M.Sc. Microbiology

NEP Syllabus- 2022-23

(CBCS system)

Raja Mahendra Pratap Singh State University,

Aligarh(UP)202001.

M.Sc. Microbiology

Scheme of Semester System Examination

(NEP-2022-23)

First Semester						
	Paper Code	**SUBJECTS**	**Credits**	**Internal Marks**	**External Marks**	**Total**
Compulsory Course	RB080701T	Mycology	4	25	75	100
	RB080702T	Virology	4	25	75	100
	RB080703T	Bacteriology	4	25	75	100
	RB080704T	Microbial Biochemistry	4	25	75	100
Compulsory Course Practical	RB080705P	**Practical (based on course 701-704)**	4	25	75	100
	RB080706R	**Research work/ Tour/Review**	-	-	-	-
MINOR	RB080707*	(**Any One**) from other Faculty	4	25	75	100
		Total	**24**	**230**	**470**	**700**

Second Semester						
	Paper Code	**SUBJECTS**	**Credits**	**Internal Marks**	**External Marks**	**Total**
Compulsory Course	RB0807801T	Microbial Metabolism	4	25	75	100
	RB080802T	Microbial Genetics	4	25	75	
	RB080803T	Bioanalytical Technology	4	25	75	100
Elective I	RB080804T	Medical Microbiology	4	25	75	100
	RB080805T	Clinical Microbiology				
Compulsory Course Practical	RB080806P	**Practical (based on course 801-805)**	4	25	75	100
GE-II	RB080807R	**(Any One) Review/ Tour**	4	25	75	100
		Total	**24**	**230**	**470**	**700**

Third Semester						
	Paper Code	**SUBJECTS**	**Credits**	**Internal Marks**	**External Marks**	**Total**
Compulsory Course	RB080901T	Immunology	4	25	75	100
	RB080902T	Molecular Biology and RDT	4	25	75	100
	RB080903T	Biostatistics & Comp. Application	4	25	75	100

Elective-Il (Any one)	RB080904T	Pharmaceutical Microbiology	4	25	75	100
	RB080905T	Products & Process Development				
Compulsory Course Practical	RB080906P	**Practical (based on course 901-905)**	4	25	75	100
	RB080907R	**Review/Tour/Assignment**	4	25	75	100
		Total	**24**	**230**	**470**	**700**

Fourth Semester						
	Paper Code	**SUBJECTS**	**Credits**	**Internal Marks**	**External Marks**	**Total**
Compulsory Course	RB081001T	Environmental Microbiology	4	25	75	100
	RB081002T	Agriculture and Soil Microbiology	4	25	75	100
Elective-Ill (Any one)	RB081003T	Food and Dairy Microbiology	4	25	75	100
	RB081004T	Microbial Genomics and Proteomics				
Elective-IV (Any one)	RB081005T	Industrial Microbiology	4	25	75	100
	RB081006T	Bioentrepreneurship				
	RB081007P	Dissertation/Project Work	4	25	75	100
Compulsory Course Practical	RB081008R	Practical **(based on course 1001-1006)**	4	50	50	100
		Total	**24**	**175**	**425**	**600**

***Project Dissertation 25**

***Presentation 25**

***Viva Voce 25**

***Scientific Paper 25**

***Minor from other faculty.**

RB080701- MYCOLOGY

UNIT –I

Status of fungi in living world, general features of fungi and fungus like organisms, recent trends in the classification of fungi, physiology and growth of fungi, nutritional and environmental factors affecting growth, saprotrophs, parasites of Mutualistic symbionts, physiology of reproduction in fungi, Phylogeny of fungi. Fungi and Biotechnology Production of alcoholoic beverages, antibiotics, organic acids, ergot alkaloids, the cultivation of fungi for food- Mushrooms, mycofoods, Role of fungi in agriculture and forestry- Mycorrhizae and their application.

UNIT-II

Fungal Diversity- major taxonomic groups, structure, reproduction, life cycle and significance of the following representative:

1. Gymnomycota- Cellular slime moulds (Dictyostelium), Plasmodial slime moulds (myxomycetes)
2. Mastigomycotina- Coelomomyces, Lagenidium, Achlya, Phytophthora, Peronospora, Plasmodiophora
3. Amastigomycotina- Zygomycotina, Mucor, Syncephalastrum, Blakeslea, Cunninghamella, Entomorphthora.

UNIT- III

Fungal diversity contd,

1. Ascomycotina- Taphrina, Chaetomium, Morchella, Neurospora.
2. Basidiomycotina- Puccinia, Melampsora, Polyporus, Lycoperdon.
3. Deuteromycotina- Fusarium, Cercospora, Curvularia, Beauveria, Microsporum.

UNIT- IV

1. Life cycle and sexual process in fungi,
2. Genetic variation in fungi- Nonsexual variations- haploidy, heterokaryosis, parasexuality, sexual variations, homothallisum and heterothallium, Mutation, physiological specialization.
3. Mycopesticides Mycotoxins.

Suggested Books:

1. Introductory Mycology, CJ Alexopoulos, CW Mims, M Blackwel, JohnWiley & Sons.
2. The Fungi: An Advanced Treatise, GC Ainsworth, KF Sparrow, AS Sussman.
3. An Introduction to Fungi, HC Dube, VikasPubl, New Delhi.
4. The Fungi, PD Sharma, Rastogi Publications, Meerut.
5. Fungi: Experimental Methods in Biology, R Maheshwari, CRC Press, Boka Raton, Florida.
6. Introduction to Fungi, J Webster & WS Roland, Cambridge University Press.
7. A Text Book of Modern Plant Pathology, KS Bilgrami, HC Dube.
8. Plant Pathology, RS Mehrotra.
9. Fungi and Plant Disease, VK Gupta, TS Paul
10. Diseases of Crop Plants in India, Rangaswamy & Mahadevan.
11. Plant Pathology, GN Agrio Elsevier Academic Press.
12. Molecular Plant Pathology, Dickinson CM, Bios Scientific Publisher
13. Plant Pathology: Concepts and Laboratory Exercises, NT Robert, MT Windham, AS Windham, CRC Press.
14. Principles of Plant Pathology, RS Sing, Oxford and IBH Publishing Co. Pvt Ltd.

Mycology –Lab

- Isolation and identification of fungi from different environmental samples,
- Study the nutritional requirement of fungi,
- Cultivation of fungi in submerged and solid state fermentation,
- Production of enzymes, organic acids and other metabolites by fungi,
- Collection and study of basidiomycetous fungi,
- Study and culturing of yeasts, study yeast dimorphism,
- Isolation and identification of algae from different habitats,
- Culturing of algae under lab conditions,
- Study hydrogen and bioethanol production by algae,
- Algae as a source of SCP,
- Study pollution control by algae.

RB080702-VIROLOGY

Unit I:

Classification, Morphology and Chemistry of Viruses: Virus evolution and classification, properties of viruses, virus structure, Techniques for visualization and enumeration of viral particles, measuring biological activity of viruses, assays for virus estimation and manipulation, characterization of viral products expressed in infected cells.

Unit II

Virus replication Strategies: Principal events involved in replication: Adsorption, penetration, uncoating nucleic acid and protein synthesis, intracellular trafficking, assembly, maturation and release, viral-host interaction, Host response to viral infection. Replication patterns of specific viruses: Replicative strategies employed by animal DNA viruses. Replicative strategies employed by animal RNA viruses. Identification of virus prototypes associated with different virus replication schemes; Details on important viruses namely Herpesvirus, Poliovirus, Influenza virus, Adeno Virus, Poxviruses, Hepatitis Viruses, coronaviruses, Retroviruses.

