Master of Science
in
APPLIED MICROBIOLOGY

PROGRAMME STRUCTURE AND SYLLABUS
2019-20 ADMISSIONS ONWARDS

(UNDER MAHATMA GANDHI UNIVERSITY PGCSS REGULATIONS 2019)

EXPERT COMMITTEE IN MICROBIOLOGY (PG)
MAHATMA GANDHI UNIVERSITY

2019

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Chairman
Expert Committee, Microbiology (PG)

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M. Sc. Applied Microbiology Programme

(Mahatma Gandhi University Regulations PGCSS-2019 from 2019-20 Academic Year)

1. Aim of the Programme:

Microbiology deals with the study of microbes. The M.Sc. Degree programme aims at providing an in depth understanding of the biochemistry, cell biology, molecular biology, physiology of microbes and their applications. This programme also aims to study emerging areas of Bioscience along with analytical techniques, bioinformatics and biostatistics. The students need to achieve the program specific outcome listed below.

Program Specific Outcome

In tune with the changing scenario in higher education, Mahatma Gandhi University decided to introduce outcome based syllabus for Credit Semester System in all its regular Post-graduate programmes from 2019-2020 academic years. Regulations for the same were approved by Mahatma Gandhi University. Subsequently, a draft syllabus was prepared for M.Sc. Applied microbiology conforming to the general guidelines of the curriculum for the post-graduate programmes. These are exciting times in Biology. The world of Biology has been transformed in the last few decades. There was too much to select from. However, the Expert Committee designed the programme envisioning the following objectives **(programme outcome);**

- To encourage a clear, comprehensive and advanced mastery in the field of Applied Microbiology.
- To provide the excellence of biological sciences with special reference to Microbiology and its Applicable branches.
- Enabling the students to explore the intricacies of life forms at cellular, molecular and nano level.
- To sustain students' motivation and enthusiasm and to help them not only to appreciate the beauty of microbial life forms but also to inspire them to explore the amazing properties of microbial world in favour of human life.
- To develop problem solving skills in students and encourage them to carry out innovative research projects thereby enkindling in them the spirit of knowledge creation.

2. Eligibility for Admissions

A candidate seeking admission to M Sc. Applied Microbiology must have at least 50%marks in graduation in Microbiology, Zoology, Botany, Chemistry, Biochemistry, Bioinformatics, Industrial Microbiology, Biotechnology, Food Technology & Quality Assurance, Food Science & Quality Control or any other discipline in Life Sciences viz., Environmental Sciences, Biophysics, Fishery Science, Clinical Nutrition & Dietetics.The admission to M Sc.Applied Microbiology PG Programme shall be as per the rules and regulations of the university.

3. **Medium of Instruction and Assessment**

   The medium of instruction and assessment will be English.

4. **Faculty under which the Degree is Awarded**

   Faculty of Science.

5. **Specializations offered, if any**

   Applied Microbiology

6. **Note on compliance with the UGC Minimum Standards for the conduct and award of Post Graduate Degrees**

   The programme structure and syllabus of M. Sc.Microbiology complies with the minimum standards prescribed by the University Grants Commission. The M. Sc.Microbiology programme is under the Credit Semester Scheme, consisting of four semesters spread over a period of two years.

   - Total credits are 80.
   - Number of courses: Core courses - 12, Elective courses - 3, Laboratory courses – 4
   - Evaluation: Internal assessment and external evaluation - 1:3 ratio.
   - Grading: Direct grading system on a 7 point scale.

THE PROGRAMME STRUCTURE

Course Code	Title of the Course	Type of the Course	Teaching hrs/week	Credits
FIRST SEMESTER				
MG010101	Biochemistry &Microbial metabolism	Core course	4	4
MG010102	Biophysics &Instrumentation	Core course	4	4
MG010103	General principles of Microbiology	Core course	4	4
MG010104	Cell Biology &Genetics	Core course	3	3
MG010105	Laboratory Course I	Core course	10	4
Total			**25**	**19**
SECOND SEMESTER				
MG010201	Microbial Genetics & Molecular biology	Core course	4	4
MG010202	Environmental & Agricultural Microbiology	Core course	4	4
MG010203	Virology	Core course	4	4
MG010204	Immunology	Core course	3	3
MG010205	Laboratory Course II	Core course	10	4
Total			**25**	**19**
THIRD SEMESTER				
MG010301	Medical Microbiology	Core course	4	4
MG010302	Industrial Microbiology	Core course	4	4
MG010303	Food Microbiology	Core course	4	4
MG010304	Recombinant DNA Technology	Core course	3	3
MG010305	Laboratory Course III	Core course	10	4
Total			**25**	**19**
FOURTH SEMESTER				
	Pharmaceutical Microbiology	Elective -1	4	4
	Ecology &Developmental Biology			
	Microbial Metabolites			
	Computational Biology & Research methodology	Elective -2	4	4
	Physiology			
	Plant-Microbe Interactions			

	Clinical microbiology	Elective -3	4	4
	Nano technology &Space Microbiology			
	Marine Microbiology			
MG010401	Laboratory Course IV	Core course	13	5
MG010402	Project		-	4
MG010403	Comprehensive Viva-voce		-	2
Total			**25**	**23**
Total Credits				**80**

GROUPS OF ELECTIVES

Semester	**GROUP A (MG80)**	**GROUP B (MG81)**	**GROUP C (MG82)**
Fourth Semester	MG800401 Pharmaceutical microbiology	MG810401 Ecology &Developmental Biology	MG820401 Microbial Metabolites
	MG800402 Computational Biology & Research methodology	MG810402 Physiology	MG820402 Plant-Microbe Interactions
	MG800403 Clinical microbiology	MG810403 Nano technology &Space Microbiology	MG820403 Marine microbiology

SYLLABUS

First Semester

M. Sc. Applied Microbiology

MG010101	Biochemistry & Microbial metabolism
MG010102	Biophysics & Instrumentation
MG010103	General principles of Microbiology
MG010104	Cell Biology & Genetics
MG010105	Laboratory Course I

MG010101 – BIOCHEMISTRY AND MICROBIAL METABOLISM

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students:

1. will be able to explain the fundamental biochemical principles, such as the structure/function of biomolecules.
2. will be able to explain metabolic pathways, fermentation reactions, and the regulation of biological/biochemical processes.
3. will Know the reactions of the major catabolic and anabolic pathways of carbohydrate, lipid, andnucleotides
4. will be able to explain the various fermentation reactions executed by microorganisms
5. will be able to explain the general properties of Enzymes and its regulation

Module- I Biomolecules

Carbohydrates- Overview of mono and Di saccharides**,** Structural Polysaccharides (cellulose, chitin, starch, agar, glycogen). Mucopolysaccharides, bacterial polysaccharides, introduction to glycoproteins and glycolipids.

Proteins-Protein structure; Primary structure-determination of amino acid sequence. Peptide bond; Torsion angles & Ramachandran plot. Secondary structure- alpha helix and beta pleated sheet & beta turn. Structural overview of collagen triple helix and α-Keratin. Super secondary structure-motifs. Tertiary structure-alpha and beta domains. Quaternary structure – Structure of haemoglobin& myoglobin. Forces stabilizing protein structure. Classification of proteins. Denaturation and renaturation of protein, protein folding – role of chaperons.

Lipids- classification-simple, compound and derived lipids. Eicosanoids-types and functions. Lipoproteins-types and functions. Cholesterol- structure and biological functions. Essential fatty acids. Saponification value, iodine number, acid number, rancidity of fats.

Module- II Advanced Enzymology

Enzymes: Characteristics, Nomenclature and classification. Holoenzyme- apoenzymes and coenzymes, prosthetic groups and cofactors, active site. Kinetics of single substrate enzyme catalysed reactions: Michaelis- Menton equation, Lineweaver Burk plot. Factors affecting enzymatic activity (temperature, pHetc). Role of coenzymes.

Mechanism of enzyme action-lowering of activation energy. Mechanism of Catalysis- Acid-base catalysis, covalent catalysis. Mechanism of action of Lysozyme, and Chymotrypsin. Multienzymecomplex-Pyruvate dehydrogenase complex. Allosteric enzymes. Isoenzymes, abzymes, ribozymes. Immobilized enzymes. Enzyme inhibition-competitive, uncompetitive, non-competitive and irreversible inhibition.

Module- IIIMetabolism and bioenergetics

Carbohydrate metabolism

Anaerobic-EMP, Pasteur effect, Gluconeogenesis, HMP shunt, ED pathway, Phosphoketolase pathway. Methylglyoxal bypass and glyoxalate pathway.

Aerobic-Citric acid cycle, Anaplerotic and amphibolic role of citric acid cycle. Biosynthesis of cell wall peptidoglycan.

Electron transport chain-Mitochondrial structure, Electron transport chain-organisation of electron transport complexes. Transport of electron through ETC. Inhibitors of electron transport chain. Oxidative phosphorylation-- Coupling between oxidation and phosphorylation (chemiosmotic hypothesis). ATP Synthase.

Lipid metabolism- Oxidation of fatty acids-α,β and ω oxidation of fatty acids. Ketone bodies-Utilization and clinical significance. Biosynthesis of fatty acids-Palmitic acid, elongation of fatty acids. Synthesis of cholesterol.

Module- IV Nucleic acid structure and metabolism

Watson and Crick model of DNA, forces stabilizing DNA structure, Histones. Mitochondrial DNA. Metabolism of Purines-De Novo and salvage pathways of purine and Pyrimidine biosynthesis. Degradation of Purines and Pyrimidines.

Module –V Microbial Fermentation.

Lactic acid fermentations- homolactic fermentation, heterolactic acid fermentation, Mixed acid fermentation, Butanediol Fermentation, Butyric acid fermentations, Butanol-acetone fermentation, Propionic acid fermentation. Alcohol fermentation

References

1. Understanding enzymes- Trevor Palmer
2. Fundamentals of Biochemistry - Donald Voet& Judith Voet. 2008. John Wiley & Sons Inc. NJ, USA.

