Herzenberg, Donald M. Weir, Leonard A. Herzenberg, Caroline Blackwell, Weir's Handbook of Experimental Immunology, Vol. I – IV; Blackwell Science. 1996.
7. Stefan H.E. Kaufmann and Dieter Kabelitz, Immunology of Infection. Methods in Microbiology. Vol. 25; Academic Press. 1998.
8. Sringer, T.A, Hybridoma Technology in the Biosciences and Medicine; Plenum Press. New York. 2004.
9. Garrison Fathman. C., Fitch, F.W., Isolation, Characterization and Utilization of T lymphocyte clones; Academic Press. 2003.
10. G.P.Talwar and S.K.Gupta., A Handbook of Practical and Clinical Immunology, Vol.I-II; CBS Publishers and Distributors. Delhi. 1993.

15MIM104 Research Methodology (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about research methodology; biostatistics; biomolecules; and various biotechniques.

Course Outcome

At the end of the course, learners will be able to:

CO1: Gain knowledge about the course objective and types of research.

CO2: Learn about the different experimental and non experimental research designs.

CO3: Learn about the guidelines for article writing.

CO4: Know about the various criteria of good research.

CO5: Acquire knowledge in the data analysis- collection, classifications of data and graphical presentation.

CO6: Gain knowledge about the Simple linear correlation and regression analysis.

CO7: Achieve knowledge about the basic molecular techniques – PCR, blotting, Nucleic acid sequencing, Centrifugation, NMR, fluorescent DNA sequencing and Enzyme assays.

CO8: Gain knowledge about the bioseparaion techniques.

UNIT I RESEARCH METHODOLOGY 12

Research methodology- Meaning, Course Objective and types of research. Different research designs- Experimental and Non- experimental. Review of literature- preparation of research report. Guidelines for preparing an article. Criteria of good research-problem encounters in research in India.

UNIT II BIOSTATISTICS 12

Biostatistics- collection, classification and presentation of data-graphical and diagrammatic presentation, measure of central tendencies (mean, median, mode), measure of dispersion (range, mean deviation, standard deviation) and qualitative methods of data analysis. Simple linear correlation and regression analysis- testing of hypothesis using t- test, chi-square test, analysis of variances and covariance- ANOVA.

UNIT III BIOMOLECULES 12

Nucleic acid blotting methods-PCR-principles-instrumentation –applications- primer design-Nucleic acid sequencing methods- direct PCR sequencing- automated fluorescent DNA sequencing. Protein estimation- UV-lowry method- Bradford- Kjeldahl analysis- purification methods- cell disruption- crude extract- fractionation methods. Enzyme assays- spectrophotometric and manometric methods. Immobilization of enzymes- physical and chemical methods.

UNIT IV CENTRIFUGATION 12

Centrifugation techniques- principles- types of centrifuges and their uses-Refrigerated- High speed- Continuous flow- Preparative Ultracentrifuge- Differential- Density gradient and Analytical Ultracentrifuge. Spectroscopic techniques-Principles- Instrumentation –Applications- UV-Vis Spec- Spectrofluorimetry- Atomic absorption spectroscopy -Turbidometry and Nephelometry-Luminometry-NMR.

UNIT V BIOSEPARATION 12

Electrophoretic techniques-principles-Electrophoresis of proteins-SDS-PAGE- Native gels-Gradient gels- Isoelectric focusing gels- Two dimensional PAGE- Cellulose acetate electrophoresis-western blotting. Electrophoresis of Nucleic acids- Agarose gel- Pulse – field gel and Capillary electrophoresis.Chromatographic techniques- principles – materials and applications.

Column-TLC-Low pressure column chromatography- HPLC- Adsorption – Partition and affinity chromatography- GLC.

Total: 60hours

TEXTBOOK:

Kothari CR; Research Methodology; New Age International Publishers, New Delhi. 2nd Edition; 2005.

REFERENCE BOOKS:

1. Keith Wilson and John Walker; Practical Biochemistry- principles and techniques, Cambridge University Press. 5th Edition, 2003.
2. John G. Webster; Bioinstrumentation. Student Edition, John Wiley and Sons Ltd. 2004.
3. Palanivev, P; Analytical Biochemistry and Separation Techniques- A laboratory manual, 2nd Edition. 2001.
4. Asokan P; Analytical Biochemistry (Biochemical techniques), 2001.
5. Gurumani N; Research Methodology for Biological sciences, MJP publishers, Chennai. 2006.
6. Wayne W Daniel; Biostatistics- A foundation for analysis in the health sciences. 7th Edition, John Wiley and Sons Ltd. 2000.

15MIM105 Cloning Strategies and Nanomicrobiology (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about genetic engineering; gene transfer mechanisms and related phenomena; various cloning strategies; nanomicrobiology and nanotechnologies.

Course Outcome

At the end of the course, learners will be able to:

CO1: Gain knowledge about the basics in genetic engineering.

CO2: Learn about the various strategies in obtaining clone of choice.

CO3: Study about the various types of cloning vectors used in genetic engineering.

CO4: Learn about the gene transfer methods.

CO5: Gain knowledge in cloning and expression of gene of interest in a host.

CO6: Acquire knowledge about the techniques used to characterize the nanoparticles.

CO7: Learn about the nanomicrobiology, nanobiotechnology and microbial mediated drug delivery system.

UNIT I GENETIC ENGINEERING 12

An overview of Genetic engineering- Isolation and purification of DNA from cells – Total, plasmid and phage DNA. PCR, Pulse field electrophoresis for large DNA. Restriction enzymes, DNA ligases, DNA modifying enzymes, Eukaryotic and Prokaryotic hosts for cloning. Characteristics of an ideal vector, cloning vectors – Plasmids, phages, Cosmids, Phagemids, Artificial chromosomal vectors, Shuttle vectors, choice of vectors for *E. coli*, fungi, higher plants and mammalian cells.

UNIT II GENE TRANSFER 12

Methods of gene transfer- Electroporation, transduction, and liposome mediated gene transfer. Direct transfer of DNA- Microinjection, particle bombardment. Screening of recombinants- Insertional inactivation and complementation, blue-white screening, immunodetection and radioactive probes.

UNIT III STRATEGIES 12

Strategies for obtaining the clone of choice- Direct selection – selection from gene library. Construction of cDNA libraries. Uses of cloning in medicine, agriculture, forensic science and industries. Socio-economic ethics of cloning, NIH guidelines, GEO, GMF, future of cloning techniques.

UNIT IV NANOMICROBIOLOGY 12

Basics of Nanomicrobiology- introduction, landmarks in nanomicrobiology- Techniques: microarrays- nanoarrays- protein nanoarray- microfluidics and nanofluidics. Atomic force microscopy- operation- advantages of AFM, Magnetic resonance force microscopy. Nanoparticles- Quantum dots, Gold nanoparticles, Silica nanoparticles, Fluorescent nanoparticles, cubosomes, Dendrimers, nanoparticle synthesis.

