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

ESTD-1964

DEPARTMENT OF MICROBIOLOGY

SYLLABUS

CHOICE BASED CREDIT SYSTEM

FOR
B.Sc. PROGRAMME
Biochemistry, Microbiology & Biotechnology

Botany, Biochemistry & Microbiology

(**Amended syllabus to be implemented W. E. F. 2019 – 2020)**

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE, OOTY ROAD, MYSURU-25
DEPARTMENT OF MICROBIOLOGY
PROFORMA OF INSTRUCTIONS AND EXAMINATION FOR B.Sc. PROGRAMME IN MICROBIOLOGY (CBCS)
DURATION OF THE COURSE: 3YEARS (6SEMESTER)
PROGRAMME:BScBMBt, PROGRAMME CODE:BSc06 (2019-20)

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	**DMA28006** 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	**DMB28006** 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	**DMC28006** 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	**DMD28006** 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	**DME28006 / DME28206** 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	02														
		DME28406/ DME28606 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	**DMF28006/ DMF28206** 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	02														
				Total credits				**36**										

JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE, OOTY ROAD, MYSURU-25
DEPARTMENT OF MICROBIOLOGY
PROFORMA OF INSTRUCTIONS AND EXAMINATION FOR B.Sc. PROGRAMME IN MICROBIOLOGY (CBCS)
DURATION OF THE COURSE: 3YEARS (6SEMESTER)
PROGRAMME:BScBBM, PROGRAMME CODE:BSc07 (2019-20)

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**	**DMA28007** 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	**DMB28007** 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**	**DMC28007** 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	**DMD28007** 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**	**DME28007 / DME28207** 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	02														
		DME28407/ DME28607 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	**DMF28007/ DMF28207** 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	02														
				Total credits				**36**										

DEPARTMENT OF MICROBIOLOGY
PROGRAMME: BSc BMBT
PROGRAMME CODE: BSC06

PROGRAMME OUTCOMES: B.Sc., BMBT

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, both written and oral

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

PO3. Apply the scientific method to design, execute, and analyze an experiment, to explain their scientific procedures and their experimental observations

PO4. Demonstrate an understanding of fundamental biochemical principles, structure and biological function

PO5. Work as a laboratory technician, biochemists or medical scientist

PO6. Describe/ explain the processes used by microorganisms for their replication, survival, and interaction with their environment and host populations

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

PO9. Design and develop solution to Biotechnology problems by applying appropriate tools while keeping in mind safety factor for environment & society

PO11. Create, select, and apply appropriate techniques, resources, and modern tools with an Understanding of the limitations

PO12. Support biotechnology research activity with strong technical background knowledge

PROGRAMME SPECIFIC OUTCOME

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

PSO 1: Gain and understand biochemical and molecular processes that occur in and between cells to expand understanding of biology

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

PSO3: Acquire, articulate, retain and demonstrate laboratory safety skills applicable to microbiological research or clinical methods

PSO4: Demonstrate effectively the applications of biochemical and biological sciences

PSO5: Decide and apply appropriate tools and techniques in biotechnological manipulation

PSO6: Justify societal, health, safety and legal issues and understand his or her responsibilities in biotechnological practices

PROGRAMME: BSc BBM
PROGRAMME CODE: BSC07
PROGRAMME OUTCOMES: B.Sc., BBM

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 contexts, and demonstrate the knowledge of, and need for sustainable development

PO3. Use interdisciplinary approaches with quantitative skills to work on biological problems

PO4. Demonstrate the ability to justify and explain their thinking and/or approach, both written and oral

PO5. Develop state-of-the-art laboratory and professional communication skills

PO6. Apply the scientific method to design, execute, and analyze an experiment and also to explain their scientific procedures as well as their experimental observations

PO7. Demonstrate an understanding of fundamental biochemical principles, structure and biological function

PO8. Work as a laboratory technician, biochemists or medical scientist

PO10. Describe/ explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations

PO11. Explain the theoretical basis of the tools, technologies and methods common to microbiology

PROGRAMME SPECIFIC OUTCOME

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

PSO 1: Demonstrate effectively the 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 applicable to microbiological research or clinical methods, including accurately reporting observations and analysis

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

PSO5: Be knowledgeable in proper procedures and regulations in handling and disposal of chemicals

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

DMA28006 / DMA28007 I B.Sc., I SEMESTER

DSC-I: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

60hrs (4hrs/week) credits: 4

COURSE OUTCOME:

After successful completion of the course students are able to:

- **CO1:** Gain basic knowledge about Microbiology starting from history to Microorganisms
- **CO2:** Learn about the taxonomical classification of Microbes.
- **CO3:** Understand the basic microbial structure, function and study of the comparative characteristics of prokaryotes and eukaryotes
- **CO4:** Understand the structural similarities and differences among various physiological groups of fungi, protozoa and algae
- **CO5:** Know how viruses are classified and understand the structure of viruses
- **CO6:** Know the replication strategies of representative viruses

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. Golden era of microbiology: Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming.

