JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
(An autonomous College of University of Mysuru)
Re-accredited by NAAC with 'A' grade
Ooty road, Mysuru-570 025, Karnataka

DEPARTMENT OF MICROBIOLOGY

SYLLABUS

CHOICE BASED CREDIT SYSTEM

FOR
B.Sc. PROGRAMME
Biochemistry, Microbiology & Biotechnology

Botany, Biochemistry & Microbiology

2017-2018

B.Sc UG- syllabus - Programme: Biochemistry, Microbiology & Biotechnology

Scheme of study for B.Sc. Microbiology under CBCS scheme 2017-18

Year	Semester	Course code & Core course	Title of the paper	Lecture + Practicals hours per week	No. of credits			Total credits	Total hours		Percentage			Maximum Marks in exam/Assessment			Exam Duration	
					L	T	P		Th	Pr	Th	Pr	IA	Th	Pr	IA	Th	Pr
I B.Sc	**I**	**CMA28006** DSC-I :Theory	Introduction to Microbiology and Microbial diversity	04	4	-	2	**06**	60	60	50	20	30	70	70	30	3h	3h
		DSC-I: Pract-I	Introduction to Microbiology and Microbial diversity: Based on theory	04														
	II	**CMB28006** DSC-II: Theory	Bacteriology	04	4	-	2	**06**	60	60	50	20	30	70	70	30	3h	3h
		DSC-II: Pract-II	Bacteriology: Based on theory	04														
II B.Sc	**III**	**CMC28006** DSC-III:Theory	Microbial Physiology and Metabolism	04	4	-	2	**06**	60	60	50	20	30	70	70	30	3h	3h
		DSC-III: PractIII	Microbial Physiology and Metabolism Based on theory	04														
	IV	**CMD28006** DSC-IV: Theory	Microbial Genetics and Genetic Engineering	04	4	-	2	**06**	60	60	50	20	30	70	70	30	3h	3h
		DSC-IV: Pract-IV	Microbial Genetics and Genetic Engineering Based on theory	04														
III B.Sc.	**V**	**CME28006 / CME28206** DSE-V: Theory	No. of courses:1 DSE- A: Environmental Microbiology DSE-B: Agricultural Microbiology	04	4	-	1	**5**	60	30	50	20	30	70	70	30	3h	3h
		DSE- V:Pract-V	Based on theory	03														
		CME28406/ CME28606 SEC	No. of courses:1 SEC-A : Microbial diagnosis in health clinics SEC-B: Microbial analysis of Air and water	02	2	-	-	**02**	30	-	70	-	30	50	-	30	2h	--
	VI	**CMF28006/ CMF28206** DSE-VI: Theory	No. of courses:1 DSE-A:Industrial and Food Microbiology DSE -B : Medical Microbiology and immunology	04	4	-	1	**5**	60	30	50	20	30	70	70	30	3h	3h
		DSE-VI: Pract-VI	Based on theory	03														
				Total credits				**36**										

B.Sc UG syllabus - Programme: Botany, Biochemistry & Microbiology

Scheme of study for B.Sc. Microbiology under CBCS scheme 2017-18

Year	Semester	Course code & Core course	Title of the paper	Lecture + Practicals hours per week	No. of credits			Total credits	Total hours		Percentage			Maximum Marks in exam/Assessment			Exam Duration	
					L	T	P		Th	Pr	Th	Pr	IA	Th	Pr	IA	Th	Pr
I B.Sc	**I**	**CMA28007** DSC-I :Theory	Introduction to Microbiology and Microbial diversity	04	4	-	2	**06**	60	60	50	20	30	70	70	30	3h	3h
		DSC-I: Pract-I	Introduction to Microbiology and Microbial diversity: Based on theory	04														
	II	**CMB28007** DSC-II: Theory	Bacteriology	04	4	-	2	**06**	60	60	50	20	30	70	70	30	3h	3h
		DSC-II: Pract-II	Bacteriology: Based on theory	04														
II B.Sc	**III**	**CMC28007** DSC-III:Theory	Microbial Physiology and Metabolism	04	4	-	2	**06**	60	60	50	20	30	70	70	30	3h	3h
		DSC-III: PractIII	Microbial Physiology and Metabolism Based on theory	04														
	IV	**CMD28007** DSC-IV: Theory	Microbial Genetics and Genetic Engineering	04	4	-	2	**06**	60	60	50	20	30	70	70	30	3h	3h
		DSC-IV: Pract-IV	Microbial Genetics and Genetic Engineering Based on theory	04														
III B.Sc.	**V**	**CME28007 / CME28207** DSE: Theory	No. of courses:1 DSE- A: Environmental Microbiology DSE-B: Agricultural Microbiology	04	4	-	1	**5**	60	30	50	20	30	70	70	30	3h	3h
		DSE- V:Pract-V	Based on theory	03														
		CME28407/ CME28607 SEC	No. of courses:1 SEC-A : Microbial diagnosis in health clinics SEC-B: Microbial analysis of Air and water	02	2	-	-	**02**	30	-	70	-	30	50	-	30	2h	--
	VI	**CMF28007/ CMF28207** DSE: Theory	No. of courses:1 DSE-A:Industrial and Food Microbiology DSE -B : Medical Microbiology and immunology	04	4	-	1	**5**	60	30	50	20	30	70	70	30	3h	3h
		DSE Pract-VI	Based on theory	03														
				Total credits				**36**										

DEPARTMENT OF MICROBIOLOGY

Programme Outcome for Bachelor of Science in Biochemistry, Microbiology & Biotechnology

After completing the graduation in the Bachelor of Science the students are able to:

PO1. Demonstrate the ability to justify and explain their thinking and/or approach

PO2. Develop state-of-the-art laboratory and professional communication skills

PO3. Apply the scientific method to design, execute, and analyze an experiment

PO4. Explain scientific procedures and their experimental observations

PO5. Demonstrate an understanding of fundamental biochemical principles, structure and function

PO6. Work as a laboratory technician, biochemists or medical scientist

PO7. Explain the processes used by microorganisms for the growth

PO8. Explain the theoretical basis of tools, technologies and methods of microbiology

PO9. Design and develop solution to Biotechnology problems

PO10. Applying appropriate tools keeping in mind safety factor for environment & society

PO11. Create, select, and apply appropriate techniques, resources, and modern tools

PO12. Support biotechnology research activity with strong technical background

Programme Specific Outcome for

Bachelor of Science in Biochemistry, Microbiology &Biotechnology

After completing the graduation in the Bachelor of Science the students are able to;

PSO 1: Gain and understand biochemical and molecular processes

PSO2: Communicate scientific information effectively, relating to microbes and their role in ecosystem and health

PSO3: Acquire, articulate, retain and demonstrate laboratory safety skills

PSO4: Demonstrate applications of biochemical and biological sciences

PSO5: Apply appropriate tools and techniques in biotechnological manipulation

PSO6: Understand the responsibilities of biotechnological practices

DEPARTMENT OF MICROBIOLOGY

Programme Outcome for Bachelor of Science in Botany, Biochemistry & Microbiology

After completing the graduation in the Bachelor of Science the students are able to:

PO1. Identify the taxonomic position of plants using principles and methods of nomenclature and classification in Botany

PO2. Understand the impact of the plant diversity in societal and environmental context

PO3.Demonstrate the knowledge of, and need for sustainable development

PO4. Use interdisciplinary approaches with quantitative skills to work on biological problems

PO5. Demonstrate the ability to justify and explain their thinking and/or approach

PO6. Develop state-of-the-art laboratory and professional communication skills

PO7. Apply the scientific method to design, execute, and analyze an experiment

PO8. Explain scientific procedures and their experimental observations

PO9.Demonstrate an understanding of fundamental biochemical principles, structure and function

PO10. Work as a laboratory technician, biochemists or medical scientist

PO11. Explain the processes used by microorganisms for the growth

PO12. Explain the theoretical basis of the tools, technologies and methods of microbiology

Programme Specific Outcome

Bachelor of Science in Botany, Biochemistry & Microbiology

After completing the graduation in the Bachelor of Science the students are able to;

PSO 1: Demonstrate applications of biochemical and biological sciences

PSO2: Inculcating proficiency in all experimental techniques and methods of analysis

PSO3: Acquire, articulate, retain and demonstrate laboratory safety skills

PSO4: Communicate scientific information effectively, relating to microbes and their role in ecosystem and health

PSO5: Gain proper procedures and regulations in handling and disposal of chemicals

PSO6: Understand biochemical and molecular processes that occur in and between the cells

PSO6: Gain and understanding of biochemical and molecular processes that occur in and between cells to expand understanding of biology

CMA28006 / CMA28007

I SEMESTER

Credits: Theory-4, Practicals-2 **Theory: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course, students are able to:

CO1: Learn the details of Milestones in the historical development of Microbiology
CO2: Understand the details of Systems of classification.
CO3: Specify in depth Algae, Protozoa & Fungi
CO4: Learn the classification and characteristics of virology
CO5: Specify the characteristics of Microbes

DSC-I: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

UNIT: I **No. of Hours: 15**

HISTORY OF DEVELOPMENT OF MICROBIOLOGY

A. Milestones in the historical development of Microbiology. Germ theory of disease, Development of various microbiological techniques and golden era of microbiology: Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming.
B. Development of the field of soil microbiology: Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky and Selman A. Waksman
C. Establishment of fields of medical microbiology and immunology: Contributions of Paul Ehrlich, Elie Metchnikoff and Edward Jenner.
D. Recent developments in the field of Microbiology.
E. Branches of Microbiology.
F. Scope of Microbiology

UNIT: II **No. of Hours: 15**

MICROBIAL DIVERISITY

A. Systems of classification

Definition of taxonomy and systematics. Taxonomic ranks. Classification systems- artificial and phylogenetic. Numerical taxonomy. Systems of classification: Haeckel's three- kingdom, Whittaker's five-kingdom classification systems and Cavalier-Smith's eight kingdom classification.