UNIT V NANOBIOTECHNOLOGY 12

Bacterial structures relevant to nanobiotechnology- Nanostructures on bacterial cell surface- bacterial magnetic particles- DNA nanotubes. Applications in Biology- NanoSystems Biology- Quantum dots for cell labeling and study of apoptosis- Nanofabricated structures for DNA separation- Nanopore sequencing- Nanomotor from DNA (Molecular motor). Nanoprobes for Analytical Applications-A new Methodology in medical diagnostics and Biotechnology-

Nanosensors. Nanomicrobiology in drug delivery- viruses as nanomaterials for drug delivery- Bacteria mediated drug delivery-Dendrimers- Cubosomes- Gold nanoparticles- cyclodextrin.

Total: 60 hours

TEXTBOOKS:

1. L.E.Foster, Nanotechnology-Science, Innovation and Opportunity,
Person education Inc, 2007.
2. Sardul Singh sandhu;Recombinant DNA Technology;I K International Publishing House. 2010.

REFERENCE BOOKS:

1. T.A. Brown, Gene cloning and DNA analysis- An introduction, Blackwell Science Publishers. Ed.4; 2001.
2. Old, R.S and Primrose SB, Principles of Gene manipulation: An introduction to Genetic engineering , Blackwell Scientific publications. Ed.5; 1995.
3. Glick B.R and Pasternak JJ, Molecular Biotechnology. ASM Press, Washington DC. 1994.
4. Clover D.M , DNA cloning series (Vol I-IV); IRL Press, Oxford. 1987.
5. Winnacker E L, From Genes to clones: Introduction to Gene technology; VCH Weinheim. 1987.
6. Satyanarayana. U, Biotechnology; Uppala- Author Publishers Linkers. 2005.
7. Tuan R.S , Recombinant Gene Expression Protocols; Humana Press. 1997.
8. M.Ratner and D.Ratner, Nanotechnology –A Gentle Introduction to The Next Big Idea, Pearson Education. 2007.
9. Charles P. Poole, Jr. and Frank J. Owens, Introduction to Nanotechnology; Wiley – Interscience. 2003.
10. Guozhong Cao, Nanostructures and Nanomaterials: Synthesis, Properties and Applications; Imperial College Press. 2004.
11. David S. Goodsell, Bionanotechnology: Lessons from Nature; Wiley-Liss, Inc. Hoboken, New Jersey. 2004.

15MIM106 Biostatistics (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about biostatistics; collection of data, data correlation; regression analysis and variability.

Course Outcome

At the end of the course, learners will be able to:

CO1: Basic understanding of Biostatistics.

CO2: Grasp the information on kinds of biological data

CO3: Gain knowledge on collection of data

CO4: Obtain knowledge on sampling and sampling design

CO5: Obtaining in-depth information on Correlation

CO6: Assimilate knowledge on Regression and types

CO7: Grasp the knowledge on Deviations

CO8: Gain the knowledge on graphic representations

UNIT I INTRODUCTION 12

Introduction to biostatistics – Definition, statistical methods, biological measurement, kinds of biological data, functions of statistics and limitation of statistics.

UNIT II DATA 12

Collection of data, sampling and sampling design, classification and tabulation, types of representations, graphic – bar diagrams, pie diagrams and curves.

UNIT III CORRELATION 12

Correlation – different types of correlation – positive, negative, simple, partial, multiple, linear and non linear correlation. Methods of studying correlations.

UNIT IV REGRESSION 12

Regression, types and methods of analysis. Regression line, Regression equations, Deviation taken from arithmetic mean of X on Y, Deviation taken from the assumed mean.

UNIT V VARIABILITY 12

Measures of dispersion and variability, changes. Deviations – Quartile deviation, mean deviation, standard deviation, coefficient of variation, Lorenzen's curve.

Total: 60hours

TEXTBOOK:

Khan, Fundamentals of Biostatistics, Uhaaz Publications, 1994.

REFERENCE BOOKS:

1. Palanisamy. S. and Manoharan, M. Statistical methods for Biologists (Biostatistics). Palani Paramount Publications, TamilNadu. 1994.
2. Arora, P.N. and Malhan, P.K. Biostatistics. Himalaya Publishing House, Mumbai. 1996.
3. Stanton. A.Clantz. Primer of Biostatistics – The McGraw Hill Inc. New York.1997.
4. Sokal and Rohlf. Introduction to Biostatistics – Toppan Co. Japan. 1973.
5. A. K. Vashisth. Encyclopedia of Biostatistics; Neha Publishers & Distributors. 2007.

15MIM107 Biofertilizers (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about significance of biofertilizers; various beneficial microbes like nitrogen fixers, Mycorrizhal associations and organic farming.

Course Outcome

At the end of the course, learners will be able to:

CO1: Gain knowledge about the role and importance and significance of biofertilizers.

CO2: Become trained in mass production and applications of bio fertilizer and their impact on plant growth.

CO3: Study about the nitrogen fixer such as Azospirillum, Azotobacter and the mass multiplication, maintenance of these biofertilizers.

CO4: Learn about the crop response to these biofertilizers.

CO5: Achieve information about blue green algae and its association with nitrogen fixation.

CO6: Study about the various factors affecting the growth of BGA.

CO7: Attain information about the significance of BGA in rice cultivation.

CO8: Gain knowledge in the mycorrhizal taxonomy, occurrence, distribution.

CO9: Know about the types of mycorrhizal associations.

CO10: Know-how in isolation of VAM and also its influence on growth and yield of crop plants.

CO11: Achieve knowledge in green manuring.

CO12: Gain knowledge in recycling of biodegradable municipal, agricultural and industrial wastes.

CO13: Learn about the method of vermicompost preparation and its field applications.

UNIT I INTRODUCTION 12

Introduction; General account about the microbes used as biofertilizer – Rhizobium – isolation, identification, mass multiplication, carrier based inoculants, Actinorrhizal symbiosis.

UNIT II NITROGEN FIXERS 12

Azospirillum Isolation and mass multiplication – carrier based inoculant, associative, effect of different microorganisms. Azotobacter: classification, characteristics – crop response to Azotobacter inoculum, maintenance and mass multiplication.

UNIT III ASSOCIATIONS 12

Cyanobacteria (blue green algae); *Azolla* and *Anabaena*- azollae association, nitrogen fixation, factors affecting growth, blue green algae and *Azolla* in rice cultivation.

UNIT IV MYCORRHIZA 12

Mycorrhizal association Types of mycorrhizal association, taxonomy, occurrence and distribution, phosphorus nutrition, growth and yield – colonization of VAM – isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

UNIT V ORGANIC FARMING 12

Organic farming Green manuring and organic fertilizers,Recycling of biodegradable, municipal, agricultural and Industrial wastes – biocompost making methods, types and method of vermicomposting – field application.

Total: 60 hours

TEXTBOOK:

P.C.Trivedi, Biofertilizers; Neha Publishers. 2008.

REFRENCE BOOKS:

1.Dubey, R.C., A Text book of Biotechnology S.Chand & Co, New Delhi. 2005.
2.Kumaresan, V., Biotechnology, Saras Publications, New Delhi. 2005.
3.John Jothi Prakash, E., Outlines of Plant Biotechnology. Emkay Publication, New Delhi. 2004.
4.Sathe, T.V., Vermiculture and Organic Farming. Daya Publishers.2004.
5.Subha Rao, N.S. Soil Microbiology, Oxford & IBH Publishers, New Delhi.2000.
6.Vayas,S.C, Vayas, S. and Modi, H.A. Bio-fertilizers and or ganic Farming Akta Prakashan, Nadiad.1998.
7. H.C.Lakshmi, Biofertilizers & Biopesticides; Neha Publishers. 2014.