3. Biochemistry- LubertStryer fifth edition. WH Freeman 2001
4. Principles of Biochemistry, Lehninger- David L.Nelson, Michael M Cox
5. Fundamentals of Enzymology 3rd Edition by Price
6. Harper's Illustrated Biochemistry, 26th Edition-David K Murray, Lange/McGraw-Hill Inc.
7. Molecular Cell Biology- Lodish& Berk 5th edition

MG010102 – BIOPHYSICS AND INSTRUMENTATION

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students:

1. will be able to explain the installation and operation of various instruments.
2. will be able to explain the importance of thermodynamics in living system.
3. will be able to explain the fundamentals of analytical techniques and steps of a characteristic analysis
4. will be able to evaluate the analytical data
5. will be able to effectively communicate physics basics and how it worth in the biological systems

Module -I Thermodynamics

Laws of thermodynamics, thermodynamic equilibrium,Concepts of enthalpy, entropy and free energy in biological systems, high energy compounds, redox reactions, different kinds of electron transfer

Module – II Basic laboratory Instruments

Microscopy- Working principles of microscopes (Bright light, phase contrast,interference & fluorescence microscope and electron microscopes), flow cytometry **Centrifugation:** Basic principles, Relative centrifugal force, Factors affectingsedimentation velocity, sedimentation coefficient, determination of molecular weight, Types of centrifuges, preparative and analytical centrifuges- differential centrifugation and density gradient methods and their applications.

Chromatographic techniques - Theory, principles and applications of: - thin layer chromatography, gel filtration chromatography, ion exchange chromatography, affinity chromatography, gas liquid chromatography, high pressure/ performance liquid chromatography (HPLC), GCMS.

Electrophoretic techniques - Basic principles of electrophoresis, theory and applicationof AGE, SDS PAGE, pulse field electrophoresis, Isoelectric focusing.

Module – III Spectroscopy, crystallography, and Immobilization

X-ray crystallography, Spectroscopic techniques, theory and applications of UV- Visible, IR, NMR, and Fluorescence spectroscopy. Immobilization methods such as carrier binding, entrapment and cross linking. Analytical, therapeutic & industrial applications. Properties of immobilized enzymes.

Module -IV Conformations of Nucleic acids

Structural polymorphism, Supercoiling, Topoisomerase, DNA- protein interaction, RNA-protein interaction,t-RNA structure

Module -VNuclear Medicine.

Basic principles of Nuclear Medicine, Diagnostic use of Radioisotopes, In-vivo & In-vitro procedures, (Single isotope, Double isotope methods),Radio immunoassay counting system, Detection and measurement of radioactivity using ionization chamber, proportional chamber, Geiger- Muller and Scintillation counters.

General principles & procedures of organ scanning, Renal imaging, Cardiac imaging, Blood volume determination by isotope method, Rectilinear scanners & Gamma scintillation camera,Positron emission Tomography (PET), Single Photon emission computer Tomography (SPECT), Radio pharmaceuticals & their Diagnostic applications.

Reference Books

1. Instrumental Methods of Analysis. 6th Edition by H.H. Willard, L.L. Merritt Jr. and others. 1986. CBS Publishers and Distributors.
2. Instrumental Methods of Chemical Analysis. 1989 by Chatwal G and Anand, S. Himalaya Publishing House, Mumbai.
3. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.
4. Gel Electrophoresis of Proteins- A Practical Approach by Hanes.
5. Analytical Biochemistry by Holme.
6. Spectroscopy by B.P. Straughan and S. Walker.
7. Practical aspects of Gas Chromatography and Mass Spectrometry 1984 by Gordon M. Message, John Wiley and Sons, New York.
8. Isotopes and radiations in Biology by C.C. Thornburn, Butterworth and Co. Ltd., London.
9. Biophysical chemistry -Upadhya

MG010103 – GENERAL PRINCIPLES OF MICROBIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will:

1. be able to demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures
2. be able to understand the basic microbial structure and function and study the comparative characteristics of microbes, and also understand the structural similarities and differences among various physiological groups of bacteria.
3. Know the various culture media and their applications and also understand various physical and chemical means of sterilization
4. be able to understand the microbial transport systems
5. Know the various Physical and Chemical growth requirements of bacteria and fungi

Module-I Introduction to Microbiology

History of Microbiology. Principles of classification of microbes; morphological, metabolic and molecular criteria for the classification, Ultra structure of bacteria. Microbiome and its impact on human health.

Module- II Microbial Cultivation

Nutritional types and requirements of bacteria. Cultivation of bacteria: Pure culture techniques, classification of culture media and preparation; Preservation of cultures;**aerobic** and anaerobic culture techniques. Batch, continuous, and synchronous cultures. **Growth** curve, its construction, and factors influencing growth

Module - III Control of Microbial growth

Principles and techniques: - Physical and Chemical methods. **Disinfection**- Method of action of disinfectants. Methods of testing disinfectants.

Module - IV Microbial physiology

Staining characteristics, Gram staining, AFB staining, Cultural characteristics, Photosynthetic microorganisms, cyclic and non-cyclic photophosphorylation, Bacterial aerobic respiration, Bacterial anaerobic respiration: introduction. Nitrate, carbonate and sulfate as electron acceptors.

Electron transport chains in some anaerobic bacteria. Mechanism of oxygen toxicity. Bacterial transport system-ABC, Sec pathway, PTS. Microbial communication.

Module - V Mycology

General properties of fungi, fungal classification, reproduction in fungi, economic importance of fungi, factors affecting fungal growth, control of fungal growth. General characteristics of Actinomycetes (model organism Streptomyces). Algae- General characteristics and Fritsch classification. Archaebacteria-Extremophiles.

Reference Books

1. Microbial Physiology and Metabolism by Caldwell D.R. 1995Brown Publishers.
2. Microbiology: An Introduction,Tortora, Funke, Case, PEARSON
3. Microbial Physiology by Moat A.G. and Foster J. W. 1999. Wiley.
4. Prokaryotic Development by Brun. Y.V. and Shimkets L.J. 2000. ASM Press.
5. Advances in Microbial Physiology. Volumes. Edited by By A.H. Rose. Academic Press, New York.
6. Applied Microbial Physiology by Rhodes.
7. Principles of bacteriology, virology and immunology Vol I Topley and Wilson
8. Zinser, Microbiology
9. Microbiology, Prescottt, Harley and klien
10. Foundations in Microbiology Talaro and Talaro
11. Text book of Microbiology, R Ananthanarayanan C K J Panicker
12. Microbiology, Pelczar, Chan and Kreig.

MG010104 – CELL BIOLOGY AND GENETICS

Teaching Hours/week: 3 **Credits: 3**

Course Outcome:

By attending the course, the students will:

1. be able to identify the components of a general signal transduction pathway, and provide examples of pathways initiated by different receptors
2. be able to describe the cell cycle progression and cell cycle regulation
3. be able to understand the distinction between genetic screening and genetic testing, and aware of the differences and similarities between diagnostic, predictive and carrier genetic testing
4. be able to Synthesize and incorporate the fundamentals of gene technology in order to understand how such technology impacts humans, and also employ the scientific method to generate new knowledge, and to solve problems, regarding human heredity.
5. be able to describe genetics in medical practice including recognizing congenital anomalies and syndromes, risk assessment and genetic counseling, genetic testing and screening, and plans for management and treatment.

Module- I

Structure of biological membranes, lipids and lipid modification, membrane proteins. Cell cycle- Regulation of the cell division cycle, Cell cycle checkpoints, Protein modifications and intracellular transport, glycosylation, vesicular transport, receptor mediated endocytosis, lysosomes, organelle biogenesis.

Module - II

Extracellular matrix, cell signalling- receptors, second messengers, signalling pathways. The actin-myosin cytoskeleton.

Module - III

Study tools in Human Genetics: Pedigree analysis- Mendelian inheritance and exceptions; Chromosomal analysis (in vitro, in vivo), Biochemical analysis; Somatic cell genetics (somatic cell hybrids, monochromosome hybrid panels); Molecular genetic analysis.

Human genome mapping methods: Physical mapping: Introduction to physical map markers - Chromosomal, G/Q- banding, Fluorescence in situ hybridization (FISH), comparative genome hybridization, Genetic mapping: Linkage analysis; Applications of mapping in normal and disease genome analysis; Gene identification using positional and functional cloning approach.

Module - IV

Diagnostic genetics: Biochemical/Molecular methods; Screening for mutation/ chromosomal anomaly - Adult/Prenatal/New-born screening; Pre-implantation genetic screening (Assisted reproductive technology- in vitro fertilization and Embryo transfer); Forensic testing - DNA fingerprinting, paternity testing, individual identification. Treatment of genetic disorders: Methods of therapy - Drug (recombinant proteins); Diet; Gene (Viral vectors, delivery methods, efficacy); some examples (Thalassemia, Phenylketonuria, and Cystic fibrosis).

Module - V

Methods to induce genetic variation in single genes: Insertional mutagenesis - transposon and TDNA mutagenesis; In vitro mutagenesis; Oligonucleotide- and PCR-mediated site-specific mutagenesis; RNAi mutagenesis. Molecular Evolution: Evolution of origin of species and theories of evolution; the basic force of evolution – Mutation, recombination and gene flow; Phylogeny and systematics.

Reference Books

1. Principles of Genetics, Snustad, Simmons and Jenkins, John Wiley And Sons Inc
2. Genetics, Robert Weaver and Philip Hendricks, WH.C. Brown Publishers, Iowa
3. Fundamentals of Genetics, B D Singh, Kalyani Publishers
4. Introduction to Genetic Analysis, Griffiths, Wessler, Lewontin, Gelbart,Suzuki and Miller, Freeman's and Co, New York
5. Principles of Genetics: A.G.Gardner, John Wiley and sons.
6. Cell Bilogy, Smith and Wood
7. Cell and Molecular Biology by Gerald Karp, Academic Press
8. Cell and Molecular Biology Cooper, Hausman, ASM Press.
9. World of the Cell, Becker, Reece, Poenie, The Benjamin/Cumming's Pub.
10. Cell Biology, Lodish et al, W H Freeman and Co.,NewYork.
11. Cell Biology, Thomas D Pollard and W.C.Earnshaw, Saunder's Publishers

MG010105 – LABORATORY COURSE I

Lab Hours/week: 10 **Credits: 4**

Course Outcome:

By attending the practical, the students will be:

1. Able to design and carry out experiments (safely) and to interpret experimental data
2. Acquire, discover, and apply the theories and principles of learned subjects in practical, real-world situations and problems.
3. Develop success skills in communication, critical thinking, interaction, information acquisition and interpretation, organization, professionalism, leadership, auto-didactics and life-long-learning.
4. Able to devise experiments with appropriate hypotheses and controls.