Unit III

Subviral pathogens: HDV, Prions, Viroids Pathogenesis of viral infection: Stages of infection, Patterns of some viral diseasesepidemiology, transmission, infection, symptoms, risk, transformation and oncogenesis, emerging viruses. Anti-viral strategies-prevention and control of viral diseases: Host specific and nonspecific defense mechanisms involved in resistance to and recovery from virus infections. Role of interferon in viral infections. Contributions of various host defense mechanisms in viral infections; Viral Chemotherapy: Nucleoside analogs, reverse transcriptase inhibitors, protease inhibitors. History of vaccines especially smallpox and polio. New methods: subunit vaccines, anti-idiotype and DNA vaccines.

Unit IV

History and development of plant virology, cryptograms, and classification of plant viruses and viroids: Brief history of virology highlighting the significant contributions of scientists to the development of plant virology; significance of plant virology and modern classification of plant viruses and viroids according to ICTV; and cryptograms of various plant viruses and virus groups

Symptoms of plant virus diseases, transmission of plant viruses, viral and viroid diseases and their control: General discussion on symptoms caused by viruses and viroids in diseased economically important trees and agricultural crops, and their control including development of virus disease resistant transgenetics Microbial viruses: Diversity, classification, characteristics and applications of bacteriophages, and general account on algal, fungal and protozoan viruses.

Suggested Books

1. Medical Virology 10 Th Edition by Morag C and Tim bury M C . ChurchilLivingstone, London.
2. Introduction to Modern Virology 4th Edition by Dimmock N J, Primrose S. B.. Blackwell Scientific Publications. Oxford.
3. Virology by Conrat H.F., Kimball P.C. and Levy J.A.Prentice Hall, Englewood Cliff, New Jersey.
4. Text Book on Principles of Bacteriology, Virology and Immunology Topley and Wilsons.
5. Molecular Biology, Pathogenesis and Control by S.J. Flint and others. ASM Press, Washington, D.C.
6. Applied Virology. 1984. Edited by Edonard Kurstak. Academic Press Inc.
7. Introduction to Modern Virology by Dimmock. MB.

PRACTICAL PAPER –VIROLOGY

1. One step growth curve for determination of virus titre.
2. Phage typing of E.coli bacteriophages.
3. Induction of lambda lysogen by UV radiations.
4. Studies on Specialized transduction.
5. Isolation of lambda DNA and their characterization.
6. Amplification of lambda DNA by PCR
7. Cultivation and assay of viruses using embryonated eggs and Tissue culture Technique.

RB080703- BACTERIOLOGY

UNIT –I

History, scope and development of bacteriology, Sterilization, isolation, enrichment, pure culture and staining techniques, systematic study of bacteria; morphological, physiological, biochemical and serological studies, genetic characterization. Habitat, structure, reproduction & classification of bacteria.

UNIT- II

1. The photosynthetic bacteria; cyanobacteria, green bacteria, halobacteria and their economic importance 2. Methanogenic bacteria and their significance 3. Chemoautotrophs and Methylotrophs: Nitrifying bacteria, sulphur oxidizers, iron bacteria and their economic importance.

UNIT- III

1. Enterobacteriaceae and related organisms, their morphological & physiological characters, genetic interrelationship, taxonomic sub-division & their importance in human health. 2. Myxobacteria, cytophage group, filamentous & gliding chemoheterotrophs & filamentous sulphur oxidizing bacteria.

UNIT IV

1. Gram positive spore forming bacteria: Unicellular endospore former-bacillus Clostridia.
2. Miscellaneous bacteria: Lactic acid bacteria, Micrococci, Corynebacteria, Mycobacteria.
3. Actinomycetes, Mycoplasma, Rickettsiae, Chlamydiae and their significance.

Suggested reading:

1. General Microbiology: R Y Stanier, Adelberg E A and J L Ingraham, Mac Millan Press Inc
2. Introduction to microbiology: Ingraham J L and Ingraham C A Thomson Brooks/ Cole
3. Principles of microbiology R M Atlas Wm C brown Publishers
4. Brock’s biology of Microorganisms Madigan M T and Martinko J M Pearson Education Inc
5. Microbiology: An introduction: Tortora G J, Funke B R and Case C L Pearson Education Inc

BACTERIOLOGY -LAB

- Methods of isolation, purification and maintenance of microorganisms from differentenvironments (air, water, soil, milk and food).
- Staining of bacteria and actinomycetes,
- Use of selective media,
- Enrichment culture technique – isolation of asymbiotic nitrogen fixing bacteria;
- Isolation of symbiotic nitrogen fixing bacteria from nodules,
- Isolation of antibiotic producing microorganisms.
- Morphological, physiological and biochemical characterization of isolated bacterial cultures.

RB080704-MICROBIAL BIOCHEMISTRY

Unit I

1. Biomolecules – Chemical composition and bonding, three dimensional structure, configuration and confirmation.
2. Chemical reactivity – five general types of chemical transformation of: oxidation reduction reactions, nucleophilic substitution, electron transfer with in molecules producting internal rearrangement, group transfer reaction, condensation reaction
3. Water – weak interactions in aqueous system, ionization of water, weak acid and weak base, concept of pH &pKa, Buffers (bicarbonate buffering system).
4. Principles of Bioenergentics – Entropy, enthalpy and free energy.
5. Oxidative and Photophosphorylation, ATP production.

Unit II

1. Carbohydrates: Classification, Structure, chemical feature and function.
2. Lipids – Classification, Structure, chemical feature and function
3. Amino acids, peptides and proteins - Classification, Reaction & physical properties. Three dimensional structure of protein and protein folding.
4. Nucleotides and nucleic acids

Unit III

1. Cell Signaling: paracrine, endocrine, autocrine. Signaling molecules – hormones, neurotransmitter, proteins and environmental factors. Cell surface receptors - G protein coupled receptor, receptor protein tyrosine kinase, cytokine receptor and non-receptor protein tyrosine kinase, receptor linked to other enzymatic activities.
2. Signaling pathways : Cyclic AMP pathway (second messenger and protein phosphorylation), cyclic GMP pathway, phospholipids and Ca 2+ pathway, Ras-Raf and MAP kinase pathway, JAK/STAT pathway,

Unit IV

1. Enzymes – Classification and factors affecting enzyme activity
2. Allosteric Enzymes and their regulation
3. Enzyme kinetics – Equilibrium and steady state theory (MichalisMenten equation) and determination of kinetic parameters.
4. Enzyme inhibition – reversible and irreversible inhibition, competitive, non-competitive and un-competitive inhibition

Suggested Books:

1. Biochemistry, Voet Donald and Voet J.G ., John Wiley and sons INC
2. Biochemistry, Zubay .G. - Wm.C.brown Publishers
3. The Physiology and Biochemistry of prokaryotes White .D. -Oxford Univ.press
4. Principles of Biochemistry, Lehninger A.L.Cox and Nelson , CBS Publishers and Distribution Pvt.Ltd
5. Biochemistry, Stryer .L., W.H.Freeman and Co
6. Principle and Techniques –Practical Biochemistry Wilson. K. and Walker.J. -Cambridge University press
7. Biochemistry, Murray, Harpers Mc Graw Hill
8. Biochemistry, Satyanarayana and Chakrapani, Books and Allied Publishers
9. Fundamentals of Biochemistry, Voet Donald,J.W.Voet and Ch.W.Pratt, Jhon Willey & Sons Inc.
10. 10. Enzyme Kinetics by Paul Engel. John Wiley and Sons.

BIOCHEMISTRY -LAB

Biochemistry:

- Preparation of standard and buffer solutions;
- Use of simple techniques in laboratory (spectrophotometery-verification of Beer's law, relation between O.D. and percentage transmission; Centrifugation)
- Estimation of sugars,
- Estimation of Proteins by Lowry,,s method;
- Estimation of DNA and RNA by diphenylamine and orcinol methods;
- Determination of enzyme activity and study of enzyme kinetics;
- Separation of biomolecules by electrophoresis.

RB080801-MICROBIAL METABOLISM

Unit I

Nutritional Categories of microorganisms based on carbon and energy sources, Metabolite Transport- Passive and facilitated, Primary and secondary active transport, Group translocation (phosphotransferase system), symport, antiport and uniport, electrogenic and electro neutral transport, transport of Iron.