B. Development in the field of Soil Microbiology: Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky and Selman A. Waksman.

C. Development in the 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. System of classification: Haeckel's three- kingdom, Whittaker's five-kingdom classification and Cavalier-Smith's eight kingdom classification.

General characteristics of different groups – a. Acellular microorganisms: Virus, Viroids, Prions. b. Cellular microorganisms: 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 (in brief).

b. Structure of typical algal cell (E.g: *Chlamydomonas*) - occurence, thallus organization,

Pigments, flagella, eyespot, food reserves and vegetative, asexual and sexual reproduction.

c. 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, asexual and sexual reproduction.

Definition- Heterokaryosis, Heterothallism and Parasexuality.

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

d. Study of thallus structure, reproduction, life cycle and economic importance 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.

Total marks 100: 50(Theory) + 30 (C1+C2)+ 20 (Practicals)

I B.Sc., I SEMESTER
DSC-I: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY (PRACTICALS)

TOTAL HOURS: 60 **CREDITS: 2**

1. Microbiology Good Laboratory Practices and Biosafety.
2. Study of contributions 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. Study of photographs of the following: Bacteriophages, TMV and HIV

REFERENCES:

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10. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.
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18. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
19. Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.
20. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.

DMB28006 / DMB28007 I B.Sc., II SEMESTER
DSC-II: BACTERIOLOGY
TOTAL HOURS: **60hrs (4hrs/week)** **CREDITS: 4**

Course Outcome:
After successful completion of the course students are able to:

CO1: Bacteria, microscopes and basic laboratory techniques
CO2: Demonstrate theory and practical skills in microscopy, their handling techniques and staining procedures
CO3: Various Culture media and their applications and physical and chemical means of sterilization
CO4: To identify the bacteria based on staining and cultural characteristics
CO5: The maintenance and preservation of cultures

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), 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 Archaea.

B. Bacterial diversity:

a. Methanogens, Rickettsiae, Chlamydiae, Mollicutes (Mycoplasmas), Spirochaetes and Actinomycetes
b. Cyanobacteria: Occurrence, structure, reproduction and economic importance of the following: *Microcystis, Spirulina & Anabaena*

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

BACTERIOLOGICAL TECHNIQUES

A. Cultivation of bacteria

a. Culture media – Types, Cultivation of aerobic and anaerobic bacteria.

b. Pure culture and Cultural characteristics: Pure culture techniques- Serial dilution, Pour plate, Spread plate, Streak plate and Micromanipulator technique. Cultural characteristics of bacteria – plate cultures/solid media and broth cultures/liquid media.

c. Maintenance and Preservation of pure cultures – Sub culturing, overlaying with mineral oil, refigeration ($4^{\circ}C$), 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), 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. Hanging drop method for bacterial motility.

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

MICROSCOPY

A. **Light Microscope: a.** 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.

b. 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 - Alcohols, Aldehydes, Halogens, Phenols, Heavy metals, Quaternary Ammonium compounds and Sterilizing gases (ethylene oxide).

Total marks 100: 50 (Theory) + 30(C1+C2) + 20 (Practicals)

REFERENCES:

1. Dubey,R.C. and Maheshwari, D.K. (1999). **A text book of Microbiology** .S.Chand and company limited , Ramnagar, New Delhi.

2. Gunashekaran,P. (1996). **Laboratory Manual in Microbiology**. New age International Pvt limited publishers, New Delhi

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I B.Sc., II SEMESTER
DSC-II: BACTERIOLOGY
PRACTICAL

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

1. Study 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 and Gram's iodine.
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, Colony counter. BOD incubator, pH meter & Biosafety cabinet.
9. Preparation of Chromic acid and its use.
10. Cleaning and Sterilization of glasswares. Preparation of culture 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. Demonstration of bacterial motility by Hanging drop technique

DMC28006 / DMC28007 II B.Sc., III SEMESTER
DSC-III: MICROBIAL PHYSIOLOGY AND METABOLISM
TOTAL HOURS: 60hrs (4hrs/week) CREDITS: 4

COURSE OUTCOME:

After successful completion of the course students are able to:
CO1. Inculcate the knowledge regarding microbial growth, functions, physiology and metabolism
CO2. Know the microbial growth in response to environmental factors
CO3. Get equipped with various methods of bacterial growth measurement
CO4. Know about the biological nitrogen fixation
CO5. Knowledge of properties, structure, function of enzymes, enzyme kinetics and their regulation

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, phosphorous, sulphur, oxygen and energy sources. Trace elements: 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, neutophiles), 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.

