From,

Subject Experts in Microbiology,

Department of Microbiology.

M.V.R. Degree College.

To,

Prof. Y. Nazeer Ahammed,
Secretary,
APSCHE,
Andhra Pradesh.

Sub: Submission of B.Sc. Honors Major and Minor MICROBIOLOGY syllabi

- MICROBIOLOGY - Regarding.

Respected Sir,

Ref: Lr.No.Rc.No. APSCHE/AC/CBCS/Gen UG/4™Y1/2023, Dated 18.1.2023.

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With reference to the above, as per the guidelines given by APSCHE, the subject

experts, Dr.P.V.D. SOUJANAYA KUMARI , Associate Professor, Dept. of. Microbiology, M.V.R. Degree Collegeand Dr.B.Santhdevi, Lecturer in Microbiology, GDC, Srikakulam, framed the B. Sc. Honors Major and Minor Microbiology syllabi andsubmitting the same to the Secretary of APSCHE and to the Dean of Academic Affairs.

This is for your approval and further necessary action.

Thanking you.

Yours sincerely,

PVDSoujanya Kumari

Dr. P.V.D. SOUJANAYA KUMARI
Head of the Department
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Copy to: The Dean of Academic Affairs, AU, VSP.

ANDHRA PRADESH STATE COUNCIL FOR HIGHER EDUCATION
B.SC. (HONS) SYLLABUS UNDER CBCS W.E.F. 2023-2024

Subject: Microbiology

Semester	Major Courses	Minor Courses
II	C3:Introduction to microbiology	C3:Introduction to microbiology
	C4 : Bacteriology and Virology	
III	C5: Eukaryotic microorganisms	
	C6: Biomolecules & Enzymology	C6: Biomolecules & Enzymology
	C7: Microbial and Analytical Techniques	
	C8: Cell biology and genetics	
IV	C9:Molecular Biology and Microbial genetics	C9:Molecular Biology and Microbialgenetics
	C10:Microbial Physiology and Metabolism	C10:Microbial Physiology and Metabolism
	C11: r DNA technology, Biostatistics &Bioinformatics	
	Any two of the following sets(SKILL ENHANCEMENT)	**Any one of the following (SKILL ENHANCEMENT)**
V	C12:Immunology & Medical Microbiology and C13:Applied Microbiology	C12:Immunology &Medical Microbiology and C13:Applied Microbiology
	C14: Industrial Microbiology and C15: Food and Dairy Microbiology	C14: Industrial Microbiology and C15: Food and Dairy Microbiology
	C16: Pharmaceutical Microbiology and C17:Diagnostic Microbiology	
	C18:Agricultural Microbiology and C19:Environmental Biotechnology	

ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION
REVISED UG SINGLE MAJOR SYLLABUS UNDER CBCS
(Implemented from Academic Year 2023- 24)
PROGRAMME: B. Sc (Honors) in Microbiology
Major Subject: MICROBIOLOGY
SEMESTER -II

MB C3 - INTRODUCTION TO MICROBIOLOGY
MINOR COURSE

I. Course Outcomes:

On successful completion of the course, the students will be able to

1. Understand the historical significance of microbiology and the contributions of key scientists.
2. Recognize the classification of microorganisms and their place in the living world.
3. Comprehend the scope and applications of microbiology, including the origin of microbial life and the distinction between eukaryotic and prokaryotic cells.
4. Describe the characteristics of bacteria, archaea, fungi, algae, and protozoa.
5. Describe viruses, including their nature, composition, and diversity in structure.
6. Develop practical skills in aseptic techniques, growth media preparation, isolation methods, and the identification of bacteria and fungi.

II Syllabus: (Total Teaching Hours: 45)

Unit - 1: History of Microbiology **No. of Hours: 10**

1. Discovery of Microscope and microbial world by Anton von Leeuwenhoek; Aseptic techniques with reference to Charak Samhita, Sushruta Samhita and Ignaz Philipp Semmelweis

2. Golden era of Microbiology- Refutation of abiogenesis; Germ theory of Disease; Discovery of vaccination; Discovery of penicillin

3. Major contributions of Scientists: Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Ivanowsky, Martinus Beijerinck and Sergei Winogradsky

Unit - 2: Place of Microorganisms in the living world **No. of Hours:10**

1. Haeckel's three Kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woese

2. Definition and scope of Microbiology; Applications of Microbiology; Diverse groups of Microorganisms

3. Origin of microbial life on earth- Timeline, Miller's Experiment, endosymbiosis (cyanobacteria), distinguishing features of eukaryotic and prokaryotic cell

Unit - 3: Prokaryotic microorganisms and Viruses **No. of Hours:10**

1. General characteristics of Bacteria (Morphology, metabolic diversity and reproduction)

2. General characteristics of Archaea differentiating them from Bacteria

3. General characteristics of viruses (Nature, composition, size, host specificity, diversity in structure)

Unit - 4: Eukaryotic microorganisms **No. of Hours: 10**

1. Fungi - Habitat, nutrition, vegetative structure and modes of reproduction;

2. Algae- Habitat, thallus organization, photosynthetic pigments, storage forms of food, reproduction.

3. Protozoa–Habitat, cell structure, nutrition, locomotion, excretion, reproduction, encystment.

Unit - 5: Growing Microbes in Lab: Five I's **No. of Hours:05**

1. Inoculation-Aseptic methods of introducing inoculum to growth media; Composition of basic growth media, solid and liquid

2. Incubation and Isolation- Ambient temperature for growth of microorganisms; Concept of Pure culture, mixed culture and contaminated culture

3. Inspection and Identification - Observation of colour, size and shape of colonies; Wet mount and simple staining of bacteria and fungi

III. Skill Outcomes:

1. Implement safety protocols, handling hazardous materials, and practicing personal protective measures.

2. Identify microscope parts, adjusting focus and diaphragm, and accurately observing and documenting microscopic images.

3. Prepare smears, identifying different microorganisms, and interpreting microscopic characteristics.

4. Analyze electron micrographs, identifying virus types, and describing their morphology and size.

5. Operate Autoclave, Hot Air Oven, and Laminar Air Flow Chamber for sterilization and decontamination purposes.

IV. Practical Syllabus: Hours 2 hours per week = 30 hours

1. Good Laboratory Practices and Biosafety
2.Compound Light microscope -Parts and its handling
3.Microscopic observation of bacteria, Algae and Fungi and protozoa
4.Observation of electron micrographs of viruses (Lambda, T4, TMV, HIV, SARS CoV-2, Polio)
5.Laboratory equipment -Working principles of Autoclave, Hot air oven, Laminar airflow chamber

V. References:

1. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (1993). Microbiology. 5th Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi.
2. ·Dube, R.C. and Maheswari, D.K. (2000) General Microbiology. S Chand, New Delhi. Edition), Himalaya Publishing House, Mumbai.
3. Prescott, M.J., Harley, J.P. and Klein, D.A. (2012). Microbiology. 5th Edition, WCB McGraw Hill, New York.
4. Reddy, S.M. and Reddy, S.R. (1998). Microbiology Practical Manual, 3 rd Edition, Sri Padmavathi Publications, Hyderabad.
5. Singh, R.P. (2007). General Microbiology. Kalyani Publishers, New Delhi.
6. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). General Microbiology, 5th Ed.,Prentice Hall of India Pvt. Ltd., New Delhi.
7. Jaya Babu (2006). Practical Manual on Microbial Metabolisms and General Microbiology. Kalyani Publishers, New Delhi.
8. Gopal Reddy et al., Laboratory Experiments in Microbiology

VI. Co-Curricular Activities:

1. Establish a Microbiology Club where students can come together to discuss and explore various topics related to microbiology.

2. Organizing microbiology-themed events like microbiology day

3 Poster presentations, oral presentations, and Q&A sessions.

4. Field Trips to Microbiology-related Sites

5. Establish a Microbiology Journal Club where students can review and discuss scientific articles related to microbiology.

ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION
REVISED UG SINGLE MAJOR SYLLABUS UNDER CBCS
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PROGRAMME: B.Sc (Honors) in Microbiology
Major Subject : MICROBIOLOGY
SEMESTER-II

MB C4: BACTERIOLOGY AND VIROLOGY

I. Learning Outcomes:

On successful completion of the course, the students will be able to

1. Understand the concept of prokaryotic diversity and taxonomy.
2. Identify and describe the salient features of various bacterial groups
3. Comprehend the discovery, nature, and definition of viruses.
4. Describe the replication processes of specific viruses
5. Comprehend the concept of oncogenic viruses, and role of viruses in the ecosystem.

II Syllabus : (Total Teaching Hours : 45)

Unit -1: Bacterial Taxonomy and Ultrastructure **No. of Hours: 9**

1. Introduction to prokaryotic diversity and taxonomy. Types of classification- Numerical and Phylogenetic
2. Introduction to Bergy's manual of Systematic Bacteriology
3. Non-Culturables and Metagenomics
4. Ultrastructure of a Bacterial Cell-Invariable components -cell wall, Structure and/Functions of cell membrane, cytoplasm, nucleoid; Variable components- plasmid, inclusion bodies, flagella (structure and arrangement), pili, capsule, endospore.

Unit - 2: Type studies of Bacteria and Archae **No. of Hours:9**

1. Salient features of:

a) Photosynthetic bacteria - Purple bacteria, Green bacteria and *Anabaena*

b) Gliding bacteria - Myxobacteria and Cytophaga group

c) Filamentous -Actinomycetes

d) Spore forming bacteria - Bacillus and Clostridia

e) Miscellaneous - Mycoplasma, Rickettsia, Chlamydia

2. Salient features of Fermentative bacteria, Sulphur bacteria, Nitrogen fixing bacteria
3. Salient features of Extremophiles- Methanogens and halobacteria.

Unit - 3: General Properties and Classification of Viruses **No. of Hours:9**

1. Discovery of viruses, Nature and definition of viruses, general properties
2. Heirarchy of ICTV nomenclature
3. Outline of Baltimore system of classification.
4. Cultivation of Viruses, Virus Purification and Assay.