General characteristics of different groups – a. Acellular microorganisms: Virus, Viroids, Prions. b. Cellular microorganism: Bacteria, Algae, Fungi and Protozoa

Difference between prokaryotic and eukaryotic microorganisms.

B. Algae

a. History of phycology with emphasis on contributions of Indian scientists; Ghosh, M.O.P. Iyengar, T.V. Desikachary, Y. Bhardwaja, M. S. Randhawa and R. N. Singh.
b. Structure of typical algal cell (E.g: *Chlamydomonas*) - occurence, thallus organization, Pigments, flagella, eyespot, food reserves and vegetative, asexual and sexual reproduction.

c. Applications of algae in agriculture, industry, environment and food. Outline classification (Fritsch, 1935).

d. Study of thallus structure, reproduction and economic importance of the following: *Chlorella, Spirogyra,* Diatoms and *Gracilaria*

UNIT: III **No. of Hours: 15**

FUNGI AND PROTOZOA

A. Fungi

a. Historical development of Mycology including significant contributions of eminent Mycologists:E J Butler,J F Dastur and C.V.Subramanian.

b. General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra- structure, thallus organization and aggregation, fungal wall structure and synthesis, asexual reproduction and sexual reproduction.
Definition- Heterokaryosis, Heterothallism and Parasexuality.

c. Economic importance of fungi with examples in agriculture, environment, Industry, medicine, food, biodeterioration and mycotoxins.

d. Outline classification as per Alexopoulus and Mims (1979)

e. Study of thallus structure, reproduction and life cycle of the following: *Pythium, Saccharomyces, Penicillium, Agaricus and Fusarium*

B. **Protozoa**

Outline classification, Morphology, reproduction and life cycle of: *Euglena,Paramoecium, Entamoeba* and *Plasmodium*

UNIT: IV **No. of Hours: 15**

VIRUSES

A. Definition, early developments in Virology. General properties of viruses – size, shape and chemical composition, viral classification.

B. Study of structure of the following viruses:

1 Bacteriophages – T-4 phage (replication in brief)
2 Cyanophages
3 Phytophagenae – TMV
4 Zoophagenae – Influenza Virus and HIV

C. Significance of Viruses

D. Viroids and Prions-a brief account.

I SEMESTER

DSC-I: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

(PRACTICALS)

TOTAL HOURS: 60hrs (4hrs/week) **CREDITS: 2**

1. Microbiology Good Laboratory Practices and Biosafety.
2. Display of photographs of microbiologists
3. Study of typical prokaryotic and eukaryotic cell
4. Demonstration of the presence of microflora in the environment by exposing nutrient agar Plates to air.
5. Staining and mounting of Algae (Eg. *Spirogyra*) and Fungi (Eg. *Rhizopus*).

6-7.Study of the following Algae – *Chlamydomonas, Chlorella, Spirogyra, Diatoms and Gracilaria*

8-10. Study of the following Fungi – *Pythium, Rhizopus, Saccharomyces, Penicillium, Agaricus and Fusarium*

11. Microscopic examination of free-living Protozoa of a pond.

12-13. Study of the following Protozoans – *Euglena, Paramoecium, Entamoeba.* And *Plasmodium*

14. Demonstration of plaque assay for coliphages.
15. Display of photographs of the following: Bacteriophages, TMV and HIV

REFERENCES:

1. Alexopoulas C.J. and Mims C.W., Introductory Mycology, Wile Eastern Limited, New Delhi.
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7. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.
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15. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
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17. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005). General Microbiology. 5th edition McMillan.
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19. Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.
20. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.

CMB28006 / CMB28007

II SEMESTER

Credits: Theory-4, Practicals-2 **Theory: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course, students are able to:

CO1: Learn the details of Bacterial cell organization
CO2: Understand the details of Microbial techniques
CO3: Learn in depth Microscopy
CO4: Understand in depth Sterilization techniques
CO5: Specify the classification and characteristics of staining techniques

DSC-II: BACTERIOLOGY

UNIT I No. of Hours: 15

BACTERIAL CELL ORGANIZATION

A. Outline classification of bacteria as per Bergey'manual of Systematic Bacteriology. Occurrence, shape and arrangement of bacterial cell. Structure of eubacteria- cell wall (Gram positive, Gram negative, L-forms and Archaebacteria.), Glycocalyx, capsule, cell membranes, periplasmic space, flagella, fimbriae, cilia and pili. Cell Membrane: Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids.

Endospore: Structure, formation and stages of sporulation.

Reproduction in Bacteria. General characteristics of Archaebacteria.

B. Bacterial diversity:

a. Methanogens, Rickettsiae, Chlamydiae, Mollicutes (Mycoplasmas), Spirochaetes and Actinomycetes

b. Cyanobacteria: Occurrence, structure, reproduction of the following: *Microcystis, Spirulina & Anabaena*

Unit: II No. of Hours: 15

BACTERIOLOGICAL TECHNIQUES

A. Cultivation of bacteria

a. Media – Types, Cultivation of aerobic and anaerobic bacteria.

b. Pure culture and Cultural characteristics: Serial dilution, pure culture by isolation – Pour plate, Spread plate, Streak plate and Micromanipulator techniques Colony characteristics – plate cultures/solid media and broth cultures/liquid media.

c. Maintenance and Preservation of pure cultures – Sub culturing, overlaying with mineral oil, Refigeration (4^0C) Lyophilization and cryopreservation.

B. Microbiological stains and staining techniques

a. Types of stains: Acidic (Nigrosin), Basic (Crystal violet, Methylene blue); Stains for bacteria (Methylene blue, Nigrosin), Fungi (Cotton blue in Lactophenol), Algae (Safranin) and Protozoa (Dien's stain).Mechanisms of staining (in brief).

b. Preparation of bacterial smears for light microscopy – fixation, simple staining, Negative staining, Differential staining – Gram's staining and Acid fast staining;

Structural staining – capsule, flagella, cell wall, endospore and nuclear staining.

c. Staining of Algae and Fungi- Wet mounting method using Safranin and Cotton blue.

d. Hanging drop method for bacterial motility.

UNIT: III **No. of Hours: 15**

MICROSCOPY

A. **Light Microscope:** Different types of microscopes, their construction and working principles. Simple microscope (dissection microscope), Compound microscope - bright field, dark field, phase contrast, stereomicroscope and fluorescence microscope. Micrometry.

B. Electron Microscope: Principle, construction and applications of Scanning and Transmission electron microscopes. Preparation of specimens for electron microscopic studies: TEM – Dehydration and fixation, ultra sectioning,Negative staining, Shadow casting and Freeze etching (in brief) and SEM – Dehydration,Shadow casting and surface replica (in brief)

UNIT: IV **No. of Hours: 15**

PHYSICAL AND CHEMICAL METHODS OF MICROBIAL CONTROL

Methods of sterilization

A. Physical methods:

a) Heat – i) Dry heat – Hot air oven
ii) Incineration –Incinerator, direct flaming.
iii) Moist heat method – Autoclave and Pressure cooker
iv) Tyndallization (fractional steam sterilization)

b) Filtration–Types of filters: Membrane filter, Hepa filter (e.g., Laminar air flow) and Berkefeld filter (Diatomaceous earth)

c) Radiation methods – UV rays, Gamma rays and Cathode rays

B. Chemical method: Definition of terms-Disinfectants, antiseptics, sanitizers, microbicides ,virucide, algicide, fungicide and sporicide, microbistatic-bacteriostatic and fungistatic.

Use and mode of action of- Alcohols, Aldehydes, Halogens, Phenols, Heavy metals, Quaternary Ammonium compounds and Sterilizing gases (ethylene dioxide).

II SEMESTER
DSC-II: BACTERIOLOGY
PRACTICAL

TOTAL HOURS: 60hrs (4hrs/week) **CREDITS: 2**

1. Display of photographs of microscopes mentioned in the theory syllabus
2. Study of simple and compound microscopes, including oil immersion objectives
3. Microscopic measurements of microorganisms or spores using Stage and Ocular micrometer.
4. Preparation of stains and mordant– Methylene blue, Crystal Violet, Safranin, Nigrosin, Carbol fuchsin, Malachite green, Gram's iodine, Cotton blue in Lactophenol.
5. Simple staining and Negative staining.
6. Differential staining (Gram's staining).
7. Structural staining- (cellwall, and endospore of bacteria).
8. Demonstration of laboratory equipments – Autoclave, Pressure cooker, Hot air oven, Incubator, Refrigerator, Inoculation hood or chamber, Membrane filter and Colony counter. BOD incubator, pH meter & Biosafety cabinet.
9. Preparation of Chromic acid and its use.
10. Cleaning and Sterilization of glasswares. Preparation of media – Nutrient broth, Nutrient agar, Potato dextrose agar, Czapeck dox agar and Mac Conkey's agar.
11. Cultivation of microorganisms on Agar plate (Point inoculation), Broth, Anaerobic cultivation (Candle jar or Gas pack method).
12. Preparation of Physiological saline and Serial dilution.
13. Method of obtaining pure cultures of Microorganisms – Streak plate, Pour plate and Spread plate method.
14. Maintenance of pure culture – Sub culturing, Slope culture and refrigeration, Mineral oil overlay method and Stab culture
15. Hanging drop technique for demonstrating motility of bacteria

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CMC28006 / CMC28007

III SEMESTER

Credits: Theory-4, Practicals-2 **Theory: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course, students are able to:
CO1. Learn the details of Microbial nutrition
CO2. Specify in depth Microbial growth
CO3. Understand the details of Microbial Metabolism
CO4. Understand the details of aerobic and anerobic respiration
CO5. Learn in depth Fermentation

DSC-III: MICROBIAL PHYSIOLOGY AND METABOLISM

UNIT I No. of Hours: 15

MICROBIAL NUTRITION

A. Classification of microorganisms based on energy- Phototroph and chemotroph, electron- lithotroph and organotroph and carbon source- Autotroph and Heterotroph
Major nutritional type of Microorganisms: chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph and Photoorganoheterotroph. .
B. Nutritional requirements of Microorganisms. Elementary nutrients: Carbon, Nitrogen, Sulphur, Oxygen and Energy sources, Vitamins and Growth factors.
C. Uptake of nutrients: Diffusion- Simple and Facilitated, Active transport (use of Proton Motive force, ATP : ABC transporter), Group translocation, Iron uptake**.**

MICROBIAL GROWTH

A. Definition, Growth rate and generation time. The growth curve in batch culture - Phases of growth and their significance. Diauxic growth.
B. Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity(halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe,facultative anaerobe) and barophilic.
D. Measurement of growth by cell number (Haemocytometer) and cell mass (Turbidometer).
E. Batch culture and continuous culture of microorganisms – Chemostat, Turbidostat. Synchronization of cell division.