Total marks 100: 50(Theory)+30(C1+C2)+ 20 (Practicals)

II B.Sc., III SEMESTER
DSC-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. Production of ammonia from organic compounds- Ammonification.
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.

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1. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
2. Brock T. D. and Madigan M.T., Biology of Microoragnisms, Prentice hall of India Pvt. Ltd, New Delhi.
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4. Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India
5. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
6. Karp G (2010). Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons. Inc.
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8. Lansing M. Prescott,John P.Harley,Donald A.klein, Microbiology,5th ed. WCB Mc Graw Hill, New york.
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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
13. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
14. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
15. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

DMD28006 / DMD28007 II B.Sc., IV SEMESTER
DSC-IV: MICROBIAL GENETICS AND GENETIC ENGINEERING
TOTAL HOURS: 60hrs (4hrs/week) CREDITS: 4

COURSE OUTCOME:

After successful completion of the course students are able to:

CO1. Know genetics of microorganisms and recombinant DNA technology used in microbiological research
CO2. Know the terms and terminologies related to molecular biology and microbial genetics
CO3. Understand the properties, structure and function of genes in microorganisms
CO4. Conceptualize knowledge about DNA and RNA as a genetic material, enzymology, and replication strategies
CO5. Know the importance of genetic code and Recombination
CO6. The concept of recombination and gene transfer mechanisms
CO7. Understand techniques, social and ethical issues concerning genetic engineering
CO8. Applications of genetic engineering in various fields

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.
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 .

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.

Total marks 100: 50(Theory)+30(C1+C2)+ 20 (Practicals)

II B.SC., IV SEMESTER
DSCIV: 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
5-6. Preparation of Master and Replica Plates
7. Isolation of streptomycin resistant strain of *E.coli* by gradient plate method.
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
4. Klug WS, Cummings MR, Spencer, C, Palladino, M (2011). Concepts of Genetics, 10th Ed., Benjamin Cummings
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.
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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

DME28006 / DME28007 V SEMESTER

DSE-A: ENVIRONMENTAL MICROBIOLOGY

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

COURSE OUTCOME:

After successful completion of the course students are able to:

CO1. Know **t**he role of microorganisms in soil, air, water, waste water and bioremediation

CO2. Learn the occurrence, abundance and distribution of microorganisms in the environment and their role in the environment

CO3. Understand various biogeochemical cycles – Carbon, Nitrogen, Phosphorus cycles etc. and microbes involved in these cycles

CO4. Understand various plant microbes interactions and their applications.

CO5. Understand the basic principles of bioremediation

C**O6.** The various methods to determine the Sanitary quality of water and sewage treatment methods employed in waste water treatment

UNIT 1 No. of Hours: 15

SOIL MICROBIOLOGY

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

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

UNIT: II No. of Hours: 15

AEROBIOLOGY

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**

AQUATIC MICROBIOLOGY

A. 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.

B. Water pollution: Sources, water borne diseases- Viral (jaundice), Bacterial (cholera) and Protozoan (amoebic dysentery). Biological indicator of water pollution.

C. 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 (According to WHO).

SEWAGE MICROBIOLOGY

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.

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.

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

AGRICULTURAL MICROBIOLOGY

A. Introduction – Classification of plant diseases on the basis of spread and severity of infection

B. Microbes and Plant diseases - Entry of pathogens into host-prepenetration, penetration, post penetration.

C. Microbes in Agriculture: Biofertilizers: Definition and Types. Mass production of Bacterial inoculants (*Rhizobium , Azospirillum & Cyanobacteria)*. Biopesticides: Definition, Types – Bacterial, Viral, Fungal and Protozoan, Mode of action, Microbial herbicides.

D. Plant diseases: Study of Symptoms, Etiology, Epidemiology, Management of the following diseases – Bean Mosaic, Sandal spike, Citrus canker, Downy mildew of Bajra, Powdery mildew of mulberry, Rust of sorghum, Blast of paddy, Red rot of sugarcane, Tikka disease of groundnut.