15MIM108 Animal Cell Culture (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about structure of animal cells; culture media and cultivation of animal cells; quantitation of cells and their applications.

Course Outcome

At the end of the course, learners will be able to:

CO1: Gain knowledge about the structure and organization of animal cells.

CO2: Study about the basics of cell line cultures.

CO3: Learn about the culture media used in animal cell culture.

CO4: Get knowledge about the biology and characterization of the cultured cells.

CO5: Gain knowledge in the in vitro techniques of mammalian cell culture.

CO6: Achieve knowledge about the maintenance of cell culture.

CO7: Get knowledge about the cell synchronization.

CO8: Attain knowledge on the application of animal cell culture.

CO9: Know about the scaling up processes of animal cell culture and stem cell culture techniques.

CO10: Study about the cell culture based vaccines and somatic cell genetics.

UNIT I STRUCTURE 12

Structure and Organization of animal cell; Equipments and materials for animal cell culture technology; Primary and established cell line cultures; Introduction to the balanced salt solutions and simple growth medium,

UNIT II CULTURE MEDIUM 12

Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Role of carbon dioxide. Role of serum and supplements; Serum and protein free defined media and their application.

Unit III QUANTITATION 12

Measurement of viability and cytotoxicity; Biology and characterization of the cultured cells, measuring parameters of growth;

UNIT IV CELL CULTURE 12

Basic techniques of mammalian cell culture in vitro; disaggregation of tissue and primary culture,

maintenance of cell culture; cell separation.

UNIT V APPLICATIONS 12

Cell synchronization; Cell cloning and micromanipulation; Cell transformation; Application of animal cell culture; Scaling-up of animal cell culture. Stem cell cultures, embryonic stem cells and their applications; Cell culture based vaccines, Somatic cell genetics.

Total: 60hours

TEXTBOOK:

Mishra Bina, Animal Cell Culture.Studium Press. 2011.

REFERENCE BOOKS :

1.Basanth Kumar Sinha, Rinesh Kumar; Principles of animal Cell Culture. IBDC Press.2008.
2.Kumaresan, V., Biotechnology, Saras Publications, New Delhi. 2005.
3.John Masters, Animal Cell Culture: A Practical Approach. Oxford University Presss. 2000.
4.Ian Freshney.R, Culture of Animal Cells: A Manual of Basic Technique and Specialized Application. Wiley-Blackwell.2010.

15MIM109 Good Manufacturing Practices (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about quality control and GMP; statistical basis for GMP; quality control systems and quality assurance.

Course Outcome

At the end of the course, learners will be able to:

CO1: Gain knowledge about basics of quality management

CO2: Study about the basics of quality control measures

CO3: Learn about the sampling, analysis, validation and documentation.

CO4: Get knowledge on using statistical models in quality control.

CO5: Gain knowledge international quality system.

CO6: Achieve knowledge quality auditing.

UNIT I INTRODUCTION 12

Introduction to quality control History – Definition – quality in manufacturing and service system – Philosophy of quality management (Deming, Juran, Croshy and others) Red bead and funnel experiment.

UNIT II QUALITY CONTROL 12

Laboratory and quality control: Personnel training – Sampling procedures – Sample submittal – Receipt and handling of samples – Analytical methods and method validation – equipment calibration and maintenance – Data validation and interpretation – reporting – documentation and sample retention – corrective action.

UNIT III STATISTICS 12

Statistical quality control: Descriptive statistics – confidence intervals – tests of mean – correlation – regression – ANOVA – x chart. HACCP, GMP, cGMP, GILSP, SSOP. Writing QA manual, Biosafety manual – SOPs – Inter laboratory QC program.

UNIT IV QUALITY SYSTEMS 12

International quality systems: Introduction to ISO family – ISO – 9001; ISO – 17025 – regulatory bodies of quality – Good laboratory practice. Six sigma concept. Quality frame work.

UNIT V QUALITY AUDITING 12

Quality auditing: Audit definition and fundamentals of auditing – preparation – performance – reporting – closure-post script – internal system audit - procedure- auditing check list.

Total: 60hours

TEXTBOOK:

HACCP: A Systematic Approach to Food Safety. A Comprehensive Manual for Developing and Implementing a Hazard Analysis and Critical Control Point Plan. Virginia N. Scott and Kenneth E. Stevenson, Editors, Food Products Association, Fourth Edition, 2006.

REFERENCE BOOKS:

1. Shayne Cox Gad. Pharmaceutical Manufacturing Handbook, Published by John Wiley and Sons, Inc., 2008
2. Good manufacturing practices for pharmaceutical products. In: *WHO Expert Committee on Specifications for Pharmaceutical Preparations. Thirty-seventh report*. Geneva, World Health Organization, 2003 (WHO Technical Report Series, No. 908), Annex 4.
3. Validation of analytical procedures used in the examination of pharmaceutical materials. In: *WHOExpert Committee on Specifications for Pharmaceutical Preparations. Thirty-second report*. Geneva,World Health Organization, 1992 (WHO Technical Report Series, No. 823), Annex 5.
4. *EudraLex* – Volume 4. *Good manufacturing practice (GMP) Guidelines. European Commission*. (http://ec.europa.eu/health/documents/eudralex/vol-4/ index_en.htm).

15MIM110 Medical Microbiology (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about pathogenesis, diagnosis, control and treatment of medically important – viral diseases; bacterial diseases; fungal diseases; and parasitic infections.

Course Outcome

At the end of the course, learners will be able to:

CO1: Study about the properties, pathogenecity, lab diagnosis of pathogenic viruses.

CO2: Know about the normal microbial flora of human

CO3: Learn about the characters, pathogenecity, lab diagnosis of bacterila pathogens.

CO4: Get knowledge on nosocomial infections.

CO5: Gain knowledge hospital waste management

CO6: Get in-depth knowledge on fungal pathogens.

CO7: Learn about pathogenic protozoans and helminthes.

UNIT I VIROLOGY 12

General properties of viruses Structure, cultivation, pathogenesis and various diagnosis techniques. Antiviral agents, chemotherapy and vaccines. Viroids, prions, virusoids and satellite RNA. General properties, antigenic structure, pathogenesis, clinical findings, lab diagnosis, prevention, control and treatment of - HIV, HAV, HBV, Rabies, Influenza, Dengue, Yellow Fever, Measles, Mumps, Rubella, Polio, Oncogenic Viruses.

UNIT II BACTERIOLOGY 12

Normal flora of human body. General attributes and virulence factors of bacteria causing infections – invasiveness and toxigenicity. Pathogens, pathogenesis, clinical manifestations, lab diagnosis, epidemiology, chemotherapy and prevention of diseases caused by– *Staphylococcus, Streptococcus, C. diphtheriae, Cl. tetani, Cl. botulinam, B.pertussis, M. tuberculosis, N. gonorrheae, S. typhi, V. cholera , S. dysentriae, T. pallidum*. Y. *pestis, Leptospira interrogans.*

UNIT III INFECTION 12

Epidemiology and control of community infections. Nosocomial infections – factors that influence hospital infection, hospital pathogens, routes of transmission, investigation, prevention and control. Hospital waste management.