UNIT II No. of Hours: 15

METABOLISM

A. Microbial Enzymes: Definition, Nomenclature, Classification, Properties, Mode and Mechanism of enzyme action, Factors effecting enzyme action, Enzyme regulation, Inhibition: Competitive and Noncompetitive and Allosteric enzymes, their importance. Cofactors and Coenzymes.
B. Nitrogen metabolism: Biological N_2 Fixation-Symbiotic and asymbiotic N_2 Fixation, nodule formation, bacteroids, Leg haemoglobin in Nitrogen fixation, Mechanism and Biochemistry of Nitrogen fixation, Role of Nitrogenase and Hydrogenase in Nitrogen

fixation. Nitrogen assimilation**.**

C. Lipid metabolism: Breakdown of lipids by microorganisms, beta-oxidation of fatty acids.

UNIT III **No. of Hours: 15**

CHEMOHETEROTROPHIC METABOLISM

A. Aerobic respiration: Concept of respiration: aerobic, anaerobic respiration and fermentation. Ultra structure of Mitochondrion, Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, Formation of acetyl CoA from pyruvate, TCA cycle, Electron transport system and Oxidative phosphorylation **.**

B. Anaerobic respiration and Fermentation

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction) Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways).

UNIT IV **No. of Hours: 15**

CHEMOLITHOTROPHIC AND PHOTOTROPHIC METABOLISM

A. Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction)

B. Photosynthesis: Definition, Photosynthetic microorganisms, Anoxygenic and Oxygenic photosynthesis, Light as a source of energy, Pigments of photosynthetic bacteria and photosynthetic apparatus in prokaryotes and eukaryotes. Mechanism of photosynthesis in bacteria. Comparison of photosynthesis in bacteria and eukaryotes.

III SEMESTER

DCS-III: MICROBIAL PHYSIOLOGY AND METABOLISM (PRACTICAL)

TOTAL HOURS: 60hrs (4hrs/week) **CREDITS: 2**

1. Effect of temperature on growth of microorganisms.
2. Effect of pH on growth of microorganisms.
3. Effect of carbon and nitrogen sources on growth of *E.coli*
4. Effect of salt on growth of *E. coli*
5. Study and plot the growth curve of *E. coli* by turbidometric method
6. Measurement of growth by cell number using Haemocytometer.
7. Study of bacteroids from root nodules.
8. Detection of amino acids by paper chromatography.
9. Acid and gas production from carbohydrates- Demonstration of fermentation of lactose
10. Starch hydrolysis.
11. Gelatin hydrolysis.
12. Detection of Catalase production by microorganisms.
13. Urease test
14. Isolation and culturing of photosynthetic bacteria
15. Demonstration of fermentation of glucose using Kuhne's fermentation vessel.

REFERENCES:

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10. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
11. Nelson David L and Cox Michael M., Lehninger, Principles of Biochemistry, Macmillan Press, Worth Publishers, New Delhi.
12. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
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14. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
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CMD28006 / CMD28007

IV SEMESTER

Credits: Theory-4, Practicals-2 **Theory: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course, students are able to:

CO1. Understand in depth Microbial genetics
CO2. Learn the details of Molecular genetics
CO3. Specify in depth Genetic engineering
CO4. Learn in depth Techniques in genetic engineering
CO5. Understand in details with examples Applications of genetic engineering

DSC-IV: MICROBIAL GENETICS AND GENETIC ENGINEERING

UNIT: I **No. of Hours: 15**

MICROBIAL GENETICS

A. History and development of genetics. Chromosomes: Chromosome number, Morphology, Karyotype and Idiogram. Chemical composition. Prokaryotic and Eukaryotic chromosomal organization

Cell division: Mitosis, Meiosis and Cell cycle in brief.

B. a. Recombination in bacteria: Transformation, Transduction (types) and Conjugation process – F-factor and Sexduction.

b. Extra-chromosomal genetic elements and their importance. Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast- 2 µ plasmid.

c. Prokaryotic and Eukaryotic transposable elements. Transposition

d. Chemical basis of heredity: Evidence for DNA (Griffith experiment and Hershey and chase experiment) and RNA as genetic material (Fraenkel-Conrat's experiment).

e. DNA Structure: Miescher to Watson and Crick- historic perspective, Chemistry of nucleic acids. Watson and Crick model of DNA, Types of DNA, denaturation and renaturation . Organization of DNA: Prokaryotes, Eukaryotes and Viruses. RNA Structure and function. Organelle DNA -- mitochondria and chloroplast DNA.

UNIT-II **No. of Hours: 15**

MOLECULAR GENETICS

A. DNA Replication –Types, Modes and mechanism of DNA replication by semiconservative method, Replication in Prokaryotes (Cairn's model). Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends . Various models of DNA replication: rolling circle, D- loop (mitochondrial), Θ (theta) mode of replication.

B. Genetic code – features, Wobble hypothesis and evolution of genetic code.
Protein synthesis – Transcription and Translation in prokaryotes.
Regulation of gene expression in prokaryotes (Lac operon concept).

C. Gene mutation: Types of mutations. Mutagenic agents: Physical and chemical mutagens. Significance of mutations.
DNA damage and repair: Photo reactivation and SOS repair

UNIT -III **No. of Hours: 15**

GENETIC ENGINEERING

A. a. Genetic engineering: Milestones in genetic engineering and biotechnology. Cloning tools; restriction modification systems: types I,II and III. mode of action, nomenclature, applications of type II restriction enzymes in genetic engineering
b. DNA modifying enzymes and their applications: DNA polymerases. terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases
c. Cloning vectors –1. Cloning plasmids (pBR 322 and pUC 18). 2. Viruses as cloning vehicles (Lambda DNA, M13). 3. Hybrid vectors (Cosmid, YAC).
d. Cloning host (*E. coli*) **.**

B. Methods in Molecular cloning: Transformation of DNA-Calcium chloride method. Gene delivery-Microinjection, Electroporation, Biolistic method (gene gun), *Agrobacterium*- mediated delivery.

C. Screening and detection of transformants: Blue white selection, replica plate technique and antibiotic resistance.

UNIT –IV **No. of Hours: 15**

TECHNIQUES IN GENETIC ENGINEERING

A. a. Gene cloning: DNA isolation (Phenol-Chloroform method). DNA separation by Gel electrophoresis: Agarose gel – principle and method, Transformation methods.
b. DNA libraries: Brief account of genomic library -application
c. Blotting – Southern and Western.
d. Gene screening and Isolation – Nucleic acid hybridization method (DNA) – Colony and Plaque hybridization.
e. DNA sequencing: Brief account of Sanger's dideoxynucleotide synthetic method.
f. DNA amplification – Principle of PCR.
g. DNA fingerprinting- Restriction Fragment Length Polymorphism (RFLP)

B. Applications of Genetic Engineering:
a. Medical Application.
b. Industrial Application.
c. Agricultural Application.
d. Environmental Application.

C. Social and ethical issues concerning Genetic Engineering.

IV SEMESTER

DSC-IV: MICROBIAL GENETICS AND GENETIC ENGINEERING (PRACTICALS)

TOTAL HOURS: 60hrs (4hrs/week) **CREDITS: 2**

1. Study of mitosis in onion root.
2. Demonstration of meiosis from flower buds of onion / *Chlorophytum / Tradescantia*.
3. Demonstration of Bacterial Conjugation
4. Demonstration of bacterial transformation and transduction
5. Preparation of Master and Replica Plates

6-7. Study the effect of chemical (HNO_2) and physical (UV) mutagens on bacterial cells

8. Isolation and Quantification of Nucleic acids (DNA) from *E.coli* or Yeast.
9. Demonstration of AMES test
10. Demonstration of Amplification of DNA by PCR
11. Demonstration of Southern blotting
12. Study survival curve of bacteria after exposure to ultraviolet (UV) light
13. Isolation of Plasmid DNA from *E.coli*

14-15. Demonstration of the following models or photographs of – DNA, t-RNA, mRNA, transformation, conjugation and transduction, Transcription, Translation and DNA replication.

REFERENCES:

1. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford, U.K.
2. Clark DP and Pazdernik NJ. (2009). Biotechnology: Applying the Genetic Revolution. Elsevier Academic Press, USA
3. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
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5. Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
6. Maloy SR, Cronan JE and Friefelder D(2004) Microbial Genetics 2nd EDITION., Jones and Barlett Pub.
7. Pierce BA (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning
8. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.
9. Primrose SB and Twyman RM. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.
10. Russell PJ. (2009). i Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
11. Sambrook J and Russell D. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press
12. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
13. Watson JD, Baker TA, Bell SP et al. (2008) Molecular Biology of the Gene, 6th Ed., Benjamin Cummings
14. Wiley JM, Sherwood LM and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. McGraw Hill Higher Education

CME28006 / CME28007

V SEMESTER

Credits: Theory-4, Practicals-1 **Theory: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course, students are able to:

CO1. Understand in depth Soil Microbiology
CO2. Learn the details of Aerobiology
CO3. Specify the characteristics of Aquatic Microbiology
CO4. Understand the characteristics of Sewage Microbiology.
CO5. Specify the details of Bioremediation

DSE-A: ENVIRONMENTAL MICROBIOLOGY

UNIT 1 **No. of Hours: 15**

MICROBIOLOGY OF SOIL

A. Introduction: Definition, Soil types, Soil profile and Physical characteristics of soil- Mineral particles, Organic residues, Water and Gases. Soil fertility. Role of microorganisms in soil formation(in brief).