Estimation of carbohydrates (Any three to be done)

Estimation of total sugar by anthrone method

Estimation of sugars by DNS method.

Estimation of glucose by ortho-toluidine method

Estimation of fructose by Roe-Pappadapoulose method.

Estimation of reducing sugars by Nelson-Somogyi method

Estimation of proteins (Any two to be done)

Estimation of protein by Lowry's method

Estimation of proteins by Benedict's method

Estimation of protein by Bradford' method

Estimation of lipids

Estimation of cholesterol by Zak's method

Estimation of nucleic acids

Estimation of DNA by diphenylamine method

Estimation of RNA by Orcinol method

Separation techniques

Separation of amino acids by paper chromatography (Ascending or Descending)

(Minimum 3 standard amino acids and 2 unknown amino acids should be given)

Thin layer chromatography to separate carbohydrates/amino acids /plant pigments.

Separation of bio-molecules by column chromatography

Separation of bio-molecules by PAGE

Clinical biochemistry/Enzymology

Estimation of the activity of SGOT and SGPT in the serum samples

Analysis of Spectrum data

U-V spectrum analysis

Interpretation of given XRD data

Interpretation of given NMR data

Microbiology

Hanging drop technique for demonstrating motility of bacteria, Preparation of culture media: for microorganisms, cultivation of bacteria. Sterilization techniques, Staining techniques: Gram staining- Acid fast staining- Spore staining-Metachromatic granule staining, Flagellarstaining,- Capsule staining and Fungal staining (LPCB). Antibiotic sensitivity tests, testing of disinfectants. Media – selective, differential and enriched. Bichememical tests.

Genetics and Cell biology

Reasoning and Problem solving, Protoplasm isolation

SYLLABUS

Second Semester

M. Sc. Applied Microbiology

MG010201	Microbial Genetics & Molecular biology
MG010202	Environmental & Agricultural Microbiology
MG010203	Virology
MG010204	Immunology
MG010205	Laboratory Course II

MG010201 – MICROBIAL GENETICS AND MOLECULARBIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. understand the scientific process, in the context of learning the fundamental biological and chemical ‘facts' of molecular biology.
2. gain skills required to effectively do scientific research.
3. explain the mechanisms of DNA replication and repair, RNA synthesis and processing, and protein synthesis.
4. describe how gene expression is regulated at the transcriptional and post-transcriptional level.
5. discuss the mechanisms of cell to cell signalling, including intracellular second-messenger pathways

MODULE - I Microbial Genetics & central dogma of Molecular biology

Gene expression and regulation: Operons and regulons, repression and activation of*Lac,* trp, and, arb operon. Feedback inhibition and regulation of virulence genes inpathogenic bacteria. Extra chromosomal elements, Signal transduction in microbes. A brief account of genetic recombination in bacteria (transformation, conjugation and transduction), DNA replication, transcription, post transcriptional modifications, translation, post translational modification,

MODULE- II Mutagenesis

Molecular basis of mutations, Types of gene mutations, suppression of mutations.

Radiation induced mutations, toxicity testing. Systems that safeguard DNA - DNA methylation and DNA repair mechanisms –Daughter – strand gap repair (in lesions) bypass synthesis, transcription coupled DNA repair, Direct reversal of DNA damage, excision repair, mismatch repair, error prone repair by homologous recombination, end joining repair, SOS repair

MODULE- III Transposable elements and Genetic recombination

Transposition: Structure of Transposons, types of transposons, mechanism of transposition, transposon mutagenesis. Genetic recombination; Holliday model, Meselson- Radding model

Genetic counselling

MODULE- IV Molecular techniques

Blotting: Principles, types of blotting, immunoblotting- Southern, Northern, Western and Dot blots. DNA amplification: PCR, RT- PCR. DNA sequencing: Various methods of DNA sequencing. Gene silencing: RNA interference (RNAi). Mapping of genome: Molecular markers as tools for mapping- Restriction Fragment Length Polymorphism (RFLP), randomly amplified polymorphic DNA (RAPD), simple sequence length polymorphism (SSCP), amplified fragment length polymorphism (AFLP). Functional genomics: entire genome expression analysis- microarrays, expressed sequence tags (ESTs), serial analysis of gene expression (SAGE), single nucleotide polymorphism (SNP).

MODULE- V Molecular biology of cancer

Benign and malignant tumors, metastasis- principle, and stages, types of cancer, properties of cancerous cells, stages in cancer development, functions of tumour suppressor gene products. Cancer-causing agents, proto oncogenes and oncogenes, apoptosis, anti-apoptotic proteins and DNA repair proteins, P53 as tumour suppressor genes, induced cell suicide, telomerase expression & immortalization of cells.

Reference Books

1. Microbial Genetics by Maloy ET. Al. 1994. Jones and Bartlett Publishers.
2. Molecular Genetics of Bacteria by J. W. Dale. 1994. John Wiley and Sons.
3. Modern Microbial Genetics. 1991 by Streips and Yasbin. Niley Ltd.
4. Moleculat Biology of the Gene 4th Edition by J.D. Watson, N.H. Hoppkins, J.W. Roberts, J.A. Steitz and A.M. Weiner. 1987, The Benjamin / Cummings Publications Co. California.
5. Gene VII by Lewin Oxford University Press. 2000.
6. Bacterial and Bacteriophage Genetics. 4 th Editions by Birge.
7. Microbial Genetics by Frefielder. 4th Edition.
8. DNA repair and mutagenesis. 1995 by Errol C. Friedberg, Graham C. Walker and Wolfram, Siede, ASM Publications.
9. Molecular Genetics of Bacteria, 1997 by Larry, Snyder and Wendy, Champness, ASM Publications.
10. Recombinant DNA by Watson, J.D.
11. Mobile DNA II by Nancy Craig, Martin Gellet Allan Lambowitz.

MG010202 – ENVIRONMENTAL & AGRICULTURAL MICROBIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. Demonstrate insight into quantitative assessments of microbial biodiversity, microbial biomass, growth and metabolic activity of microbes, and relevant environmental parameters in plant – microbe interactions
2. Demonstrate an insight to central methods in plant disease microbiology
3. Devise experimental strategies for analysing microbial populations, and their activity in environment.
4. Critically read, analyse, discuss and present topics from the original scientific literature (articles and reviews) in Agricultural and Environmental microbiology.
5. Know various culturing technique for microbes from agricultural field and other environmental niche.

Module – 1: Microbial Ecosystem

Introduction to-Aeromicrobiology: Microorganisms in outdoor atmosphericenvironment, nature of bio aerosols, their fate and transport. Microorganisms in aquatic environments, biogeochemical cycles-sulpor, nitrogen, Marine microbiology - general overview. Role of microorganisms for bio monitoring of various quality-parameters related to water Biosensors.

Module -2: Waste water treatment & Bioremediation of Xenobiotics

Various stages of wastewater treatment: Primary, secondary and tertiary treatment. Batch and continuous reactor-systems: Attached growth and suspended culture systems, stabilization ponds. Control of pathogens in water and wastewater, Use of microorganisms for removal of various toxins and metallic ions from wastewater,Microbiology of degradation of xenobiotics in the environment, oil pollution, surfactants and pesticides. Genetically Modified Organisms released and its environmental impact assessment and ethical issues.

Module -3: Bio fertilizer, Bio pesticides and other microbial products:

Mass cultivation of microbial inoculants; Rhizobium, PSM, BGA; algalization; *Azolla*. Microbial products and plant health: PGPR (plant growth promoting rhizobacteria); Mycorrhizae and its significance;Microbial herbicides;Biological control (NPV, CPV, GV, BT, Pseudomonas, Trichoderma, Nosemasps)Modern trends in microbial production-Microbial production of bioplastics (PHB,PHA), Useful features of bio-fuels, microorganisms in the process of biogas production (biomethanation). Production of bio-ethanol using microbial fermentation,**:** Use of microbes in environmental bioremediation

Module – 4: Soil microbiology &microbial interaction

Microorganisms in soil environments:- (Fungi, bacteria, and Actinomycetes), factors affecting soil flora, interaction among soil microbes, plant microbe interaction – rhizosphere effect, spermosphere effect, phyllosphere effect, Composting technology, production of silage

Module:-5 Plant pathology

Plant diseases and control: - Bacterial disease of plant- host pathogen interaction, Softrot, wilt, blights, viral pathogens of plant (any 8 diseases), and fungal pathogens of plant (any 8 diseases)Disseminating agents in plant disease.Strategies forcontrol of bacterial, fungal and viral plant diseases

References

1. *Industrial Microbiology by G. Reed (Ed), CBS Publishers (AVI Publishing Co.)*
2. *Biology of Industrial Microorganisms by A.L. Demain.*
3. *Genetics and Biotechnology of Industrial Microorgansims by C.l. Hershnergey, S.W. Queener and Q. Hegeman. Publisher. ASM. Ewesis ET. Al. 1998. Bioremediation Principles. Mac Graw Hill.*
4. *Annual Reports in Fermentation Processes by D. Pearlman, Academic Press.*
5. *Fundamentals of Biochemical Engineering by Bailey and Ollis.*
6. *Annual Review of Microbiology by Charles E. Cliffton (Volumes)*
7. *Biotechnology, A textbook of industrial Microbiology by Creuger and Creuger, Sinaeur associates.*
8. *Manual of industrial Microbiology and Biotechnology 2nd edition by Davis J.E. and Demain A.L. ASM publications.*
9. *Agricultural microbiology by Rangaswamay G*

MG010203 – VIROLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

- be able to describe elements of the viral life cycle, explain viral replication strategies and compare replication mechanisms used by viruses relevant for human disease.
- be able to explain host antiviral immune mechanisms, explain vaccine strategies and mechanisms of antiviral drugs.
- be able to describe viral strategies to evade host immune and cellular factors.
- be able to discuss principles of virus pathogenesis, describe methods used for laboratory diagnosis of viral infections.
- Can acquire knowledge about epidemiology and prophylaxis of viruses that are significant as human pathogens.

