

KUVEMPU UNIVERSITY

Revised Syllabus

Semester scheme syllabus for B.Sc. Degree course of Microbiology (Effective from 2018-19 onwards)

SCHEME OF THE COURSE

(Three year course with two semesters in each year)

First Semester

Paper I: General Microbiology

Practical I

Second Semester

Paper II: Microbiological techniques and instrumentation Part I

Practical II

Third Semester

Paper III: Microbiological techniques and instrumentation Part II

Practical III

Fourth Semester

Paper IV: Microbial physiology and Genetics

Practical IV

Fifth Semester:

Paper V: Environmental Microbiology

Paper VI: Agricultural Microbiology and Biotechnology

Practical V

Practical VI

Sixth Semester:

Paper VII: Food, Dairy and Industrial Microbiology

Paper VIII: Immunology and Medical Microbiology

Practical VII: Project/Dissertation

Teaching Hours:

a. 1st to 4th Semester

Theory: 04 hrs/paper/week

Practicals: 03 hrs/paper/week

b. 5th & 6th Semester

Theory: 03 hrs/paper/week

Practicals: 03 hrs/paper/week

Dissertation/Project work: 03 hrs/week

SCHEME OF EXAMINATION

First Semester

	Duration	Marks	Internal assessment
Theory Paper I:	03 hrs.	50	10 (Two tests of 05 marks)
Practical I	03 hrs	40 (Practical proper 30; Record 05; Viva 05)	
	Total	100	

Second Semester

Theory Paper II:	03 hrs.	50	10 (Two tests of 05 marks)
Practical II	03 hrs	40 (Practical proper 30; Record 05; Viva 05)	
	Total	100	

Third Semester

Theory Paper III:	03 hrs.	50	10 (Two tests of 05 marks)
Practical III	03 hrs	40 (Practical proper 30; Record 05; Viva 05)	
	Total	100	

Fourth Semester

Theory Paper IV:	03 hrs.	50	10 (Two tests of 05 marks)
Practical IV	03 hrs	40 (Practical proper 30; Record 05; Viva 05)	
	Total	100	

Fifth Semester:

Theory Paper V:	03 hrs.	50	10 (Two tests of 05 marks)
Theory Paper VI:	03 hrs.	50	10 (Two tests of 05 marks)
Practical V	03 hrs	40 (Practical proper 30; Record 05; Viva 05)	
Practical VI	03 hrs	40 (Practical proper 30; Record 05; Viva 05)	
	Total	200	

Sixth Semester:

Theory Paper VII:	03 hrs.	50	10(Two tests of 05 marks)
Theory Paper VIII:	03 hrs.	50	10 (Two tests of 05 marks)
Practical VII	03 hrs	40 (Practical proper 40; Record 05; Viva 05)	
Dissertation or Project	03 hrs	40 (Project/Dissertation 30 and Seminar 10)	
	Total	200	

Grand Total 800 Marks

FIRST SEMESTER:

Paper I: General Microbiology

60 hrs.

1. Introduction

20 hrs

Definition and history of microbiology, Contribution of Anton Von Leeuwenhoek, Edward Jenner, Louis Pasteur, Robert Koch, Joseph Lister, Beijerinck, Elie Metchnikoff, Alexander Fleming, Iwanowsky to the development of Microbiology. Scope of microbiology as modern science. Branches of microbiology: Bacteriology, Virology, Phycology, Mycology, Protozoology, Food and dairy microbiology, aquatic microbiology, soil microbiology, air microbiology, agriculture microbiology, Industrial and Medical microbiology.

2. Microscopy

10 hrs

Discovery of microscope, Detailed study of compound Microscope and its principles, Different types of microscope – Dark field, phase contrast, Stereomicroscope, Fluorescent Microscope, Electron microscope- scanning and transmission microscope and their applications.