B. Microbial flora of Soil: A brief account of Bacteria, Fungi, Algae, Actinomycetes, Protozoa and Viruses.

C. Biogeochemical cycles : Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin
Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction
Phosphorus cycle: Phosphate immobilization and solubilisation.
Sulphur cycle: Microbes involved in sulphur cycle
Other elemental cycles: Iron and manganese

D. Associated soil microorganisms with plants- the Rhizosphere and Rhizoplane microflora, Actinorrhizae, and Mycorrhizae (AM), Tripartite and Tetra partite association.

E. Interaction among soil microorganisms – Neutralism, Mutualism, Commensalism, Antagonism and Parasitism. (In brief).
Microbe-Plant interaction: Symbiotic and non symbiotic interactions
Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria
Microbial succession in decomposition of plant organic matter

UNIT:II **No. of Hours: 15**

MICROBIOLOGY OF AIR

A. Introduction: Definition, history and development, aim and scope of aerobiology.

B. Microbes and atmosphere: Atmospheric layers, sources of microorganisms, Air spora of indoor and outdoor environment. Factors affecting air spora. Significance of air borne microbes. Management of air-borne microbes. Human air borne diseases (Tuberculosis, Rhinitis and Aspergillosis).

C. Techniques of trapping air-borne microorganisms: Impactors- The slit sampler, Hirst spore trap, Andersen sampler, Rotorod sampler, Vertical cylinder spore trap, Burkard spore traps. Impingers and Filtration. Advantages and disadvantages of the techniques.

UNIT-III **No. of Hours: 15**

MICROBIOLOGY OF WATER

1. Introduction: Natural waters- atmospheric water, surface water and ground water. Distribution of microorganisms in aquatic environment-Neuston, plankton (Phytoplankton, Zooplankton). Aquatic microorganisms-lakes,ponds, streams, rivers estuaries, and marine plankton. Lotic and benthic population.
2. Water pollution: Sources, water borne diseases- Viral (jaundice), Bacterial (cholera) and Protozoan (amoebic dysentery). Biological indicator of water pollution.
3. Determination of sanitary quality of water: SPC, Tests for coliforms, MPN, IMViC reactions and membrane filter.

D. Water purification in Municipal water supply, Parameters of potable water (WHO).

MICROBIOLOGY OF WASTE WATER

A. Introduction: Sources of waste water- Domestic, Agricultural and Industrial. Physical, chemical and microbiological characteristics of waste water

B. Waste water treatment: Single dwelling unit-Septic tank. Municipal waste treatment – Primary (screening, coagulation and sedimentation), Secondary (trickling filter, activated sludge process, oxidation pond), Tertiary (reverse osmosis, ion exchange method and electro-dialysis in brief).

C. Solid waste recycling- Anaerobic digestion process, Biogas and Composting.

4. Microbes in extreme environments: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity & low nutrient levels. Microbial succession in decomposition of plant organic matter

UNIT:IV **No. of Hours: 15**

MICROBIAL BIOREMEDIATION

In situ –Intrinsic, engineered and *Ex situ* bioremediation- Solid phase system (composting, composting process), Slurry phase system (aerated lagoons, low shear air lift reactor). Bioremediation of hydrocarbons- use of genetically engineered bacterial strains. Bioremediation of xenobiotics, Microbial leaching.

V SEMESTER

DSE-A: ENVIRONMENTAL MICROBIOLOGY (PRATICALS)

TOTAL HOURS: 30hrs (2hrs/week) **CREDITS: 1**

1. a. Isolation and identification of fungi from soil by serial dilution method.
   b. Isolation and enumeration of bacteria from soil by serial dilution method.
2. Study of AM fungi
3. Isolation of Nitrogen fixing bacteria- *Rhizobium*
4. Study of antagonism between microorganisms
5. Isolation of airborne microorganisms (Bacteria and Fungi) by Petriplate exposure method.

6-7. Demonstration of air samplers: equipments / photographs of vertical cylindrical spore trap, Rotorod sampler, Hirst's spore trap, Andersen's sampler, Liquid impingement method (bead bubbler device) and Membrane filter.

8. Microscopic observation of different water samples for biological indicators of water pollution.
9. a. Standard analysis of water sample
   b. Determination of MPN.
10. IMViC reactions.
11. Water quality test by Hydrogen sulphide strip test.
12. Display of photographs of water purification process (Baffles, Flocculator, Clarifier, Sand filter, Back wash, Chlorinometer and Chloroscope).
13. a. Determination of biological oxygen demand (BOD) of water.
    b. Determination of chemical oxygen demand (COD) of water.
14. a. Estimation of total solids in sewage.
    b. Display of photographs - Septic tank, Trickling filter, Activated sludge process, Oxidation ponds, Sedimentation tank, and anaerobic digester.
15. a. Demonstration of composting
    b. Display of photographs: composting, composting process, aerated lagoons, low shear air lift reactor and microbial leaching.

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NOTE: Visit to water treatment plant/ sewage treatment plant/ industrial effluent treatment plant. Each student shall submit an independent report on the visit along with the practical record for the internal assessment.

REFERENCES:

1. Alexander A.M. 1987. Introduction to soil Microbiology, 5th ed., John Wiley and sons.
2. Atlas, R.M., and Bartha, R. (1993). Microbial Ecology: Fundamentals and applications, 3rd ed., Benjamin and Cummings Pub.Co.New york.
3. Daniel Environmental Microbiology
4. Grant W.D.P.E, Long: 1981 Environmental Microbiology, Thomson Litho ltd.
5. Maier and Pepper, Environmental Microbiology
6. Mehrotra R.S., Plant Pathalogy, Tata Mc Graw Hill Pubilications Limited, New Delhi.
7. Michael. J.Pelczar, Jr.E.C.S. Chan, Moel: Microbiology, Mc Graw Hill Book Company, New york).
8. Mitchell R (1992), Introduction to Environmental Microbiology, Prentice Hall Inc, Englewood Cliffs.
9. Powar and Daginwala 1996 . General Microbiology, Vol 2. Himalaya Publishing House, Bombay
10. Powar and Daginwala 1996. General Microbiology, Vol 1. Himalaya Publishing House, Bombay.
11. Rangaswamy.G and Bagyaraj, D.J.(2001), Agricultural Microbiology, 2nd ed. Prentice hall of India pvt.ltd., New Delhi.
12. Rao, M.N. and Datta , A.K. (1987).Waste Water Treatment. Oxford and I.B.H.
13. Rheinhermer, G.1986. Aquatic Microbiology Jhon Wiely and sons, New york.
14. Subba Rao, N.S.(2002) Soil Microorganisms and Plant Growth 4th ed., Oxford and IBH Pub.Co.Pvt.ltd., New Delhi.
15. Subha Rao.N.S., 1988. Biofertilizers in Agricultural 2nd ed.Oxford and IBH Pub.Co., New Delhi.

CME28206 / CME28207

V SEMESTER

Credits: Theory-4, Practicals-1 **Theory: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course, students are able to:

CO1 Understand the details of History of plant pathology
CO2. Specify the details of Microorganisms in agriculture
CO3. Learn the details of Plant disease Management
CO4. Understand the details of Specific Plant diseases
CO5. Identify the details of Phytopathology

DSE-B: AGRICULTURAL MICROBIOLOGY

UNIT I **No. of Hours: 15**

INTRODUCTION AND HISTORY OF PLANT PATHOLOGY

A. Concept of plant disease- definitions of disease, disease cycle & pathogenicity, symptoms associated with microbial plant diseases, types of plant pathogens, Koch's postulates, economic losses and social impact of plant diseases.

B. Significant landmarks in the field of plant pathology- Contributions of Anton DeBary, Millardet, T J Burrill, E. Smith, Adolph Mayer, Dmitri Ivanowski, Diener, Stakman, H.H. Flor, Van Der Plank. Contributions of eminent Indian plant pathologists- E J Butler, B B Mundkar, K V Subbarao and M J Thirumalachar.

MICROORGANISMS IN AGRICULTURE

A. Biofertilizers: Definition, Types- Nitrogen fixing, Phosphate solubilizing and cellulolytic microbes. Mass production of Bacterial inoculants (*Rhizobium, Azospirillum, Azotobacter, Cyanobacteria*). Mode of application, Advantages and limitations.

B. Biopesticides: Definition, Types – Bacterial, Viral, Fungal and Protozoan, Mode of action, Microbial herbicides.

UNIT:II **No. of Hours: 15**

PHYTOPATHOLOGY

A. Stages in development of a disease : Introduction – Classification of plant diseases on the basis of spread and severity of infection. Microbes and Plant diseases - Entry of pathogens into host-prepenetration (Infection) penetration, post penetration (invasion, colonization, dissemination of pathogens and perennation).

B. Plant disease epidemiology: Concepts of monocyclic, polycyclic and polyetic diseases, disease triangle & disease pyramid, forecasting of plant diseases.