Unit - 4: Replication of Viruses **No. of Hours:9**

1. General features of Viral Replication

2. Replication of T4, lambda, TMV , HIV

3. Replication of Polio, Influenza, Adeno Viruses

Unit - 5: Pathogenic and other Viruses **No. of Hours:**9

1. Defective Viruses- viroids, virusoids, satellite viruses and Prions.
2. Emergence of Viral Pathogens, Introduction to Oncogenic viruses, Concept of Oncogenes and Protooncogenes
3. Role of viruses in Ecosystems; Applications in Biotechnology

III. Skill Outcomes:

On successful completion of the course, the students will be able to

1. Develop practical skills in the isolation, identification, and cultivation of bacteria.
2. Acquire knowledge about the preparation of growth media and study host-pathogen interactions.
3. Gain the ability to examine the bacteria through microscopy.
4. Demonstrate proficiency in isolating bacteria from natural environment

IV. Practical Syllabus: Hours 2 hours per week = 30 hours

1. Study of bacteria by colony observation and staining-simple, gram
2. Observation of motility and capsule
3. Isolation of bacteria using Winogradsky column and observation
4. Study of viruses (Bacteriophage, TMV and HIV) using micrographs
5. Isolation and enumeration of bacteriophages (PFU) from water/sewagesample using double agar layer technique.
6. Studying isolation and propagation of animal viruses by chick embryo technique.
7. Study of cytopathic effects of viruses using photographs.
8. Perform local lesion technique for assaying plant viruses.

V. References:

1. Prescott, M.J.,Harley,J.P.andKlein,D.A.Microbiology. 5th Edition WCB Mc GrawHill, New York, (2002).
2. Tortora, G.J., Funke ,B.R. and Case, C.L. Microbiology : An Introduction. Pearson Education, Singapore, (2004).
3. Alcomo,I.E.FundamentalsofMicrobiology.VIEdition, JonesandBartlettPublishers.Sudbury.Massachusetts, (2001).
4. BlackJ.G.Microbiology-Principlesand Explorations.JohnWiley&SonsInc.NewYork, (2002).
5. Tom Besty,D.C Jim Koegh.Microbiology Demystified McGRAW-HILL.
6. Christopher Burrell Colin Howard Frederick Murphy. Fenner and White's MedicalVirology 5th Edition.Academic Press

VI. Co-Curricular Activities:

1. Invite guest speakers, to provide insights into the latest advancements and emerging trends in bacteriology and virology.

2. Conduct laboratory workshops that allow students to gain hands-on experience in bacterial culture techniques

3. Case Study Competitions: Organize case study competitions where students can work in teams to analyze and solve hypothetical cases related to bacteriology and virology

4. Arrange field trips to microbiology research facilities, such as government labs, industrial settings, or healthcare institutions

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Major Subject : MICROBIOLOGY
SEMESTER -III

MB C5: EUKARYOTIC MICROORGANISMS

I. Course Outcomes:

On successful completion of the course, the students will be able to

1. Understand the characteristics, classification, and reproductive mechanisms of fungi, algae, and protozoa.
2. Recognize the importance of fungi in biotechnology, including their roles in food production, medicine, and agriculture.
3. Comprehend the significance of algae in various industries, the environment, and as a source of food.
4. Identify pathogenic protozoa and understand their impact on human health and the environment.

II. Syllabus : (Total Teaching Hours : 45)

Unit 1: Fungi No. of Hours:9

1. Habitat, distribution, nutritional requirements, fungal cell ultra-structure, fungal wall, Outline classification of Fungi

2. Reproduction in different fungal groups- Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes

3. Heterokaryosi s, heterothallism and parasexual mechanism.

4. Fungal dimorphism (Candida albicans)

Unit 2: Importance of Fungi No. of Hours:9

1. Role of fungi in biotechnology: food, medicine and pharmaceutical industry (baking, brewing, antibiotics, alcohols, enzymes, organic acids, and pharmaceuticals)

2. Beneficial Role of fungi in Agriculture: Biofertilizers, Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides).

3. Mushrooms and its cultivation. (White button, Milky and Oyster)

4. Fungi as plant and animal pathogens (Cercospora, Puccinia, Candida, Aspergillus)

Unit 3: Algae **No. of Hours:9**

1. Algae- occurrence, thallus organization, algae cell ultra-structure, pigments, flagella, eyespot food reserves, outline classification

2. Vegetative, asexual and sexual reproduction in Algae

3. Photosynthetic apparatus, and outline of Photosynthesis in Algae

Unit 4: Importance and cultivation of Algae **No. of Hours:9**

1. Importance of algae in agriculture, industry, environment and food with examples.

2. Algal culture techniques- Indoor, Outdoor, Closed, Open, Batch, continuous, Fed batch

3. Culture media and growth parameters for algal cultivation (Spirulina)

Unit 5: Protozoa **No. of Hours:9**

1. General characteristics with special reference to Amoeba, Paramecium
2. Pathogenic Protozoa- Plasmodium, Leishmania and Giardia
3. Importance of protozoa (in waste management, soil fertility, industry and scientific study)
4. Culturing protozoans from natural sources-Hay water, pond water, Chalkley's solution
5. Haplobiontic (Nemalion), Haplontic (Chlamydomonas), Diplontic (Cladophora), Diplobiontic (Polysiphonia) and Diplohaplontic (Cladophora) life cycles. deleted

III. Skill Outcomes:

On successful completion of the course, the students will be able to

1. Develop practical skills in the isolation, identification, and cultivation of

fungi and algae.
2.Acquire knowledge about the preparation of growth media and study host-pathogen interactions.
3.Gain the ability to examine the vegetative and reproductive structures of selected genera through microscopy.
4.Demonstrate proficiency in purifying and preserving pure cultures of common algae and fungi.

IV. Practical Syllabus: Hours 2 hours per week = 30 hours

1. Preparation of Potato Dextrose Medium.
2. Isolation and identification of pathogenic and non-pathogenic fungi.
3. Study of host-pathogen interaction.
4. Study of the vegetative and reproductive structures of following genera through temporary and permanent slides: *Mucor, Saccharomyces, Penicillium, Agaricus* and *Alternaria*
5. Purification and preservation of pure cultures of common algae and fungi.

V. References

1. Alexopoulus, C.J., Mims,C.W. and Blackwel, M, Introductory Mycology. John Wiley,New York.
2. Mehrotra, R.S. and K.R.Aneja An Introduction to Mycology. New Age International press, New Delhi
3. Webster, J. Introduction to fungi. Cambridge University Press. Cambridge, U.K. (1985).
4. Bessey E.A. Morphology and Taxonomy of fungi. Vikas Publishing House Pvt. Ltd.,New Delhi.
5. Jhon Webster and R W S Weber. Introduction to Fungi. Cambridge University Press2007.
6. A. V. S. S. .Sambamurty. A Textbook of Algae. I.K. International Publishing House Pvt.Limited, 2010
7. H.D. Kumar and H.N. Singh.A Textbook on Algae (Macmillan international collegeedition)

VI. Co- Curricular Activities

1. Conduct hands-on microscopy workshops using to observe eukaryotic microorganisms
2. Organize field trips to natural habitats, such as forests, ponds, or marine

environments, where eukaryotic microorganisms thrive.

3Arrange culturing workshops where students can learn how to isolate and culture eukaryotic microorganisms in the laboratory.

4. Eukaryotic Microorganism Photography Contest

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Major Subject: MICROBIOLOGY
SEMESTER -III

MB C5 BIOMOLECULES AND ENZYMOLOGY
MINOR COURSE

I. Course Outcomes:

On successful completion of the course, the students will be able to

1. Understand the classification and properties of carbohydrates, including monosaccharides, disaccharides, polysaccharides, and sugar derivatives.
2. Gain knowledge of lipids and fatty acids, including their classification, structures, functions, and their role in cell signaling and metabolism.
3. Comprehend the structure and functions of amino acids and proteins, including their primary, secondary, tertiary, and quaternary structures.
4. Learn about the structure and functions of nucleic acids, including DNA and RNA, as well as the concept of base composition and nucleic acid-protein interactions. They will also be introduced to the role of vitamins in metabolism.
5. Understand the structure of enzymes, enzyme classification, and mechanisms of action. They will also learn about the factors influencing enzyme activity and various types of enzyme inhibition.

II Syllabus : (Total Teaching Hours : 45)

UNIT-I: Carbohydrates — No. of hours: 9

1. General characters and outline classification of Carbohydrates
2. Monosaccharides- Glucose, fructose, ribose; Stereo isomerism of monosaccharides, epimers, mutarotation and anomers of glucose
3. Disaccharides- concept of reducing and non-reducing sugars; Sucrose, Lactose
4. Polysaccharides- Storage -Starch, glycogen, Structural-Cellulose peptidoglycan and chitin
5. Sugar derivatives- glucosamine.

UNIT-II: Lipids and fatty acids — No. of hours: 9

1.Definition and classification of lipids. Structure and properties of lipids. Importance of lipids in biological systems.

2.Introduction to fatty acids: definition, structure, and nomenclature. Saturated and unsaturated fatty acids.

3.Triglycerides: structure, function, and metabolism.
Phospholipids: structure, function, and role in cell membranes.
Steroids: structure, biosynthesis, and physiological roles.
Waxes: structure, functions, and applications.

UNIT-III: Amino acids and Proteins. No. of hours:9

1. Biochemical structure and notation of standard protein amino acids
2. General characteristics of amino acids and proteins.
3. Primary, secondary, tertiary and quaternary structures of Protein
4. Non protein amino acids: Gramicidin, beta-alanine, D-alanine and D-glutamic acid.

UNIT-IV: **Nucleic acids and Vitamins No. of hours:9**

1. Structure and functions of DNA and RNA.
2. Base composition. A+T and G+C rich genomes. Basic concept of nucleic acids protein interactions.
3. Concept and types of vitamins and their role in metabolism.

UNIT-V: Enzymes No. of hours: 9

1. Structure of enzyme, Apoenzyme and cofactors, prosthetic group-TPP, coenzyme -NAD, metal cofactors; Definitions of terms – enzyme unit, specific activity and turnover number

2. Classification of enzymes, Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis.

3. Effect of pH and temperature on enzyme activity.
4. Inhibition of enzyme activity- competitive, noncompetitive, uncompetitive and allosteric.