3. General account of microorganisms

30 hrs

- a) Comparative study of typical cell of prokaryotes and Eukaryotes and their cellular organization.
- b) General principles of classification and nomenclature of microorganisms (kingdom, domain concepts).
- c) Study of the following (With reference to general characteristics, structure, classification and reproduction).
 - i. Viruses : Plant, animal, bacterial viruses, prions and viroids
 - ii. Bacteria: Classification (According to Bergey's Manual) up to the levels of section : bacteria, Mycoplasmas, Rickettsias, Actinomycetes, Chlamydiae, Cyanobacteria. (*Microcystis*, *Spirulina*, *Nostoc*).
 - iii. Algae : *Chlorella*, Diatoms
 - iv. Fungi – *Pythium*, *Saccharomyces*, *Aspergillus*, *Agaricus* and *Fusarium*
 - v. Protozoa: *Entamoeba*, *Trichomonas*, and *Plasmodium*

B.Sc., I Semester Microbiology

PRACTICAL – I: General Microbiology

1. Safety measures in microbiology laboratory
2. Study of micrometry
3. Contributions of microbiologists (Based on theory)
4. Study of different parts of compound microscope including oil immersion.
5. Study of different types of micro charts
6. Study of bacteria-bacilli, Cocci
7. Microscopic mounting techniques-wet mount, dry mount and scotch mount preparations
8. Study of fungi *Pythium*, *Saccharomyces*, *Aspergillus*, *Agaricus*, *Fusarium*
9. Study of algae *Microcystis*, *Spirulina*, *Nostoc*, *Chlorella* and *Diatoms*.
10. Study of protozoa *Entamoeba*, *Trichomonas*, *Plasmodium vivax*

Scheme of Practical Examination

B.Sc. I Semester Microbiology Practical I: General Microbiology

Time : 03 hours

Max. Marks:40

1. Make a microscopic preparation of the given materials A, B and C with labeled diagrams and reasons (one specimen from bacteria, cyanobacteria, algae, fungi and protozoans mentioned in the syllabus.) (Identification-1 mark, labeled with diagram-1 mark and reasons 1-mark)
3x3=9 marks
2. Demonstration/calculation 'D' write the principle and applications of micrometry (calibration - 2m, principle-2m and applications/results-2m).
06 marks
3. Write critical notes E and F (Pictures of scientists, different types and parts of microscopes, path of light in microscope) (Identification-1/2 mark, diagram-1/2 mark, critical notes-2 mark).
2x3=06 marks
4. Identify the microslides G, H and I giving reasons with labeled diagrams (Identification – 1 mark, Labeled diagram with reason – 2 marks).
Each slide from bacteria, cyanobacteria, Algae, fungi and Protozoa) 3x3=09 marks
5. Class record 05 marks
6. Viva voce 05 marks

Note; The candidate must submit the duly certified class record at the time of first appearance, without which he/she will not be permitted to take the practical examination.

References:

- Microbiology: Pelczar, Chan and Kreig; Tata McGraw Hill Pub. Co. Ltd
- Microbiology, an introduction: Tortora, Funk and Case; Benjamin-Cummings Pub. Co.
- General Microbiology: [RY Stanier](#); McMillan Press
- General Microbiology: [Hans G Schiegel](#); Cambridge University Press
- A Textbook of Microbiology: R C, Dubey and D.K. Maheshwari; S. Chand Co Ltd.
- Cell Biology: CB Powar; Himalaya Publishing House
- College Microbiology Volume 1: Sundararajan S; Vardhana Publications.
- Microbiology, Prescott Lansing M, Harley John P. and Klein's Donald A., WCB McGraw-Hill, New York.
- Microbiology- Sullia and Shantharam
- Microbiology- Aneja.

SECOND SEMESTER:

Paper II: Microbiological techniques and instrumentation Part I

60 hrs.

1. Microbiological techniques

a) Sterilization: Principles and methods of sterilization 18 hrs

i) **Physical methods;** Heat-dry, Incineration and moist heat, Tyndallization, Autoclave, Pressure cooker, Hot air oven, Laminar air flow, filtration-Seitz filter, Membrane filter.

ii) **Radiation methods:** Ionizing and non-ionizing radiations (UV Rays, Gamma Rays and cathode rays).

iii) **Chemical methods:** Disinfectants (Phenol/Alcohol), Antiseptic (Iodine,/ hydrogen peroxide), Sanitizer (chlorine), Germicidal (Glutaraldehyde/octenidene), Microbicidal (Silver nitrate/streptomycin), Microbiostatic agents (Sodium azide/ penicillin), Gaseous agents, Heavy metals and detergents.

b) Stains and staining technique 12 hrs

i) Principles of staining. Types of stains, physical and chemical properties of stains, staining techniques-Simple staining. Differential staining-(Gram staining & acid fast staining), structural staining- (capsule, flagella and endospore).

ii) Motility in bacteria, fungi and protozoa 05 hrs

2. Instruments: Inoculation chamber, Inoculation loop & needle, centrifuge, pH meter, Colony counter, Incubator (Principles, components and use) 05 hrs

3. Nutritional requirements and their up take by microorganisms (passive, active and facilitative absorption). Macro nutrients and micronutrients, their physiological role. Nutritional classification of microorganisms. 10 hrs.