C. Host Pathogen Interaction

a. *Microbial Pathogenicity*

Virulence factors of pathogen: Role of Enzymes-pectic enzymes, Toxins: Host specific (Tabtoxin) and host non-specific (Victorin and T toxin) and growth regulating substance in disease development- Auxins and Gibberellins.

b. *Defense Mechanisms in Plants*

Defence mechanism in plants: Preexisting (fungitoxic exudates and phenolic compounds) Structural (formation of cork layers, abscission layer and tyloses) and Biochemical defense mechanism (simple phenolic compounds), Hypersensitivity (in brief).

UNIT: III **No. of Hours: 15**

CONTROL OF PLANT DISEASES

A. 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 : a. Cultural-Host eradication, crop rotation, sanitization, polythene traps and mulches(in brief).

B. Chemical- Inorganic chemicals: Copper compounds-Bordeaux mixture and Bordeaux paste, Organic chemicals- Organic sulfur compounds (Dithiocarbamates), Systemic fungicide, Heterocyclic compounds (Benomyl), antibiotics (Agrimycin).

C. Physical method-Soil sterilization by heat, soil solarization, hot water treatment of propagative organs and hot air treatment of storage organs (in brief)

D. Biological methods- suppressive soils, antagonism, antagonistic plants and trap plants (in brief).

E. IDM-Perennial Crop and annual crop (in brief).

UNIT:IV **No. of Hours: 15**

SPECIFIC PLANT DISEASES

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

A. Important diseases caused by fungi

Late blight of potato - *Phytophthora infestans*
Powdery mildew of wheat - *Erysiphe graminis*
Ergot of rye - *Claviceps purpurea*
Loose smut of wheat - *Ustilago nuda*
Wilt of tomato - *Fusarium oxysporum* f.sp. *lycopersici*
Red rot of sugarcane - *Colletotrichum falcatum*
Blast of rice-*Magnaporthe grisea*

B. Important diseases caused by phytopathogenic bacteria: Bacterial leaf blight of rice, Bacterial cankers of citrus

C. Important diseases caused by phytoplasmas: Sandal spike

D. Important diseases caused by viruses: Papaya ring spot, Bunchy top of banana, Bean mosaic.

E. Important diseases caused by viroids: Potato spindle tuber.

V SEMESTER

DSE-B: AGRICULTURAL MICROBIOLOGY PRACTICAL

TOTAL HOURS: 30hrs (2hrs/week) **CREDITS: 1**

1. Demonstration of Koch's postulates in fungal disease.
2-5. Study of important diseases of crop plants by cutting sections of infected plant material - *Phytophthora infestans, Erysiphe graminis, Claviceps purpurea, Ustilago nuda Fusarium, Colletotrichum* and *Magnaporthe grisea.*
6. Gram's staining of citrus canker specimen
7-8. Mounting of fungal pathogen- *Phytophthora infestans, Fusarium, Colletotrichum* and *Magnaporthe grisea.*
9. Observation of specimens-Bean mosaic and sandal spike
10. Observation of root nodule formation in plants (*Trigonella/Crotolaria*)
11. Demonstration of Indole acetic acid (IAA) production by soil fungi
12. Plant disease control by fungicides
13. Chemical determination of IAA produced by soil fungi *in vitro*
14. Isolation of fungal pathogens from soil/diseased plant
15. Isolation of fungal pathogens from diseased parts of plant

NOTE: Visit to Agricultural research station. Each student shall submit an independent report on the visit along with the practical record for the internal assessment.

REFERENCES:

1. Rangaswamy.G and Bagyaraj, D.J.(2001), Agricultural Microbiology, 2nd ed. Prentice hall of India pvt.ltd., New Delhi.
2. Rao, M.N. and Datta , A.K. (1987).Waste Water Treatment. Oxford and I.B.H.
3. Rheinhermer, G.1986. Aquatic Microbiology Jhon Wiely and sons, New york.
4. Subha Rao.N.S., 1988. Biofertilizers in Agricultural 2nd ed.Oxford and IBH Pub.Co., New Delhi.
5. Agrios.2009. Agricultural Microbiology

6. Rangaswamy.G.(1996). **Diseases of crop plants in India**. 3 rd edition .Prentice- Hall of India Pvt Ltd. New Delhi.

CME28406 / CME28407

V SEMESTER

Credits: Theory-2 **Theory: 30 Lectures**

COURSE OUTCOME:

After successful completion of the course, students are able to:

CO1. Learn the details of Diagnosis of diseases
CO2. Learn in details with examples Collection of clinical samples
CO3. Understand in depth Microscopic examination of microbes
CO4. Specify the details of Testing for antibiotic sensitivity in bacteria

SEC-A: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

UNIT: I No of Hours: 5

IMPORTANCE OF DIAGNOSIS OF DISEASES

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

UNIT:II No of Hours: 5

COLLECTION OF CLINICAL SAMPLES

Collection of clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.

UNIT :III No of Hours: 15

DIRECT MICROSCOPIC EXAMINATION AND CULTURE

Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsastained,Thin blood film for malaria, Preparation and use of culture media – Blood agar,Chocolate agar,Lowenstein-Jensen medium, MacConkey agar,Distinct colony properties of various bacterial pathogens.

Serological and Molecular Methods

Serological Methods – Agglutination, Precipitation, ELISA and PCR.
Test for Typhoid, Dengue and HIV and Swine flu
Laboratory exposure to students: demonstration of staining.

UNIT: IV No of Hours: 5

TESTING FOR ANTIBIOTIC SENSITIVITY IN BACTERIA

Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial dilution method

REFERENCES:

1. Jagadish Chandra (1996). Text Book of Medical Mycology. Oreint Longman
2. Jawetz, Melnick, Adelberg, Medical Microbiolgy, Prentice Hall Inc, London.
3. Mackie and Mc catney, Medical Microbiolgy I and II. Charchill Livingston , 14th ed.
4. Nandhini Shetty 1993. Immunology: Inductory Text Book . New Age International Ltd.
5. R.P.Singh, Immunology and Medical Microbiology
6. Rajan. S. Medical Microbiology. MJP Publishers, Chennai.
7. Roitt I.M., Essentials of Immunology, ELBS, Blackwell Scientific Publishers, London.

CME28606 / CME28607

V SEMESTER

Credits: Theory-2 **Theory: 30 Lectures**

COURSE OUTCOME:

After successful completion of the course students are able to:

CO1. Understand in depth Air Microbiology
CO2. Specify the characteristics of Water Microbiology
CO3. Learn in depth Microbiological analysis of water
CO4. Understand the details of Laboratory safety Measures

SEC-B: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

UNIT: I No of Hours: 10

AIR MICROBIOLOGY

Bioaerosols, Air borne microorganisms (bacteria, Viruses, fungi) and their impact on human health and environment, significance in food and pharma industries and operation theatres, allergens

Air Sample Collection and Analysis

Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi.

Control Measures

Fate of bioaerosols, inactivation mechanisms – UV light, HEPA filters, desiccation and Incineration

UNIT:II No of Hours: 5

WATER MICROBIOLOGY

Water borne diseases and their management: Cholera, Typhoid, Gastroenteritis and Traveller's diarrhoea.

UNIT: III No of Hours: 5

MICROBIOLOGICAL ANALYSIS OF WATER

Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive/MPN tests, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests

UNIT: IV No of Hours: 5

CONTROL MEASURES

Precipitation, chemical disinfection, filtration, high temperature, UV light

Laboratory exposure to students: demonstration of air borne and water borne microbes.

REFERENCES:

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and WaterA Laboratory Manual, CRC Press
2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press

CMF28006 / CMF28007

VI SEMESTER

Credits: Theory-4, Practicals-1 **Theory: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course students are able to:

CO1. Specify the details of Industrial Microbiology
CO2. Learn in depth Industrial production
CO3. Understand in depth Food Microbiology
CO4. Specify the details of Dairy Microbiology

DSE-A: INDUSTRIAL AND FOOD MICROBIOLOGY

UNIT: I **No of Hours: 15**

INDUSTRIAL MICROBIOLOGY

A. Brief history and developments in industrial microbiology

B. Microorganisms of industrial importance. Biology of industrial microorganisms: Isolation, Screening and Preservation.

C. A brief account of production medium, inoculum medium, raw materials-Molasses, corn steep liquor, sulphite waste liquor,yeast extract and whey. Buffers, Precursors, Inhibitors and Antifoam agents.

D. Fermenters and fermentation process: Design, types and basic function of fermenters, sterilization, devices for aeration and agitation (in brief).

Types of fermenters – laboratory, pilot-scale and production fermenters

Components of a typical continuously stirred tank bioreactor

Fermentation process – Surface, Submerged and Solid state fermentation.Types- Batch and Continuous fermentation.

Downstream processing: Steps in recovery and purification of fermented products – Precipitation, Filtration, Centrifugation, Distillation, Cell disruption, Solvent recovery, chromatography, Drying and crystallization.

E. Strain improvement of Microorganisms for industrial purposes.

UNIT: II **No of Hours: 15**

INDUSTRIAL PRODUCTION

A. a. Organic acids – Citric acid.
b. Antibiotics – Penicillin.
c. Enzymes –Pectinase and amylase.
d. Alcohol – Ethanol.
e. Amino acid –Glutamatic acid.

B. Mushroom cultivation – Oyster mushroom (bag method). Nutritional value.

C. Role of microorganisms in the production and recovery of minerals and petroleum.

D. Single cell protein: *Spirulina*.

Unit: III **No of Hours: 15**

FOOD MICROBIOLOGY

A. Introduction to Food Microbiology: Definition, Concept and Scope. Food as a substrate for microorganisms, Factors influencing microbial growth in foods (intrinsic and extrinsic factors)**.**

B. Sources of contamination, Microbial spoilage of foods – fruits, vegetables, meat, poultry, canned foods, cereals and cereal products.