Unit II

Microbial Growth- Definition balanced and unbalanced growth, growth curve, the mathematics of growth, Generation time, specific growth rate, batch and continuous culture, synchronous growth, diauxic growth curve. Types of Culture media, Isolation of pure cultures.

Unit III

Brief account of photosynthetic and accessory pigments - chlorophyll, bacteriochlorophyll, rhodopsin, carotenoids, phycobiliproteins; Carbohydrates- anabolism. Autotrophy, oxygenic,

anoxygenic photosynthesis – autotrophic generation of ATP; fixation of CO2, Calvin cycle, C3, C4 pathway. Chemolithotrophy:sulphur, iron, hydrogen, nitrogen oxidations, methanogenesis, luminescence.

Unit IV

Respiratory metabolism, Embden-Mayer Hoff pathway, EntnerDoudroff pathway, glyoxalate pathway, Krebs cycle, oxidative and substrate level phosphorylation, reverse TCA cycle, gluconeogenesis, Pasteur effect; Fermentation of carbohydrates, homo and heterolactic fermentations.

Unit V

Biosynthesis of peptidoglycan, polysaccharides, major amino acids, polyamines, Lipids, Nucleotides:Purines and Pyrimidines; Assimilation of nitrogen; Dormancy and germination; Microbial Differentiation, sporulation and morphogenesis, Cell division cycle in *E.coli* andyeast.

Suggested Readings

1. Doelle H.W. 1969. Bacterial Metabolism. Academic Press.
2. Gottschalk G. 1979. Bacterial Metabolism. Springer Verlag. Moat AG. 1979. Microbial Physiology. John Wiley & Sons.
3. Sokatch JR. 1969. Bacterial Physiology and Metabolism. Academic Press.
4. Moat A G., Foster J W., Spector M P. Microbial Physiology, 4th Ed: Wiley India Pvt Ltd 2009

MICROBIAL METABOLISM (LAB)

- Determination of viable number of Bacterial cells in a given sample.
- Determination of bacterial growth by turbidity measurements (Bacterial growth curve).
- To study the microscopic measurements.
- To study the types of growth (synchronous, diauxic, batch).

- Effects of incubation temperature on the growth of microorganisms.
- To study the lethal effect of temperature.
- Effects of different pH on the growth of microorganisms.
- To study the bacterial growth under aerobic, microaerophilic and anaerobic conditions.
- Effect of salt concentration on the growth of microorganisms.
- Preparation of selective and differential media for the growth of microorganisms.
- Ferrmentation of different carbohydrates.Morphological, Physiological and Biochemicaltests of selected bacterial cultures.

RB080802-MICROBIAL GENETICS

Unit I

Mendel‟s work on transmission of traits; Genetic Variation; Molecular basis of Genetic Information;Mitosis and Meiosis; Linkage and crossing over; Molecular mechanism of crossing over; Recombination and recombination frequency.

Unit II

Mutations-Induced versus Spontaneous mutations, Suppressor mutations, Molecular basis of Mutations,mutant enrichment; Complementation tests; recombination tests and gene replacements; Cloning genes by complementation and marker rescue; DNA repair mechanisms, Mutation and Microbial evolution.

Unit III

Molecular mechanism of gene transfer by conjugation. Regulation of gene transfer by conjugation. Mapping bacterial genomes using Hfr strains. Transfer systems in gram positive bacteria. Ti plasmid and application.

Unit IV

Transformation and transduction:Natural transformation and competence. Molecular basis

of natural transformation; Regulation of competence in *B.subtilis*. Artificially induced competence. Generalized versus specialized transduction, Mapping bacterial genes by transduction;Tetrad analysis in fungi,Positive and negative gene regulation and attenuation, using the *lac*, *gal*, *trp* and*ara* operons, with emphasis on recent advances.

Unit V

Lytic cycle of T4 and T7 bacteriphages, Regulation of expression of genes in phage T4 and T7. Replication and packaging of filamentous phages M13 . Benzer‟s experiments with the rII genes of phage T4 to construct phage genetic linkage maps. Lambda phage – Lytic and lysogenic cycles. Other lysogenic phages – P1 and □x174. Transposons and gene regulation.Yeast Ty-1 transposon. Phase variation in bacteria , Transplantation (Synthetic genome).

MICROBIAL GENETICS-LAB

Microbial Genetics:

- Inactivation of microorganisms by different mutagens.
- Production, isolation and characterization of mutants.
- Determination of mutation rate.
- Isolation, characterization and curing of plasmids.
- Preparation of competent cells,
- Transformationof*E.coli*. using plasmid DNA
- Transfer of plasmid by conjugation, electroporation. T
- etrad and random spore analysis

RB080803-BIOINSTRUMENTATION

Unit I

1. Photometry – Basic principles, Instrumentation and applications of UV-Visible spectrophotometry
2. Infrared (IR) spectroscopy and its applications
3. Fluorescence spectroscopy – principle, instrumentation and applications.

4. Mass spectroscopy – Mass analyzers, principle, instrumentation and applications.

Unit II

1. Raman spectroscopy and its applications
2. Electron spin resonance (ESR) spectroscopy and applications
3. Nuclear magnetic resonance (NMR) Spectroscopy – principle, instrumentation and applications
4. Circular Dichroism (CD) spectroscopy – principle, instrumentation and applications
5. X-ray Crystallography – principle, instrumentation and applications.

UNIT III

1. Centrifugation – basic principle, types and applications
2. Chromatography: Principle, types and applications of Paper, Thin layer, High performance liquid chromatography; Column Chromatography – Gel filtration, Ion exchange chromatography, affinity chromatography, adsorption chromatography.
3. Electrophoresis: Principle, types and applications; Agarose gel, PAGE, SDS-PAGE, Iso-electric focusing, Two Dimensional gel electrophoresis, Immuno-electrophoresis, Capillary electrophoresis, Pulse Field gel electrophoresis.
4. Autoradiography – Principle and applications, radioisotopes used in biology and their application.

Unit IV

1. Microscopy – Basic principle and components of microscope, phase contrast and fluorescent and Confocal microscopes
2. Electron microscopy – principle and applications
3. Sequencing techniques for proteins and nucleic acids
4. Nano-biotechnology: definition history and Application of nanoparticles in diagnosis therapy.

Suggested Books:

1. Instrumental Methods of Analysis. H.H. Willard, L.L. Merritt Jr. and others. CBS Publishers and Distributors.
2. Instrumental Methods of Chemical Analysis. Chatwal G and Anand, S. Himalaya Publishing House, Mumbai.

4. Spectroscopy. Volume 1. Edited by B.B. Straughan and S. Walker. Chapman and Hall Ltd.
5. Chromatography: Concepts and Contrasts- 1988 by James Miller. John Wiley and Sons. Inc., New York.
6. Analytical Biochemistry by Holme.
7. Introduction to High Performance Liquid Chromatography by R. J. Hamilton and P. A. Sewell.

BIOANALYTAL TECHNIQUES -LAB

- Determination of absorption maxima of some important chemicals from their absorptionspectra,
- Estimation of biomolecule using spectrophotometer,
- Separation of carbohydrates and amino acids by paper chromatography,
- Separation of lipids by thin layer and column chromatography,
- Separation of proteins by ion exchange and gel filtration chromatography,
- Electrophoretic techniques to separate proteins and nucleic acids,
- Preparation of stock solutions and buffers;
- Standard curves of BSA;
- Estimation of protein, RNA and DNA;
- SDS-PAGE of proteins;
- Polymerase chain reaction;
- RAPD analysis;
- DNA restriction analysis.

RB080804-MEDICAL MICROBIOLOGY

Unit I

Early discovery of pathogenic microorganisms, development of medical microbiology as adiscipline, normal microbial flora of the human body and their importance. Host parasite relationships:

Definitions: infection, invasion, pathogen, pathogenicity, toxigenicity, virulence, carrier, types of carriers, opportunistic infections. Role of aggressins, depolymerizing enzymes, organotrophism. Transmission and spread of infection. Hospital acquired infections and their management.