III. Skill Outcomes:

On successful completion of the course, the students will be able to

1. Qualitatively Identify mono and disaccharides
2. Qualitatively Identify specific aminoacids
3. Quantitatively estimate DNA
4. Quantitatively estimate protein

IV. Practical Syllabus: Hours 2 hours per week = 30 hours

1. Qualitative tests for sugars
2. Qualitative Analysis of Aminoacids.

3. Colorimetric estimation DNA by diphenylamine method.
4. Colorimetric estimation of proteins by Biuret/Lowry method

V. References:

1. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications,Iowa, USA.
2. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2 nd Edition, CBS Publishers and Distributors, New Delhi.
3. Sashidhara Rao, B. and Deshpande, V. (2007). Experimental Biochemistry: A student Companion. I.K. International Pvt. Ltd.
4. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
5. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons
6. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York.

VI. Co-Curricular Activities:

1. Organize Biomolecule Modeling Workshops where students can learn to build physical models or use computer simulations to visualize biomolecules such as proteins, nucleic acids, carbohydrates, and lipids. These workshops can help students understand the three-dimensional structures and interactions of biomolecules, enhancing their comprehension of molecular biology concepts.

2. Assign Biomolecule and Enzyme Case Studies case studies that require students to analyze real-world scenarios related to biomolecules and enzymes in medicine, biotechnology, or environmental science.

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Major Subject: MICROBIOLOGY
SEMESTER -III

MB C7: MICROBIAL AND ANALYTICAL TECHNIQUES

I . Course Outcomes:

On completion of the course, the students will be able to

1. Understand the principles and applications of microscopy techniques, including bright field microscopy and electron microscopy (SEM and TEM), as well as staining techniques.
2. Know various sterilization and disinfection techniques, including physical methods (dry heat, moist heat, filtration, radiation) and chemical methods (disinfectants, alcohols, aldehydes, fumigants, phenols, halogens, heavy metals).
3. Perform pure culture isolation, maintenance and preservation of cultures, cultivation of anaerobic bacteria, and accessing viable non-culturable bacteria (VNBC).
4. Understand the principles and applications of spectrophotometry and chromatography techniques, including UV-visible spectrophotometry, colorimetry, turbidometry, paper chromatography, and column chromatography.
5. Gain knowledge of centrifugation principles and applications, electrophoretic techniques (agarose and SDS polyacrylamide gel), and the principles and applications of radioisotopes.

II. Syllabus : (Total Teaching Hours : 45)

Unit -1: Microscopy — No. of Hours: 9hrs

1 Microscopy: Principle, mechanism and applications of Bright field microscope.
2 Principle, mechanism and applications of electron microscope (SEM and TEM). Micrometry.
3 Staining Techniques – Simple, negative and Differential staining techniques (Gram staining, spore staining, Acid fast staining).

Unit-2: Sterilization and disinfection techniques — No. of Hours: 9hrs

1Sterilization, Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Virucide, Bacteriostatic and Bactericidal agent.
2 Physical methods of microbial control: Dry heat-Incineration, Hot air

oven; Moist heat- Pressure cooker, autoclave; Filter sterilization- laminar air flow, Membrane filter; Radiation methods – UV rays, Gamma rays.
3 Chemical methods of microbial control: disinfectants, types and mode of action- alcohols, aldehydes, fumigants, phenols, halogens and heavy metals.

Unit -3: Microbiological techniques No. of Hours: 9hrs

1 Pure culture isolation: Streaking, serial dilution and plating methods, micromanipulator; cultivation.
2 Maintenance and preservation/stocking of pure cultures: sub culturing, overlaying cultures with mineral oils, lyophilization, sand cultures, storage at low temperature, Culture collection centers(MTCC, ATCC, DSMZ);
3 Cultivation of anaerobic bacteria; Accessing Viable non-culturable bacteria (VNBC). Buffers in culture medium. Cultivation of fungi, Actinomycetes, yeasts.

Unit-4: Spectrophotometry & Chromatography No. of Hours: 9

1 Spectroscopy – Principles, laws of light absorption, Instrumentation and applications of UV- visible spectrophotometer. Colorimetry and turbidometry.
2 Chromatography: Principles and applications of paper chromatography (Ascending, Descending and 2-D), Thin layer chromatography.

3 Principle and applications of column chromatography (Partition, adsorption, ion exchange, exclusion and affinity chromatography). Column packing and fraction collection.

Unit - 5: Centrifugation, Electrophoresis & Radio isotopes No. of Hours:9

1 Centrifugation-Principles, types and applications.

2 Electrophoretic technique (agarose and SDS polyacrylamide gel) its Components, working principle and applications

3 Radioisotopes– characters and applications of radioisotopes, principle of autoradiography.

III. Skill Outcomes:

On successful completion of the course, the students will be able to

1. Recognize different microscopy techniques, identify microbial cell structures, interpret micrograph images, and understanding the principles of image contrast.
2. Prepare stained slides, differentiate stained and unstained structures, recognizing staining techniques, and describing the staining characteristics

of microbial cells.

3. Perform the staining procedure, distinguishing between Gram-positive and Gram-negative bacteria, recognizing the importance of Gram's staining in bacterial classification, and interpreting Gram-stained slides.

4. Understand sterilization principles, operate autoclave and hot air oven, implement proper sterilization protocols, ensure sterility of media and glassware, and recognize the importance of sterile techniques in microbiology.

5. Understand streaking techniques, perform streak plate method, obtain isolated colonies, recognize contamination, and demonstrate proficiency in maintaining pure cultures for further study.

IV. Practical Syllabus: Hours 2 hours per week = 30

1. Study of bright field, dark field and phase contrast, Electron microscope micrographs to visualize microbial cells.
2. Simple staining & Negative staining.
3. Gram's staining.
4. Sterilization of medium using Autoclave, Sterilization of glassware using Hot Air Oven.
5. Isolation of pure cultures of bacteria by streaking method.
6. Isolation of bacteria from natural habitat by spread and pour plate method (using serial dilution method)
7. Separation of monosaccharides/amino acids by paper/thin layer chromatography.
8. Demonstration of column packing in gel filtration chromatography.
9. Determination of absorption max for an aromatic amino acid.
10. Separation of bacterial cells (cell pellet) from broth culture by using a laboratory scale centrifuge.
11. Separation of DNA fragments by Agarose gel electrophoresis.

V References:

1. Pelczar M., Chan E.C.S. and Krieg, N.R. Microbiology. Tata Mc Grew Hill Publishing Co. Ltd., New Delhi.
2. Stainier R.V., Ingraham, J.L., Wheelis, M.L. and Painter P.R. The Microbial World. Printice-Hall of India (Pvt.) Ltd., New Delhi

1. Wilson& Walker. Principles and Techniques in Practical B i o c h e m i s t r y . 5th Edition

Cambridge University Press (2000).

2. Murphy D.B. Fundamental of Light Microscopy & Electron Imaging.1st Edition. Wiley Liss. (2001).
3. K L Ghatak. Techniques and Methods In Biology PHI Publication (2011)
4. Pranav Kumar. Fundamentals and Techniques of Biophysics and Molecular Biology (2016)
5. Aurora Blair. Laboratory Techniques & Experiments in Biology.Intelliz Press
6. D.T Plummer. An Introduction to Practical Biochemistry. McGraw Hill Publication 1987
7. Beckner, W.M., Kleinsmith L.J and Hardin J. The world of cell. IV edition

Benjamin/Cummings (2000)

VI. Co-Curricular Activities:

1. Competition in performing laboratory techniques like staining
2. Artwork with bacteria or fungi in petridish
3. Quiz in identifying microscopic technique in various micrographs

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PROGRAMME: B.Sc (Honors) in Microbiology
Major Subject: MICROBIOLOGY
SEMESTER -III

MB C8: CELL BIOLOGY AND GENETICS

I. Course Outcomes:

By the Completion of the course the learner should able to–

1. Understand cell theory, cell organelles, the cell cycle, and the role of the cytoskeleton.
2. Students will comprehend the structure and functions of the cell membrane, nuclear envelope, and nucleolus, as well as gain basic knowledge of cancer development.
3. Learn about protein sorting, intracellular signal transduction pathways, programmed cell death, stem cells, and specialized chromosomes.
4. Gain knowledge of Mendelian genetics, including mono-hybrid and dihybrid crosses, inheritance patterns, and allele frequencies.
5. Understand the concepts of linkage, crossing over, the Hardy-Weinberg Law, natural selection, genetic drift, and the mechanisms of sex determination and inheritance.

II Syllabus: (Total Teaching Hours: 45)

Unit 1 **Hours : 09**

1. Cell theory and cell organelles (Mitochondria, Chloroplasts, Lysosomes, Glyoxysomes and Peroxisomes, Golgi apparatus and ER).
2. Cell cycle and its regulation.
3. Cytoskeleton: Structure and organization of actin, myosin and intermediate filaments, microtubules, and their role.

Unit 2 **Hours : 09**

1. Structure and functions Cell membrane, proton pumps associated (Na-K, Cacalmodulin etc. and their distribution), phagocytosis, pinocytosis, exocytosis.
2. Nuclear envelope, structure of nuclear pore complex, nuclear lamina, transport across nuclear membrane, Nucleolus.
3. Elementary knowledge of development and causes of cancer; Oncogenes and suppressor genes,

Unit 3 **Hours : 09**

1. Protein sorting and Transport Intracellular signal transduction pathways (GPCR , ERK Pathway, mTOR Signaling)
2. Programmed Cell Death; Stem cells.

3. Specialized chromosomes (polytene, lampbrush)

UNIT 4 **Hours : 09**

1. Mendalien Genetics , Mono hybrid and Dihybrid cross , Law of dominance segregation and Independent assortment.
2. Chromosome theory of inheritance, Pedigree analysis, Incomplete dominance and co-dominance,
3. Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Allele frequencies, Genotype frequencies.