C. Methods of food preservation: Physical method – high temperature, low temperature, canning. Drying – solar drying, drum drying, spray drying and Radiation.
Chemical methods – chemical preservatives – (propionates, benzoate, sorbates, nitrates and nitrites, sugar and salt)

D. Food borne intoxication and infection:
Bacterial intoxication- Staphylococcal intoxication and Botulism.
Bacterial infection- Salmonellosis.
Mycotoxin –Types and importance of toxins with special reference to Aflatoxins.

E. Food safety and quality control. –A brief account on FPO, HACCP, Food laws and Food standards (in brief)

UNIT:IV **No of Hours: 15**

DAIRY MICROBIOLOGY

A. Introduction to Dairy Microbiology: Source of milk contamination. Types of microorganisms in milk.

B. Methods to detect microbial spoilage by SPC, Reductase test.

C. Biochemical changes of milk - Souring, Gassy fermentation, Proteolysis, Lipolysis, and Ropiness.

D. Fermented dairy products (a brief account of characteristic and therapeutic value). Acidophilus milk, Yoghurt, Butter milk, Srikhand. Types of cheese. Probiotics and their benefits.

5. Preservation of milk and milk products – Pasteurization and Sterilization. Microbiological standard for milk and milk products (in brief).

VI SEMESTER

DSE-A: INDUSTRIAL AND FOOD MICROBIOLOGY (PRACTICAL)

TOTAL HOURS: 30hrs (2hrs/week) **CREDITS:1**

1-2. Isolation and enumeration of bacteria from utensils
Isolation and identification of fungi from food utensils

3-4. Isolation and enumeration of bacteria from spoiled vegetables
Isolation and identification fungi from spoiled vegetables.

5-6. Isolation and enumeration of bacteria from spoiled fruits.
Isolation and identification of fungi from spoiled fruits.

7-8.Isolation and identification of *Aspergillus* on groundnut by standard blotters Method (ISTA,1982).

9. Estimation of lactic acid in milk.
10. Determination of phosphatase activity of milk
11. Turbidity test to detect boiled and unboiled milk.
12. Methylene blue reductase test to determine the quality of milk.
13. Preparation of wine from grapes.
14 a. Preparation of alcohol using jaggery or molasses.
b**.** Estimation of percentage alcohol in a given sample by specific gravity method.
15. Production of citric acid using *Aspergillus niger*

NOTE: Visit to food industries or food research laboratories, dairy industries and distilleries. Each student shall submit an independent report on the visit along with the practical record for the internal assessment.

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9.Glodsby Richard A., Kindt Thomas J. And Osborne Barbara A., Kuby Immunology, W. H. Freeman and Company New York.

10.Jagadish Chandra (1996). Text Book of Medical Mycology. Oreint Longman

11.Jawetz, Melnick, Adelberg, Medical Microbiolgy, Prentice Hall Inc, London.

12.Mackie and Mc catney, Medical Microbiolgy I and II. Charchill Livingston , 14th ed.

13.Nandhini Shetty 1993. Immunology: Inductory Text Book . New Age International Ltd.

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CMF28206 / CMF28207

VI SEMESTER

Credits: Theory-4, Practicals-1 **Theory: 60 Lectures**

COURSE OUTCOME:

After successful completion of the course students are able to:

CO1. Understand in depth Medical Microbiology
CO2. Specify in details with examples Human diseases
CO3. Learn the details of Immunology
CO4. Specify the classification and characteristics of Antigens and antibodies

DSE-B: MEDICAL MICROBIOLOGY AND IMMUNOLOGY

UNIT :I **No of Hours: 15**

MEDICAL MICROBIOLOGY

A. Introduction – History and development of medical microbiology. Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract

B. Infection and disease transmission – Signs, symptoms, syndrome. Types of Infection: opportunistic infection and Nosocomial infection, mode of transmission.

C. Host pathogen interaction – Infection, Invasion, Pathogen, Pathogenicity, microbial virulence, microbial toxins, opportunistic and true pathogens.

D. Antimicrobial chemotherapy – General characteristics and types of antibiotics. Mode of action of -Penicillin, Aminoglycosides, Erythromycin, Chloramphenicol, Antifungal drugs- Griseofulvin, Nystatin Antiviral drugs-Acyclovir, Amantadine and Azidothymidine .Multiple Drug Resistance (in brief).

UNIT:II **No. of Hours:15**

HUMAN DISEASES

A. Collection, transportation, culturing and identification of clinically important pathogens.

B. Pathogen –Cultural and Biochemical characteristics,clinical symptoms, laboratory diagnosis, prophylaxis and treatment of the following diseases:

a. Air borne: Influenza, Diphtheria, Blastomycosis
b. Direct contact: Warts, Syphilis, Sporotrichosis
c. Vector borne: Dengue, Malaria
d. Water borne: Typhoid, Amoebic dysentry

UNIT III **No. of Hours:15**

IMMUNOLOGY: IMMUNE CELLS AND ORGANS

A. Historical account and introduction to immune system – Blood and Plasma system.

B. Types of immunity – Innate (non specific) and Adaptive immunity (specific).

Hummoral and cell mediated immunity.

C. Structure, Functions and Properties of: Immune Cells –T cell, B cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell.
Cells and tissues of immune systems-Structure and role of primary lymphoid organs (bone marrow,thymus),secondary lymphoid organs (spleen, lymph nodes and tonsils).
B&T lymphocytes, phagocytes, NK cells

UNIT-IV **No. of Hours:15**

IMMUNOLOGY: ANTIGENS AND ANTIBODIES

A. Antigens – Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes), Adjuvants.

B. Antibodies – Basic structure of immunoglobulin (Ig G). Biological properties of Immunoglobulin classes, monoclonal antibodies, antigen antibody reactions – salient features. precipitation reaction, neutralization test, opsonisation , agglutination reaction, compliment fixation. Immunotechniques – RIA, ELISA and ELISPOT. Hypersensitivity (Type I to V - in brief).
Immunoprophylaxis – Vaccine – Types – killed, Live and Attenuated (Bacterial and Viral) and Toxoid with an example each.
National Immunization program (Tabular form).

VI SEMESTER

DSE-B: MEDICAL MICROBIOLOGY AND IMMUNOLOGY (PRACTICALS)

TOTAL HOURS: 30hrs (2hrs/week) **CREDITS: 1**

1. Determination of blood group and Rh factor.
2. Enumerate RBC in given blood sample
3. Enumerate WBC in given blood sample
4. Demonstration of precipitation reaction-Double diffusion in two dimensions (Ouchterlony procedure).
5. Antibiotic sensitivity test.
6. Estimation of urine bacteria by calibrated loop- direct streak method.
7. Determination of susceptibility to dental carrier-Snydal test
8. Identification of dermatophytes from human skin.
9. Detection of typhoid by Widal test
10. Rapid plasma reagin (RPR) card test for syphilis
11. Identify bacteria on the basis of cultural, morphological and biochemical characteristics: IMViC,TSI, nitrate reduction, urease production and catalase tests

12-15.Material/ microscopic observation/ display of photographs of human pathogens as per theory syllabus: Influenza virus, *Corynebacterium diphtheriae*, *Blastomyces dermatitidis*, Human papilloma virus, *Tryponema pallidum, Sporothrix schenckii, Plasmodium*, Dengue viruses (DENV), *Salmonella typhi* and *Entamoeba histolytica*)

NOTE: Visit to pharmaceuticals and pathological laboratories.Each student shall submit an independent report on the visit along with the practical record for the internal assessment.

REFERENCES:

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
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8. Jagadish Chandra (1996). Text Book of Medical Mycology. Oreint Longman
9. Jawetz, Melnick, Adelberg, Medical Microbiolgy, Prentice Hall Inc, London.
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10. Mackie and Mc catney, Medical Microbiolgy I and II. Charchill Livingston , 14th ed.
11. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition
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18. Roitt I.M., Essentials of Immunology, ELBS, Blackwell Scientific Publishers, London.
19. Stanbury P.T. and Whitaker 1984, Principles of Fermentation Technology, Pergamong Press, Newyork.
20. Tizard, I.R. 1998 . Immunology An Introduction, 2nd ed. W.B. Saunders, Philadelphia.
21. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education

PATTERN OF QUESTION PAPER (CBCS)
SUBJECT: MICROBIOLOGY
DSCI-DSCIV
(THEORY: I SEMESTER TO IV SEMESTER)

Time: 3hours Max marks: 70

I. Answer the following 1X5=05Marks
1
2
3
4
5

II Answer any five of the following: 3X5=15 Marks
(Seven questions to be given and four to be answered)-short answer type
6
7
8
9
10
11
12

III Answer any four of the following: 5X4=20
(Six questions to be given and four to be answered)-short answer type

13
14
15
16
17
18

III Answer any three of the following 10X3=30
(Five questions to be given and four to be answered- essay type questions)

19
20
21
22
23

C1+C2=30(15+15) Continuous assessment

PATTERN OF QUESTION PAPER (CBCS)
SUBJECT: MICROBIOLOGY
(THEORY: V SEMESTER TO VI SEMESTER)

Time: 3hours Max marks: 70

I. Answer the following 1X5=05Marks
1
2
3
4
5

II Answer any five of the following: 3X5=15 Marks
(Seven questions to be given and four to be answered)-short answer type
6
7
8
9
10
11
12

III Answer any four of the following: 5X4=20
(Six questions to be given and four to be answered)-short answer type

13
14
15
16
17
18

III Answer any three of the following 10X3=30
(Five questions to be given and four to be answered- essay type questions)

19
20
21
22
23

C1+C2=30(15+15) Continuous assessment

PATTERN OF QUESTION PAPER (CBCS)
SUBJECT: MICROBIOLOGY
SEC(A)-SEC(B)
(THEORY: V SEMESTER)

Time: 2 hours Max marks: 50

I. Answer the following 1X3=03
1
2
3

II Answer any four of the following: 3X4=12
(Six questions to be given and four to be answered)-short answer type
6
7
8
9
10
11