4. Culture media: Definition, classification and types- solid, semisolid, broth, Natural, semisynthetic, synthetic, enrichment, enriched, differential and selective media, transport media, anaerobic media, Nutrient agar (NA), nutrient broth, Potato dextrose agar (PDA), Yeast extract mannitol agar (YEMA), Sabourud's dextrose agar (SDA), Mac Conkey's agar (MA), Blood agar (BA), Chocolate agar (CA), Cary Blairs media, Robertson cooked meat broth (RCM). 10 hrs.

B.Sc. II Semester Microbiology

PRACTICAL –II: Microbiological techniques and instrumentation Part 1

1. Preparation and use of chromic acid.
2. Preparation of glassware for sterilization.
3. Use of antiseptics and disinfectants : Phenol, ethyl alcohol, formaldehyde, iodine, Detergents, hydrogen peroxide, mercuric chloride and sodium hypochlorite.
4. Demonstration of laboratory equipments: Autoclave, Hot air oven, incubator, laminar air flow, Inoculation needle, Inoculation loop, Membrane filter, Seitz filter, pH meter and centrifuge.
5. Preparation of staining reagents : Saffranin, Crystal violet, Nigrosine, cotton blue, Malachite green, Methylene blue, Carbol fuchsin, Acid alcohol mixture, Grams iodine, 95% alcohol.
6. Staining techniques: Staining of bacteria and fungi.
 - a) Direct staining
 - b) Negative staining
 - c) Grams staining
 - d) Endospore staining
 - e) Fungal staining
7. Preparation of media- nutrient broth, nutrient agar, MacConkey's agar, Potato dextrose agar, Sabouraud's Dextrose agar, Blood agar, Chocolate agar, EMB and Transport media.
8. Study of bacterial motility by hanging drop method.

B.Sc.. II Semester Microbiology
Scheme of Practical Examination

Practical II: Microbiological techniques and instrumentation Part 1

Time : 03 hours

Max. Marks:40

1. Make a temporary slide on a clean and dry slide of the given material A and identify giving reasons 08 marks
Draw a diagram and leave the preparation for evaluation (Direct staining/ Negative Staining/ Gram staining/Endospore staining/Motility by hanging drop method/Fungal staining) (Procedure-2 mark, preparation-3mark, diagram-1mark, result-2mark).

2. Prepare/demonstrate the experiment B _____ giving the procedure and principle. 07 marks
(Nutrient broth, nutrient agar, MacConkey's agar, Potato dextrose agar, Sabouraud's Dextrose agar, Blood agar, Chocolate agar, EMB and Transport media) (composition 3 marks, procedure and principle 4 marks)

3. Identify the material and write the significance of C, D, E, F and G. 5x3=15 marks
(Identification – 1 mark, Labelled diagram with reason – 2 marks).
(Autoclave, Hot air oven, incubator, Inoculation loop, Membrane filter, Inoculation needle, Seitz filter, pH meter, centrifuge, staining reagents, antiseptics and disinfectants).

4. Class record 05 marks

5. Viva voce 05 marks

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References:

- Microbiology: Pelczar, Chan and Kreig; Tata McGraw Hill Pub. Co. Ltd.
- Microbiology, an introduction: Tortora, Funk and Case; Benjamin-Cummings Pub. Co.
- General Microbiology: [RY Stanier](#); McMillan Press.
- Methods in Microbiology- Microscopy and Staining: Desai and Desai; Emkay Publications.
- General Microbiology: [Hans G Schiegel](#); Cambridge University Press.
- Microbiology- Upadhaya and Upadhaya.

THIRD SEMESTER:

Paper III: Microbiological techniques and instrumentation Part II

60 hrs.