Unit – 5 **Hours : 09**

1. Linkage and Crossing over, Molecular mechanism of crossing over. Recombination frequency as a measure of linkage intensity,
2. Hardy-Weinberg Law, role of natural selection, Genetic drift. Speciation
3. Sex determination – Sex linked inheritance, extra chromosomal Inheritance

III. Skill Outcomes:

On successful completion of the course, the students will be able to

1. Develop proficiency in cell counting and viability assessment techniques.
2. Observe and analyze mitosis and meiosis in onion root tips, understanding their stages and significance.
3. Identify and analyze the ultrastructure of cells through electron micrographs.
4. Recognize and interpret cancer cells through permanent slides or photographs.
5. Understand genetic concepts like linkage, recombination, gene mapping, DNA fingerprinting, and pedigree chart analysis

IV. Practical Syllabus: Hours 2 hours per week = 30

1. Cell counting and Viability
2. Mitosis from onion root tips
3. Meiosis of onion root tips
4. Study of ultrastructure of cell (Plasma membrane, Nucleus, Nuclear Pore Complex, Chloroplast, Mitochondrion, Golgi bodies, Lysosomes, SER and RER)
5. Identification and study of types of cancer, cancer cells by permanent slides/ photographs.
6. Study of Linkage, recombination, gene mapping using marker-based data from Drosophila.
7. Demonstration of DNA fingerprinting.
8. Pedigree chart analysis.

V. References:

1.A.J.F Griffiths, S. R Wessler, S. B Carroll & J. Doebley, An Introduction to Genetic Analysis,. 10th Ed., W.H. Freeman & Company (New York) 2010

Geoffrey M. Cooper and Robert E. Hausman - The cell a molecular approach.

Bruce Alberts , Rebecca Heald, et al. Molecular Biology Of The Cell

Arnold Berk (Author), Chris A. Kaiser (Author), Harvey Lodish (Author), Angelika Amon (Author), Molecular Cell Biology.

Benjamin Lewin Genes

Eldon John Gardner, Michael J. Simmons, D. Peter Snustad Principles of Genetics

Karp G, John Wiley Cell Biology

Jane B. Reece (Author), Martha R. Taylor (Author), Eric J. Simon (Author), Jean L. Dickey , Campbell Biology: Concepts and Connections

Veer Bala Rastogi, Genetics

B D Singh, Genetics

VI. Co-Curricular Activities:

1. Laboratory demonstrations where students can observe and participate in various experiments related to cell biology and genetics.

2. Guest Lectures: Invite experts and professionals from the field of cell biology and genetics to deliver guest lectures. They can share their research, industry experiences, and advancements in the field, providing students with valuable insights and exposure to real-world applications.

3. Seminars and Workshops on emerging areas, such as gene editing technologies, stem cell research, or personalized medicine

4. Research Project on literature reviews, designing experiments, and analyzing data.

5. Science Outreach Programs: Giving presentations at local schools, or creating educational materials

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Major Subject: MICROBIOLOGY
SEMESTER -IV

MB C9:MOLECULAR BIOLOGY AND MICROBIAL GENETICS
MINOR COURSE

I. Course Outcomes:

By the Completion of the course the learner should able to–

1. Understand the nature of genetic material, its organization in prokaryotes and eukaryotes, and the role of DNA and RNA.
2. Explain the process of DNA replication in prokaryotes and the involvement of enzymes and factors.
3. Recognize the characteristics, types, and applications of extra chromosomal genetic elements such as plasmids and transposons.
4. Differentiate between classical and modern concepts of genes, understand gene structure, and the process of transcription.
5. Comprehend the genetic code, translation process, and regulation of gene expression in bacteria.
6. Define and classify mutations, understand their molecular basis, and gain knowledge of DNA repair mechanisms.
7. Familiarize with genetic recombination in bacteria, including conjugation, transformation, and transduction processes.

II Syllabus: (Total Teaching Hours: 45)

Unit - 1: DNA/RNA as genetic material, Replication of DNA No. of Hours:9

1.1 Experimental evidences that established DNA and RNA as genetic material. Genome organization in prokaryotes and eukaryotes.

1.2 Replication of DNA in prokaryotes.: Bidirectional and unidirectional replication, Semiconservative replication, Proof of Semiconservative replication (Messelson – Stahl Experiment). Mechanism of DNA Replication in Prokaryotes: step by step process, Enzymes and factors involved in replication- Primase, Helicase, Gyrase, DNA polymerases, DNA ligase, SSB proteins.

1.3 Extra chromosomal genetic elements: General characters, types and applications of Plasmids and transposons.

Unit - 2: Concept of gene, Transcription No. of Hours:9

2.1 Classical Concept of gene: Muton, Recon and Cistron;
One gene-one enzyme and one gene - one polypeptide and One gene – One Product hypotheses.

2.2Modern concept of gene: Definition of gene; Open reading frame; structural, constitutive and regulatory genes; uninterrupted genes, Split genes- concept of introns and exons.

2,3 Protein synthesis in Prokaryotes: Transcription- Definition, difference from replication, promoter, RNA Polymerase, mechanism of transcription.
RNA splicing in eukaryotes;

Unit - 3: Translation and regulation of gene expression No. of Hours:9

Protein synthesis in Prokaryotes
3.1 Genetic code: Salient features, Wobble hypothesis.
3.2 Translation- Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides. Inhibitors of protein synthesis.
3.3 Regulation of gene expression in bacteria – lac operon.

Unit - 4: Mutations and DNA repair No. of Hours:9

4.1 Mutations: Definition and types of Mutations (Spontaneous and induced, Somatic and germline); Physical and chemical mutagens;
4.2 Molecular basis of mutations (base pair changes, frame shifts, deletions, inversions, tandem duplications, insertions); Functional mutants (loss and gain of function mutants); Uses of mutations.
4.3 Outlines of DNA repair mechanisms: Direct repair, Excision repair, Mismatch Repair, Recombination Repair, SOS Repair.

Unit - 5: Genetic recombination in bacteria No. of Hours:9

5.1 Conjugation - discovery, F-factor, F+ & Hfr, mechanism of conjugation, applications of conjugation;
5.2Transformation- Discovery, mechanism of transformation, Competence Factors affecting transformation and application of transformation.
5.3 Transduction- discovery, mechanism and types of transduction.

III. Skill Outcomes:

1. performing cell lysis and purification, quantifying DNA, and recognizing the importance of genomic DNA isolation.
2. Estimate DNA using UV Spectrophotometer include preparing DNA samples, measuring absorbance at 260 nm, calculating DNA concentration, and assessing DNA purity.
3. Solve Problems related to DNA and RNA characteristics, Transcription and Translation. 4. Analyze and solve problems related to DNA and RNA structure, understanding transcription and translation processes, and interpreting the impact of mutations on protein synthesis.
4. Prepare gels, loading DNA samples, visualizing DNA bands, analyzing fragment size, and understanding the principles of electrophoresis.

5 Understand Mutagenesis principles, perform UV exposure, assessing mutation frequency, and comprehend the effects of mutations on bacterial phenotypes.

IV. Practical Syllabus: Hours 2 hours per week = 30 hours

1. Isolation of genomic DNA from E. coli
2. Estimation of DNA using UV spectrophotometer (A260measurement).
3. Problems related to DNA and RNA characteristics, Transcription and Translation.
4. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
5. Problems related to DNA and RNA characteristics, Transcription and Translation.
6. Induction of mutations in bacteria by UV light.
7. Study of different conformations of plasmid DNA through agarose gel electrophoresis.
8. Demonstration of bacterial transformation
9. Instrumentation in molecular biology – Ultra centrifuge, Transilluminator, PCR
10. Study of different types of DNA and RNA using micrographs and model / schematic
11. representations
12. Study of semi-conservative replication of DNA through micrographs / schematic
13. Representations

V. References

Text books:
1. James D. Watson Tania A. Baker, Stephen P. Bell Alexander Gann, Michael Levine, Richard Losick, 2013, Molecular Biology of the Gene, 5th Edition, Pearson Edu Publishers.
2. Roger Y. Stanier, Edward A. Adelberg, John L. Ingraham, 1977, General Microbiology 5th edition, London Macmillan.
3. David Freifelder1986 Molecular Biology 3rd edition, Jones & Bartlett Publishers
4. T.A. Brown, Gene cloning and DNA analysis- An Introduction, 4thedition
5. Bernard R. Glick and Jack. J. Pasternak, Molecular Biotechnology. 3rdedition
6. David Freifelder.Essentials of molecular biology.Jones and Bartlett Publishers, 1998

VI. Co-Curricular Activities:

1.Conduct poster presentations, oral presentations, and interactive sessions.
2. Visit laboratories employing molecular biology techniques

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Major Subject: MICROBIOLOGY

SEMESTER -IV

MB C10: MICROBIAL PHYSIOLOGY AND METABOLISM
MINOR COURSE

I. Course Outcomes:

On successful completion of the course, the students will be able to

1. Understand the nutritional requirements of microorganisms and the different methods of nutrient uptake. They will also gain knowledge of different nutritional groups and types of growth media used for microbial cultivation.
2. Comprehend microbial growth, including the definition of growth, generation time, and the different phases of growth. They will also learn about factors influencing microbial growth and methods for measuring it.
3. Gain knowledge of thermodynamics in biological systems, including concepts of free energy, enthalpy, and entropy. They will also learn about ATP structure and properties, oxidation-reduction reactions, and carbohydrate breakdown pathways.
4. Understand microbial respiration, including aerobic and anaerobic respiration, chemoautotrophy, and fermentative modes.
5. Differentiate the processes of oxygenic and anoxygenic photosynthesis.

II Syllabus : (Total Teaching Hours : 45)

UNIT I: Microbial Nutrition No. of hours: 9

1. Nutritional requirements of Microorganisms

2. Methods of uptake of nutrients by cells- Primary and secondary active transport, concept of uniport, symport and antiport Group translocation; Iron uptake

3. Nutritional groups of microorganisms-based on C, energy and electron. sources

4. Growth media - synthetic, nonsynthetic, selective, enrichment and differential media.

UNIT II: Microbial Growth No. of hours:9

1. Microbial Growth- Definitions of growth, generation time and specific growth rate; different phases of growth in batch cultures;
2. Synchronous, continuous, biphasic growth.

3 . Factors influencing microbial growth
4.Methods for measuring microbial growth - Direct microscopy, viable count estimates, turbidometry and biomass.