Module - I Classification and Cultivation of Viruses.

Cataloging virus through virus classification schemes of ICTV/ICNV. Baltimore system of virus classification. Morphology and Ultrastructure of viruses. Cultivation of viruses using embryonated eggs, experimental animals and cell cultures (cell-lines, cell strains and transgenic systems). Viral antigen detection using Serological methods(ELISA, Haemagglutination, Complement fixation, Immunofluorescence), Viral antigen detection using Microscopic techniques(electron microscopy).viral antigen detection using Molecular techniques(PCR, Western Blot),Physical and Chemical methods (Adsorption, Filtration, Precipitation) Infectivity assays for viruses (Quantitative assay- Plaque assay, Pock assay, Quantal assay- Endpoint dilution assay, Focus Forming Assay).

Module - II Viral multiplication and Control of viruses.

Animal virus replication (adsorption, penetration, uncoating, biosynthesis, maturation release). Abnormal replicative cycles. Control of viral infection (General prophylaxis, Immunoprophylaxis, Vaccines, Interferon, Chemoprophylaxis).Virus-host interactions (human).

Module - III Phages and Virus related agents.

T4 Phage (structure, life cycle- lytic cycle) Lambda Temperate Phage (structure, life cycle-lysogenic), Lysogenic repression. Prions- mechanism of Prion diseases (CJD, BSE, Mad cow, Slow viral infections), Viroids, Virusoids.

Module - IV Medical Virology.

Immunodeficiency virus-HIV (structure, antigens, AIDS-Pathogenesis, Lab diagnosis, Prophylaxis). General overview, mode of transmission, symptoms, lab diagnosis, prevention and control of:- Respiratory viral infections- RSV, Influenza virus, Para-influenza virus. Respiratory viral infections- Adenovirus, Rhinovirus, Corona virus (General overview, mode of transmission, symptoms, lab diagnosis, prevention and control). General overview, mode of transmission, symptoms, lab diagnosis, prevention and control of: - Viral enteric diseases-Adenovirus, Rotavirus, Astrovirus, Calicivirus (Norovirus). General overview, mode of transmission, symptoms, lab diagnosis, prevention and control of :- Viral Haemorrhagic fevers-4 RNA virus families; Arenaviridae (Lassa fever), Filoviridae(Ebola, Marburg). General overview, mode of transmission, symptoms, lab diagnosis, prevention and control of:-Viral Haemorrhagic fevers- Bunyaviridae (Rift valley fever), Flaviviridae (Yellow fever ,Dengue virus).

Module – V Medical Virology.

Oncoviruses, Properties of transformed cells. Hepatitis viruses- Hepatitis B. Other hepatitis viruses (general overview). Neuroencephalitis viruses- Rabies, Polio. General overview, mode of transmission, symptoms, lab diagnosis, prevention and controlof:-Encephalitis viruses- Japanese Encephalitis, HSV1 and2, EBV, VZV, CMV. General overview, mode of transmission, symptoms, lab diagnosis, prevention and control of: - Exanthematous viral diseases-Mumps, Measles, Rubella. General overview, mode of transmission, symptoms, lab diagnosis, prevention and control of: - Exanthematous viral diseases- VZV, Herpes Zoster, Parvovirus B19 (Erythema infectiosum), Adenovirus.

Reference Books

1. Medical Virology 10 Th Edition by Morag C and Tim bury M C 1994. Churchil
2. Virology 3 rd Edition by Conrat H.F., Kimball P.C. and Levy J.A. 1994. Prentice Hall, Englewood Cliff, New Jersey.

3. Text Book on Principles of Bacteriology, Virology and Immunology Topley and Wilsons 1995.
4. Applied Virology. 1984. Edited by EdonardKurstak. Academic Press Inc.
5. Introduction to Modern Virology by Dimmock.
6. Prion diseases by Gaschup, M.H.
7. Clinical virology Manual by Steven, S., Adinka, R.L., Young, S.A.
8. Principles of Virology. 2000 by Edward Arnold.

MG010204 – IMMUNOLOGY

Teaching Hours/week: 3 **Credits: 3**

Course Outcome:

By attending the course, the students will be able to:

1. Describe the basic mechanisms, distinctions and functional interplay of innate and adaptive immunity
2. Define the cellular/molecular pathways of humoral /cell-mediated adaptive responses
3. Define the basic mechanisms that regulate immune responses and maintain tolerance
4. Explain the cellular and molecular aspects of lymphocyte activation, homeostasis, differentiation, and memory.
5. Understand the molecular basis of complex, cellular processes involved in inflammation and immunity, in states of health and disease.

Module – I Immune System

Introduction to immunology, infections.Components of innate immune system. Organs and cells involved in immune system. Lymphocytes,their subpopulation, development and maturation, their properties and functions, membrane bound receptors.

Module – II Antigens and Immunoglobulins

Concept of haptens, determinants, conditions of antigenicity, antigens and immunogenecity, adjuvants (Freund's adjuvant) superantigen. Immunoglobulins: Structure and properties of immunoglobulin classes.hybridoma technology for monoclonal antibodies and designer monoclonal antibodies. Genetic basis of antibody diversity, Organization and expression of immunoglobulin genes, V(D)J rearrangements; somatic hypermutation and affinity maturation

Module – III Antigen – Antibody reactions

Antigen-Antibody reaction by precipitation, agglutination and complement fixation, ELISA, Immunofluorescence. Complement system: Classical, alternate, lectin pathway of complement activation.

Module – IV Expressions of Immune Response

Antigen processing and presentation, MHC restriction, generation of humoral and cell mediated immune response, maturation and activation of B and T lymphocytes, cytokines and their role in immune regulation,Immunological tolerance & regulation. Cell mediated cytotoxicity: Mechanism of T cells and NK cell mediated lysis, ADCC, and macrophage mediated cytotoxicity.

Module - V Immunity in Medical biology

Transplantation immunology: MHC, typing, types of grafts, grafts rejection, GVH reactions, mechanism of graft rejection, and prevention of graft rejection. Immuno deficiencies and autoimmunity. Hypersensitivity, Tumor immunology,immune hematology – ABO, Rh, and Duffy systems, transfusion reactions, Immune response against parasitic and viral infection.

Reference Books

1. Fundamental immunology, Paul w e (ed)
2. Principles of bacteriology, virology and immunity Vol I Topley and Wilson.
3. The Elements of Immunology, Fahim Halim Khan, PEARSON
4. Essential clinical immunology- Helen chappu and Manselhaeny
5. Introduction to immunology John w Kimball
6. Textbook of microbiology, Ananthanarayanan and Jayarampaicker.
7. Essential immunology Roitt
8. Basic and clinical immunology stiles, Stobo,Fuden berg wells (eds)
9. Microbiology and immunology David J Hantges

MG010205- LABORATORY COURSE II

Lab Hours/week: 10 **Credits: 4**

Course Outcome:

By attending the practical, the students will be able to:

1. Able to design and carry out experiments (safely) and to interpret experimental data
2. Acquire, discover, and apply the theories and principles of learned subjects in practical, real-world situations and problems.
3. Develop success skills in communication, critical thinking, interaction, information acquisition and interpretation, organization, professionalism, leadership, auto-didactics and life-long-learning.
4. Able to devise experiments with appropriate hypotheses and controls.

Molecular biology &Immunology

- Isolation, purification and estimation of DNA and RNA from eukaryotic and prokaryotic cells.
- Isolation of plasmids.
    - Mini preparation
    - Midi preparation
    - Maxi preparation
- RFLP, ligation, PCR, transformation, RAPD.
- Preparation and standardization of antigens, immune sera, serological tests for diagnosis of microbial infections- Widal test, VDRL, ELISA test.
- Studies on antibody-antigen reaction: agglutination and precipitation test.
- Water quality analysis- chemical and microbial analysis

    BOD,
    COD,
    Dissolved oxygen
    Ions estimation, (Cl^-, Ca^{2+}, etc)

- Lethal effect of temperature on microorganisms (TDP, TDT)
- Isolation of PSM, Rhizobium, and Bejerinkia from soil
- Mini production of Pseudomonas bio- pesticides/ bio fertilizer.

- Enumeration of soil microorganism and calculation of rhizhosphere to non-rhizhosphere ratio
- Field study and preparation of herbarium of any ten plant disease with specimens

SYLLABUS

Third Semester

M. Sc. Applied Microbiology

MG010301	Medical Microbiology
MG010302	Industrial Microbiology
MG010303	Food Microbiology
MG010304	Recombinant DNA Technology
MG010305	Laboratory Course III

MG010301 – MEDICAL MICROBIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. identify common infectious agents and the diseases that they cause.
2. explain general and specific mechanisms by which an infectious agent causes disease.
3. describe the epidemiology of infectious agents including how infectious diseases are transmitted.
4. explain interventions employed to prevent infectious diseases including infection control measure and vaccines
5. have comprehensive knowledge and understanding of medically significant microorganisms and its diagnosis and treatment

Module-I Systematic Bacteriology

General overview, mode of transmission, pathogenesis, clinical manifestations, lab diagnosis, prevention and control of:- Gram positive cocci – Staphylococcus and Streptococcus, General overview, mode of transmission, pathogenesis, clinical manifestations, lab diagnosis, prevention and control of:- Gram negative cocci - meningitis, gonorrhea; General overview, mode of transmission, pathogenesis, clinical manifestations, lab diagnosis, prevention and control of:- Mycobacteriacace - tuberculosis, leprosy,

Module - II

General overview, mode of transmission, pathogenesis, clinical manifestations, lab diagnosis, prevention and control of: - toxigenic bacteria- Diphtheria, Clostridium, Bacillus, Vibrio, General overview, mode of transmission, clinical manifestations, and lab diagnosis of- Coxiella, Rikettsia, Haemophilus, Treponema, Propionibacterium

General overview, mode of transmission, pathogenesis, clinical manifestations, lab diagnosis, prevention and control of:- Gram negative bacteria of family Enterobacteriaceae -Salmonella, bacillary dysentery, E.coli UTI, General overview, mode of transmission, pathogenesis, clinical manifestations, and lab diagnoses of - Helicobactor, Klebsiella, Proteus; sexually

transmitted diseases (spirochaetes); Diseases caused by mycoplasma, Chlamydia, Bordetella, Legionella Diseases caused by Pseudomonas .