Unit II

Principle of different diagnostic tests (ELISA, Immunofluorescence, agglutination based tests). Modern approaches for diagnosis of infectious diseases: Basic concepts of gene probes, dot hybridization and PCR assays. Mechanism of action of various chemotherapeutic agents (antibacterial, antifungal and antiviral). Principle of drug resistance. Various methods of drug susceptibility testing, passive and active prophylactic measures.

Unit III

Study of important bacterial diseases caused by the following generawith reference to causative agent, pathogenesis, symptoms, transmission, control measures, epidemiology and diagnosis. *Bacillus anthracis, Staphylococcus, E.coli, Salmonella typhii, Shigella dysenteriae, Vibrio cholerae, Haemophilus influenzae, Mycobacterium tuberculosis*, *Corynebacterium diptheriae*, *Treponema palladium*. Emerging and reemerging bacterial pathogens.

Unit IV

Study of important viral diseases wih reference to causative agent, pathogenesis, symptoms, transmission, control measures, epidemiology and diagnosis. Hepatitis, influenza, rabies, polio, chicken pox, herpes, dengue fever, AIDS and viral cancers. An overview of emerging and reemerging viral diseases: Ebola, SARS, Hanta and Chikungunya.

Unit V

Introduction to protozoan, fungal and helminthes diseases:Malaria, Giardiasis, & leishmaniasis; Superficial, subcutaneous, systemic and opportunistic mycose.

RB080805T-CLINICAL MICROBIOLOGY

UNIT-I

INTRODUCTION, HISTORY & SCOPE OF MICROBIOLOGY

Introduction and history & developments of microbiology, scope of microbiology, general characteristics of prokaryotes and eukaryotes, classification of prokaryotes, introduction to mycology, virology and parasitology

STRUCTURE OF BACTERIAL CELL structure and functions of gram positive and gram negative bacteria, cell wall, cell membrane, cytoplasmic inclusions and mesosomes, flagella, capsule, ribosome, chromosome, plasmid and endospore, morphological classification of bacteria

UNIT-II

MICROSCOPY 12

Definition,Importance of microscopy, principle, operation and applications of light microscope, phase contrast microscopy, fluorescence microscopy, electron microscopy STERILIZATION AND DISINFECTION Introduction and its types, principle,procedure and its application, definition and types of disinfectant, quality control for sterilization and disinfection, biosafety in microbiology lab, biowaste management

UNIT-III-(15)

CHEMOTHERAPY AND CHEMOTHERAPEUTIC AGENTS 15

Introduction, types of chemotherapeutic agents, mode of action and clinical importance of different chemotherapeutic agents, antibiotic sensitivity tests and its medical importance, introduction,types,mode of action and importance of multiple drugs resistance, mechanism of drug resistance

NORMAL MICROBIAL FLORA AND PATHOGENIC MICROORGANISMS

Normal microbial flora of the human body, collection and transport of specimens, processing of clinical specimens for microbiological examination

MICROBIAL NUTRITION AND GROWTH Growth kinetics, different types of culture medium, continuous culture and synchronous growth cultures, aerobic & anaerobic cultures, Introduction and its types, various affecting factors on microbial growth

UNIT-IV

NOSOCOMIAL INFECTIONS-(12)

Introduction and its types, pathogenicity and laboratory diagnosis of nosocomial infection, prevention and control of nosocomial infections ENVIRONMENTAL MICROBIOLOGY

Bacteriology of air, water, food, milk, soil

SUGGESTED BOOKS:

1.Tortora, G.J., Microbiology: An Benjamin/Cummings Funke, B.R., Introduction Publishing And Case, C.L Company, Inc.

2 Pelczar, M.T. Microbiology Tata Mcgraw Hill Publication, New Delhi.

3. Schegel, H.G General Microbiology Cambridge University Press

4. Stanier, R.Y. General Microbiology Macmillian Press London

CLINICAL MICROBIOLOGYLAB

Simple staining of bacteria

- To prepare bacterial smear and perform simple staining using methylene blue Gram staining
- To perform Gram staining of different bacterial cultures Special stain
- To perform endospore staining, acid-fast staining and Albert's staining of bacterial cultures Counting of bacterial cell
- To perform viable count of bacteria using pour plating technique Effect of nutritional factors on growth
- To study the effect of different carbon & nitrogen sources on the growth of microorganisms Effect of environmental factors on growth
- To study the effect of pH on the growth of microorganisms
- To study the effects of UV radiation on growth of microorganisms

Bacteriological examination of water & milk

- To perform the bacteriological examination of water and milk
- To perform the bacteriological examination of milk by methylene reductase test Microbes in hospital environment
- To isolate and identify the bacteria and fungi from hospital environment

Qualitative analysis of biomolecules

- Qualitative test for carbohydrates: Molisch Test, Benedict test
- Qualitative test for amino acid and protein: Biuret test, Ninhydrin test
- Qualitative test for lipid: Acrolein test Quantitative analysis of blood parameters
- Quantitative estimation of blood cholesterol
- Quantitative estimation of blood glucose

- Quantitative estimation of blood urea Quantitative analysis of blood parameters
- Quantitative estimation of creatinine
- Quantitative estimation of protein albumin
- Quantitative estimation of uric acid Quantitative analysis of liver enzymatic markers
- Quantitative estimation of SGPT
- Quantitative estimation of ALP Quantitative analysis of heart enzymatic marker
- Quantitative estimation of SGOT a cardiac marker Quantitative analysis of prostate gland enzymatic marker
- Quantitative estimation of ACP

RB080901-IMMUNOLOGY

Unit I:

Introduction to the immune system: Innate immunity; anatomic, physiological, phagocytic & inflammatory barriers. Adaptive immunity; natural & artificial immunity. Cells involved in immune response: lymphoid lineage (producing B & T lymphocytes) & Myeloid lineage (phagocytes: macrophages, neutrophils & eosinophils and auxillary cells; basophils, mast cells &platelets). Organs involved in immune system: primary & secondary lymphoid organs.

Unit II:

Antigens: preparation of antigens, types of antigens- haptens, superantigens & cluster of differentiation molecules (CDs), Processing and presentation of antigens.. Immunoglobulins: structure & types of immunoglobulins, genetic diversity of immunoglobulins, catalytic antibodies. B-cell biology & T-cell biology (major histocompatibility complex (MHC) molecules). HLA and H-2 systems.

Unit III:

Vaccines immunizations: types of vaccines (DNA vaccines, recombinant DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines) & their characteristics. Immunization of test animals, hyperimmune antisera; Prophylactic immunization; Immune Disorders: hypersensitivities, autoimmune diseases, transplantation (tissue) rejection, immunodeficiency's.

Unit IV:

Complement: Classical alternative and lectin pathway of complement activation, regulation of complement system, biological consequence of complement activation. Cytokines: interferons (α, β & γ), TNF, interleukins (1-16), hematopoietins & chemokines, Regulation of immune response.

Unit V:

Monoclonal antibodies: hybridoma technology, applications of monoclonal antibodies. Antigen-Antibody reactions in vitro: agglutination reactions (Widal, Haemagglutination), precipitation reactions (Immunodiffusion, Immuno electrophorectic method), Immunoblotting, ELISA, RIA, fluorescence immunosorbent assay, immuno-electronmicroscopy.

Suggested Readings (Latest Editions):

1. Riott I M (2003). Essentials of Immunology. Blackwell Scientific Publishers, London.
2. Claus D (2005). Immunology- Understanding of Immune System. Wiley - Liss, New York.
3. William P (Latest Edition). Fundamentals of Immunology. 4.Abbas (2004). Cellular and Molecular Immunology.
4. Benjamin (2004). Immunology- A short Course.
5. Tizard Ian R (2009). Immunology. An introduction, 4th Edition.
6. Kindt, Goldsby and d Osborne (2013). Kuby Immunology. MacMillan HigherEducation.