UNIT IV: Thermodynamics; Breakdown of Carbohydrates **No.of hours: 9**

1. Thermodynamics in biological systems - Concept of free energy, Enthalpy, Standard Free Energy change of reaction, Entropy. First and Second law of Thermodynamics. Open and Closed system.
2. Structure and properties of ATP, Standard Free energy change of hydrolysis of ATP and other high energy compounds. Biological oxidation-reduction reactions. Structure and Function of NAD and FAD.
3. Breakdown of carbohydrates· Glycolytic pathways- EMP, HMP shunt/pentose phosphate pathway and ED; TCA cycle.

UNIT V: Microbial Respiration and Fermentation **No. of hours: 9**

1. Aerobic respiration - ETS and oxidative phosphorylation
2. Anaerobic respiration, chemoautotrophy - oxidation of inorganic compounds - N, S, Fe and H.
3. Fermentative modes in microorganisms with special reference to alcoholic, Lactic acid fermentations

UNIT V: Bacterial Photosynthesis **No. of hours:9**

1. Photosynthetic pigments, Photosynthetic apparatus in prokaryotes
2. Outline of oxygenic photosynthesis in bacteria
3. Outline of anoxygenic photosynthesis in bacteria

II. **Skill Outcomes**:

On successful completion of the course, the students will be able to

1. Understand the impact of temperature and pH on bacterial growth and metabolism.
2. Gain proficiency in colony counting techniques for microbial enumeration.
3. Analyze and interpret growth curve data to understand bacterial growth dynamics.
4. Develop skills in observing and identifying cyanobacteria under the microscope.
5. Apply knowledge of microbial growth factors and techniques to interpret and analyze experimental results.

IV Practical Syllabus: Hours 2 hours per week = 30 hours

1.Effect of Temperature on bacterial growth
2.Effect of pH on bacterial growth
3. Colony count in Plates

4. Study and plot the growth curve of E. coli by turbidometric and standard plate count methods
5. Observation and identification of permanent slides of cyanobacteria

V References:

1. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H.Freeman and Company Caldwell, D.R. (1995). Microbial Physiology and Metabolism, W.C. Brown Publications,Iowa, USA.
2. Lehninger, A.L., Nelson, D.L. and Cox, M.M. (1993). Principles of Biochemistry, 2 nd Edition, CBS Publishers and Distributors, New Delhi.
3. Sashidhara Rao, B. and Deshpande, V. (2007). Experimental Biochemistry: A student Companion. I.K. International Pvt. Ltd.
4. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W.H.Freeman
5. Voet,D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons
6. White, D. (1995). The Physiology and Biochemistry of Prokaryotes, Oxford University Press, New York.

VI Co-Curricular Activities:

1. Assignments in nutrient utilization, energy production, metabolic pathways,

2. Students can study microbial growth curves, metabolic pathways, or physiological responses to environmental factors.

3. Organize seminars where students can deliver presentations on specific topics in microbial physiology and metabolism.

4. Create visual representations of microbial metabolic pathways.

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SEMESTER -IV

MB C11: R DNA TECHNOLOGY, BIOINFORMATICS AND BIOSTATISTICS

I. Course Outcomes:

On successful completion of the course, the students will be able to

1. Learn the principles and techniques of genetic engineering, including g restriction endonucleases, and DNA transformation.
2. Understand the use of vectors and the basics of polymerase chain reactic also explore the applications of genetic engineering in industry, agr medicine.
3. Gain knowledge of blotting techniques, DNA labeling, DNA sequenc basics of intellectual property rights.
4. Learn about bioinformatic resources, sequence databases, sequence alignı use of biostatistics in data analysis.
5. Develop skills in measuring central tendency and dispersion, understanc types of data, and utilizing biostatistical software for analysis and data pr

II Syllabus: (Total Teaching Hours: 45) **No. of Hours: 9**

UNIT- I: Recombinant DNA Technology

1. Basic principles of genetic engineering. Steps in gene cloning.
2. Restriction endonucleases- applications of Type II restriction enzymes in genetic engineering; DNA polymerases and ligases;Use of linkers and adaptors
3. Vectors – Cosmid , Bacteriophages , BAC, YAC
4. Transformation of DNA by Chemical method, Electroporation.

UNIT- II: Applications of r-DNA technolo **No. of Hours: 9**

1. Genomic and C-DNA Libraries, RFLP, RAPD,
2. Basics of Polymerase chain Reaction
3. Application of genetic engineering in industry, agriculture and medicine, Hybirdoma Technology.

UNIT- III: Techniques in genetic engineering and IPR **No. of Hours: 9**

1. Blotting Techniques.
2. Labeling of DNA, DNA foot printing.
3. DNA Sequencing-Sanger's method
4. Outlines of Intellectual property Rights (Patents,Trademark,Copyright)

UNIT- IV:Bioinformatics **No. of Hours: 9**

1. Bioinformatic resources : NCBI, EBI, DDBJ, PUBMED, BIOMED.
2. Sequence Databases – GENBANK, BLAST, FASTA, ExPasy, PDB, NDB, UNIPROT – SWISS PROT.
3. Sequence alignment – Sequence homology, pairwise sequence alignment , automated DNA sequencing, ChIP.

UNIT- V:Biostatistics **No. of Hours: 9**

1. Measurement of central tendency : MEAN , MEDIAN, MODE.
2. Measurement of dispersion : RANGE, MEAN DEVIATION , STANDARD DEVIATION.
3. Use of Biostatistic softwares.
4. Sample and population ; Types of Data , methods of Data presentation.

III. Skill Outcomes: On successful completion of the course, the student will be able to

1. Perform plasmid DNA isolation, agarose gel electrophoresis

2. Understand the principles and applications of DNA fingerprinting for genetic profiling and identification.

3. Utilize nucleic acid and protein databases to access, retrieve, and analyze genetic and protein sequence information
4. Apply sequence alignment algorithms and tools

5. Develop skills using bioinformatics tools and databases

IV Practical Syllabus: Hours 2 hours per week = 30 hours

1. Isolation of plasmid DNA by Agarose gel Electrophoresis.
2. Preparation of Recombinant vector by using T4 DNA Ligase.
3. To Understand the concept of DNA fingerprinting by Random Ampilification of Polymorphic DNA.
4. Nucleic acid and protein databases.
5. Sequence alignment
6. Sequence homology and Gene annotation.

V References:

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.
3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. II Edition. Benjamin Cummings. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates, Inc.
4. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press.
5. Glazer AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications
6. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
7. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.
8. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2nd edition., Elsevier Science
9. Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201.

VI Co – curricular Activities:

1. Training of students and basic gene cloning methods.
2. Industrial visit on Recombinant products.
3. Prepearation of videos on labeling of DNA and DNA sequencing.
4. Students participation in seminars of the copyright, Patent, Trademark and IPR.
5. Assignments on PCR, Restriction enzymes , vectors , RFLP, RAPD, Hybridoma Technology, Sequence alignment tools of DNA , central tendancy , Data collection and presentation.
6. Conducting group discussion , Quiz, debate in related topics.

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SEMESTER V

SKILL ENCHANCEMENT COURSES

ANY OF THE 2 OF THE FOLLOWING SETS

SET -A

MB C 12: IMMUNOLOGY AND MEDICAL MICROBIOLOGY MINOR COURSE

I Course outcomes:

By the Completion of the course the learner should able to–

1. Describe the key concepts in Immunology and how the immune system is able to discriminate self vs. non-self

2. Explain how the innate and adaptive immune systems work together to generate an effective immune response against a specific pathogen.

3. Explain how the immune system is able to respond to so many diverse antigens.

4. To understand the importance of pathogenic microorganisms in human disease with respect to infections of the respiratory tract, gastrointestinal tract, urinary tract etc

5. To understand and able to correlate disease symptoms with causative agent, isolate and identify pathogens.

II Syllabus: (Total Teaching Hours: 45)

Unit - 1: **Immune System** **No. of Hours:9**

1. Concept of Innate and Adaptive immunity
2. Primary and secondary organs of immune system - thymus, bursa fabricius, bone marrow, spleen, lymph nodes and lymphoid tissues
3. Cells of immune system- Identification and function of B and T lymphocytes, null cells, monocytes, macrophages, neutrophils, basophils and eosinophils

Components of innate immunity;Complement system (in brief)

Unit - 2: **Immune response** No. of Hours 9

1. Characteristics of antigen (Foreignness, Molecular size, Heterogeneity and solubility) haptens.
2. Antibodies - basic structure and types.
3. Generation of Immune Response - Primary and Secondary

Generation of Humoral Immune Response (Plasma and Memory cells), MHC
Generation of Cell Mediated Immune Response

4. Immune complex formation and elimination - Agglutination, Precipitation, Neutralisation, Complement fixation, Phagocytosis
5. Hypersensitivity- definition and types (in brief)

Unit - 3: Microbes in Health and Disease **No. of Hours:9**

1. Normal flora of human body.
2. Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Opportunistic infections, Nosocomial infections.
3. General account on microbial diseases - causal organism, pathogenesis, epidemiology, diagnosis, prevention and control of the following

   Bacterial diseases - Tuberculosis, Typhoid, Botulism
   Fungal diseases - Candidiasis.
   Viral Diseases - Hepatitis- A and AIDS

Unit - 4: Principles of Diagnosis **No. of Hours:9**

1. General principles of diagnostic microbiology- Collection, transport of clinical samples
2. Identification by culturing
3. Identification by biochemical/physiological properties
4. Identification by molecular assays (PCR, DNA probes)
5. Identification by serological tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation)

Unit - 5: Prevention and Treatment **No. of Hours:9**

1. Vaccines - Active (Natural and recombinant) and passive
2. Antimicrobial agents- General modes of action of antibacterial (Penicillin, Streptomycin), antifungal (Amphotericin and Griseofulvin), antiviral (Amantadine, Acyclovir)agents
3. Interferons
4. Antibiotic resistance -Tests for antimicrobial susceptibility (Disc diffusion)

III Skill Outcomes:

By the completion of the course the learner should able to–

1**.**Perform some of the ag-ab reactions

2. Carry out the biochemical tests useful for identification of of bacteria

3. Perform antibiotic sensitivity test

4. Identify some common symptoms and relate them to etiology

5. Prepare some differential media routinely used for identification of bacteria

IV Practical Syllabus: **Hours 2 hours per week = 30**

1. Identification of human blood groups.
2. Separate serum from the blood sample (demonstration).
3. Immunodiffusion by Ouchterlony method.
4. Identification of any of the bacteria (*E. coli, Pseudomonas, Staphylococcus*, *Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, urease production and catalase tests
5. Study of composition and use of important differential media for identification of

bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS Isolation of bacterial flora of skin by swab method.