UNIT IV MYCOLOGY 12

Detection and recovery of fungi from clinical specimens. Molecular and advanced diagnostic methods for mycological infections. Antifungal agents- testing methods and quality control. Yeasts of medical importance – *Candida, Cryptococcus sp.* Fungi of medical importance – Dermatophytes and Superficial mycoses, systemic mycoses, opportunistic mycoses, Dimatiaceous fungi, Eumycotic mycetoma.

UNIT V PARASITOLOGY 12

Introduction to parasitology, Host–parasite relationship, mechanism of pathogenesis, transmission and life cycle of the Protozoan – *Entamoeba, Toxoplasma, Cryptosporidium, Leishmania, Giardia, Trypanosoma, Trichomonas, Balantidium* and *Plasmodium.* Helminthes – Cestodes – *Taenia solium* and *T.saginata, Echinococcus*. Trematodes – *Fasciola hepatica, Fasciolopsis buski, Paragonium, Schistosomes*. Nematodes – *Ascaris, Ankylostoma, Trichuris, Trichinella, Enterobius, Wucheriria*.

Total: 60 hours

TEXTBOOK:

Jawetz. E, Melnick J.L, Adelberg E.A , Review of Medical Microbiology, Lange Medical Publications, ELBS, London. Ed. 28; 2013.

REFERENCE BOOKS:

1. Ananthnarayanan. R & C. K. Jeyaram Panicker, Textbook of Microbiology,;Orient Longman. Ed.8; 2006.
2. David Greenwood, Richard B. Slack John F. Peutherer Medical Microbiology, Churchill Livingstone, London. 16th Edn., 2002.
3. Baron EJ, Fine Gold S.M; Diagnostic Microbiology. Blackwell Scientific Systems. 1995.
4. J.G. Colle, A.Simmons, A.G. Fraser, B.P. Marmion, Mackie & McCartney Practical Medical Microbiology, Elsevier.Ed.14; 2006.
5. Topley & Wilson, Topley & Wilson's Principles of Bacteriology, Virology & Immunity, Vol III; Bacterial Diseases, Edward Arolla, London. Ed.8; 1990.
6. Jagadish Chandar, 1996; A Textbook of Medical Mycology; Interprint, New Delhi.
7. Alexopoulos C.J, Introductory Mycology; John Wiley & Sons Inc, N.Y. 1992.
8. H.C. Dube , Introduction to Fungi, Vikas Publishing House. Ed.3; 2005.
9. D.R. Arora & B.R. Arora Medical Parasitology, CBS Publishers & Distributors, New Delhi. 1st Edn., 2002.
10. Subhas Chandra Parija, Medical Parasitology, 2nd Edn., 2009.

15MIM111 Industrial and Pharmaceutical Microbiology (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about industrially important organisms, strain improvement; production of major products involving microbes; biogas, biofuels; Antimicrobials production; Immobilisation and sterilization.

Course Outcome

At the end of the course, learners will be able to:

CO1: Gain knowledge on industrially important microbes.

CO2: Grasp information on improvement of industrially important microbes.

CO3: Understanding basics of fermentor, its structure & types.

CO4: Assimilate knowledge on industrial production of microbial -Organic acids, Amino acids & enzymes.

CO5: Understanding production of SCP, Mushroom & dairy and non-dairy products.

CO6: Gain knowledge on production of Biofuel & Biogas.

CO7: A thorough knowledge on production of non-microbial products through microbes.

CO8: Obtain knowledge on petroleum microbiology

CO9: Understanding microbial production of antimicrobial agents, antifungal students and antitumour agents.

CO10: Grasp knowledge on sterilization of Pharmaceutical products & spoilage of Pharmaceutical products.

CO11: Gain knowledge on application of biosensors in Pharmaceuticals.

CO12: Grasp information on regulatory aspects of quality control.

UNIT I INTRODUCTION 12

Introduction to industrial microbiology. Study of industrially important microbes- yeast, *Lactobacillus, Hansenula, Spirulina, Streptomyces, Penicillium.* Methods for the improvement of microbial strains having industrial value. Fermentor- basic function, design and components, types of fermentor, types of fermentation.

UNIT II PRODUCTION 12

Production of organic acids- vinegar, citric acid, vitamins- riboflavin, cyanocobalamine, amino acid- glutamic acid, lysine, enzymes- cellulases, amylases, pectinases, proteases. Mushroom cultivation, production of SCP (Spirulina, yeast). Production of fermented food- dairy and non dairy products.

UNIT III EFFLUENT TREATMENT 12

Production of biogas, biofuel. Production of non microbial products through microbes- insulin, interferon, B-cell growth factor. A brief mention about effluent treatment in industries using microbes. Petroleum Microbiology- organisms involved. Introduction to antibiotics. Mode of action of antibiotic-cell wall, cell membrane, nucleic acids, protein synthesis, enzyme inhibition.

UNIT IV DRUG 12

Important microbes producing antimicrobial agents, synthetic antimicrobial agents, antifungal agents and antitumor agents. Drug targeting, drug delivery system in gene therapy. Resistant to antibiotics-bacteria, yeast. Sterilisation of pharmaceutical products, contamination and spoilage of pharmaceutical products. Other pharmaceutical products produced by microbes (streptokinase, streptodornase, botox).

UNIT V PHARMACEUTICAL APPLICATIONS 12

Immobilisation procedure for pharmaceutical applications (lipososmes), biosensors in pharmaceuticals. Applications of microbial enzymes in pharmaceuticals. Regulatory aspects of quality control. Sterilisation, control and sterility testing (Heat sterilization, D-value, Z-value, radiation, Gaseous and filter sterilization), chemical and biological indicators used.

Total: 60 hours

TEXTBOOK:

Arnold .L, Demain and Davis. J. E., Manual of Industrial Microbiology and Biotechnology; ASM Press. Washington DC. 1999.

REFERENCE BOOKS:

1. Stanbury. P .F, Whitaker. A. Hall. S. J, Principles of Fermentation Technology; Pergamon Press. 1995.
2. Reed. G, Prescott and Dunn's Industrial Microbiology; Macmillan Publishers. 1982.
3. W.B. Hugo and A. D. Russell, Pharmaceutical microbiology, Blackwell scientific Publications; Ed. 6; 2002.
4. Fredrick Kavanagh, Analytical microbiology, Vol I & II;Academic press, New York. 2003.
5. Murray. S. Cooper, Quality control in pharmaceutical industry, Vol 2; Academic press, New York. 2001.
6. S.P.Vyas, V.K. Dixit, Pharmaceutical Biotechnology; CBS publishers and Distributors, New Delhi. 2004.
7. Rajesh Bhatia, Ratanlal Ihhpunjani, Quality assurance in Microbiology; CBS publishers and distributors, New Delhi. 2005.