Immunology-Lab

- Determine total leucocyte count (TLC) of a given blood sample.
- To perform differential leucocyte count (DLC) of the blood sample.
- Separation of serum from the blood sample,
- Identification of human blood groups o ABO and Rh factor,
- Immunodiffusion by Ouchterlony method,
- Immuno-electrophoresis with a given antigen,

- antibody system,
- Dot- ELISA;
- Demonstration of Western blotting.

RB080902-MOLECULAR BIOLOGY AND R-DNA TECHNOLOGY

Unit I

1. Introduction of molecular biology and genetics. 2. Genome organization – genome, c-value, c-value paradox, genome complexity, 3. DNA Replication Prokaryotic and eukaryotic DNA replication, mechanism of DNA replication, enzymes and accessory proteins involved in DNA replication. 4. DNA Repair.

Unit II

1. Transcription Prokaryotic transcription and eukaryotic transcription, RNA polymerase, General and specific transcription factors, regulatory element and mechanisms of transcription regulation.
2. Transcriptional and post transcriptional gene silencing.
3. Modification of RNA 5'-cap formation, transcription termination, 3' end processing and polyadenylation, splicing, Editing, Nuclear export of mRNA, mRNA stability.
4. Translation Prokaryotic and eukaryotic translation, the translation machinery, mechanisms of initiation, elongation and termination, regulation of translation.

Unit III

1. Co- and Post- translational modifications of proteins.
2. Protein localization and transport Synthesis of secretary and membrane, import into nucleus. Mitochondria E. R., Golgi complex, chloroplast, and peroxisomes, Receptor mediated endocytosis.
3. Antisense and ribozyme technology Molecular mechanism of antisense molecules, inhibition of splicing, polyadenylation and translation.Disruption of RNA structureand capping biochemistry of ribozyme; hammerhead, hairpin and other ribozymes, strategies for designing ribozyme, application of antisense and ribozyme technologies.
4. Pedigree analysis.

Unit IV

1 Recombination - Homologus recombination - Holiday junction, site specific recombination - FLP/FRT and Cre lox recombination, Rec A and other recombinases

2. Genetic and physical mapping.

3. Southern, Northern and florescence in situ hybridization for genome analysis.

4. Chromosome micro-dissection and micro-cloning.

5. Molecular markers in genome analysis, RFLP,RAPD, AFLP, STS, SCAR (Sequence characterized amplified regions), microsatellite, SSCP, QTL.

Suggested Books

1. Principles of Gene Manipulations Old and Primrose Blackwell Scientific Publications.
2. DNA Cloning: A Practical Approach by D.M. Glower and B.D. Hames, IRL Press, Oxford.
3. Molecular Biotechnology, S.B. Primrose. Blackwell Scientific Publishers, Oxford.
4. Genetic Engineering and Introduction to Gene Analysis and Exploitation in Eukaryotes, S.M. Kingsman and A.J. Kingsman, Blackwell Scientific Publications, Oxford.
5. PCR Technology - Principles and Applications for DNA Amplification,Henry A. Erlich (Ed.) Stockton Pres
6. Molecular Biotechnology: Principles and Applications of Recombinant DNA, Bernard R. Glick and Jack J. Pastemak, ASM Publications.

MOLECULAR BIOLOGY AND RDT-LAB

- Isolation of plasmid and genomic DNA, Plasmid as cloning vector,
- Restriction enzymes and their role in biotechnology,
- Ligation method
- Expression of recombinant proteins using bacterial, animal and plant vectors,
- Agrobacterium-mediated gene transformation,

- Preparation of competent cells and transformation,
- Study microbial cell and enzyme immobilization. Designing of gene specific primers.
- Estimation of protein, RNA and DNA;
- SDS-PAGE of proteins; DNA isolation;
- Purification; polymerase chain reaction; DNA restriction analysis; RFLP and RAPDanalysis; Transformation of *E. coli* using plasmid DNA,
- Genetic improvement of Isolated industrially important microorganisms for production of microbial metabolites.
- Comparative studies of ethanol production using different substrates,
- Production of antibiotics and microbial enzymes.
- To study agarose gel electrophoresis of genomic DNA,
- To study genomic DNA isolation from bacteria and fungi, DNA isolation from humusrich soil samples and diversity study using 16s rDNA primers,
- To study restriction profile of isolated DNA and plasmid samples,
- Isolation of plasmids from *E.coli DH5α* cells,
- Isolation of DNA fragments which carry promoter sequence,
- Synthesis and codon modification of bacterial hemoglobin gene,
- Agrobacterium mediated gene transformation studies in fungi,
- To prepare chemically competent cells of *E. coli* DH5α and determine their transformation efficiency,
- To amplify the laccase/phytase/xylanase gene by Polymerase Chain Reaction,
- To clone the laccase/cellulase/phytase/xylanase amplicon into the TA cloning vector pGEM-T.

RB080903-BIOSTATISTICS, COMPUTER APPLICATIONS ANDBIOINFORMATICS

Unit I:

Presentation of data; Frequency distributions; Graphical representation of data by histogram, polygon, frequency curves and pie diagram. Measures of central tendency: Mean, median and mode; Measures of dispersion: Mean deviation, standard deviation, variance, Standard error, coefficient of variation; Correlation and regression : properties, nature, coefficient of correlation, rank correlation, linear regression and regression equations and multiple linear regression, significance of correlation and regression.

Unit II:

Probability: Basic concepts related to probability theory, classical probability. Probability Distributions: Introduction and simple properties of Binomial, Poisson and Normal Distributions and their applications in biology. Sampling: Concept of sampling and sampling techniques.

Unit III:

Testing of hypotheses: Some basic concepts, Errors in hypothesis testing; critical region; Students t-test for the significance of population mean and the difference between two population means; Paired t-test; Chi square test for population variance, goodness of fit and for the independence of two attributes in a contingency table; F-test for the equality of two populationvariance; Analysis of variance- One-way and two-way analysis of variance.

Unit IV:

Introduction to Computers : Definition, Components of computer, Classification of Computers, Generation of Computers; Number system; Introduction to Software; Translators (Compiler & Interpreter); Basics for operating systems (MS-DOS, Windows, Unix and Linux); Introduction to MS Office (MS-Word, MS-Excel, MS-Power Point); Introduction to Networking, Internet (E-Mail, File Transfer Protocol, Usenet, Telnet).

Unit V:

Introduction to Bioinformatics: Definition and scope; Search engines: tools for web search; Introduction to biological databases (NCBI, EBI, DDBJ, GenBank, PDB, NDB and MMDB),

Introduction to BLAST and FASTA; Brief idea about important softwares for microbiological studies.

Suggested Readings (Latest Editions):

1. Bailey, NT J (2000). Statistical Methods in Biology. English Univ. Press.
2. Campbell R.C (Latest Edition). Statistics for Biologist. Cambridge University Press,UK.
3. Sinha PK (Latest Edition). Fundamentals of computers. BPB Publication, New Delhi.
4. .Jonathan, P. 2008. Bioinformatics & Functional Genomics.
5. .B.D.Singh(2015). Biotechnology, Kalyani Publication Sharma and Munjal(2015).
6. A test book of Bioinformatics, Rastogi publication.

RB080904-PHARMACEUTICAL MICROBIOLOGY

UNIT-I

Antibiotics and synthetic antimicrobial agents: Antibiotics and synthetic antimicrobial lactams, tetracyclines, ansamycins, macrolid antibiotics) Antifungal agents(Aminoglycosides, antibiotics, antitumor substances. Peptide antibiotics, Chloramphenicol, Sulphonamides and Quinolinone antimicrobial agents. Chemical disinfectants, antiseptics and preservatives. Mechanism of action of antibiotics: Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis)Molecular principles of drug targeting. Drug delivery system in gene therapy, Bacterial resistance to antibiotics, Mode of action of bacterial killing by quinolinones, Bacterial resistance to quionolinones, Mode of action of non – antibiotic antimicrobial agents. Penetrating defenses – How the antimicrobial agents reach the targets (cellular permeability barrier, cellular transport system and drug diffusion).