6.Antibacterial sensitivity by Kirby-Bauer method

7.Determination of minimal inhibitory concentration of an antibiotic

8.Study symptoms of the diseases with the help of photographs: Anthrax,Polio, Herpes, chicken pox, HPV warts, Dermatomycoses (ring worms)

9.Isolation of Normal flora of human body (Hands, Feet, Nostrils, Teeth Surface) by swab method.

V References

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
3. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley-Blackwell Scientific Publication, Oxford.
4. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
5. Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
6. Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Microbiology. 4th edition. Elsevier Publication.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education Practical microbiology-M.N.Reddy Practical microbiology-M.N.Reddy
8. Microbiology: a laboratory manual / James G. Cappuccino, Natalie.
9. Plant pathology and Microbiology-K.R.Aneja
10. Mackie & Mccartney Practical Medical Microbiology,

VI. Co-Curricular Activities:

1. Screening of Blood groups
2. Visit to Diagnostic /Laboratory
3. Competition on composition and sterile media preparation
4. Competition on Isolation and Identification of bacteria from a sample

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SEMESTER V

SKILL ENCHANCEMENT COURSES

ANY OF THE 2 OF THE FOLLOWING SETS

SET -A
MB C13: APPLIED MICROBIOLOGY
MINOR COURSE

I. **Course Outcomes:**

By the completion of the course the learner should able to–

1. Identify the areas of entrepreneurship, and assess the scope for establishment.
2. Explain production of fermentation products and economics
3. Explain the production method of biofertilisers and mushrooms
4. Explain the process of baking and brewing
5. Prepare DPR and understand patenting

II. Syllabus : (Total Teaching Hours : 45)

Unit–I: Entrepreneurial skill **No of Hours: 9**

Entrepreneurial skills–Institutes involved, Government support to entrepreneurs, Incubation centers, risk assessment. Scope for small, medium and Large scale industries in Microbiology

Unit–II: Fermentation Products **No of Hours: 9**

Microbial cells as fermentation products-

Bakers yeast, food and feed yeasts, SCP, Bacterial Insecticides, Legume Inoculants, Algae.

Enzymes as fermentation products–

Bacterial and Fungal Amylases, Proteolytic Enzymes, Pectinases, Invertases, and other enzymes

Fermentation Economics

Unit–III: Bio-fertilisers and Mushrooms **No of Hours: 9**

Mushroom cultivation–Cultivation of *Agaricus campestris*,Calocyba indica, *Agaricus bisporus*, and *Volvariella volvaciae;* Preparation of compost, filling tray beds, spawning, maintaing optimal temperature, casing, watering, harvesting, storage.

Biofertilizers –Chemical fertilizers versus biofertilizers, organic farming. Production of biofertilisers-*Rhizobium* sp, *Azospirillum*sp, *Azotobacter*sp.

Microbial consortia for composting and as biofertilisers

Unit–IV: Baking and Brewing processes **No of Hours: 9**

Brewing–Media components, preparation of medium, Microorganisms involved, maturation,

carbonation, packaging, keeping quality, contamination, by products.

Bread making- Yeast activation,

Unit–V:DPR and Patents **No of Hours: 9**

Preparation of DPR (Detailed Project Report)

Patents and secret processes –History of patenting, composition, subject matter and characteristics of a patent, Inventor, Infringement, cost of patent

III. Skill Outcomes:

By the completion of the course the learner should able to–

1. Prepare Microbial consortia for composting
2. Prepare a report on the working of production unit of mushrooms/biofertiliser
3. Prepare sample DPR

IV. **Practical Syllabus**: Hours 2 hours per week = 30

1. Preparation of Microbial consortia for composting
2. Field visit and report preparation of Mushroom cultivation unit/ Biofertiliser

production centre/or any other

3. Preparation of sample DPR

V.References:

1. Entrepreneurial Development in India -ByArora.

2. Sathyanarayana.U, Biotechnology.(2005)1st Ed.BooksandAllied(P)Ltd.

3. Casida,LEJR,(2019). Industrial Microbiology.NewAge International Publishers

4. K.R.Aneja,ExperimentsinMicrobiology,Plantpathology,TissueultureandMushroom productiontechnology,6th Ed.SChandPublication

5. NdukaOkafor.ModernIndustrialMicrobiologyandBiotechnology.2007.CRCPress

6. MichaelJ.Waites,NeilL.Morgan,JohnS.Rockey,GaryHigton.IndustrialMicrobiology: AnIntroduction.2013.WileyBlackwellPublishers.

7. A.H.Patel.IndustrialMicrobiology.2016.2nd Ed.LaxmiPublications,NewDelhi.

8. DubeyRC.ATextbookofBiotechnology.(2014).SChand Publishers.

9. RobertD.Hisrich,MichaelP.Peters,"EntrepreneurshipDevelopment",TataMcGraw Hill

VI.Co-Curricular Activities:

1. Prepare fermented foods
2. Workshop on project report preparation of mushroom cultivation unit
3. Visit to industry producing microbial products

ANDHRA PRADESH STATE COUNCIL OF HIGHER EDUCATION
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Major Subject: MICROBIOLOGY

SEMESTER V

SKILL ENCHANCEMENT COURSES

ANY OF THE 2 OF THE FOLLOWING SETS

SET -B

MB C14: INDUSTRIAL MICROBIOLOGY
MINOR COURSE

Course Outcomes: By the Completion of the course, the learner should able to–

1. Recognize various industrially important microorganisms
2. Identify the methods of screening of required microorganisms
3. Identify the appropriate methods of fermentation to be adapted for productions
4. Discuss the basic concepts in industrial microbiology, industrially important microbes and metabolites
5. Explain the components of upstream and downstream bioprocessing

II Syllabus: (Total Teaching Hours : 45)

UNIT I: Microorganisms of industrial importance No. of hours: 9

1. Brief history and developments in industrial microbiology.
2. Microorganisms of industrial importance -yeasts (*Saccharomyces cerevisiae*), molds (*Aspergillus niger*) bacteria (*E.coli*), actinomycetes (*Streptomyces griseus*).
3. Industrially important Primary and secondary microbial metabolites- Techniques involved in selection of industrially important metabolites from microbes.

UNIT II : Screening and Strain Improvement No. of hours: 9

1. Primary and secondary screening. Preservation and maintenance of industrial strains

2. Outlines of strain improvement.

3. Fermentation media (Crude and synthetic media; molasses, corn- steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates)

UNIT III: Bioreactors **No. of hours: 9**

1. Components of a typical continuously stirred tank bioreactor.
2. Types of fermenters – laboratory, pilot-scale and production fermenters.
3. Types of fermentation processes- solid state, liquid state; batch, fed-batch, continuous; aerobic, anaerobic; submerged, surface

UNIT IV: Fermentation and Downstream processes **No. of hours: 9**

1. Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration

2. Downstream processing - filtration, centrifugation, cell disruption, solvent extraction.

3. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes.

UNIT V: Microbial Productions **No. of hours: 9**

1. Production of citric acid, ethanol and penicillin.

2. Production of Glutamic acid and vitamin B12

3. Industrial production and uses of amylases, proteases, lipases and cellulases.

III. Skill Outcomes:

By the completion of the course the learner should able to–

1. Comprehend the significance of and demonstrate microbial diversity by isolating microorganisms from natural environments.

2.Microscopically demonstrate the microorganisms found in fermented food; prepare some of the fermented products(wine) in the laboratory to observe the associated physical and chemical changes.

3.Carry out microbial productions in small scale (citric acid) and estimate the product

IV. Practical Syllabus: Hours 2 hours per week = 30

1. Microbial fermentation for the production and estimation of ethanol
2. Isolation of amylase producing microorganisms from soil
3. Production of amylase from bacteria and fungi
4. Assay of amylase
5. Demonstration of fermenter
6. Production of wine from grapes
7. Growth curve and kinetics of any two industrially important microorganisms.
8. Microbial fermentation for the production and estimation of citric acid

V. References:

1. Stanbury, P.F., Whitaker, A. and Hall, S.J. (1997). Principles of Fermentation Technology, Aditya Books (P) Ltd. New Delhi.

2. Doyle, M.P., Beuchat, L.R. and Montville, T.J. (1997). Food Microbiology: Fundamentals and Frontiers. ASM Press, Washington D.C., USA.

VI. Co-Curricular Activities:

1.Lectures/ Seminar on current trends in industrial microbiology
2. Field visit to related industry
3. Assignments on identifying and procuring industrially important microorganisms

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SEMESTER V

SKILL ENCHANCEMENT COURSES

ANY OF THE 2 OF THE FOLLOWING SETS

SET -B

MB C 15: FOOD AND DAIRY MICROBIOLOGY

MINOR COURSE

I. Course Outcomes: By the Completion of the course the learner should able to–

1. Understand the factors influencing microbial growth, contamination in foods, and sources of microbial contamination.
2.Gain knowledge of Microflora of milk, microbial contamination of raw milk and butter, and spoilage of various food types.
3. Use dairy starter cultures in fermented dairy products, other fermented foods, and probiotics.
4. Differentiate Foodborne diseases, intoxications, and infections
5. To adopt food sanitation, control measures, Follow HACCP; Carry out tests to detect pathogens in foods

II Syllabus :(Total Teaching Hours : 45)

Unit1: Microbes in Food and Dairy No. of Hours: 9

1. Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

2. Microflora associated with milk and milk products and their importance. Sources of microbial contamination of raw milk and butter

3. Sources of microbial contamination and spoilage of vegetables, fruits, meat, eggs, bread, canned Foods;

Unit 2: Food Preservation No. of Hours: 9

1. Principles of food preservation: temperature, canning, drying, irradiation, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO2, citrates, benzoates,nitrite and nitrates etc.