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

5a. Gram's staining of citrus canker specimen

b. Observation of specimens - Bean mosaic, Sandal spike, Citrus canker, Downy mildew of Bajra, Powdery mildew of mulberry, Rust of sorghum, Blast of paddy, Red rot of Sugarcane, Tikka disease of groundnut.

6. Isolation of airborne microorganisms (Bacteria and Fungi) by Petriplate exposure method.
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. Determination of biological oxygen demand (BOD) 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/Agricultural research institute. 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.
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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).
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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.
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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.

DME28206 / DME28207 V SEMESTER

DSE-B: AGRICULTURAL MICROBIOLOGY

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

COURSE OUTCOME:

After successful completion of the course students are able to:

CO1. Know microorganisms in agriculture, plant pathology and control of plant diseases and their significance

CO2. Understand the land mark in the field of Agricultural microbiology

CO3. Gain knowledge about biofertilizers and biopesticide in agriculture

CO4. Know the stages in disease development, epidemiology and host pathogen interaction

CO5. Know about principles and practices involved in the management of plant diseases

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.

Total marks 100: 50(Theory)+30(C1+C2)+ 20 (Practicals)

V SEMESTER
DSE-B: AGRICULTURAL MICROBIOLOGY
PRACTICAL

TOTAL HOURS: 30hrs (2hrs/week) **CREDITS: 01**

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 - Late blight of potato, Powdery mildew of wheat, Ergot of rye, Loose smut of wheat, Wilt of tomato, Red rot of sugarcane, Blast of rice
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
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.

DMF28006 / DMF28007 VI SEMESTER

DSE-A: INDUSTRIAL AND FOOD MICROBIOLOGY

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

COURSE OUTCOME:

After successful completion of the course students are able to:

CO1.Understand food related microorganisms, their contamination, spoilage and preservation

CO2. Understand the beneficial role of microorganisms in fermented dairy products

CO3. Know the principles involving various methods of food preservation & Spoilage

CO4. Understand how microbiology is applied in manufacture of industrial products

CO5. Identify techniques applicable for strain Improvement of microorganism

CO6. The underlying principles in downstream processing

UNIT: I No of Hours: 15

INDUSTRIAL MICROBIOLOGY

A. Brief history and developments in industrial microbiology

B. Microorganisms of industrial importance; Isolation, Screening and Preservation of industrial important microbes..

C. Strain improvement of Microorganisms for industrial purposes.

D.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.

E. 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.

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.

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

Total marks 100: 50(Theory)+30(C1+C2)+ 20 (Practicals)

VI SEMESTER
DSE-A: INDUSTRIAL AND FOOD MICROBIOLOGY
PRACTICAL

TOTAL HOURS: 30hrs (2hrs/week) **CREDITS: 01**

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.

DME28406 / DME28407 SEMESTER – V

SEC-A: MICROBIAL DIAGNOSIS IN HEALTH CLINICS

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

COURSE OUTCOME

After successful completion of the course students are able to:

CO1. Gain experience in health clinics such as examination, collection of clinical samples and diagnosis

CO2.Demonstrate scientific quantitative skills, the ability to evaluate experimental design, read graphs

CO3. Understand and use information from scientific papers/Journals

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/sputum, throat, skin, blood, CSF, urine and faeces) and handling clinical specimens. 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, Giemsa stained, 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 ,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.

DME28606 / DME28607 SEMESTER – V

SEC-II: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER

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

COURSE OUTCOME:

After successful completion of the course students are able to:

CO1. Know about bioaerosols, airsample collection and analysis

CO2.Control measures of air microbes

CO3. Know about the water borne diseases and their management

CO4.To identify water borne pathogens

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.

UNIT: IV No of Hours: 5

LABORATORY SAFETY 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

REFERENCES:

1.Adams M.R.and Moss M.O., 1995, Food Microbiology. Royal Society of Chemistry , Cambridge University Press.

2.Anathanarayanan C and Paniker, C.K.J. Text Book of Microbiology, 9th ed. Orinet Longman ltd., Chennai.

3.Banwart, G.J.(1987) Basic Food Microbiology. CBS Publishers and distributors, New Delhi.

4.Casida,LE Jr 1968 Industrial Mirobiology. New Age International Publishers.

5.Frazier & Westhoff, D.C.1995,Food Microbiology Tata McGraw Hill Pub. Company Ltd.,New Dehli.