Module - III Overview of medical mycology

General overview, pathogenesis, clinical manifestations, lab diagnosis, prevention and control of superficial mycosis;General overview, mode of transmission, pathogenesis, clinical manifestations, lab diagnosis, prevention and control of subcutaneous, systemic mycosis; opportunistic mycosis

Module – IV Zoonotic bacteria

General overview, mode of transmission, pathogenesis, clinical manifestations, lab diagnosis, prevention and control of: - Brucella, Erysipelothrix, **L**isteria, **Y**ersinia

Module – V Overview of medical parasitology:

General overview, mode of transmission, pathogenesis, clinical manifestations, lab diagnosis, prevention and control of: - Important protozoal diseases: Malaria, Leishmaniasis, Amoebiasis, trypanosome. Toxoplasma,Trichomonas

Reference Books

1. BERGEY'S MANUEL of systemic bacteriology vol I-IV by Kreig n r (ed)
2. Principles of bacteriology, virology and immunology Topley and Wilson
3. Zinsser microbiology
4. Textbook of microbiology by Ananthanarayanan and Panicker.
5. Medical microbiology, Mackie and McCartney
6. Review of medical microbiology, Jawetzz, Melnik and Adelberg
7. Principles of bacteriology virology and immunity Vol I by Wilson
8. Medical mycology a practical approach by Evads and Richardson
9. Parasitology k d Chatterjee

MG010302 – INDUSTRIAL MICROBIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. describe the main steps and processes used to produce biological products in industry
2. discover new useful microorganisms and store them reliably for later use
3. explain the microorganism used industry.
4. explain the production of industrial products from microorganisms with fermentation.

Module - I Isolation, Selection and Strain improvement:

Screening and isolation of microorganisms, primary and secondary metabolites, enrichment, specific screening for the desired product. Mutation and screening of improved cultures, protoplast fusion techniques for strain improvement of primary and secondary metabolites, improvement of characters other than products and its application in the industry. Importance of media in fermentation, media formulation and modification. Kinetics of growth in batch culture, continuous culture with respect to substrate utilization, specific growth rate, steady state in chemostat, fed- batch fermentation, yield of biomass, product, calculation of productivity, substrate utilization kinetics.

Module – II Bioreactors

Bioreactors configuration, design features, individual parts, baffles, impellers, foam separators, sparger, culture vessel,cooling and heating devices, probes for online monitoring, measurement and control of fermentation process.Reactors for specialized applications**:** Tube reactors, packed bed reactors, fluidized bed reactors, cyclone reactors. Mass transfer in reactors: Transport phenomena in fermentation, Gas liquid exchanged and mass transfer. Techniques oxygen transfer, critical oxygen concentration, determination of KLa, basic concepts of heat transfer,aeration/agitation and its importance.Sterilization of Bioreactors, nutrients, air supply, products and effluents, process variables and control. Scaling up of process from shake flask to industrial fermentation.

Module-III Downstream processing

Biomass separation by centrifugation, filtration, flocculation and other recent developments. Cell disintegration: Physical, chemical and enzymatic methods. Extraction: Solvent, two phases, liquid extraction, whole broth, aqueous multiphase extraction. Batch extraction, Staged extraction, Differential extraction, Fractional extraction. Adsorption: Batch adsorption, continues stirred tank adsorption and fixed bed adsorption. Purification by different methods: Concentration by precipitation. Ultra filtration, reverse osmosis. Drying and crystallization, Product purification and Elution, Precipitation with non- solvent, Salt precipitation, Temperature precipitation. Crystallization and Drying: Basic concepts of crystallization, Nucleation crystal growth crystal distribution, Recrystallization, Basic concepts of drying: - Conduction Adiabatic Spray drying methods. Principles of validation: Preparation of SOPs, validation protocols for methods in quality control and process validation.

Module- IV Animal cell culture

Laboratory facilities for tissue culture, different substrate for the cell growth media for mammalian cell culture, impact of serum in culture media, primary culture, and application of animal cell culture. Introduction to concepts in cell biology (renewal potency), definition of terms (adult stem cell, embryonic stem cell, germ line stem cell), cell differentiation (muscles & bone stem cell, hematopoietic stem cell) Stem cells & therapeutics.

Module –V Microbial Products

Industrial production of antibiotics – streptomycin, penicillin, cephalosporin and tetracycline, organic acids – citric acid, lactic acid, amino acids – L- lysine, enzymes – amylases, proteases and lactases, stabilization of enzymes, vaccines – rabies, FMD vaccines, hepatitis B , alcohol- ethanol and butanol. Microbial leaching- Organisms of leaching, chemistry of microbial leaching

References

1. *Principles of Fermentation Technology by Stanbury, P.F., Whitaker A. and Hall. 1995. Butterworth Heinemann*
2. *Biochemical Reactors by Atkinson B., Pion, Ltd. London.*
3. *Biotechnology - A Text Book of Industrial Microbiology by Cruger.*
4. *Biochemical Engineering Fundamentals by Bailey and Ollis, Tata McGraw Hill, N.Y.*
5. *Biotechnology. Volume 3. Edited by H. J. Rehm and G. Reed. VerlagChemie. 1983.*
6. *Biotechnology- A textbook of Industrial Microbiology by Creuger and Creuger, Sinaeur*

Associates.

Industrial Microbiology by L.E. Casida, Wiley Eastern

MG010303– FOOD MICROBIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. identify the important pathogens and spoilage microorganisms in foods and the conditions under which they will grow
2. identify the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods
3. explain the significance and activities of microorganisms in Dairy and dairy products.
4. explain why microbiological quality control programmes are necessary in food production.
5. commit to the highest standards of professional integrity and ethical values

Module – I General Principles of food microbiology

Factors affecting microbial growth in food - intrinsic factors – hydrogen ion concentration – moisture or water activity – oxidation- reduction potential – nutrient content – inhibitory substances and biological structure – combined effect of various factors - Extrinsic factors: Temperature of storage – Relative humidity – Concentration of gases, - Application of microbial enzymes in food industry, probiotics and single cell protein; Starter cultures and their biochemical activities, production and preservation of the following fermented foods:-

a. Soy sauce fermentation by Moulds

b. Fermented vegetables – Sauerkraut

c. Fermented Meat – Sausages

d. Production and application of Baker's Yeast

Module – II Microbiology of cheese and beverage fermentation.

Microbiology of fermented milk products (acidophilus milk, yoghurt, cheese). Role of microorganisms in beverages – bread, tea, and coffee fermentations.Vinegar

Fermentation, microbiology of wine industry.

Module – IIIMicrobial Contamination, Spoilage and Preservation of Foods

Preservations- Radiations -UV, Gamma and microwave, - Temperature, Chemical and naturally occurring antimicrobials. Microbial Food spoilage, Contamination and Spoilage of Canned foods

Module – IV Quality assurances in foods

Food borne infections and intoxications; bacterial with examples of infective and toxic types –, Clostridium, Salmonella, Shigella, Staphylococcus, Campylobacter, Listeria. Mycotoxins in food with reference to Aspergillus species. Quality assurance: Microbiological quality standards of food. methods for microbiological examination of foods, rapid methods for the detection of specific organisms, Government regulatory practices and policies. FDA, EPA, HACCP, ISI, ISO.

Module – V Advanced Food Microbiology

Genetically modified foods. Biosensors in food, Applications of microbial enzymes in dairy industry [Protease, Lipases]. Utilization and disposal of dairy by-product - whey.

Reference Books

1. Food Microbiology. 2nd Edition by Adams
2. Basic Food Microbiology by Banwart George J.
3. Food Microbiology: Fundamentals and Frontiers by Dolle
4. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2 by Joshi.
5. Fundamentals of Dairy Microbiology by Prajapati.
6. Essentials of Food Microbiology. Edited by John Garbult. Arnold International Students Edition

MG010304 – RECOMBINANT DNA TECHNOLOGY

Teaching Hours/week: 3 **Credits: 3**

Course Outcome:

By attending the course, the students will:

1. have technical know- how on versatile techniques in recombinant DNA technology.
2. be an understanding on application of genetic engineering techniques in basic and applied experimental biology
3. be show proficiency in designing and conducting experiments involving genetic manipulation
4. be able to demonstrate the basic techniques involved in recombinant DNA manipulations including DNA restriction, ligation, transformation and selection of recombinant plasmid.
5. be able to explain the principles and application of PCR, and other sophisticated machineries.

Module – I Enzymes in genetic recombination

Core techniques and essential enzymes used in recombination; restriction endonucleases, type I, II, III, recognition sequences, properties, classification of type II endonucleases, their activity. DNA ligase: Properties and specificity, S1 nuclease, BAL 31 nuclease, DNA polymerase, polynucleotide kinase, phosphatase, **R**everse transcriptase its activity and mode of action.

Module – II Plasmids

Properties, incompatibility, isolation and purification techniques of plasmid vectors, copy number,**pBR322**– its construction and derivatives, single stranded plasmids, promoter probe-vectors, runaway plasmid vectors. Bacteriophage lambda (l) as a vector: Essential features, organization of genome, general structure, rationale for vector construction cosmids, phasmids, filamentous phage vectors, l zap, l blue print vectors, shuttle vectors. Expression vectors, promoter probe vectors, vectors for library construction.