15MIM112 Cell Culture and Fermentation Technology (Theory) 4 0 0 4

Course Objective: The candidate will gain knowledge about fermentation types and kinetics, fermentors; media formulation and characteristics; industrial type/ scale sterilization, GLISP; animal culture; animal cell culture systems and applications.

Course Outcome

At the end of the course, learners will be able to:

CO1: Gain knowledge on the fermentation process and its types with adequate information on the fermentors and its types

CO2: Know about the growth and fermentation kinetics

CO3: Acquire knowledge on the the strategy involved in the Media formulation and fermentation process control

CO4: Gain knowledge about sterilization, screening, scale up, downstream processing and commercially important products

CO5: Know about the cell culture basics, techniques involved in animal cell culture and its Maintainence

CO6: Know about stem cell cultures, ES cell application, vaccines and somatic cell genetics

UNIT I FERMENTATION 12

General consideration of fermentation process. Types of fermentation-submerged, solid state, batch, fed batch, continuous, single, dual, multiple. Design of fermentor. Types of fermentor-Air lift, cylindro conical, fluidized bed, stirred, Tower fermentor, growth kinetics of batch and continuous culture-chemostat and turbidostat. Primary and secondary metabolites-product fermentation kinetics.

UNIT II MEDIA FORMULATION 12

Media formulation- Strategy involved - aeration and agitation. Factors affecting oxygen transfer – Determination of K_{La} Values-Newtonian and non Newtonian fluids. Physical and chemical environmental sensors, fermentation control systems-manual and automatic.

UNIT III PRODUCTS 12

Sterilization-Types of sterilization, batch and continuous, Insitu and exsitu. Sterilisation of media, bioreactor and accessories, fed additives. Sterilisation kinetics – del factor, TDT, 12 D concepts, asepsis and containment – GMP, GILSP, HACCP, IPR, TRIPS, GATT. Screening and selection of

industrially important cultures. Inoculum development, scale up process and downstream processing. Commercial fermentation products – enzymes – protease, amylase, lipase, cellulase, organic solvents – ethanol, butanol, Acids-Acetic acid and lactic acid, SCP-BGA, Vitamins – Vit B12, Vit C. Amino acids-Glutamic and threonine. Non microbial products produced through microbes – Hormones – GH, IFN, TPA, B-cell growth factor.

UNIT IV ANIMAL CELL CULTURE 12

Structure and Organization of animal cell; Equipments and materials for animal cell culture technology; Primary and established cell line cultures. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium. Measurement of viability and cytotoxicity and Growth.

UNIT V CELL CULTURE TECHNIQUES 12

Basic techniques of mammalian cell culture in vitro; disaggregation of tissue and primary culture, maintenance of cell culture; cell separation. Cell synchronization; Cell cloning and micromanipulation; Cell transformation; Application of animal cell culture; Scaling-up of animal cell culture. Stem cell cultures, embryonic stem cells and their applications; Cell culture based vaccines, Somatic cell genetics.

Total: 60hours

TEXTBOOK:

1. Mukhopadhyay S., Process Biotechnology Fundamentals, Ed.2; Viva Books Pvt. Ltd. 2004.

REFERENCE BOOKS:

1. Glyn Stacey, Medicines from Animal Cell Culture; John Wiley and Sons Ltd. 2007.
2. Ralf Portner, Animal Cell Biotechnology: Methods and Protocols (Methods in Biotechnology); Humana Press Inc., U.S. 2007.
3. Joanna Picot, Human Cell Culture Protocols (Methods in Molecular Medicine); Humana Press Inc., U.S. 2004.
4. Jan-Thorsten Schantz and Kee Woei Ng., A Manual for Primary Human Cell Culture ;World Scientific Publication. 2004.
5. Sadettin Ozturk and Wei-Shou Hu, Cell Culture – Technology for Pharmaceutical and Cell – Based Therapies (Biotechnology and Bioprocessing); Taylor and Francis. 2004.
6. Butler, M., Animal Cell Culture and Technology: The Basics; Garland Science. 2003.
7. Davis. J.M., Basic Cell Culture: A Practical Approach ; Oxford University Press. 2002.

8. John R.W. Masters, Animal Cell Culture: A Practical Approach, Ed.3; Oxford University Press. 2000.
9. Stanbury PF, Whitaker A, Hall SJ, Principles of Fermentation Technology; Pergamon Press. 1995.
10. Anton Moser, Bioprocess Technology – Kinetics and Reaction; Springer Verlag, New York. 1998.
11. El-Mansi, EMT., Fermentation Microbiology and Biotechnology; Taylor and Francis Publishers. 2005.
12. Balasubramanian, D., Bryce CFA, Dharmalingam, K., Green J., Kunthala Jayaraman., Concepts of Biotechnology; University Press. 2004.

List of Generic Electives (Any 3 papers) **4 0 0 4**

GE 1: 15MIM151 - Introduction and Scope of Microbiology

GE 2: 15MIM152 - Bacteriology and Virology

GE 3: 15MIM153 - Microbial Metabolism

GE 4: 15MIM154 - Industrial and Food Microbiology

GE 5: 15MIM155 - Microbes in Environment

GE 6: 15MIM156 - Medical Microbiology and Immunology

GE 7: 15MIM157 - Genetic Engineering and Biotechnology

GE 8: 15MIM158 - Microbial Genetics and Molecular Biology

15MIM151 Introduction and Scope of Microbiology (Theory) 2 0 0 2

Course Objectives: The candidates will understand the development of microbiology, diversity of microorganisms,Microscopy and other microbiological concepts.

Course Outcome

At the end of the course, learners will be able to:

CO1: Learn basics of microbiology

CO2: Learn about the significance of classification and features of microbes.

CO3: Able to suitably address the ways to view microbes and the role of fermentations in human activity.

CO4: Gain knowledge regarding control of microbes, uses and impact of microorganisms regarding food.

CO5: Comprehend the role of microorganisms in health and environment.

UNIT I HISTORY OF DEVELOPMENT OF MICROBIOLOGY 6

Development of microbiology as a discipline, Spontaneous generation *vs*. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. Role of microorganisms in fermentation, Germ theory of disease,

UNIT II DIVERSITY OF MICROORGANISMS 6

Systems of classification : Binomial nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. General characteristics of different groups: Acellular microorganisms and Cellular microorganisms giving definitions and citing examples.

UNIT III MICROSCOPY 6

Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluoresence Microscope,Transmission Electron Microscope, Scanning Electron Microscope.

Unit IV STERILIZATION 6

Moist Heat, Autoclave, Dry Heat, Hot Air Oven, Tyndallization, Filteration. Microorganisms as food (SCP), microorganisms in food fermentations (dairy and non dairy based fermented food products) and probiotics.

Unit V MICROBES IN HUMAN HEALTH AND ENVIRONMENT 6

Medical microbiology and immunology: List of important human diseases and their causative agents of various human systems. **Environmental microbiology**: Definitions and examples of important microbial interactions – mutualism, commensalism- parasitism

Total: 30hours

TEXTBOOK:

Ananthnarayanan. R & C. K. Jeyaram Panicker; TEXTBOOKS of Microbiology, Orient Longman. 2010.