UNIT-II

Microbial production and Spoilage of pharmaceutical Products Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, non injectibles, ophthalmic preparations and implants) and their sterilization. Manufacturing procedures and in process control of pharmaceuticals. Other pharmaceuticals produced by microbial fermentations (Streptokinase, Streptodornase).New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent

subunit vaccines. Vaccine clinical trials.

UNIT-III

Regulatory practices, biosensors and applications in Pharmaceuticals Financing R&D capital and market outlook. IP, BP, USP. Government regulatory practices and policies, FDA perspective. Reimbursement of drugs and biologicals, legislative perspective. Rational drug design. Immobilization procedures for pharmaceutical applications (liposomes). Macromolecular, cellular and synthetic drug carriers. Biosensors in Pharmaceuticals. Application of microbial enzymes in pharmaceuticals.

UNIT-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. Sterilization control and sterility testing (heat sterilization, D value, z value, survival curve, Radiation, gaseous and filter sterilization).Chemical and biological indicators.Design and layout of sterile product manufacturing unit. Designing of Microbiology laboratory, Safety in microbiology laboratory.

PRACTICAL-- PHARMACEUTICAL MICROBIOLOGY

- Spectrophotometric / Microbiological methods for the determination of Griesofulvin.
- Bioassay of chloremphenicol by plate assay method or turbidiometric Assay method.
- Treatment of bacterial cells with cetrimide, phenol and detection of Leaky substances such as potassium ions, aminoacids, purines, Pyrimidines and pentoses due to cytoplasmic membrane damage.
- To determine MIC, LD 50 of Beta-lactum/aminoglycoside/ tetracycline/ansamycins.
- Sterility testing by Bacillus stearothermophilus
- Sampling of pharmaceuticals for microbial contamination and load (syrups, suspensions, creams and ointments, ophthalmic preparations).

- Determination of D value, Z value for heat sterilization in pharmaceuticals. 8. Determination of antimicrobial activity of a chemical compound (Phenol, resorcinol, thymol, formaldehyde) to that of phenol under Standardized experimental conditions.

RB080905-PRODUCTS AND PROCESS DEVELOPMENT

UNIT-I

Bioprocess technology: Microbial growth patterns and kinetics in batch culture, Microbial growth parameters. Quantitative analysis of microbial growth by direct & indirect methods, Role of diffusion in Bioprocessing, Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Basic concepts of computer modelling and optimization in bioprocess applications.

UNIT-II

Bioreactor design: General requirements of fermentation process, types of fermentationand fermenters; batch, fed batch and continuous. Solid state and submerged fermentation. Microbial growth kinetics-Monod equation, Stoichiometry of cell growth-mass and energy balances, yield coefficients, growth limiting substrate and yield factors, factors of optimization, rheology of fermentation fluids, Oxygen transfer kinetics.

UNIT-III

Details of the process, parameters and materials - for industrial production of Antibiotics (penicillin, streptomycin and their derivatives), Biopharmaceuticals (Insulin/Interferon), Role of microbes in milk and dairy products, Food fermentation- bread, cheese, vinegar, yogurt, sour milk, oriental fermented foods. Production of starter culture (LAB) for dairy industries. Microbial biomass: Single cell proteins and myco-protein.

UNIT-IV

Biofertilizers and biopesticides Plant Growth Promoting Rhizobacteria (PGPR) – mycorrhiza, Mass production of biofertilizers and quality control. Biopesticides - microbial pesticides, Bioconversion of waste for fuels: production of CH_4, bioethanol, biogas and other hydrocarbons, biodiesel and H_2 as fuel by microbes; Immobilization of microbial enzymes and whole cells and their applications in industries. Industrial enzymes

production: Cellulases, Xylanases, Proteases, & Amylases

UNIT-V

Fundamentals of Bioentrepreneurship: decision making for starting a venture, sources of financial assistance, approaching the sources for loan, statutory and legal requirements of starting a company, assessment of market demand for product, developing distribution channels: pricing/ policies/ competition/ promotion/ advertising, negotiation strategy with various agencies, Humanresource development

Suggested Readings (Latest Editions):

1. Cruger, W. and Anneliese Cruger, A. 2005. Biotechnoloogy, A text book of industrial Microbiology, Panima Publishers, New Delhi, 2nd Edition
2. Casida, L.E. 2010. Industrial Microbiology, Willey Eastern Ltd, New Delhi, 1st Edition
3. Stanbury, P.F. and Whitaker, A. 2005. Principles of Fermentation Technology, Pergamon Press,Oxford, 2nd Edition
4. Okafar, N. 2007. Modern Industrial Microbiology and Biotechnology, 1st Edition

RB081001-ENVIRONMENTAL MICROBIOLOGY

Unit I:

Microbial Ecology versus Environmental Microbiology; Historical perspectives; Major fields and modern Environmental Microbiology; Overall role of microbes in ecosystem. Aeromicrobilogy and aquatic microbiology-Allergic disorders; Bioaerosols; Biowarfare agents; Air sampling of bioaerosols; Microbial growth patterns in aquatic environments.

Unit II:

Soil microbiology: Microbial diversity in surface soils; Microbial decomposition of organic matters; Microbial successions within and above the soil; Biogeochemical cycles- C, N, S, P, Fe, Mn, Hg,.

Unit III:

Microbiomics and microbial interactions: Normal microbiota of human body and microflora of ruminant's body; Microbes-Animals, Microbes-plant interactions; Phyllosphere, Rhizosphere, Endophytes, PGPM, Mycorrhiza.

Unit IV:

Microbial degradation, deterioration and bioremeadiation; Biodegradation of xenobiotics including pesticides and military chemicals (explosives and gases); Biocorrsion of metals; Microbe –metal interactions (bioleaching, biomining, biohydrometallurgy); Enhanced petroleum recovery; Integrated microbial bioremediation including oil spills; Role of biosurfactants.

Unit V:

Microbes and water potability- Purification of potable water; Sanitary analysis of water (indicator microbes and methods of their detection); Standards (tolerable levels) of water quality of faecal contamination. Microbes in solid waste and sewage management- Sanitary land fills and composting; Solid waste management in India; Methods of sewage management (composition ofsewage, small scale and modern sewage treatment methods – oxidation ponds, trickling filters, biodisc system); Measurement of water quality after sewage removal.

Suggested Readings (Latest Editions):

1. Sharma, P.D. (2016). Environmental Microbiology, Rastogi Publications.
2. Prakash S. Bisen (2014). Microbes in practice-I K international publication house pvtltd.
3. Prakash S. Bisen (2012). Microbes-concepts and applications Willey BlackWell Pub. 4.Pepper IL,
4. Gerba CP and Brusseau ML (2006). Environmental and Pollution Science. Academic Press. USA
5. Forster CF and John DA (2000). Environmental Biotechnology. Ellis Horwood Ltd. Publication.
6. Christon JH (Latest Edition). A Manual of Environment al Microbiology. ASM Publications.
7. Maier RM, Pepper IL and Gerba CP (2000). Environmental Microbiology. AcademicPress.

USA

8. Michel R (Latest Edition). Introduction of Environmental Microbiology.

ENVIRONMENTAL MICROBIOLOGY LAB

- Bacterial examination of water by multiple tube fermentation test.
- Counting of MPN number.
- Isolation and screening of cellulose degrading organism.
- Determination of biological oxygen demand of water.
- Effect of cleaning and sweeping of floors on the microbial population of labs.
- Isolation of air microorganism.
- Screening for amylase producing organisms
- Isolation of rhizobia from root nodule.
- Analysis of water for pH, turbidity, color, total dissolved solids.
- Identification and estimation of nitrate, arsenic, iron and alkanity in water.
- Microscopic studies of fresh water algae and protozoan.
- To check the pollution levels by collection of particulate settled on leaves at variousplaces in the city.