Module - III Specialized cloning strategies

Genomic DNA libraries, chromosome walking and jumping, cDNA libraries, short gun

cloning, directed cloning, phage display. Recombinant DNA technology with reference to cloning and production of interferon and insulin. Fusion proteins, Miscellaneous applications of genetically engineered micro organisms (GEMS) / genetically modified organisms (GMO's). Chemical synthesis of DNA. Restriction digestion, ligation and transformation (α-complimentation). Cloning techniques and methods of gene transfer, screening of recombinant DNA by colony hybridisation, electrophoretic mobility shift assay(EMSA).

Module – IV Molecular mapping of genome

Genetic and physical maps, physical mapping and map –based cloning, choice of mapping population, simple sequence repeat loci, southern and fluorescence in situ hybridization for genome analysis, Chromosome micro dissection and microcloning, Germplasm maintenance.

Module - V Application of Genetic engineering

Applications of genetic engineering in industrial & healthcare, Gene therapy for inherited disorders and neoplastic disorders, human cloning and bioethics, therapeutic cloning, bone marrow transplantation. Terminator gene therapy, Knock out and knock down. Applications in Agriculture

Reference Books

1. Glick BR, Pasternak JJ. (2003). Molecular Biotechnology. ASM Press Washington D.C.
2. Old and Primrose (2001). Principles of Gene Manipulation. Blackwell Scientific Publication.
3. Brown TA (2006). Gene Cloning. Blackwell Publishing.
4. Sambrook, Fritsch and Miniatis (2006). Molecular cloning- A laboratory manual. Cold Spring Harber Laboratory Press.
5. Nicholl DST (2008). An Introduction to Genetic Engineering, Cambridge University Press.
6. Principles of Gene Manipulations 1994 by Old and Primrose Blackwell Scientific Publications.
7. DNA Cloning: A Practical Approach by D.M. Glower and B.D. Hames, IRL Press, Oxford. 1995.
8. Molecular Biotechnology 2nd Edition by S.B. Primrose. Blackwell Scientific Publishers, Oxford. 1994.
9. Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes by S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford 1998.
10. Biotechnology: A Guide to Genetic Engineering by Peters.
11. Genetic Engineering – 2000 by Nicholl.
12. Molecular Biotechnology: Principles and Applications of Recombinant DNA. 2 nd Edition.

1998 by Bernard R. Glick and Jack J. Pastemak, ASM Publications.

MG010305– LABORATORY COURSE III

Teaching Hours/week: 10 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. design and carry out experiments (safely) and to interpret experimental data
2. Acquire, discover, and apply the theories and principles of learned subjects in practical, real-world situations and problems.
3. Develop success skills in communication, critical thinking, interaction, information acquisition and interpretation, organization, professionalism, leadership, auto-didactics and life-long-learning.
4. devise experiments with appropriate hypotheses and controls.

Bioprocess Engineering, and r- DNA Technology

- Crowded plate technique for isolation of antibiotic producing organisms.
- Antibiotic production &Assay techniques.
- Isolation of amylase producing organism from appropriate samples and qualitative estimation of the enzyme after pilot fermentation.
- Fermentation- submerged and solid state and production of industrial applicable products.
- Mushroom cultivation.
- Production of ethyl alcohol and wine, production of organic acids- citric acid and lactic acid, Immobilization of cells and enzymes.
- Transformation –α complimentation
- Immobilization of yeast and detection of its enzymatic activity.

Food Microbiology and Medical Microbiology

- Microbiological examination of food, milk, vegetables, meat, fish, etc.
- Methylene Blue Reductase test,Resazurin Dye reduction test, methods used for spoilage analysis, counting of yeast and molds, culturing of canned products, sterility tests for canned foods.
- yoghurt preparation and lactic acid estimation
- Mixed culture Analysis
- Collection of materials for the study of pathogenic fungi, Culture methods for pathogenic fungi, Identification of pathogenic fungi.
- Microscopic examination of peripheral blood smears for malarial parasites.
- Industrial visit and report preparation.

***FDA and FSSAI protocols recommended for the food microbiology Practical.**

SYLLABUS

Fourth Semester

MG800401	Pharmaceutical Microbiology	Elective -1

M. Sc. Applied Microbiology

MG810401	Ecology & Developmental Biology	
MG820401	Microbial Metabolites	
MG800402	Computational biology &Research Methodology	Elective -2
MG810402	Physiology	
MG820402	Plant-Microbe Interactions	
MG800403	Clinical Microbiology	Elective -3
MG810403	Nanotechnology & Space Microbiology	
MG820403	Marine Microbiology	
MG020401	Laboratory Course IV	Core course

MG800401– PHARMACEUTICAL MICROBIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. describe microorganisms and microbial cell biology of relevance to healthcare and the pharmaceutical industry.
2. explain the action of both therapeutic and non-therapeutic antimicrobial agents and the role of the immune system in host defence.
3. discuss microbial contamination and spoilage of pharmaceutical formulations during production and in products.
4. demonstrate a knowledge and understanding of the practical aspects of pharmaceutical microbiology.
5. perform practical procedures to demonstrate competence of aseptic manipulation used in pharmaceutical microbiology.

Module – I Antibiotics and their Mechanism of action

Antibiotics and synthetic antimicrobial agents. Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis). Bacterial resistance to antibiotics,drug targeting. Mode of action of bacterial killing by quinolinones. Bacterial resistance to quionolinones. Mode of action of non – antibiotic antimicrobial agents. Discovery and preclinical development of new antibiotics.

Module – II Microbial production and Spoilage of pharmaceutical Products

Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, non injectibles, ophthalmic preparations and implants) sterilization of pharmaceuticals. Pharmaceutical preservatives. New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines. Vaccine clinical trials.

Module - III Regulatory practices, biosensors and applications in Pharmaceuticals

Methods for standardization of antibiotics, vitamins and amino acids. Government regulatory practices and policies, IP, BP, USP, FDA perspective.Rational drug design: - Principle (Structure activity relationship -SAR). Immobilization procedures for pharmaceutical applications (liposomes).Macromolecular, cellular and synthetic drug carriers.Biosensors in pharmaceuticals.

Module – IV Quality Assurance and Validation

Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry. Regulatory aspects of quality control. Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification.

Module – V Sterilization of pharmaceuticals

Sterilization control and sterility testing (heat sterilization, D value, z value, survival curve,Radiation, gaseous and filter sterilization) Chemical and biological indicators. Safety in microbiology laboratory. (Designing of Microbiology laboratory)Estimation of toxicity: LD50 and ED50. Microbial Limit Tests for Non-sterile pharmaceuticals.

Reference books

1. Pharmaceutical Microbiology – Edt. by W.B.Hugo&A.D.Russell Sixth edition. Blackwell scientific Publications.

2. Analytical Microbiology –Edt by Frederick Kavanagh Volume I & II. Academic Press New York.
3. Quinolinone antimicrobial agents – Edt. by David C. Hooper, John S.Wolfson .ASM Washington DC.
4. Quality control in the Pharmaceutical Industry - Edt. by Murray S.Cooper Vol.2. Academic Press New York.
5. Biotechnology – Edt. by H.J.Rehm&G.Reed, Vol 4. VCH Publications, Federal Republic of Germany.
6. Pharmaceutical Biotechnology by S.P.Vyas&V.K.Dixit. CBS Publishers & Distributors, New Delhi.
7. Good Manufacturing Practices for Pharmaceuticals Second Edition, by Sydney H.Willig, Murray M.Tuckerman, William S.Hitchings IV. Mercel Dekker N.York.
8. Advances in Applied Biotechnology Series Vol 10, Biopharmaceuticals in transition. Industrial Biotechnology Association by Paine Webber. Gulf Publishing Company Houston.

MG810401– ECOLOGY AND DEVELOPMENTAL BIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. list the types of characteristics that make an organism ideal for the study of developmental biology.
2. be familiar with the events that lead up to and comprise the process of fertilization.
3. describe the stages and cellular.
4. describe in general terms how vertebrates gastrulate.
5. know the difference between autonomous versus conditional modes of specification.

Module - I

Fertilization and early development in animals: Cleavage, gastrulation, cell specification; axis and pattern formation with examples from C. elegans, Drosophila, amphibians, chick and mammals.Limb development and regeneration in vertebrates

Module - II

Model organisms:Dictyostelium, Caenorhabditiselegans, Drosophila, Zebrafish, Arabidopsis Rice.

Module - III

Ectoderm-eye development, epidermis, neural crest, tooth development and axon guidance. Mesoderm- somites, Development of muscle, bone,kidney, heart and vessels,formation of limbs

Module - IV

Ecological Context of Evolution& Adaptation, Population Ecology & Demography, Competition Theory,

Module- V

Ecology of Predation, Grazing & Disease, Ecology of Mutualisms & Parasitism, Community: Diversity/Stability

Reference Books

1. Scott F. Gilbert, Developmental Biology, Seventh Edition,2003,Sinauer Associates, Inc., Sunderland, MA,ISBN 0-87893-258-5
2. John Gerhart and Marc Kirschner, Cells, Embryos, and Evolution,1997,Blackwell Science, ISBN 0-86542-574-4,
3. Fred H. Wilt & Sarah C. Hake, Principles of developmental Biology, 2004, W.W. Norton & Company, Inc., New York, NY, ISBN 0-393-97430-8
4. Lewis Wolpert, Rosa Beddington, Thomas Jessell, Peter Lawrence, Elliot Meyerowitz, Jim Smith, Principles of Development, Second Edition,2002,Oxford University Press, ISBN 0-19-924939-3
5. Fundamentals of Ecology by Eugene Odum and Gary W. Barrett(Jul 27, 2004)
6. Ecology: Theories and applications, Peter D. Stiling Edition2, illustrated Publisher Prentice Hall, 1996 Original from the University of California Digitized

7. Animal Behavior; An Evolutionary approach, John Alcock, Ninth edition, Sinauer Associates Inc. Sunderland, Massachusetts

8. Animal Behavior, mechanism, Development, Function and Evolution, Christopher J Bernard, Pearson Education, 2004.

MG820401 – MICROBIAL METABOLITES

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. Productively translate both basic and frontiers research concepts relating to protein production and purification into a modern industrial bioprocess perspective.
2. Describe and analyse the control of in vitro cellular growth processes within the industrial-scale bioreactor environment,
3. Demonstrate a technical lexicon that will allow productive interface with complementary disciplines.
4. Discuss and evaluate the operational considerations and relative advantages relating to the choice of techniques used in downstream processing of biotechnology products.