REFERENCE BOOKS:

1. Tortora GJ, Funke BR and Case CL., Microbiology: An Introduction; Pearson Education. 9th edition.,2008.
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP., Brock Biology of Microorganisms. Pearson International Edition. 14th edition. 2014.
3. Cappucino J and Sherman N., Microbiology: A Laboratory Manual. PearsonEducation Limited. 9th edition. 2010.
4.Wiley JM, Sherwood LM and Woolverton CJ. Prescott's Microbiology. McGrawHill International. 9th Edition. 2013.
5. Atlas RM., Principles of Microbiology. 2nd edition. WM.T.Brown Publishers. 1997.

6. Pelczar MJ, Chan ECS and Krieg NR., Microbiology. McGraw Hill Book Company. 5th edition. 1993.
7. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR., General Microbiology. McMillan. 5th edition. 2005.

15MIM152 Bacteriology and Virology (Theory) 2 0 0 2

Course Objectives: The candidates will understand the cell organization, bacterial growth and control, bacterial systematic and classification of viruses.

Course Outcome

At the end of the course, learners will be able to:

CO1: Get a wide knowledge on gram positive, gram negative organisms and archeal groups.

CO2: Have a wide knowledge on cultivation of microorganisms and selection by pure culture methods by learning different components of media and their types which include selective, differential, enriched, enrichment and defined media.

CO3: Have a thorough description on different isolation methods like streaking, dilution and plating techniques.

CO4: Gain a deep knowledge on taxonomy and types of classification systems.

CO5: Learn the different groups like archea which can adapt to drastic environments like methanogens, thermophiles and halophiles.

CO6: Assimilate knowledge on the propertied of viral proteins, capsoids, size and structure of viruses.

CO7: Obtain knowledge on other viral proteins such as prions, viroids which cause infection.

CO8: Understand different cultivation methods of viruses like egg inoculation, cell lines and animal inoculation methods.

CO9: Gain knowledge of the mechanism of other viruses which cause infection on plants, bacteria(phages) and humans like T4, Tobacco Mossaic virus, Cauliflower Mosaic Virus HIV and hepatitis viruses.

UNIT I CELL ORGANIZATION 6

Cell size, shape and arrangements, capsule, flagella and pili, Composition and detailed structure of gram- positive and gram- negative cell wall and archaeal cell wall structure.

Unit II BACTERIAL GROWTH AND CONTROL 6

Culture media: Components of media, Synthetic or defined media, Complex media, enriched media, selective media, differential media, enrichment culture media.Pure culture isolation: Streaking, serial dilution and plating methods.

Unit III BACTERIAL SYSTEMATICS AND TAXONOMY 6

Taxonomy, nomenclature, systematics, types of classifications. Morphology, ecological significance and economic importance of the following groups: Archaea: methanogens, thermophiles and halophiles.

Unit IV INTRODUCTION TO VIRUSES 6

Properties of viruses; general nature and important features. Subviral particles; viroids, prions and their importance. Isolation and cultivation of viruses.

Unit V STRUCTURE OF VIRUSES 6

Description of important viruses: salient features of the viruses infecting different hosts - Bacteriophages (T4 & Lambda); Plant (TMV & Cauliflower Mosaic Virus), Human (HIV & Hepatitis viruses).

Total: 30hours

TEXTBOOK:

Ananthnarayanan. R & C. K. Jeyaram Panicker; TEXTBOOKS of Microbiology, Orient Longman. 2010.

REFERENCE BOOKS:

1. Atlas RM., Principles of Microbiology. WM.T.Brown Publishers. 2nd edition.1997.
2. Madigan MT, Martinko JM, Dunlap PV and Clark DP, Brock Biology of Microorganisms. Pearson Education, Inc. 14th edition. 2014.
3. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. General Microbiology. McMillan, 5th edition. 2005.
4. Carter J and Saunders V, Virology; Principles and Applications. John Wiley and Sons. 2007.
5. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR Skalka, AM, Principles of Virology,Molecular Biology, Pathogenesis and Control. ASM Press. 2nd ed. 2004
6. Shors Teri, Understanding Viruses; Jones and Bartlett Learning Burlington USA. 2nd edition, 2013.
7. Pelczar Jr MJ, Chan ECS, and Krieg NR., Microbiology. Tata McGraw Hill. 5th edition, 2004.

8. Tortora GJ, Funke BR, and Case CL., Microbiology: An Introduction.Pearson Education. 9th edition, 2008.
9. Willey JM, Sherwood LM, and Woolverton CJ., Prescott's Microbiology. McGraw Hill Higher Education. 9th edition. 2013.
10. Dimmock, NJ, Easton, AL, Leppard, KN, Introduction to Modern Virology. Blackwell Publishing Ltd. 6th edition, 2007.
11. Cann AJ, Principles of Molecular Virology, Academic Press Oxford UK. 2012.

15MIM153 Microbial Metabolism (Theory) 2 0 0 2

Course Objectives: The candidates will understand the microbial growth, nutrient uptake and transport, chemoheterotrophic metabolism, anaerobic respiration and fermentation, chemolithotrophic and phototrophic metabolism.

Course Outcome

At the end of the course, learners will be able to:

CO1: Gain knowledge about the microbial growth and nutritional categories of microorganisms.

CO2: Understand various nutritional uptake and transport mechanism.

CO3: Learn about the chemo heterotrophic metabolism and types of respiration and fermentation.

CO4: Learn anaerobic respiration and types of fermentation

CO5: Understand chemolithotrophic and phototrophic metabolismism

CO6: Gain knowledge on biological nitrogen fixation.

UNIT I MICROBIAL GROWTH 6

Definitions of growth, Batch culture, Continuous culture, generation time and specific growth rate. Temperature and temperature ranges of growth - pH and pH ranges of growth; Effect of solute and water activity on growth; Effect of oxygen concentration on growth. Nutritional categories of microorganisms

UNIT II NUTRIENT UPTAKE AND TRANSPORT 6

Passive and facilitated diffusion; Primary and secondary active transport, concept of uniport, symport and antiport; Group translocation; Iron uptake

UNIT III CHEMOHETEROTROPHIC METABOLISM 6

Concept of aerobic respiration, anaerobic respiration and fermentation. Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, TCA cycle

UNIT IV ANAEROBIC RESPIRATION AND FERMENTATION 6

Anaerobic respiration,-Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction). Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways.

UNIT V CHEMOLITHOTROPHIC AND PHOTOTROPHIC METABOLISM 6

Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction). Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic *vs.* oxygenic photosynthesis with REFERENCE BOOKS to photosynthesis in green bacteria and Cyanobacteria. Introduction to biological nitrogen fixation - Ammonia assimilation; Assimilatory nitrate reduction.

Total: 30hours

TEXTBOOK:

Ananthnarayanan. R & C. K. Jeyaram Panicker; TEXTBOOKS of Microbiology, Orient Longman. 2010.

REFERENCE BOOKS:

1. Madigan MT, and Martinko JM, Brock Biology of Microorganisms. Prentice Hall International Inc.14th edition. 2014.
2. Moat AG and Foster JW., Microbial Physiology. John Wiley & Sons. 4th edition.2002.
3. Reddy SR and Reddy SM., Microbial Physiology. Scientific Publishers India. 2005.
4. Gottschalk G., Bacterial Metabolism. Springer Verlag. 2nd edition. 1986.
5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR., General Microbiology. McMillan Press. 5th edition, 1987.
6. Willey JM, Sherwood LM, and Woolverton CJ., Prescott's Microbiology. McGraw Hill Higher Education. 9th edition. 2013.