6.Jay, J.M. (1985). Modern Food Microbiology.CBS Publishers and distributors, New Delhi.

Banwart, G.J. (1987). **Basic Food Microbiology**. CBS publishers and distributors, New Delhi.

7.Benson,H.J. **Microbiological applications- laboratory manual in general microbiology,** fifth edition.C.Brown publishers.

8.Cappuccino,J.G., And Sherman,N. (1999). **Microbiology- A Laboratory Manual,** Fourth edition.

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.

14. R.P.Singh, Immunology and Medical Microbiology

15.Rajan. S. Medical Microbiology. MJP Publishers, Chennai.

DMF28206 / DMF28207 VI SEMESTER

DSE-B: MEDICAL MICROBIOLOGY AND IMMUNOLOGY

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

COURSE OUTCOME

After successful completion of the course students are able to:

CO1. Know the human immune response towards microbes, Know the relationship between microorganism and human disease, pathogenicity, Laboratory diagnosis, treatment and prophylaxis

CO2. Demonstrate an understanding of key concepts in immunology

CO3. Understand the overall organization of the immune system

CO4. Understand the salient features of antigen antibody reaction & its uses in diagnostics and other studies

CO5. Learn about immunization and their preparation and importance

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, Phagocytes and NK cells. Cells and tissues of immune systems-Structure and role of primary lymphoid organs (bone marrow,thymus),secondary lymphoid organs (spleen, lymph nodes and tonsils).

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).

Total marks 100: 50(Theory)+30(C1+C2)+ 20 (Practicals)

DSE- B
VI SEMESTER
DSE-B: MEDICAL MICROBIOLOGY AND IMMUNOLOGY
PRACTICALS

TOTAL HOURS: 30hrs (2hrs/week) **CREDITS: 01**

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 caries-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
3. 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
4. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition WileyBlackwell Scientific Publication, Oxford.
5. Glodsby Richard A., Kindt Thomas J. And Osborne Barbara A., Kuby Immunology, W. H. Freeman and Company New York.
6. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
7. Gupte S.M.D (1986). Short Text Book of Medical Microbiology. Jaypee Brothers, Medical Publishers, New Delhi.
8. Jagadish Chandra (1996). Text Book of Medical Mycology. Oreint Longman
9. Jawetz, Melnick, Adelberg, Medical Microbiolgy, Prentice Hall Inc, London.
16. Jayaram Panicker, C.K. 1993 Text Book of Medical Parsitology Jaypee Brothers, Medical Publishers, New Delhi.
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
12. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
13. Nandhini Shetty 1993. Immunology: Inductory Text Book . New Age International Ltd.
14. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.
15. R.P.Singh, Immunology and Medical Microbiology
16. Rajan. S. Medical Microbiology. MJP Publishers, Chennai.
17. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication
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
DSE (A/B) - DSE(A/B)
(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 (SEI-SEII)
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

SCHEME OF THEORY EXAMINATION

I B.Sc., I SEMESTER

DSC-I: 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

SCHEME OF PRACTICAL EXAMINATION

I B.Sc., I SEMESTER

PRACTICAL-I: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

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

I. Identify the materials **A, B** and **C** with labelled diagrams and reasons 5X2=10
(1 material each from Algae and Fungi 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 5X3=15
(One slide each from Algae, Fungi and Protozoa as per the theory syllabus)
(Identification –1mark; labelled diagram with reasons-4mark)

IV. Stain the given material **J** by…….method. Write the principle, procedure and leave the preparation for evaluation 10
(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)]

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

SCHEME OF PRACTICAL EXAMINATION
I B.Sc., II SEMESTER: PRACTICAL-II
PRACTICALS-II: 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 / Laboratory equipments/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)]

SCHEME OF THEORY EXAMINATION

II B.Sc., III SEMESTER

DSC-III: 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

II B.Sc.-IIISEMESTER

SCHEME OF PRACTICAL EXAMINATION

PRACTICAL III: MICROBIAL PHYSIOLOGY AND METABOLISM

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

I. Demonstrate the experiment **A**, giving principle and procedure. Record the results. 15
(Demonstration-5marks; principle -5mark; procedure -3marks; result-2mark)
(Ammonification /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).