RB081002-AGRICULTURAL MICROBIOLOGY

UNIT – I

Microbes and Plant interactions: Rhizosphere-microbial flora, rhizosphere influence on plant growth, plant pathogens and rhizophere; ectotrophic and endotrophic microrrhizal associations and importance; phyllosphere- ecology of phyllosphere flora and importance. Spermosphere Nitrogen fixation : Ecology and biology of non-symbiotic and symbiotic nitrogen fixers, infection and nodulation, associative symbiosis, mechanism of nitrogen fixation, role of nitrogenase and hydrogenase, methods for evaluation of biological nitrogen fixation, significance of nitrogen fixation. Biofertilizers : Cultivation and mass production of Rhizobium and Azotobacter, phosphate

solubilizing bacteria, blue-green algae, carrier based inoculants. Methods of application.

UNIT – II

Decomposition of waste agricultural products : Microbiology and biochemistry of decomposition of cellulose, hemi-cellulose, starch, pectin, lignin, chitin. Factors governing the decomposition. Microbial pesticides for biocontrol of pests and pathogens : Introduction, useful microbes (bacteria, fungi and viruses), production, formulation, economics, safety, advantages and disadvantages. Principles of Plant Pathology : Brief history and development of plant pathology (contributions of pioneers). Types of plant diseases and their significance. Symptoms of plant diseases. Basic procedures in the diagnosis of plant diseases. Host-pathogen interactions-virulence factors of pathogens and defense mechanisms of plants against pathogens. Environmental effects on disease development and disease epidemiology. Control of plant diseases by various approaches.

UNIT – III

Plant diseases : Symptoms, etiology, epidemiology / disease cycle and control measures with reference to the following : Fungal : damping of seedlings, Phytopthora root and stem rots, downy mildew of grapes, powdery mildew of cucurbits, rust of groundnut, Fusarium wilts, red rot of sugarcane, tikka disease of groundnut, blast disease of rice. Bacterial : Citrus canker, blight of rice, angular leaf spot of cotton. Viral and viroid – rice tungro, sugarcane mosaic/ streak, potato leaf roll and spindle tuber viroid diseases, tomato/tobacco leaf curl, okra yellow vein mosaic, yellow mosaic of grain legumes, pigeon pea sterility mosaic, peanut bud and stem necrosis, citrus tristeza and yellow mosaic, papaya ringspot, banana bunchy top. Phytoplasmal : Little leaf of brinjal.

UNIT – IV

Diseases of animals (symptoms, etiology, pathogenesis, epidemiology and prevention and control) : Poultry : Viral-New castle, infectious bursal, Marek's, egg drop syndrome, avian influenza, infectious laryngotrachites; Bacterial – Avian pasteurellosis, salmonellosis; Fungal – Aspergillosis, Aflotoxicosis. Fish : Viral – infectious pancreatic necrosis, viral haemorrhagic septicemia, infectious haemorrhagic necrosis, Bacterial-Pseudomonas, Chondrococcus, Vibrio, Nocardial infections. Prawn: Viral-Monodon baculovirus, yellow head, white spot diseases; Bacterial – vibrio sp. and Pseudomonas sp. caused diseases; Fungus- Larval mycosis caused by Fusarium sp., Red disease caused by mycotoxins; Protozoa – Microsporidia, Zoothamnium caused diseases. Mulberry and

Silkworm diseases: Mulberry: Fungal – Leaf spot, powdery mildew, rust; bacterial blight. Silkworm: Viral-Nuclear polyhedrosis, cytoplasmic polyhedrosis; Bacterial – Septicemia, Sotto; Fungal- White and green muscardine, aspergillosis; protozoan- pebrine.

AGRICULTURAL MICROBIOLOGY LAB

- Isolation and characterization of microorganisms from soil
- Isolation and characterization of microorganisms from Water
- Isolation and characterization of microorganisms from air samples
- Isolation of halophiles/acidophiles/methanogens
- Isolation of Rhizobia from root nodule using Yeast Extract Agar Medium (YEMA).

RB081003- FOOD AND DAIRY MICROBIOLOGY

Unit I:

Important microbes involved in spoilage of food, meat, poultry, vegetables and dairy products; food preservation. Microbial deterioration of cereals, pulses, fish and sea-foods during storage; Common food borne pathogens, diseases caused by them and their symptoms, food borne illness, prevention and complication of food borne diseases outbreaks, epidemiology

Unit II:

Bacterial and mycotoxins, Important microbes secreting toxins, chemical nature of important toxins; their role in food poisoning; physiology and mechanism of action, modification and detoxification; prevention and control of toxin contamination.

Unit III-

Microbial biomass: Single cell proteins and myco-protein; Use of microbial enzymes in food;

Food quality monitoring, Fermented foods and traditional fungal foods (shoya, miso, tempe *etc.*). Fermented vegetable, meat and milk products (cheeses, butter and yoghurt).

Unit IV-

Use of microbial enzymes in food; low calorie sweeteners, Flavour modifiers; Food additives; Food quality monitoring, biosensors and immune-assays, Indian fermented foods.

Unit V-

Role of microbes in milk and dairy products**,** Microbiological examination of milk, standard plate count, direct microscopic count and reductase test, composition of milk, sources of contamination of milk, types of microbes in milk, pasteurization of milk, ability of milk to causedisease; Manufacture of cheeses, butter, yoghurt and fermented milk.

Suggested Readings (Latest Editions):

1. Butt, TM, Jackson CW and Magan N (2004). Fungi as Biocontrol agent. CABI Publishing,UK.
2. Adams (2004). Food Microbiology.
3. Prajapati (2007). Fundamentals of Dairy Microbiology.
4. John C, Ayres OM, William ES (2004). .Microbiology of Foods. W. H. Freeman and Co.
5. Robinson (Latest Edition). Dairy Microbiology.
6. Jay JM (2000). Modern Food Microbiology. Van Nostraaand Reinhold Co., New York.
7. Andrew Proctor (2011). Alternatives to conventional food processing, RSC pub.
8. Frazer WC and Westhoff DC (2014). Food Microbiology. Mcgraw Hill, New York.
9. B.D. Singh(2015). Biotechnology, Kalyani Publication

FOOD MICROBIOLOGY-LAB

- Isolation of Lactobacilli from curd or milk sample,
- Detection of number of bacteria in milk by SPC,
- Determination of quality of milk sample by methylene blue reductase test (MBRT),

Microbiological examination of different food samples;

- Production of Sauerkraut by microorganisms, Determination of antibacterial activity of lactic acid bacteria using agar well diffusion method.
- Statutory, recommended and supplementary tests for microbiological analysis of various foods: Baby foods, canned foods, milk and dairy products, eggs, meat, vegetables, fruits, cereals, surfaces, containers and water.

RB081004-MICROBIAL GENOMICS AND PROTEOMICS

Unit-I

Introduction to microbial genomics - sequencing genomes – first generation DNA sequencing – shot gun sequencing – second generation DNA sequencing – third and fourth generation DNA sequencing

Biological sequences as information – DNA, RNA and protein as informative molecules – general characteristics of microbial genomes – genome assembly – genome annotation – identification of an open reading frame in a genome.

Microbial genomes size and content – small genomes and large genomes – genomes of organelles – symbionts and organelles – eukaryotic microbial genomes an introduction: genomes of microbial parasites – the yeast genome.

Unit-II

Functional genomics: microarrays and transcriptomes – gene chips and gene expression and its applications – RNA sequence analysis – methods in proteomics – comparative genomics and proteomics – the interactome.

Culture independent studies of microorganisms – metagenomics: principles and applications – steps in construction of a metagenomes – examples of metagenomic studies – metagenomics as a tool to reveal the vast microbial diversity.