III Answer any three of the following: 5X3=15
(Five questions to be given and three to be answered)-short answer type

12
13
14
15
16

III Answer any two of the following 10X2=20
(Four questions to be given and two to be answered- essay type questions)

17
18
19
20

C1+C2=30(15+15) Continuous assessment

DSC-I
SCHEME OF THEORY EXAMINATION
I B.Sc., I SEMESTER
TITLE: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY
Times:3hrs **Max Marks:70**
Question Paper to be set for total of 106marks including choices

UNITS	1 mark questions	3 mark questions	5 mark questions	10 mark questions	Total Marks
UNITS: **1** **History of development of microbiology**	2	3	1	1	26
UNIT:2 **Microbial Diversity**	1	2	2	1	27
UNIT:3 **Fungi and Protozoa**	1	-----	1	2	26
UNIT:4 **Viruses**	1	2	2	1	27

I Main: 1x5=05Marks
II Main: 3x7=21Marks
III Main: 5x6=30Marks
IVMain: 10x5=50Marks

DSC-1
SCHEME OF PRACTICAL EXAMINATION
I B.Sc., I SEMESTER: PRACTICAL-I
TITLE: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY
Time: 3hours **Max marks: 70**

I. Identify the materials **A, B**and **C** with labelled diagrams and reasons 5X3=15
(1 material each from Algae, Fungi and Protozoa as per syllabus)
(Identification -1mark; diagram and reasons-4mark)

II. Write critical notes on **D, E** and **F.** 5X3=15
(Photographs/materials of Bacteriophages /TMV/HIV/ Plaque assay/ prokaryotic and Eukaryotic cell/Microbiologists/Exposed plates to air)

III. Identify the slides **G, H** and **I** with labelled diagrams and reasons 4X3=12
(One slide each from Algae, Fungi and Protozoa as per the theory syllabus)
(Identification –1mark; labelled diagram with reasons-3mark)

IV. Stain the given material **J** by…….method. Write the principle, procedure and leave the preparation for evaluation 08
(Wet mounting of Algae/Fungi)
(Preparation-4 marks; Principle and Procedure-4 marks)

V. Record 10

VI. Viva 10

Total marks: 70: [50 (Practical Exam) + 20 (10 -record+ 10- viva)]

DSC-II
SCHEME OF THEORY EXAMINATION
I B.Sc.,II SEMESTER
TITLE: BACTERIOLOGY

Times:3hrs **Max Marks:70**

Question Paper to be set for total of 106 marks including choices

UNITS	1 mark questions	3 mark questions	5 mark questions	10 mark questions	Total Marks
UNITS: **1** Bacterial cell organization	2	-	1	2	27
UNIT:2 Bacteriological techniques	1	2	2	1	27
UNIT:3 Microscopy	2	3	1	1	26
UNIT:4 Physical and chemical methods of Microbial control	-	2	2	1	26

I Main: 1x5=05Marks
II Main: 3x7=21Marks
III Main: 5x6=30Marks
IVMain: 10x5=50Marks

DSC-II
SCHEME OF PRACTICAL EXAMINATION
I B.Sc., II SEMESTER: PRACTICAL-II
TITLE: BACTERIOLOGY

Time: 3hours **Max marks: 70**

I. Write critical notes on **A, B, C** and **D** 3X4=1 2
(Microscopes-Charts/Photographs/Instruments/Oil immersion objective/ Stains / Laboratoryequipments/Chromicacid/Detergents/Microbiologists/Media/cultivation of microorganisms/pure cultures/maintenance of culture) as per the theory syllabus.

II. Measure the length/breadth/diameter of the given material **E** using Stage and Ocular Micrometer. Write the procedure and result. 15
(Procedure-6marks; calibration -4marks; Results-5marks)

III. Stain the given material **F** by…….method. Write the principle, procedure and leave the preparation for evaluation. 08
(Simple staining/Negative staining/Gram-staining/Cell wall/ Endospore)
(Preparation-4marks; Principle and Procedure-4 marks)

IV. Demonstrate/ Perform the experiment **G** giving the principle and procedure. Record the result. 15
(Demonstration- 5marks; principle-5mark; procedure-3marks; results-2marks)
(Serial dilution/ measurement of growth by cell number using Haemocytometer/ Pour plate/Spread plate/Streak plate/Point inoculation)

V. Record. 10

VI. Viva 10

Total marks: 70: [50 (Practical Exam) + 20 (10 -record+ 10- viva)]

DSC-III
SCHEME OF THEORY EXAMINATION
II B.Sc.,III SEMESTER
TITLE: MICROBIAL PHYSIOLOGY AND METABOLISM

Times:3hrs **Max Marks:70**

Question Paper to be set for total of 106marks including choices

UNITS	1 mark questions	3 mark questions	5 mark questions	10 mark questions	Total Marks
UNITS: **1** Mcrobial Growth & Microbial nutrition	2	-	1	2	27
UNIT:2 Metabolism	1	2	2	1	27
UNIT:3 Chemoheterotrophic metabolism	2	3	1	1	26
UNIT:4 Chemolithotrophic & phototrophic metabolism	-	2	2	1	26

I Main: 1x5=05Marks
II Main: 3x7=21Marks
III Main: 5x6=30Marks
IVMain: 10x5=50Marks

DSC-III

II B.Sc.-IIISEMESTER

SCHEME OF PRACTICAL EXAMINATION

PRACTICAL III: MICROBIAL PHYSIOLOGY AND METABOLISM

Time: 3hours **Max. marks :70**

E. Demonstrate the experiment **A**, giving principle and procedure. Record the results.
(Demonstration-5marks; principle -5mark; procedure -3marks; result-2mark)
(Detection of amino acids by Paper chromatography /Effect of temperature on growth of microorganisms/Effect of pH on the growth of microorganisms /Effect of salt concentration on growth of microorganism/ Effect of carbon and nitrogen on growth of microorganism). 15

II. Perform/conduct the experiment **B,** giving principle and procedure. Record the results. 10
(Demonstration-5marks; principle -2mark; procedure -2marks; result-1mark)
(Fermentation of lactose / starch hydrolysis/gelatin hydrolysis / catalase activity/urease test)

III. Prepare a temporary slide of **C** and identify the microorganisms giving reasons. Leave the preparation for evaluation. 10
(Preparation of slide-5marks, identification- 1mark, reason-4mark, Material to be given is root nodules)

IV. Write critical notes on **D, E & F** 5X3=15
(Fermentation of lactose / glucose/Starch hydrolysis/Gelatin hydrolysis / Catalase Activity/Urease test/Haemocytometer/Turbidometer/fermentation of Kuhne's fermentation vessel)

V. Record 10

VI. Viva 10

Total marks: 70: [50 (Practical Exam) + 20 (10 -record+10- viva)]

DSC-IV
SCHEME OF THEORY EXAMINATION
II B.Sc.,IV SEMESTER
TITLE: MICROBIAL GENETICS AND GENETIC ENGINEERING

Times: 3hrs **Max Marks:70**

Question Paper to be set for total of 106marks including choices

UNITS	1 mark questions	3 mark questions	5 mark questions	10 mark questions	Total Marks
UNITS: **1** Microbial genetics	2	-	1	2	27
UNIT:2 Molecular Genetics	1	2	2	1	27
UNIT:3 Genetic Engineering	2	3	1	1	26
UNIT:4 Tools in genetic Engineering	-	2	2	1	26

I Main: 1x5=05Marks
II Main: 3x7=21Marks
III Main: 5x6=30Marks
IVMain: 10x5=50Marks

DSC-IV
II B.Sc.-IV SEMESTER
SCHEME OF PRACTICAL EXAMINATION
PRACTICAL IV: MICROBIAL GENETICS AND GENETIC ENGINEERING

Time: 3hours **Max. marks :70**

I. Identify the materials **A, B**and **C** with labelled diagrams and reasons 5X3=15
(conjugation/transduction/ AMES test/Amplification of PCR/Southern blotting/Plasmid DNA)
(Identification -1mark; diagram and reasons-4mark)

II. Write critical notes on **D, E** and **F.** 5 X3=15
(DNA model /Transcription and Translation model/DNA replication model/t-RNA/Plasmids /Episomes/ mRNA, transformation, conjugation and transduction)

III. Demonstrate the experiment **G,** giving principle and procedure. Record the results. 10
(Replica plating /Quantification of DNA/Conjugation/transformation/transduction)
(Demonstration-5marks; principle -5mark; procedure -3marks; result-2mark)

IV. Prepare the slide **H** giving the procedure and results. 10
(Preparation of slide-5marks, Procedure-2 reason-2mark, Diagram-1)
(onion root tip or flower buds mentioned in the practical syllabus)

V. Record 10

VI. Viva 10

Total marks: 70: [50 (Practical Exam) + 20 (10 -record+ 10- viva)]

DSE(A)
SCHEME OF THEORY EXAMINATION
III B.Sc.,V SEMESTER
TITLE: ENVIRONMENTAL MICROBIOLOGY

Times: 3hrs **Max Marks:70**

Question Paper to be set for total of 106marks including choices

UNITS	1 mark questions	3 mark questions	5 mark questions	10 mark questions	Total Marks
UNITS: **1** Microbiology of soil	2	-	1	2	27
UNIT:2 Microbiology of Air	1	2	2	1	27
UNIT:3 Microbiology of water & waste water	2	3	1	1	26
UNIT:4 Microbial Bioremediation	-	2	2	1	26

I Main: 1x5=05Marks
II Main: 3x7=21Marks
III Main: 5x6=30Marks
IVMain: 10x5=50Marks

DSE(B)
SCHEME OF THEORY EXAMINATION
III B.Sc.,V SEMESTER
TITLE: AGRICULTURAL MICROBIOLOGY

Times: 3hrs **Max Marks:70**

Question Paper to be set for total of 106marks including choices

UNITS	1 mark questions	3 mark questions	5 mark questions	10 mark questions	Total Marks
UNITS: **1** Introduction & History of Plant pathology & Microorganism in Agriculture	-	2	2	1	26
UNIT:2 Phytopathology	1	2	2	1	27
UNIT:3 Control of Plant diseases	2	3	1	1	26
UNIT:4 Specific Plant disease	2	-	1	2	27

I Main: 1x5=05Marks
II Main: 3x7=21Marks
III Main: 5x6=30Marks
IVMain: 10x5=50Marks

DSE(A)

III B.Sc.-VSEMESTER

SCHEME OF PRACTICAL EXAMINATION

PRACTICAL V: ENVIRONMENTAL MICROBIOLOGY

Time: 3hours **Max. marks :70**

I. Demonstrate /perform the experiment **A**, giving principle and procedure. Record and interpret the result. 10

(Demonstration- 5marks; principle-2marks; procedure-2marks; results-1marks)

(Petriplate exposure method/standard analysis of water/ determination of MPN/ Isolation of Bacteria /Fungi from soil by serial dilution method/Antagonism between microorganisms).