Module - I Introduction

Growth kinetics of microorganisms: Microbial products as primary and secondary metabolites; trophophase- Idiophase relationships in production of secondary metabolite; Role of secondary metabolites in physiology of organisms producing them; Pathways for the synthesis of primary and secondary metabolites of commercial importance; Metabolic control mechanisms: substrate induction; catabolic regulation; feedback regulation;amino acid regulation of RNA synthesis; Energy charge regulation and permeability control; Bypassing/ disorganization of regulatory mechanisms for over production of primary and secondary metabolites.

Module –II Microbial Production Organic Acids and Amino Acids and Enzymes

Organic feedstock: ethanol; Acetone; Ethanol Organic acids: Production of Citric acid; Acetic acid; Lactic acid; Gluconic acid; Kojic acid; itaconic acid; Amino acids: Use of amino acids in industry; methods of production; Production of individual amino acids (L-Glutamic acid; L Lysin; L-Tryptophan).

Module III

Enzymes: commercial applications; production of Amylases; Glucose Isomerase; L Asparaginase, Proteases Renin; Penicillin acylases; Lactases; Pectinases; Lipases; Structure and biosynthesis of Nucleosides, Nucleotides and related compounds.

Module –IV Microbial Production of Vitamins and Antibiotics

Vitamins-Vitamin B12; Riboflavin; B carotene; Antibiotics: beta-Lactam antibiotics; amino acid and peptide antibiotics; Carbohydrate antibiotics; Tetracycline and antracyclines; Nucleoside antibiotics; Aromatic antibiotics; Bio plastics (PHB; PHA); biotransformation of steroids.

Module –VMicrobialBiotransformations

Types of bioconversion reactions; procedures for biotransformation; Applications of bioconversions; biotransformation of steroids, sterols, non-steroid compounds, antibiotics pesticides.

Reference Books

1. WulfCruger and AnnelieseCruger., Biotechnoloogy, (A text book of industrial Microbiology),Panima Publishers, New Delhi, 2ndedition, .
2. Casida, J.R., L.E., Industrial Microbiology, Willey Eastern Ltd, New Delhi, 1stEdition.
3. .Prescott and Dunn, Industrial Microbiology, CBS Publishers, New Delhi, 4th Edition.
4. Stanbury, P.F., and Whitaker, A., Principles of Fermentation Technology, 2nd Edition,Pergamon Press, Oxford.
5. NdukaOkafar., Modern Industrial Microbiology and Biotechnology, 1stEdition., 2001

MG800402 – COMPUTATIONAL BIOLOGY AND RESEARCH METHODOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. be able to demonstrate the knowledge and awareness of the world-renowned biotechnology information repositories, such as NCBI, PDB etc..
2. be able to the proficient use of search algorithms for genes, proteins, and compounds and biologics from these repositories ,existing software effectively to extract information from large databases and to use this information in computer modelling.

3. be able to demonstrate the ability to choose methods appropriate to research aims and objectives, and understand the limitations of particular research methods
4. be able to develop skills in qualitative and quantitative data analysis and presentation
5. be able to communicate the results of statistical analyses accurately and effectively

Module -IBioinformatics and its applications

Bioinformatics overview, Public biological databases-Nucleic acid and protein sequence databases, structure classification databases, specialised database –KEGG, COG Cluster, OMIM ESTS, search engines and servers-ExPasy.Genomics &Proteomics - structural, functional, and comparative genomics, comparative proteomics and its applications, genomics in medicine, drug discovery and genomics, genome technology,IPR &bioinformatics patents, microarray, protein and DNA microarray, advantages and dis advantages of DNA and protein microarray

Module - IISequence analysis and structural biology

Local and global alignments, scoring matrices, methods and models for sequence analysis, Heuristic methods-BLAST, FASTA, Multiple sequence analysis-Clustal-w, phylogenetic analysis, Molecular visualisation tools& software- Rasmol, SwissPdb , data mining tools.

Module-III Computational methods in structure prediction

DNA Structure prediction- Genscan, ORF. Protein primary structure prediction-Protparam,Peptide cutter, secondary protein structure prediction-GOR , Chou fasman,NN predict, tertiary structure prediction-Homology modelling, Abinitio, threading, structure based drug design, molecular docking, mechanisms in molecular docking, applications in docking, de novo ligand design, personalised drug design, virtual screening, active site analysis tools, high throughput sequencing and assembly.

Module – IV Biostatistics

Introduction to - mean, median, mode and standard deviation. Types of data- primary, and secondary.Sampling- Representative sample, sample size, sampling bias and sampling techniques. Correlation and regression: Positive and negative correlation and calculation of Karl-Pearsons co-efficient of correlation. Linear regression and regression equation and concept of multiple regression, one and two way classification. **Probability-** Events, classical & frequency definitions, Standard probability distributions –Binomial, Poisson and Normal

properties. Tests of hypothesis- Type 1 and Type 2 errors significance level, Tests for mean of a normal population equality of variances, tests for significance of a correlation coefficient. Non parametric tests –Chi square test for goodness of fit and independence of attributes, t-test, ANNOVA, F test, and z test. Statistical software SPSS,SAS,STATA, and R for computation of mean, variance correlation, t tests, F tests etc.

Module – VResearch Methodology

Research Design: Concept and Importance in Research – Features of a good research design – Exploratory Research Design – concept, types and uses, Descriptive Research Designs – concept, types and uses. Experimental Design: Concept of Independent & Dependent variables. Interpretation of Data and Paper Writing – Layout of a Research Paper, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism.Use of tools / techniques for Research: methods to search required information effectively, Reference Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism

References

1. *PAUSE V G and Sukhame P V (1967) statistical methods for agricultural workers.*
2. *Arora P N, Malhan P K (1996) Biostatistics Himalaya publishing house.*
3. *Gupta S C and Kapoor V K (2002) fundamentals of mathematical statistics Sultan Chand and sons*
4. *Nigam A K , V K Gupta (1979) handbook on analysis of agricultural experiments I A S R I New Delhi*
5. *E Balaguruswamy (1992) basic programming Tata Mc Graw hill*
6. *Paul rkinnear and coll in d gray (1997) SPSS for windows made simple.*
7. *Ron cody and ray pass (1995) SAS programmigm by example SAS institute, u s*
8. Research Methodology – C.R.Kothari

MG810402 – PHYSIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. demonstrate a fundamental knowledge of comparative vertebrate animal physiology and anatomy.
2. use physiological and anatomical knowledge to enhance their personal lives.
3. explain the properties of circulatory and respiratory systems

4. Use anatomical knowledge to predict physiological consequences, and use knowledge of function to predict the features of anatomical structures.
5. Synthesize ideas to make a connection between knowledge of anatomy and physiology and real-world situations, including healthy lifestyle decisions and homeostatic imbalances.

Module – I BasicCell Physiology and respiratory system

Cell Structure and membrane transport, Resting Membrane Potential, Composition of ECF and ICF, Goldman Equation.

Respiration: Functional anatomy of the respiratory system, Mechanism of breathing, Dead space, Transport of oxygen and carbon dioxide,Regulation of Respiration, Cyanosis, Hypoxia, Oxygen toxicity

Module - IICirculatory and excretory system.

Blood: Function and Composition, Erythrocytes, Haemoglobin, Leucocytes,thrombocytesCardiovascular SystemCardiac Muscle, Physiological anatomy of heart and conduction system, Cardiac Action Potential, Excretory System: Function of kidney, Structure of nephron, Juxta glomerular apparatus, Formation of urine- Counter current mechanism, Acidification of urine & role of kidney in maintenance of acid base balance, Renal function tests, Micturition.

Module - IIINervous System

Neuron (structure, function and classification), Action Potential, Neuromuscular junction, Organization of the ANS, Chemo-transmitters, (a) General organization of CNS & PNS, Sensory system :(General sensations, receptors, sensory pathways, sensory areas of brain)(b) Motor system: (muscle spindle, Golgi tendon organ, reflex arc, corticospinal and extra-pyramidal tracts)

Module - IV sensory organs

Special SensesEye (functional anatomy, mechanism of vision), Ear (structure of internal ear, mechanism of hearing), Taste (distribution and structure of taste buds and taste papillae), Smell (olfactory epithelium and pathway)

Module – V Endocrine& Reproductive System

Mechanism of action of hormones, Functions of the following glands: Pituitary, thyroid, parathyroid, adrenal (cortex and medulla), pancreas**.** General organization of male and female reproductive systems, Male: Spermatogenesis and actions of male sex hormones, Female: Sexual cycles and actions of female sex hormones, pregnancy, parturition and lactation, Family planning.

Reference books

1. Textbook of Medical Physiology. Arthur C.Guyton and John E.Hall
2. Essentials of Medical Physiology. K.Sembulingam and PremaSembulingam
3. Endocrinology. Mac E. Hadley.
4. Molecular Endocrinology. FraklynF.Bolander

MG820402– PLANT-MICROBE INTERACTIONS

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. Demonstrate insight into quantitative assessments of microbial biodiversity, microbial biomass, growth and metabolic activity of microbes, and relevant environmental parameters in plant – microbe interactions
2. Demonstrate an insight to central methods in plant disease microbiology
3. Devise experimental strategies for analysing microbial populations, and their activity in plant ecosystems.
4. Critically read, analyse, discuss and present topics from the original scientific literature (articles and reviews) in plant pathology.
5. Know various culturing technique for microbes from plant eco system

Module –I - Plant–Bacteria Interactions

Phytopathogens and overview of bacterial pathogenesis, Agrobacterium crown gall disease, exploitation of tumorigenesis, bacterial secretion systems, gene regulation and quorum sensing, beneficial bacteria, Rhizobium and host interactions, nodulation and nitrogen fixation.