15MIM154 Industrial and Food Microbiology (Theory) 2 0 0 2

Course Objectives: The candidates will understand the development of food microbiology, microbial fermentation processes, food preservation and food-borne diseases.

Course Outcome

At the end of the course, learners will be able to:

CO1: Realize the importance of microbes in the production of many useful products

CO2: Understand fermenters and fermentation processes.

CO3: Gain knowledge in downstream processing and industrial production of various products.

CO4: Understand the relationship between foods and microbes and its impact on human health

CO5: Assimilate information on Microbial production of foods and food sanitation

UNIT I INTRODUCTION 6

Brief history and developments in industrial microbiology. Types of fermentation processes - solid state, liquid state, batch, fed-batch and continuous. Types of fermenters – laboratory, pilot-scale and production fermenters.

UNIT II MICROBIAL FERMENTATION PROCESSES 6

Ingredients used in fermentation medium - molasses, corn steep liquor, whey & Yeast extract. Downstream processing - filtration, centrifugation, cell disruption, solvent extraction. Microbial production of industrial products - citric acid, ethanol and penicillin. Industrial production and uses of the enzymes - amylases, proteases, lipases and cellulases

UNIT III FOOD AS A SUBSTRATE FOR MICROBIAL GROWTH 6

Intrinsic and extrinsic parameters that affect microbial growth in food. Microbial spoilage of food – seafoods, fruits and vegetables, milk, egg, bread and canned foods

UNIT IV PRINCIPLES AND METHODS OF FOOD PRESERVATION 6

Physical methods - high temperature, low temperature, irradiation, aseptic packaging

Chemical methods - salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite. Food sanitation and control – HACCP

UNIT V DAIRY PRODUCTS, PROBIOTICS AND FOOD-BORNE DISEASES 6

Fermented dairy products - yogurt, acidophilus milk, kefir, dahi and cheese. Probiotics definition, examples and benefits Food intoxication by *Clostridium botulinum* and *Staphylococcus aureus,* Food infection by *Salmonella* and *E.coli.*

Total: 30hours

TEXTBOOK:

Frazier WC and Westhoff DC., Food Microbiology. Tata McGraw-Hill Publishing Company Ltd, New Delhi, India. 3rd edition. 1992.

REFERENCE BOOKS:

1. Crueger W and Crueger A., Biotechnology: A TEXTBOOKS of Industrial Microbiology. Panima Publishing Company, New Delhi. 2nd Edition. 2000.
2. Patel AH., Industrial Microbiology . MacMillan India Limited Publishing Company Ltd. New Delhi, India. 1996.
3. Tortora GJ, Funke BR, and Case CL., Microbiology: An introduction. Pearson Education. 9th Edition. 2008.
4. Willey JM, Sherwood LM AND Woolverton CJ, Prescott, Harley and Klein's Microbiology. McGraw Hill Higher education. 9th Edition. 2013.
5. Casida LE., Industrial Microbiology. Wiley Eastern Limited. 1991.
6. Stanbury PF, Whitaker A and Hall SJ., Principles of Fermentation Technology. Elsevier Science Ltd. 2nd edition, 2006.
7. Adams MR and Moss MO., Food Microbiology; New Age International (P) Limited Publishers, New Delhi, India. . 4th edition, 1995.
8. Banwart JM. Basic Food Microbiology. CBS Publishers and Distributors, Delhi, India. 1987.
9. Jay JM, Loessner MJ and Golden DA., Modern Food Microbiology. CBS Publishers and Distributors, Delhi, India. 7th edition, 2005.

15MIM155 Microbes in Environment (Theory) 2 0 0 2

Course Objectives: The candidates will understand the microorganisms and their habitats, microbial interactions, biogeochemical cycling and waste management.

Course Outcome

At the end of the course, learners will be able to:

CO1: Learn about the structure and functions of ecosystem.

CO2: Gain knowledge on ecological role of microbes in the environment.

CO3: Assimilate information on microbial communities in the environment.

CO4: Obtain knowledge about microbial interactions – symbiosis, antagonism, synergism, commensalism, amensalism, parasitism, and predation.

CO5: Have information on micro- animal interaction.

CO6: Gain knowledge in the importance of biogeochemical cycling in the ecosystems.

CO7: Obtain knowledge on microbiological aspects and management of waste water.

CO8: Learn about the microbial bioremediation of pesticides, hydrocarbons, oil spills.

UNIT I MICROORGANISMS AND THEIR HABITATS 6

Structure and function of ecosystems. Terrestrial Environment: Soil profile and soil microflora. Aquatic Environment: Microflora of fresh water and marine habitats

Atmosphere: Aeromicroflora and dispersal of microbes.

UNIT II MICROBIAL INTERACTIONS 6

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non symbiotic interactions. Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria.

UNIT III BIOGEOCHEMICAL CYCLING 6

Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin

Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction. Phosphorus cycle: Phosphate immobilization and solubilisation

Sulphur cycle: Microbes involved in sulphur cycle. Other elemental cycles: Iron and manganese.

UNIT IV WASTE MANAGEMENT 6

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill). Liquid waste management: Composition and strength of sewage (BOD and COD).

UNIT V MICROBIAL BIOREMEDIATION 6

Principles and degradation of common pesticides, hydrocarbons (oil spills). Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.

Total: 30hours

TEXTBOOK:

Pradipta.K.M., TEXTBOOK of Environmental Microbiology; I.K.Publishing House; 2008.

REFERENCE BOOKS:

1. Atlas RM and Bartha R. Microbial Ecology: Fundamentals & Applications. Benjamin/Cummings Science Publishing, USA. 4th edition. 2000.
2. Madigan MT, Martinko JM and Parker J. Brock Biology of Microorganisms. Pearson/ Benjamin Cummings. 14th edition. 2014.
3. Maier RM, Pepper IL and Gerba CP., Environmental Microbiology. Academic Press. 2nd edition, 2009.
4. Okafor, N, Environmental Microbiology of Aquatic & Waste systems. Springer, New York. 2011.
5. Singh A, Kuhad, RC & Ward OP, Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg. 2009.
6. Barton LL & Northup DE, Microbial Ecology. Wiley Blackwell, USA2011.

15MIM156 Medical Microbiology and Immunology (Theory) 2 0 0 2

Course Objectives: The candidates will understand the concepts of normal flora organisms microbial diseases, antimicrobial agents and immune cells, and immune response and immunological disorders.

Course Outcome

At the end of the course, learners will be able to:

CO1: Realize the importance of normal microbial flora in human health

CO2: Study normal microbiota of different organs in human body.

CO3: Assimilate knowledge on microbial diseses affecting various organ systems.

CO4: Understand the mechanisms of mode of action of different class of antibiotics

CO5: Realize the role of immune cells in developing immunity against microbial diseases

CO6: Assimilate information on significant role of immune organs

CO7: Understand the vital role of antibodies and their development

CO8: Realize the development of HMI and CMI

CO9: Comprehend importance of immunological disorders.