1. Pure culture-definition, methods of obtaining pure culture- serial dilution, pour plate, streak plate and spread plate techniques, Anaerobic culture methods (gas pack, candle jar), cultural characteristics of microorganisms and methods of preservation. 12hrs.
2. Microbial growth – Definition, growth curve, synchronous and continuous growth, diauxic growth. environmental factors influencing microbial growth (Temperature, pH, Humidity, osmotic pressure, radiation, CO₂ and O₂). 10 hrs
3. Methods of measuring microbial growth (Direct microscopic count, coulter counter, plate count, membrane filter count and turbidometric method). 10 hrs.
4. Biophysical techniques:
 - a. Centrifugation techniques: Basic principle, types and construction of centrifuges, techniques and applications of differential, density gradient, rate zonal and isopycnic centrifugation. 08 hrs.
 - b. Chromatography: General principles, techniques and applications of chromatography, Paper chromatography-Ascending, descending and radial, Thin-layer chromatography, Gel filtration, ion-exchange chromatography, gas chromatography, HPLC, Affinity chromatography, Adsorption chromatography. 08 hrs
 - c. Electrophoresis; Principle, technique and application- PAGE and Agarose gel electrophoresis. 05 hrs
 - d. Spectroscopic techniques: General principles and Beer Lambert's law, Deviation from Beer's law, construction, working principles and applications of colorimeter, spectrophotometer, nephelometer, turbidometer, double beam, dual wave length and Spectrophotometer. 07 hrs

B.Sc. III Semester Microbiology

Practical III: Microbiological techniques and instrumentation Part II

1. Preparation of physiological saline and serial dilution
2. Pure culture techniques - pour plate, streak plate and spread plate. Stab culture, broth culture, agar slope.
3. Counting of bacteria or yeast using haemocytometer/Neuber chamber
4. Measurement of yeast cells or fungal spores or bacterial cells by micrometry
5. Study of nephelometer, spectrophotometer, colorimeter, colony counter, gas pack & Turbidometer.
6. Effect of carbon sources on growth-glucose, fructose, sucrose, lactose, starch, cellulose
7. Effect of pH and temperature on growth.
8. Effect of phenol on growth
9. Effect of osmotic pressure on microbial growth
10. A) Determination of growth curve in bacteria/ yeast using haemocytometer
B) Measurement of microbial growth in terms of cell mass using spectrophotometer/ Photocolorimeter/ turbidostat.
11. Paper chromatography and thin layer chromatography for sugars or amino acid separation.
12. Preservation of microbial cultures-periodic sub culture, distilled water, oil over lag method, sterile soil.

B.Sc. III Semester Microbiology
Scheme of Practical Examination
Practical III: Microbiological techniques and instrumentation Part II

Time : 03 hours

Max. Marks:40

1. Count the number of cells in the given sample **A** using haemocytometer / Measure the given organism **A** using calibrated micrometer 8 marks
(Demonstration-4mark, principle and procedure-3mark, result-1mark)

2. Demonstrate the experiment with sample **B**_____ giving procedures and principles 8 marks
(Demonstration 4 marks; procedure and principle 4 marks)
(Serial dilution / effect of phenol on growth / Effect of temperature on growth/ effect of carbon source on growth/turbidity measurements/microbial preservation/TLC, paper chromatography)

3. Inoculate the given material **C** by _____method / technique, write the procedure and Principle. 5 marks
(Pour plate technique / streak plate / spread plate technique / slope culture / stab culture/ broth culture) (Demonstration-3mark, principle and procedure-2mark)

4. Write a critical notes on **D, E** and **F** _____ 3 x 3 =9 marks
(Pour plate / streak plate/ slope culture / stab culture/ broth culture/effect of phenol / haemocytometer / spectrophotometer/ colorimeter/ charts / diagram/Paper chromatography set up/thin layer chromatography set up, Effect of temperature, pH, osmotic pressure, radiation, culture preservation, Chromatography column, Electrophoresis components).

5. Class record 5 marks
6. Viva voce 5 marks

Note: The candidate must submit the duly certified practical record at the time of first appearance, Without which he / she will not be permitted to take practical examination.