Module :-II Plant – Virus interactions

Plant–Virus Interactions- Interactions with viruses and reasons for susceptibility and requirements for virus resistance. RNA viruses: Tobacco mosaic virus and tobacco rattle virus, DNA viruses-Cauliflower mosaic virus, **v**irus replication and movement, Plant virus vectors for gene silencing.

Module –III Plant–Fungal Interactions

Infection Processes-fungi and toxins, fungal elicitors/AVR proteins, Plant disease resistance genes and Genetic engineering for resistance, Induced resistance: Secondary product responses, Genetic control of host perception and fungal virulenceInfection processes. Interactions with host plants and other soil microbes. control of fungal infections.

Module –IV- Plant–Nematode Interactions

Nematode typeslife cycle, infection on economically important crop plants and its effects. Resistance and control against nematodes.

Module –V-Biochemistry and Molecular Biology of Resistance

Introduction and the biochemistry of the hypersensitive response,Induced resistance. Protein defence responses and systemic responses. Recognition events in induced resistance

Reference Books

1. Susan Isaac, Fungal-Plant Interactions, Chapman Hall, 19922.
2. George Agrios, Plant Pathology, Academic Press, 2005-Fifth Edition.
3. Plant-microbe interactions. Edited by Kamal Bouarab, Normand Brisson and Fouad Daayf. 2009

MG800403 – CLINICAL MICROBIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. Apply principles of safety, quality assurance and quality control in Clinical Microbiology
2. Evaluate specimen acceptability.
3. Perform and interpret antimicrobial susceptibility testing.
4. Select additional procedures based on preliminary results
5. Correlate test results with patient condition(s)

Module -I Microbiology Laboratory Safety& the Laboratory Role in Infection Control

General Safety Principles, Handling of Biologic Hazards, Disposal of Infectious waste, Chemical Safety, General concepts in infection control practice, Outbreak investigation, education, emerging and re-emerging pathogens; General guidelines for establishing quality control, performance improvement, **A**nalytical analysis of tests, clinical analysis of test, operational analysis of test, choosing a laboratory method, test validation.

Module -II Host-Parasite Interaction

Indigenous Microbial Flora- skin, mouth, Indigenous Microbial Flora - respiratory tract, gastrointestinal tract, genitourinary tract,Opportunistic pathogens, Pathogens, Virulence, Host Resistance Factors, Infectious Agent Factors, Routes of Transmission

Module -III Specimen collection and Processing

Basic principle of specimen collection, specimen receipt and processing, culture works up, Non routine specimens, Collection and processing of blood, and urine, Collection and processing of faeces, Collection and processing of sputum.

Module - IVMicroscopic examination of infected material & Antimicrobial Susceptibility Testing

Preparation of samples, examination of prepared sample, grading or classifying materials, quality control in direct microscopic examination, MIC, MBC, time - kill assay, measurement of antibiotic concentration in body fluids, automated antimicrobial susceptibility test, methods for detecting antimicrobial inactivating enzyme, quality control of antimicrobial susceptibility test,

Module - V Nosocomial infection

Nosocmial infections - Common nosocomial infections, source of nosocomial infection, **C**ontrol of nosocomial infection, hospitalhygiene

Reference Books

1. BERGEY'S MANUEL of systemic bacteriology vol I-IV by Kreig n r (ed)

2. Principles of bacteriology, virology and immunology Topley and Wilson
3. Zinsser microbiology
4. Textbook of microbiology by Ananthanarayanan and Panicker.
5. Medical microbiology, Mackie and McCartney
6. Review of medical microbiology, Jawetzz, Melnik and Adelberg
7. Principles of bacteriology virology and immunity Vol I by Wilson
8. Medical mycology a practical approach by Evads and Richardson
9. Parasitology k d Chatterjee
10. Diagonostic Microbiology, Mahon

MG810403 – NANOTECHNOLOGY AND SPACE MICROBIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. Describe the basic science behind the properties of materials at the nanometre scale, and the principles behind advanced experimental and computational techniques for studying nanomaterials.
2. Communicate clearly, precisely and effectively using conventional scientific language and mathematical notation.
3. Systematically solve scientific problems related specifically to nanotechnological materials using conventional scientific and mathematical notation.
4. explain primary aspects of space microbiology that have been studied to date.

Module- I

Functional Principles of Nano-biotechnology, Basic biology principles and practice of micro fabrication techniques, Atomic force microscopy, Biological production of metal nano particles, macro molecular assemblies.

Module- II

Bacterial structure relevant to nano-biotechnology, Cubosomes, Dendrimers, DNA Nanoparticle Conjugates, DNA Octahedron, Fullerenes, Nanoshells, Carbon Nanotubes, Nanopores, Nano structured Sillicon, Viruses as nano-particles, nano chemicals and application.,

Module - III

Drug delivery tools through nano-biotechnology, tumor targeting and other diagnostic applications, nano particle based immobilization assays, quantum dots technology and its application, immuno-nanotechnology**.** Biosensors and nano-biotechnology, principles used in construction of microelectronic devices, sensors and macro mechanical structures and their functioning,

Module - IV

DNA based Nanostructures- DNA-protein nanostructures-Methods- Self assembled DNA nanotubes- Nucleic acid Nanoparticles, DNA as a Biomolecular template-DNA branching-Metallization- Properties

Module - V

Space Microbiology: An Overview, Monitoring of astronauts microbial flora: Alterations in the load of medically important microorganisms, ESA STONE experiment. Evaluating the Biological Potential in Samples Returned from Planetary Satellites and Small Solar System Bodies.

References

1. Nanobiotechnology- concepts, applications and perspectives, Niemeyer, Christof m. Mirkin, Chad A., Wiley publishers.
2. Nanobiotechnology of biomimetic membranes, Martin, Donald (edt), Springer Verlag publishers.
3. MelgardtM.deVilliers, PornanongAramwit, Glen S.Kwon, Nanotechnology in
4. Drug Delivery, Springer-American Association of Pharmaceutical Scientists Press 2009
5. Bio Nanotechnology, Elisabeth S.Pappazoglou, AravindParthasarathy
6. Biomedical Nanostructures, Kenneth E.Goonsalves, Craig R.Halberstadt, Cate T. Laurecin, Lakshmi S.Nair

MG820403 – MARINE MICROBIOLOGY

Teaching Hours/week: 4 **Credits: 4**

Course Outcome:

By attending the course, the students will be able to:

1. Demonstrate insight into quantitative assessments of microbial biodiversity, microbial biomass, growth and metabolic activity of microbes, and relevant environmental parameters in marine waters, sediments and biofilms.
2. Demonstrate an insight to central methods in marine microbiology and virology.
3. Devise experimental strategies for analyzing microbial populations, their activity and interactions in marine ecosystems.
4. Know various culturing technique for marine microbes

Module -I

Marine microbial habitats: estuaries, mangroves, saltmarshes, beach and coastal ecosystems, reef and coral reefs, water column, sediments.Marine microbes: their growth, physiology and contribution to ocean processes. Modes of microbial growth: viable but non culturable (VBNC) microorganisms,biofilms, microbial mats, epibiosis.

Module -II

Physiology of marine microbes: metabolic diversity and energy-yielding processes: microbial loop;marine snow; phototrophy and primary productivity, fermentation, aerobic respiration, anaerobic respiration (denitrification, sulphate reduction, methanogenesis); nitrification, annamox, sulphur oxidation, methanotrophy;

Module-III

Methods in marine microbiology. Sampling equipment: water samplers such as Niskin sampler, Hydro-Bios sampler, Rosette samplers; sediment samplers such as van Veen grabs and corers. Analysis of primary productivity: the radiocarbon method. Analysis of bacterial productivity: the thymidine uptake method. Measurement of respiration rates: light-dark bottle method.

Module- IV

Tools to study marine microbial diversity: flow cytometry (bacteria, picoplankton, picoeukaryotes, viruses); molecular approaches such as metagenomics, community fingerprinting and Fluorescence in situ hybridization (FISH).

Module -V

Microbial symbionts of sponges; Symbiosis and mixotrophy in protists; Metabolic consortia and mutualism between prokaryotes. Microbial diseases of fish and invertebrates. Bacterial and viral diseases of fresh water, sea water,aqua culture: fish, bivalve mollusks, crustaceans, corals. Diagnostic methods. Control of disease. Protista infections. HAB.

References

1. Munn, C. Marine Microbiology: ecology and applications, Garland Science, Taylor and Francis group, N.Y.
2. Maier, R., Pepper, I., Gerba, C. Environmental Microbiology, Academic Press
3. Sharma, P.D. Environmental Microbiology

MG010401– LABORATORY COURSE IV

Lab Hours/week: 13 **Credits: 5**

Course Outcome:

By attending the practical, the students will be able to:

1. design and carry out experiments (safely) and to interpret experimental data
2. Acquire, discover, and apply the theories and principles of learned subjects in practical, real-world situations and problems.
3. Develop success skills in communication, critical thinking, interaction, information acquisition and interpretation, organization, professionalism, leadership, auto-didactics and life-long-learning.
4. devise experiments with appropriate hypotheses and controls

Experiments

Bio-statistics

- Test the significance of a given data using‘t’, ‘X^2’ and F tests.
- Analysis of data for correlation and regression, Analysis of set of data in CRD, RBD, LSD.

Bioinformatics

All programs and packages included in theory syllabus.

Research Methodology

Writing of research proposals

Clinical

- Techniques for collection of clinical specimens for microbiological analysis.
- Packaging and transport of specimens.
- Microbiological examination of clinical specimens, isolation and characterization of bacteria from clinical specimens, virulence and toxigenicity tests.
- Antimicrobial sensitivity testing for clinical isolates.

- Serological tests - ASO, RPR
- Isolation of PSM, Rhizobium, and Bejerinkia from soil
- Mini production of Pseudomonas bio- pesticides.
- Enumeration of soil microorganism and calculation of rhizhosphere to non rhizhosphere ratio
- Internship
- Preparation and staining of blood film and identification of different blood cells
- Differential leukocyte count
- Problems and reasoning in ecology and developmental biology
- Field study and report preparation of any three plant disease with specimens.