Unit III

Functional proteomics :Molecular analysis of gene expression (RTPCR)., CRISPR (CRISPR/Cas9)- Mechanism and applications.: Gene functions through protein interactions: Identification of Protein–Ligand Interactions. Combining yeast two-hybrid and phage display data, Detecting Interactions with Protein Fragment Complementation Assays. Mass

Spectrometry for Protein–Protein Interaction Mapping: Overview, Identification of substrates for E. coli GroEL, Studying the transcriptome and proteome of Escherichia coli and Saccharomyces cerevisiae.

Unit IV

Protein microarrays: overview, principle, limitations; Protein microarray Manufacturing technology, solid supports, different formats, experimental approach and detection, peptidomics; Microarray for protein-carbohydrate interaction (phage display technology); protein domain microarray; protein biochips; Antibody microarray; protein microarray for drug discovery

Suggested readings:

1. Madigan M.T., Bender K.S., Buckley D.H., Sattley W.M. and Stahl D.A. (2017) Brock Biology of Microorganisms, 15th Edn. (Global Edn.) Pearson Education.
2. Sanders E.R. and Miller J.H. (2010) I Microbiologist: A discovery based course in Microbial Ecology and Molecular Evolution, ASM press.
3. Fraser C.M., Read T. and Nelson K.E. (2004) Microbial Genomes, Springer.
4. Highlander S.K., Rodriguez-Valera F. and White B.A. (2015) Encyclopedia of Metagenomics: Environmental Metagenomics, Springer Science.
5. Dale J.W. and von Schantz M. (2007) From Genes to Genomes: Concepts and Applications of DNA Technology, 2nd Edn. Wiley publishers.
6.Protein Microarrays, edited by Mark schena, Jones and Bartlet pblisher, 2005.
7.Microbial Functional Genomics, Jizhong Zhou, Dorothea K. Thompson, Ying Xu, James M. Tiedje, A John Wiley & Sons, Inc., Publication, 2004.
8.Microarrays for an Integratiul J. But. Kho and Atte, Published in India by Ane Books, 2003.
9.Gene Cloning and DNA analysis An Introduction, Sixth Edition, T. A. Brown, Wiley Blackwell publications, A John Wiley & Sons, Inc., Publication,2010.

RB081005-INDUSTRIAL MICROBIOLOGY

Unit I

Introduction and scope of industrial microbiology; Biology of industrially important microbes (metabolic pathways and control mechanisms); Isolation and selection of industrially important

microorganisms; Genetic improvement of microbes; Preservation and maintenance of microbial cultures.

Unit II

Microbial substrate- Media formulation, Optimization of media; Cell growth kinetics: Kinetics of substrate utilization, biomass production and product formation in batch, fed batch and continuous cultivations; Kinetics of death of microorganisms

Unit III

Types of fermentation processes; Solid state, Static and submerged fermentations; Design of laboratory bioreactor; Types of Bioreactor: Stirred tank reactor, bubble column reactor, Airlift reactor, Packed bed reactor, Fluidized bed reactors; Scale-up principles; Instrumentation and control of bioprocesses; Downstream process; Fermentation economics.

Unit IV

Types of microbial products; Production of Biomass: Bake's Yeast, Mushroom, Single cell proteins, Biopesticides and biofertilizers; Production of primary metabolites: Ethanol; organic acids; Amino acids; Vitamins; Bioplastics; Industrial enzymes. Production of secondary metabolites: Antibiotics (penicillin, cephalosporins, streptomycin, etc), Pigments, Microbial transformation, Production of metabolites of non-microbial origin eg Insulin, Interlukin, Cytokines etc using rDNA technology. Designer microbes using synthetic genome.

Unit V

Strain development strategies. Environmental factors and genetic factors for improvement. Immobilization methods: Absorption, covalent linkage, entrapment and cross linkage, types of carriers, advantage and disadvantages.

Suggested readings:

1. Stanbury P. F., A. Whitaker, S. J. Hall. Principles of Fermentation Technology Publisher:

Butterworth-Heinemann
2. Shuler M.L. and F. Kargi: Bioprocess Engineering Basic Concepts by Publisher Prentice Hall.
3. Vogel H.C., C.L. Todaro, C.C. Todaro: Fermentation and Biochemical EngineeringHandbook: Principles, Process Design, and Equipment by Publisher: Noyes Data Corporation/ Noyes Publications.
4. W. Crueger and A.Crueger: Biotechnology. A Textbook of Industrial Microbiology, Publisher : Sinauer Associates.
5. Prescott and Dunn's Industrial Microbiology.Publisher: Gerald Reed: Books.

INDUSTRIAL MICROBIOLOGY-LAB

- Isolation of industrially important microorganism from different sources using specificsubstrates;
- Design and Preparation of Media for Bioprocesses;
- Growth curve studies of bacteria/Yeasts in batch culture and calculation of maximumspecific growth rate;
- To study the various methods of biomass measurement;
- Production of ethanol from sucrose by yeast;
- Determination of yield coefficient and Monod‟s constant and metabolic quotient of E.coliculture on glucose.;
- To study the design of fermenter and its working;
- Production of citric acid using sucrose and molasses;
- Production of extracellular enzymes ;
- Ethanol production using immobilized yeast culture.

RB081006-BIOENTREPRENEURSHIP

UNIT I

Principles of Management: Introduction, Definition: Principles and decisions on starting a venture, Sources of financial assistance: Making a business proposal, approaching loan from bank and other financial institutions, budget planning and cash flow management, Basics in accounting practices: Balance sheet, P & L account, double entry book keeping, estimation of income, expenditure, profit, income tax.

UNIT II

Human Resource Development (HRD): Recruitment and selection process, Leadership skills, Managerial skills, Organization structure, Training, Team building, Team work; Marketing: Assessment of market demand for potential products of interest; Market conditions, segments, prediction of market changes, Identifying needs of customers including gaps in the market.

UNIT III

Entrepreneur: Meaning of entrepreneur, Evaluation of the concept, function of an entrepreneur types of entrepreneur, evolution of entrepreneurship, development of entrepreneurship, stages in entrepreneurial process, role of entrepreneurs in economic development in India; Entrepreneurship- its barriers.

UNIT IV

Small scale industry: Definition, characteristics, need and rationale, objectives, scope, role of SSI in economic development, advantages of SSI, steps to start an SSI- Government policy towards SSI, different policies of SSI, Government support for SSI during 5 year plans. Impact of liberalization, privatization, globalization on SSI, effect of WTO/ GATT, supporting agencies of Government for SSI, meaning & nature of support, objectives and functions, types of help, Definitions: ancillary industry and tiny industry.

UNIT V

Institutional support: Different schemes, TECKSOK, KIADB, KSSIDC, KSIM, DIC single window agency SISI, SIDBI, KSFC. Preparation of project: Meaning of project; Project identification project selection. Project report, need and significance of report, contents, formulation, guidelines by Planning Commission for Project report; Network analysis; Errors of project report, Project appraisal, Identification of Business Opportunities, Market feasibility study, Technical feasibility study, Financial Feasibility study & Social feasibility study.

References

1. Tripati PC, Reddy PN. Principles of Management, Tata Mc Graw Hill.
2. Vasant Desai. Dynamics of Entrepreneurial Development & Management, Himalaya Publishing House
3. Poornima M Charanthmath. (2005). Entrapreneurship Development – Small Business Enterprises, Pearson Education – (2&4)
4. Robert Lusier, Management Fundamentals – Concepts, Application, Skill Development, Thomson.
5. Khanka SS, Entrepreneurship Development, S Chand & Co.
6. Stephon Robbins. (2003). Managemen, 17th Edition, Pearson Education/ PHI
Web sources
1. https://www.edx.org/learn/entrepreneurship
2. https://elearningindustry.com/entrepreneurship-and-elearning-top-5-elearning-options-newbie-entreprene
3.https://www.startupindia.gov.in/content/sih/en/reources/l-d-listing.html
4. https://swayam.gov.in/nd2_cec19_mg39/preview
5. https://nptel.ac.in/courses/110/106/110106141/
6. https://www.coursera.org/browse/business/entrepreneurship