2. Microbial and chemical changes in raw milk during chilling and refrigeration.

3. Naturally occurring preservative systems in milk like LP system, Immunoglobulins, Lysozyme, Lactoferrin. Food grade Biopreservatives (GRAS), Bacteriocins of lactic acid bacteria; Nisin and other antimicrobials produced by Lactic Acid Bacteria (LAB)

Unit 3: Fermented foods No. of Hours: 9

1. Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese

2. Other fermented foods: dosa, sauerkraut, soy sauce and tempeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

3. Utilization and disposal of dairy by-products – whey.

Unit 4: Food borne diseases No. of Hours: 9

1. Food borne diseases (causative agents, foods involved, symptoms and preventive measures)

2. Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins;

3. Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis,

Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni

Unit 5: Food Sanitation No. of Hours: 9

1. Food sanitation and control; HACCP; National and International microbiological standards for dairy products (BIS, ICMSF, Codex Alimentarius Standards.

2. Cultural and rapid detection methods of food borne pathogens and introduction to predictive microbiology.

3. Genetically modified foods, Nutraceuticals, Biosensors in food, Applications of microbial enzymes in dairy industry [Protease, Lipases].

III. **Skill Outcomes**:

1. Mastering the MBRT method and standard plate count technique, interpreting MPN results, assessing milk quality based on microbial load, and understanding the significance of microbial analysis in ensuring milk safety.

2.Check the efficiency of pasteurization of milk include understanding the principle of the test, performing the enzymatic reaction, interpreting results, and assessing the effectiveness of milk pasteurization in ensuring food safety.

3. Mastering aseptic techniques, perform sample preparation and isolation techniques, identify potential pathogens and spoilage microorganisms, and understand the role of microorganisms in food safety and spoilage.

4. Follow yogurt fermentation protocols, controlling fermentation conditions, assessing yogurt quality, and understanding the role of microbial cultures in yogurt production.

IV. Practical Syllabus: Hours 2 hours per week = 30 hours

1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of any foodborne bacteria from food products. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
4. Isolation of spoilage microorganisms from bread.
5. Preparation of Yogurt/Dahi.

V. References

1. Stanbury, PF., Principles of Fermentation Technology. Whittaker, A and Hall, S.J 2nd Edition. Pergamon Press (1995).
2. Banwart, GJ. Basic Food Microbiology. CBS Publishers and Distributors, Delhi. (1989).

3. Hobbs BC and Roberts D.Food poisoning and Food Hygiene. Edward Arnold (A division of Hodder and Stoughton) London.
4. Joshi. Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology. Volume 2.
5. John Garbult. Essentials of Food Microbiology. Arnold International.
6. John C. Ayres. J. Orwin Mundt. William E. Sandinee. Microbiology of Foods. W.H. Freeman and Co.
7. D. J. Bagyaraj and G. Rangaswami. AGRICULTURAL MICROBIOLOGY. Prentice Hall of India Pvt Ltd.2005
8. N S Subba Rao. Soil Microbiology. Oxford and IBH publishing Company 2009
9. Photis Papademas.Dairy Microbiology: A Practical Approach. CRC Press
10. Rao M.K..Food and Dairy Microbiology. Manglam Publishers
11. William Frazier. Food Microbiology. McGraw Hill Education
12. Jay, James M., Loessner, Martin J., Golden, David A. ModernFood Microbiology.Springer .

VI. Co-Curricular Activities:

1. Food Microbiology Workshops

2. Assign projects or lab exercises where students analyze food and dairy products for microbial quality and safety.

3. Organize visits to food processing facilities or dairy

4. Seminars on Food Safety and Quality Assurance, food regulations, and quality management systems.

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SEMESTER V

SKILL ENCHANCEMENT COURSES

ANY OF THE 2 OF THE FOLLOWING SETS

SET -C

MB C 16: PHARMACEUTICAL MICROBIOLOGY

I. Course Outcomes:

By the completion of the course the learner should able to–

1. Explain the principles of biosafety cabinets and biological waste management
2. Explain the methods of detection of microorganisms in phamaceuticals.
3. Explain the molecular methods of detection of pathogens for quality control
4. Design/select specific media for identification of microbes in pharmaceutical products
5. Practice safety principles

II. Syllabus: (Total Teaching Hours: 45)

Unit 1: Introduction to Pharmaceutical Microbiology No. of Hours: 9

1. Significance of microbiology in the pharmaceutical industry; Microbial contamination and spoilage of pharmaceutical products.
2. Overview of current Good Manufacturing Practices (cGMP) and regulatory requirements.
3. Principles of aseptic techniques and cleanrooms, BSL

Unit 2: Microbial Control in Pharmaceuticals No. of Hours: 9

1. Sterilization methods: physical and chemical sterilization techniques.
2. Sterility testing: principles, methods, and interpretation of results.
3. Disinfection methods: types of disinfectants, their modes of action, and

applications.

4. Microbial preservation of pharmaceutical products: antimicrobial agents and their efficacy.

Unit 3: Microorganisms of Pharmaceutical Importance No. of Hours: 9

1. Identification and characteristics of microorganisms commonly found in pharmaceutical environments.

2. Pathogenic microorganisms and their significance in pharmaceutical products.

3. Environmental monitoring and microbial enumeration techniques; Bioburden testing and its importance

Unit 4: Microbial Quality Control No. of Hours: 9

1. Validation and qualification of manufacturing processes and equipment.

2. Control of raw materials, water, and air quality in pharmaceutical production.

3. Quality control testing for microbial limits, endotoxin levels, and bioburden.

4. Environmental monitoring and trend analysis in pharmaceutical facilities.

Unit 5: Microbiology in Product Development No. of Hours: 9

1. Microbial aspects of product development and formulation.

2. Microbial stability testing of pharmaceutical products.

3. Microbial assays for antibiotics and other pharmaceutical substances.

4. Microbial quality control in vaccine production.

III. **Skill Outcomes:** By the completion of the course the learner should able to–

1. Perform sterility tests for equipment.
2. Employ disinfection methods of selected instruments
3. Perform sterility test of air in the lab
4. Test the sterility of microbiological media
5. Test the sterility of pharmaceutical products

IV. Practical Syllabus: Hours 2 hours per week = 30 hours

1. Sterility tests for Instruments – Autoclave & Hot Air Oven
2. Disinfection of selected instruments & Equipments
3. Sterility test of Air in Laboratory.
4. Sterility testing of Microbiological media
5. Sterility testing of Pharmaceutical products –Antibiotics, Vaccines & fluids

6. Standard qualitative analysis of water.
7. Analysis of food samples for Mycotoxins

V. References

1.Harrigan WF (1998) Laboratory Methods in Food Microbiology, 3rd ed. Academic Press
2.Garg N, Garg KL and Mukerji KG (2010) Laboratory Manual of Food Microbiology I K International Publishing House Pvt. Ltd.
3.Jay JM, Loessner MJ, Golden DA (2005) Modern Food Microbiology, 7th edition. Springer
4.Baird RM, Hodges NA and Denyer SP (2005) Handbook of Microbiological Quality control in Pharmaceutical and Medical Devices, Taylor and Francis Inc.
5. Microbiology - A laboratory manual, Cappuccino & Sherman , 6 th Ed, Pearson Education
6. Manual of diagnostic microbiology, Dr.B.J.Wadher & Dr.G.L.Bhoosreddy, First .Ed ., Himalaya publishing house, Nagpur.
7. Pharmaceutical Microbiology – W.B. Hugo
8. Pharmaceutical Microbiology – Purohit
9. Laboratory Exercises in Microbiology, George.A.Wistreich & Max.D.Lechtman, 3 rd Ed, Glencoe press, London.

VI.Co-Curricular Activities:

1. Visit to pharmaceutical Company
2. Project on QC and QA methods in pharma
3. Assignments on collecting SoPs from Pharma labs

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SEMESTER V

SKILL ENCHANCEMENT COURSES

ANY OF THE 2 OF THE FOLLOWING SETS

SET -C

MB C 17: DIAGNOSTIC MICROBIOLOGY

I. Course Outcomes:

By the completion of the course the learner should able to

1. To differentiate and explain various methods of staining and media preparation.
2. Explain the principle and application of serological and molecular methods of diagnosis
3. Safeguard oneself and community from antibiotic misuse.
4. Analyse the incidence, distribution and determinants of diseases.
5. To execute the methods of prevention of various infectious diseases

II. Syllabus: (Total Teaching Hours : 45)

UNIT- I: Collection of Clinical Samples No. of hours: 9

1.Clinical samples associated with various infectious diseases
2. Collection of clinical samples (oral cavity, throat, skin, blood, CSF, urine and faeces) and precautions required.
3.Method of transport of clinical samples to laboratory and storage.
4.Laboratory acquired infections, safety of laboratory workers

UNIT- II: Microscopic and culture methods of Diagnosis No. of hours: 9

1.Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria
2.Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar
3.Distinct colony properties of various bacterial pathogens.

UNIT- III: Serological and molecular methods of Diagnosis
No. of hours: 9

1.Agglutination, ELISA, immunofluorescence

2.PCR and Its Variations Real-Time and Digital PCR for Nucleic Acid Quantification; Multiplex PCR for Detection and Identification of Microbial Pathogens

3. Nonamplified Probe-Based Microbial Detection and Identification

UNIT- IV: Antimicrobials- sensitivity and resistance No. of hours:9

1. Importance of drug resistance
2. Determination of resistance/sensitivity of bacteria using disc diffusion method
3. Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method

UNIT- V: Advances in Diagnostic Microbiology No. of hours:9

1.Metagenomic studies for Pathogen Detection and Identification
2.Transcriptomic Techniques in Diagnostic Microbiology
3.Developments in molecular tests for detecting TB and anti-TB drug resistance.