II. Demonstrate /perform the experiment **B**, giving principle and procedure. Record and interpret the result. (Demonstration-3marks; principle-3mark; procedure-2mark; results-2marks) 10

(Demonstration of BOD of sewage/Estimation of total solids in sewage/IMViC/Hydrogen sulphide strip test).

III. Record the source and importance of microorganisms in the material **C** with Identification and label the diagrams. 10

(Source of the microorganisms and identification-5marks; labelled diagram- 3marks; importance- 2marks).

(Pond water, agar plates exposed to air, biological indicators of water pollution).

IV. Write critical notes on **D, E** and **F** 3x4=12

(Identification -1mark; critical comments-4marks)

(Air samplers, Results of standatrd analysis of water, MPN, IMViC reactions,Hydrogen sulphide stip test, photograghs of baffles ,flocculator, clarifier,sand filter,back wash, chlorinometer,chloroscope,septic tank, Trickling filter, activated sludge process, oxidation pond, sedimentation tank, anaerobic digester, biogas plant, composting, composting process, aerated lagoons, low shear air lift reactor and microbial leaching/ Azolla/ AM/Rhizosphere microflora).

V. Prepare a temporary stained slide of **G**.Identify with labelled sketch and reasons 08

Leave the preparation for evaluation.

(Identification -1mark; preparation-4marks; labeled diagram and reasons-3marks).

(Anabaena from Azolla/VAM/Rhizobium)

VI. Record 10

VII. Viva 10

DSE(B)

III B.Sc.-V SEMESTER

SCHEME OF PRACTICAL EXAMINATION

PRACTICAL V: AGRICULTURAL MICROBIOLOGY

Time: 3hours **Max. marks :70**

I. Demonstrate /perform the experiment **A**, giving principle and procedure. Record and Interpret the result. 15

(Demonstration-5marks; principle-4marks; procedure-4marks; results-2marks). (Isolation of Fungi from soil by serial dilution method/ from diseased parts of plants, chemical determination of IAA/plant disease control by fungicide).

II. Prepare a temporary stained slide of **B**. Identify with labeled sketch and reasons. Leave the preparation for evaluation. 15

(Identification -2mark; preparation-5marks; labeled diagram-4 and reasons-4marks).

(Plant diseases as per theory syllabus)

III. Identify the slides/materials **C, D, E** and **F** with labelled diagrams and reasons 4X5=20

(Identification-1mark; reasons-2marks; labeled sketch-1mark).

(Plant diseases as per theory syllabus/ Koch postulates)

IV. Record +Report 10

V. Viva 10

Total marks: 70: [50 (Practical Exam) + 10 (record+ report) + 5-(viva)]

DSE(A)
SCHEME OF THEORY EXAMINATION
III B.Sc.,VI SEMESTER
TITLE: FOOD MICROBIOLOGY AND INDUSTRIAL MICROBIOLOGY

Times: 3hrs **Max Marks:70**

Question Paper to be set for total of 106marks including choices

UNITS	1 mark questions	3 mark questions	5 mark questions	10 mark questions	Total Marks
UNITS: **1** Industrial microbiology	2	-	1	2	27
UNIT:2 Industrial production	2	3	1	1	26
UNIT:3 Food Microbiology	1	2	2	1	27
UNIT:4 Dairy Microbiology	-	2	2	1	26

I Main: 1x5=05Marks
II Main: 3x7=21Marks
III Main: 5x6=30Marks
IVMain: 10x5=50Marks

DSE(B)
SCHEME OF THEORY EXAMINATION
III B.Sc.,VI SEMESTER
TITLE: MEDICAL MICROBIOLOGY AND IMMUNOLOGY

Times: 3hrs **Max Marks:70**

Question Paper to be set for total of 106marks including choices

UNITS	1 mark questions	3 mark questions	5 mark questions	10 mark questions	Total Marks
UNITS: **1** Medical microbiology	2	-	1	2	27
UNIT:2 Human diseases	1	2	2	1	27
UNIT:3 Immune cells& organs	2	3	1	1	26
UNIT:4 Antigens and antibody	-	2	2	1	26

I Main: 1x5=05Marks
II Main: 3x7=21Marks
III Main: 5x6=30Marks
IVMain: 10x5=50Marks

DSE(A)
SCHEME OF PRACTICAL EXAMINATION
III B.Sc. – VI SEMESTER
TITLE: FOOD MICROBIOLOGY AND INDUSTRIAL MICROBIOLOGY

Time:3hours. **Max.marks:70**

I. Demonstrate / Perform the experiment **A**, giving principle and procedure. Record and interpret the result. 15

(Demonstration -5marks; principle-4marks; procedure-4marks; results and interpretation-2marks). (Isolation of microorganisms from utensils/spoiled vegetables/spoiled fruits).

II. Conduct the test for **B**. Write the principle and procedure. Record and interpret the results. 15

(Demonstration -5 marks; principle-4 marks; procedure-4 marks; results and interpretation- 2marks).

(Turbidity test, Phosphatase test, MBRT test, Estimation of % of alcohol in a given sample by specific gravity bottle method).

III. Write critical notes on **C, D** and **E**. (Identification -1mark; critical comments-1marks). 4X3=12

(Cheese, Yoghurt, Srikhand, Bread, Molasses, Wine, Alcohol, *Aspergillus* on groundnut, Citric acid production/alcohol from jaggery).

IV .Prepare temporary stained slide of **F.** Identify with labelled sketch and reasons. 08

Leave the preparation for evaluation.

(Identification -1mark; preparation-5marks; reasons- 4marks).

(*Spirullina, Chlorella*, Aspergillus *niger* and Yeast).

V. Record +Report 10

VI. Viva 10

DSE(B)
SCHEME OF PRACTICAL EXAMINATION
III B.Sc. – VI SEMESTER
TITLE: IMMUNOLOGY AND MEDICAL MICROBIOLOGY

Time: 3hours **Max.marks:70**

I. Demonstrate / Perform the experiment **A**, giving principle and procedure. Record and interpret the result. 15

(Demonstration -5marks; principle-4marks; procedure-4marks;results and interpretation- 2).

(Antibiotic sensitivity test/Determination of blood group and Rh factor/Demonstration of precipitation reaction-ODD).

II. Demonstrate the experiment **B.** write the principle and procedure. Record and interpret the results 15

(Demonstration -5marks; principle-4marks; procedure-4marks; results and interpretation-2m)

(RPR/Urine bacteria by calibrated loop /Enumerate RBC in given blood sample/ Enumerate WBC in given blood sample/ Snyder test).

III. Write critical notes on **C, D**, and **E**. 4x3=12

(Identification -1mark; critical comments-3marks)

(Antibiotic sensitivity test, Estimation of urine bacteria by calibrated loop/IMViC/TSI/Nitrate reduction/urease production/catalase/ Ouchterlony procedure, RPR, Widal test, Slides/ Photographs of human pathogens as per theory syllabus).

IV. .Prepare temporary stained slide of **F**. Identify with labeled sketch and reasons.

Leave the preparation for evaluation. 08

(Identification -1mark; preparation-5marks; reasons- 4marks).

(Petri plates with Fungal colonies/Bacterial colonies).

V. Record +Report 10

VI. Viva 10

Total marks: 70: [50 (Practical Exam) + 10 – (record+ report) + 5-(viva)]

SEC(A)
SCHEME OF THEORY EXAMINATION
III B.Sc.,V SEMESTER
TITLE: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

Times: 3hrs **Max Marks:50**

Question Paper to be set for total of 86 marks including choices

UNITS	1 mark questions	3 mark questions	5 mark questions	10 mark questions	Total Marks
UNITS: **1** Importance of diagnosis of diseases	1	1	1	1	19
UNIT:2 Collection of clinical samples	1	2	1	1	22
UNIT:3 Direct microscopic examination and culture	--	1	2	1	23
UNIT:4 Testing for antibiotic sensitivity in bacteria	1	2	1	1	22

I Main: 1x3=03Marks
II Main: 3x6=18Marks
III Main: 5x5=25Marks
IVMain: 10x4=40Marks

SEC(B)
SCHEME OF THEORY EXAMINATION
III B.Sc.,V SEMESTER
TITLE: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

Times: 3hrs **Max Marks:70**

Question Paper to be set for total of 86marks including choices

UNITS	1 mark questions	3 mark questions	5 mark questions	10 mark questions	Total Marks
UNITS: **1** Air microbiology	1	1	1	1	19
UNIT:2 Water microbiology	1	2	1	1	22
UNIT:3 Microbial analysis of water	--	1	2	1	23
UNIT:4 Control Measures	1	2	1	1	22

I Main: 1x3=03Marks
II Main: 3x6=18Marks
III Main: 5x5=25Marks
IVMain: 10x4=40Marks