UNIT I NORMAL MICROFLORA AND SAMPLE COLLECTION 6

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract. Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity.

UNIT II MICROBIAL DISEASES 6

List of diseases of various organ systems and their causative agents. List of diseases of various organ systems and their causative agents.List of diseases of various organ systems and their causative agents. Brief description of various types of mycoses.

UNIT III ANTIMICROBIAL AGENTS AND IMMUNE CELLS 6

Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism Antifungal agents: Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cel.

UNIT IV IMMUNE ORGANS, ANTIGENS AND ANTIBODIES 6

Immune Organs – Bone; Marrow, Thymus, Lymph Node, Spleen. Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T& B cell epitopes), Adjuvants, Structure, Types and Functions of antibodies.

UNIT V IMMUNE RESPONSE AND IMMUNOLOGICAL DISORDERS 6

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response. Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiencies - Animal models (Nude and SCID mice). Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT.

Total: 30hours

TEXTBOOK:

Ananthanarayan R. and Paniker C.K.J. Textbooks of Microbiology. University Press Publication. 8th edition, 2009.

REFERENCE BOOKS:

1. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A., Jawetz, Melnick and Adelberg's Medical Microbiology. McGraw Hill Publication. 26th edition. 2013.
2. Goering R., Dockrell H., Zuckerman M. and Wakelin D., Mims' Medical Microbiology. Elsevier. 4th edition., 2007.

15MIM157 Genetic Engineering and Biotechnology (Theory) 2 0 0 2

Course Objectives: The candidates will understand the development genetic engineering, vectors, DNA amplification and DNA sequencing, application of genetic engineering and biotechnology.

Course Outcome

At the end of the course, learners will be able to:

CO1: Gain knowledge about the basics in genetic engineering.

CO2: Learn about the various strategies of DNA RNA and Protein analysis.

CO3: Study about the various types of cloning vectors used in genetic engineering.

CO4: Learn about the DNA amplification and sequencing methods.

CO5: Acquire knowledge in gene transfer methods and also the applications of biotechnology.

CO6: Assimilate knowledge about the techniques used to characterize the nanoparticles.

CO7: Learn about the protein engineering.

CO8: Achieve knowledge about the intellectual property rights, patent, copyrights and. Trademarks

UNIT I INTRODUCTION TO GENETIC ENGINEERING 6

Milestones in genetic engineering and biotechnology. Restriction modification systems: Mode of action, applications of Type II restriction enzymes in genetic engineering. DNA modifying enzymes and their applications: DNA polymerases.

UNIT II VECTORS 6

Cloning Vectors: Definition and Properties - Plasmid vectors: pBR and pUC series
Bacteriophage lambda and M13 based vectors, Cosmids, BACs, YACs. Expression vectors: *E.coli* lac and T7 promoter-based vectors, yeast YIp, YEp and YCp vectors,
Baculovirus based vectors, mammalian SV40-based expression vectors.

UNIT III DNA AMPLIFICATION AND DNA SEQUENCING 6

PCR: Basics of PCR, RT-PCR, Real-Time PCR, Genomic and cDNA libraries: Preparation and uses, Genome sequencing - Sanger's method of DNA Sequencing: traditional and automated sequencing

UNIT IV APPLICATION OF GENETIC ENGINEERING 8

Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral mediated delivery, *Agrobacterium* - mediated delivery. Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, flavo savo tomato, Gene therapy, recombinant vaccine, protein engineering

UNIT V INTELLECTUAL PROPERTY RIGHTS 4

Patents, Copyrights, Trademarks.

Total: 30hours

TEXTBOOK:

Primrose SB and Twyman RM. Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K. 2008.

REFERENCE BOOKS:

1. Brown TA., Gene Cloning and DNA AnalysisBlackwell Publishing, Oxford, U.K. 6th edition. 2010.
2. Clark DP and Pasternik NJ. Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA. 2009.
3. Primrose SB and Twyman RM., Principles of Gene Manipulation and Genomics, Blackwell Publishing, Oxford, U.K. 7th edition. 2006.
4. Brown TA., Genomes-3. Garland Science Publishers. 2007.

15MIM158 Microbial Genetics and Molecular Biology (Theory) 2 0 0 2

Course Objectives: The candidates will understand the structures of DNA and RNA, replication of DNA and transcription, translation, gene regulation, mutations and genetic exchange.

Course Outcome

At the end of the course, learners will be able to:

CO1: Attain knowledge about the basics in structure of Nucleic acid.

CO2: Learn about the organization of genetic materials in organisms.

CO3: Study about the various types of cloning vectors used in genetic engineering.

CO4: Know about the mechanisms DNA replication, transcription and translation processes in organisms.

CO5: Gain knowledge in the mechanisms of gene expression and its regulations in organisms.

CO6: Achieve knowledge about the mutations and DNA repair mechanisms in organisms.

CO7: Realize knowledge about the transposable elements, types of plasmids and its applications.

UNIT I STRUCTURES OF DNA AND RNA 6

DNA structure, Salient features of double helix, Types of DNA, denaturation and renaturation, topoisomerases; Organization of DNA Prokaryotes,Viruses, Eukaryotes. RNA Structure.

UNIT II REPLICATION OF DNA AND TRANSCRIPTION 6

Bidirectional and unidirectional replication, semi- conservative, semi- discontinuous replication. Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA. polymerases, DNA ligase, primase, telomerase. Transcription: Definition, promoter - concept and strength of promoter.

UNIT III TRANSLATION AND GENE REGULATION 6

Genetic code, Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides.

UNIT IV MUTATIONS AND GENETIC EXCHANGE 6

Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Uses of mutations, DNA repair mechanisms. Transformation - Discovery, mechanism of natural competence. Conjugation - Discovery, mechanism, Hfr and F' strains. Transduction - Generalized transduction, specialized transduction.

UNIT V PLASMIDS AND TRANSPOSABLE ELEMENTS 6

Property and function of plasmids, Types of plasmids. Prokaryotic transposable elements – Insertion. Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Uses of transposons and transposition.

Total: 30hours

TEXTBOOK:

Russell PJ. Genetics- A Molecular Approach. Benjamin Cummings.3rd Ed, 2009.

REFERENCE BOOKS:

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R, Molecular Biology of the Gene, Cold Spring Harbour Lab. Press, Pearson Publication. 6th edition, 2008.
2. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP, The World of the Cell, Pearson Benjamin Cummings Publishing, San Francisco. 7th edition, 2009.
3. De Robertis EDP and De Robertis EMFCell and Molecular Biology, Lippincott Williams and Wilkins, Philadelphia. 8th edition, 2006.

4. Karp G, Cell and Molecular Biology: Concepts and Experiments, John Wiley & Sons. Inc. 6th edition, 2010.
5. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, Jones and Bartlett Learning
6. Gardner EJ, Simmons MJ, Snustad DP, Principles of Genetics. 8th Ed. Wiley-India. 3rd Ed., 2008.
7. Klug WS, Cummings MR, Spencer, C, Palladino, M, Concepts of Genetics, Benjamin Cummings. 10th Ed., 2011.