References:

- Biophysical chemistry: Upadhyay, Upadhyay; Himalaya Publishing House.
- An introduction to Biophysics: PK Banerjee; S. Chand Co. Ltd.
- Microbiology: Pelczar, Chan and Kreig; Tata McGraw Hill Pub. Co. Ltd
- Microbiology, an introduction: Tortora, Funk and Case; Benjamin-Cummings Pub. Co.
- Textbook of Microbiology: Dubey and Maheshwari; S. Chand Co. Ltd.
- Cell Biology: CB Powar; Himalaya Publishing House
- College Microbiology Volume 2: Sundararajan S; Vardhana Publications

FOURTH SEMESTER:

Paper IV: Microbial Physiology and Genetics

60 hrs.

1. Biomolecules : Brief account of properties, classification and importance of carbohydrates, lipids and proteins. 04 hrs

2. Enzymes : Physical, chemical and catalytic properties of enzymes, nomenclature, classification, mechanism and models of enzyme action (Lock and Key and Induced fit theory). Factors influencing enzyme activity, inhibition of enzyme action. 08 hrs

3. Microbial Metabolism; definition, types.

a) Bioenergetics: Terminologies, laws of thermodynamics, concepts of enthalpy, entropy and free energy. ΔG^0 and ΔG^{01} , redox potential. High energy compounds- Pyrophosphate (ATP), Acyl phosphates, Enolic phosphates, thiol esters and guanidine phosphates 07 hrs

b) Respiration: Definition types, Anaerobic respiration – Glycolysis, alcohol, and acetic acid fermentations. Aerobic respiration- TCA cycle, electron transport chain and oxidative phosphorylation. 06 hrs

c) Photosynthesis: definition, types (oxygenic and anoxygenic), pigments (chlorophyll, bacteriochlorophyll), Types of bacterial photosynthesis, comparison of Photosynthesis in Green plants and Bacteria. Cyclic and non cyclic photophosphorylation, calvin cycle. 07 hrs

4. Microbial Genetics; Definition, terminologies, contribution of geneticists, chromosomes morphology (prokaryotes and eukaryotes), Chemical basis of heredity :Structure of nucleic acids: DNA as genetic material, Watson-Crick model of DNA, forms of DNA. Modes of DNA replication, types of RNA and biosynthesis.

Gene expression: Genetic code, protein synthesis and gene regulation (lac- operon concept)

Mutation; definition, types (induced, spontaneous, point mutation, frame shift mutation). Biochemical and molecular basis of mutation, transposons, insertion elements.

Genetic recombination in prokaryotes: transformation, conjugation and transduction. 18 hrs

Genetic engineering: Definition and Principles of genetic engineering, tools of genetic engineering- ligases, restriction enzymes, Vectors-Plasmids, cosmids, phagemids and bacteriophages, gene cloning, ethical issues, applications of genetic engineering 10 hrs.

B.Sc. IV Semester Microbiology

Practical IV: Microbial Physiology and Genetics

1. Isolation of DNA by Phenol-chloroform method
2. Colorimetric estimation of protein by biuret method.
3. Colorimetric estimation of sugar by DNS method.
4. Estimation of DNA by Diphenylamine method.
5. Estimation of RNA by orcinol method.
6. Demonstration of Replica plating technique.
7. Biochemical tests used for the identification of bacteria.
 - a) Fermentation of glucose, sucrose and lactose.
 - b) Starch hydrolysis
 - c) Gelatin hydrolysis
 - d) Catalase test
 - e) Oxidase test
 - f) IMViC test.
 - g) Urease test
 - h) β -galactosidase test/ONPG/Triple sugar iron agar test.
8. Demonstration of gene cloning through photographs or charts and models – transformation, conjugation, transduction, plasmids, bacteriophage, gene cloning, SV40.

**B.Sc. IV Semester Microbiology
Scheme of Practical Examination
Practical IV: Microbial Physiology and Genetics**

Time : 03 hours

Max. Marks:40

1. Estimate the amount of sugar/protein/DNA/RNA in the given sample A _____ write procedure and principles plot the graph if necessary/ Isolation of DNA 12 marks
(Performance-6marks, principle-2marks, procedure-2marks, results-2marks)
2. Demonstrate/perform the experiment with sample B by specific tests and confirm with reasons. 06 marks
(Demonstration 4 marks; reasons/ results 2 marks)
(Starch hydrolysis / gelatin hydrolysis / sugar fermentation/ catalase test / IMViC / oxidase/urease/ β -galactosidase/ONPG/TSI)
3. Write a critical notes on C, D, E, and F 4 x 3 =12 marks
(Spectrophotometer/ colorimeter/ charts / diagram/photographs of episomes / plasmids / gene cloning / phages / conjugation/ transduction/transformation/replica plating/SV40) (Biochemical tests not given in experiment 2) (Identification-1mark, diagrams with reasons-2marks)
4. Class record 5 marks
5. Viva voce 5 marks

Note: The candidate must submit the duly certified practical record at the time of first appearance, without which he / she will not be permitted to take practical examination.