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 glucose by Kuhne's fermentation vessel)

V. Record 10

VI. Viva 10

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

SCHEME OF THEORY EXAMINATION

II B.Sc.,IV SEMESTER

DSC-IV: 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 of Genetic Engineering	-	2	2	1	26

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

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/Streptomycin resistant mutant)
(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, Isolation of streptomycin resistant strain of *E.coli* by gradient plate method)
(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)]

SCHEME OF THEORY EXAMINATION
III B.Sc.,V SEMESTER
DSE-A: 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** Soil Microbiology	2	-	1	2	27
UNIT:2 Aerobiology	1	2	2	1	27
UNIT:3 Aquatic, sewage & bioremediation	2	3	1	1	26
UNIT:4 Agricultural Microbiology	-	2	2	1	26

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

SCHEME OF THEORY EXAMINATION
III B.Sc.,V SEMESTER
DSE-B: 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/ VAM/Rhizosphere microflora/Plant diseases as per theory syllabus).

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/Citrus canker)

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)]

SCHEME OF THEORY EXAMINATION

III B.Sc.,VI SEMESTER

DSE-A: 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

SCHEME OF THEORY EXAMINATION

III B.Sc.,VI SEMESTER

DSE-B: 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-1marks)
(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)]

SCHEME OF THEORY EXAMINATION
III B.Sc.,V SEMESTER
SEC-A: 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 Deirect 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

SCHEME OF THEORY EXAMINATION
III B.Sc.,V SEMESTER
SEC-B: 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

Approved list of Paper setters and Valuers

Sl No.	Name	College address
1	Dr..M .Seema	Chairperson, Dept. of Microbiology JSS College, Ooty road, Mysore
2	H.P.Spoorthy	Assistant prof. Dept. of Microbiology JSS College, Ooty road, Mysore
3	Dr.S.Mahadevamurthy	Associate Prof & HOD Dept. of Microbiology Yuvaraja's college Mysore.
4	Dr.Syeda Kauser Fathima	Associate Prof. of Microbiology Maharani's Science College for women JLB road Mysore.
5	Dr. H.S. Jayanth.	Asso.Prof.of Microbiology Dept. of Microbiology Yuvaraja's college Mysore.
6	Dr.Nagarathnamma	Asso. Prof. of Microbiology Government women college Mandya
7	Sri. M. Girish	Assistant prof. Dept. of Microbiology JSS College for Women Saraswathipuram,Mysore
8	Dr. P.K.Maheshwar	Assistant Prof. Dept. of Microbiology Yuvaraja's college,Mysore.
9	Smt. M.S.Shobha	Assistant Prof, Dept. of Microbiology Maharani's Science College Mysore
10	Sri. R.A. Manjunath	Assistant Prof. Dept. of Microbiology Saradavilas College,Mysore
11	Dr.M.P. Ragavendra	Assistant Prof. Dept. of Microbiology Maharani's Science College,Mysore
12	Dr.K.Girish	Assistant Prof. Dept. of Microbiology Maharani's Science College, Mysore
13	Sri. G.S. Siddegowda	Assistant Prof.

		Dept. of Microbiology Maharani's Science College Mysore
14	Dr.N.S.Devaki	Assistant Prof. Dept. of Molecular Biology Yuvaraja's College , Mysore
15	Syeda Farahna Parveen	Assistant Prof. Dept. of Microbiology St.Philomina's College, Mysore
16	Smt. Vanitha	Assistant Prof. Dept. of Microbiology Maharani's Science College,Mysore
17	Smt. Revanamba	Assistant Prof. Dept. of Microbiology Maharani's Science College,Mysore
18	Mahadevaprasad	Assistant prof. Dept. of Microbiology JSS College for Women Saraswathipuram,Mysore
19	Dr.Nagalambika	JSS University,Mysuru
20	RajaRajeshwari.R	Assistant prof. Dept. of Microbiology SDM College JLB Road,Mysuru
21	Uzma Bathool	Assistant Prof. Dept. of Microbiology St.Philomina's College, Mysore
22	Shruthi Prakash	Assistant Prof. Dept. of Microbiology Mahajana's Science College,Mysuru
23	Athiya sultan	Assistant prof. Dept. of Microbiology SDM College JLB Road,Mysuru
24	C.Poornima Devi	Assistant Prof. Dept. of Microbiology Yuvaraja's college,Mysore
25	Dr.Rakshith	Assistant Prof. Dept. of Microbiology Yuvaraja's college,Mysore
26	Vasundara Devi R	Assistant Prof. Dept. of Microbiology Maharani's Science College,Mysore
27	Niveditha Prakash	Assistant prof. Dept. of Microbiology JSS College for Women Saraswathipuram,Mysore
28	Dr.K.Sumana	JSS University,Mysuru