III. Skill Outcomes:

1. Collect, label and transport clinical specimens
2. Isolate pure culture of bacteria
3. To identify common bacteria
4. To maintain and preserve stock culture

IV. Practical Syllabus: Hours 2 hours per week = 30 hours

1. Collection transport and processing of clinical specimens (Blood, Urine, Stool and Sputum).
2. Receipts, Labeling, recording and dispatching clinical specimens.
3. Isolation of bacteria in pure culture and Antibiotic sensitivity.
4. Identification of common bacteria by studying their morphology, cultural characters, Biochemical reactions, slide agglutination and other tests.
5. Maintenance and preservation of stock culture.

V. References

1. Ananthanarayan R and Paniker CKJ (2009)Textbook of Microbiology, 8th edition, Universities Press Private Ltd.

2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
3. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd.
4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13th edition, Mosby. 5. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and Mccartney Practical Medical Microbiology, 14th edition, Elsevier.

VI. Co-Curricular Activities:

1. Hands-on training in techniques such as sample collection, microbial culture, staining, identification methods (e.g., biochemical tests), and antimicrobial susceptibility testing.

2. Case Study Analysis individually or in groups to evaluate patient histories, laboratory test results, and diagnostic data to reach a diagnosis.

3. Project work on comparing reports from different diagnostic labs

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SEMESTER V

SKILL ENCHANCEMENT COURSES

ANY OF THE 2 OF THE FOLLOWING SETS

SET -C

MB C 18: AGRICULTURAL MICROBIOLOGY

I. COURSE OUTCOMES:

By the completion of the course the learner should able to

1. Soil Microbiology: Study soil as a microbial habitat, diversity of microorganisms, and their interactions.
2. Host Pathogen Interaction: Understand microbial pathogenicity, virulence factors, and plant defense mechanisms.
3. Control of Plant Diseases: Learn principles and practices for managing plant diseases, including regulatory, cultural, chemical, and biological methods.
4. Specific Plant Diseases: Study important plant diseases caused by fungi, bacteria, viruses, and viroids, focusing on their etiology, symptoms, epidemiology, and control.
5. Biofertilization, Phyto stimulation, Bioinsecticides: Explore plant growth-promoting bacteria, biofertilizers, mycorrhizae, and their role in enhancing plant growth. Learn about bioinsecticides and their advantages over synthetic pesticides.

II. Syllabus: (Total Teaching Hours : 45)

Unit 1: Soil Microbiology **No of Hours: 9**

1. Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil.
2. Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus.
3. Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation. Microbe-Plant interaction: Symbiotic and non symbiotic interactions.

Unit 2: Host Pathogen Interaction **No. of Hours: 9**

1. Microbial Pathogenicity Virulence factors of pathogens: enzymes, toxins (host specific and non specific) growth regulators.Virulence factors in viruses (replicase, coat protein, silencing suppressors) in disease development.

2. Effects of pathogens on host physiological processes (photosynthesis, respiration, cell membrane permeability, translocation of water and nutrients, plant growth and reproduction).
3. Defence Mechanisms in Plants: Concepts of constitutive defense mechanisms in plants, inducible structural defences (histological cork layer, abscission layer, tyloses, gums), inducible biochemical defences [hypersensitive response (HR), systemic acquired resistance (SAR), phytoalexins, pathogenesis related (PR) proteins, plantibodies, phenolics, quinones, oxidative bursts].

Unit 3: Control of Plant Diseases **No. of Hours: 9**

1. Principles & practices involved in the management of plant diseases by different methods, viz. regulatory - quarantine, crop certification, avoidance of pathogen, use of pathogen free propagative material, cultural - host eradication, crop rotation, sanitation, polyethylene traps and mulches
   chemical - protectants and systemic fungicides, antibiotics, resistance
2. of pathogens to chemicals. biological - suppressive soils, antagonistic microbes- bacteria and fungi, trap plants
3. genetic engineering of disease resistant plants- with plant derived genes and pathogen derived genes and Genetically Modified crops.

Unit: 4: Study of Plant diseases **No. of Hours: 9**

Study of some important plant diseases giving emphasis on its etiological agent, symptoms, epidemiology and control

1. Important diseases caused by fungi

a. Black stem rust of wheat - *Puccinia graminis tritici*
b. Wilt of tomato - *Fusarium oxysporum f.sp. lycopersici*
c. Early blight of potato - *Alternaria solani*

2. Important diseases caused by phytopathogenic bacteria:

   Angular leaf spot of cotton, bacterial leaf blight of rice, crown galls, bacterial cankers of citrus

3. Important diseases caused by viruses: Papaya ring spot, tomato yellow leaf curl.
   Important diseases caused by viroids: Potato spindle tuber, coconut cadang cadang

Unit 5: Biofertilization, Phyto stimulation, Bioinsecticides **No of Hours: 9**

1. Plant growth promoting bacteria, biofertilizers – symbiotic (Bradyrhizobium, Rhizobium, Frankia), Non Symbiotic (Azospirillum, Azotobacter, Phosphate solubilizers, algae)
2. Importance of mycorrizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.
3. General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, Bacillus thuringiensis- production and Field applications, Viruses – cultivation and field applications.

III. Skill Outcomes:

1 Understand soil composition and characteristics, measuring water activity and pH levels, interpreting soil profiles, and recognizing the influence of these factors on soil fertility and plant growth.

2. Identifying soil microorganisms

3.Understand Rhizobium's characteristics demonstrate field application techniques, and recognize the importance of Rhizobium inoculation in enhancing plant growth and soil fertility.

4. Demonstrate field application techniques, and recognize the role of Azotobacter in promoting plant growth and soil nitrogen availability.

5. Identify cellulose-degrading microorganisms

6. Identify the plant diseases based on section cuttings

IV. Practical Syllabus: Hours 2 hours per week = 30 hours

1. Study soil profile, water activity, pH
2. Study microflora of different types of soils
3. Rhizobium as soil inoculant, characteristics and field application
4. Azotobacter as soil inoculant, characteristics and field application
6. Isolation of cellulose degrading organisms
7. Demonstration of Koch's postulates in fungal, bacterial and viral plant pathogens.
8. Study of important diseases of crop plants by cutting sections of infected plant material (microscopic observations)- Albugo, Puccinia, Ustilago, Fusarium, Colletotrichum.

V. References:

1. AgriosGN.(2006).PlantPathology.5thedition.Academicpress,SanDiego,
2.LucasJA.(1998).PlantPathologyandPlantPathogens.3rdedition.BlackwellScience, Oxford.
3. MehrotraRS.(1994).PlantPathology. TataMcGraw-HillLimited.
4. RangaswamiG.(2005).Diseases of Crop Plants India.4th edition.Prentice Hall India Pvt.Ltd., NewDelhi.
5.SinghRS.(1998).PlantDiseasesManagement.7thedition.Oxford&IBH,NewDelhi.

VI. Co-Curricular Activities:

1. Project on collecting photographs of diseased plants and identification
2. Project on collecting photographs of diseased plant parts and identification of pathogen
3. Workshops/ Lectures on natural farming methods

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SKILL ENCHANCEMENT COURSES

ANY OF THE 2 OF THE FOLLOWING SETS

SET -C

MB C19: ENVIRONMENTAL MICROBIOLOGY

I. Course Outcomes:

By the completion of the course the learner should able to

1. Explore ecosystems (terrestrial, aquatic, atmospheric) and microflora in soil, water, atmosphere, human/animal bodies.
2. Learn about mutualism, synergism, commensalism, competition, parasitism, predation in microbes. Study plant-microbe and animal-microbe interactions.
3. Understand microbial involvement in carbon, nitrogen, phosphorus, and sulfur cycles, including organic degradation and nutrient processes.
4. Study solid waste disposal (composting, landfill), liquid waste treatment (sewage), and microbial bioremediation (pesticides, hydrocarbons, metals).
5. Apply the microorganisms in bioremediation processes

II Syllabus: (Total Teaching Hours: 45)

Unit 1: Microorganisms and their Habitats **No. of Hours: 9**

1. Structure and function of ecosystems Terrestrial Environment: Soil profile and soil microflora, Decomposition of plant organic matter.
2. Aquatic Environment: Microflora of freshwater and marine habitats. Atmosphere: Aero microflora and dispersal of microbes
3. Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body.

Unit 2: Microbial Interactions **No. of Hours: 9**

1. Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation Microbe-Plant interaction: Symbiotic and non symbiotic interactions
2. Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria.
3. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.

Unit 3: Biogeochemical Cycling **No. of Hours: 9**

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

2. Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction
3. Phosphorus cycle: Phosphate immobilization and solubilisation. Sulphur cycle: Microbes involved in sulphur cycle.

Unit 4: Waste Management **No. of Hours: 9**

1. Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill)
2. Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment
3. Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

Unit 5: Microbial Bioremediation **No. of Hours: 9**

1. Bioremediation: Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants.
2. Bioleaching, mineral recovery, removal of heavy metals from aqueous effluents. Biodegradable plastics.
3. Biogas production: Methane and hydrogen production using microbial culture.

III. Skill Outcomes:

1 Assess soil properties (pH, moisture content, water holding capacity, percolation, capillary action) and understand their impact on plant growth and soil fertility.
2. Isolate bacteria and fungi from soil samples, and comprehend the diverse microbial communities present in soil ecosystems.
3. Master techniques to isolate bacteria and fungi associated with plant roots, understand their ecological roles, and appreciate the significance of plant-microbe interactions in nutrient cycling and plant health.
4. Use the MPN method to evaluate microbial populations in water samples, and understand the importance of water quality monitoring for public health.
5. Measure BOD and COD in wastewater, and comprehend their significance in assessing pollution levels and wastewater treatment efficiency.

IV. Practical Syllabus: Hours 2 hours per week = 30 hours

1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.
2. Isolation of microbes (bacteria & fungi) from soil.
3. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
4. Assessment of microbiological quality of water by MPN method.
5. Determination of BOD of waste water sample.
6. Determination of COD of waste water sample
7. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase, urease) in soil.
8. Isolation of Rhizobium from root nodules.

9. Isolation of Azotobacter from soil.
10. Design and functioning of a biogas plant.

V. References

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1st edition, Springer, New York
5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg
6. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
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VI. Co-Curricular Activities:

1. Project work on assessment of different soil types
2. Prepare a Model of Biogas plant
3. Prepare a model of sewage treatment plant