References:

- Microbial Physiology: Moat and Foster; Wiley-Liss Inc.
- Molecular Biology: Freifelder; Narosa Pub.
- Microbial Genetics: Freifelder; Narosa Pub.
- Principles of Genetics: Gardner, Simmons and Snustad; John Wiley and Sons Pvt. Ltd.
- College Microbiology Volume 2: Sundararajan S; Vardhana Publications
- Genetic Engineering and its Applications- P Joshi; Agrobios India.
- General Microbiology: [RY Stanier](#); McMillan Press.

FIFTH SEMESTER:

Paper V: Environmental Microbiology

-45 hrs.

1. Soil Microbiology : Role of microorganisms in soil processes, Types of soil and soil profile, Carbon cycle, Nitrogen cycle, Sulfur cycle, leaching of minerals, microbes in bioremediation. Interaction among microorganisms, Neutralism, Mutualism, Commensalism, Antagonism, Parasitism, Xenobiotics with special reference to DDT and Plastic. -12 hours
2. Air Microbiology : Microbial content of air Indoor and outdoor. Techniques of trapping airborne microbes : Gravity slide, agar plate, Rotorad spore trap, vertical cylinder spore trap, Hirst trap, Burkard sampler, Anderson sampler, liquid impingement, sieve device, slit sampler and filtration. Significance of microorganisms in air, allergens, pathogens, air borne diseases (Aspergillosis, Diptheria and Influenza). -13 hours
3. Aquatic Microbiology: Types of water, Microorganisms in water, factors affecting aquatic microflora, sources of water contamination, water –borne diseases (Cholera, Hepatitis-A, Amoebiasis) and their prevention. Indicator organisms and their characteristics, Microbiological analysis of water, water purification methods (Sedimentation, filtration and disinfection). -10 hours.
4. Sewage Microbiology: Sources of sewage, Physico-chemical and microbiological characteristics of sewage. Biological oxygen demand (BOD), Chemical oxygen demand (COD). Most probable number (MPN). Septic tank. Imhoff tank, cess pool, municipal treatment with special emphasis on microbial treatment. Sludge digestion and disposal. -10 hours.

B.Sc. V -Semester Microbiology

PRACTICAL – V: Environmental Microbiology

1. Enumeration of Bacteria and Fungi in soil by serial dilution method.
2. Observation of airborne microbes by gravity slide method.
3. Demonstration of microbes from air by gravity plate method.
4. Demonstration of air sampling equipments / photographs (Anderson sampler, Rotorod sampler, Vertical cylinder spore trap, Hirst spore trap, Burkhard sampler, Impinger)
5. Standard analysis of water MPN test
6. Microscopic examination of three different water samples.
7. Estimation of solids in sewage.
8. Estimation of BOD
9. Microscopic examination of sewage sample.
10. Estimation of COD
11. Estimation of dissolved oxygen in water sample.
12. Estimation of carbon dioxide in water sample.

13. Estimation of alkalinity of water sample.
14. Estimation of acidity of water sample.
15. Figures/photographs of sewage treatment plants.
16. Visit of water purification /treatment plant
17. Demonstration of Ammonification in soil

Note: A report on the visit should be written and submitted along with the practical record (Compulsory).

**B.Sc. V Semester Microbiology
Scheme of Practical Examination
Practical V: Environmental Microbiology**

Time : 03 hours

Max. Marks:40

1. Prepare / Demonstrate / Conduct/ Estimate / _____ giving procedure and principles. Record the results. 07 marks.
(Preparation / Demonstration / Conduction / Estimation 4 marks; Procedure, principle and results 3 marks) (Enumeration of bacteria / fungi from soil by serial dilution / standard analysis of water/ estimation of solids in sewage/ Ammonification of soil).
2. Demonstration the experiment B _____ with procedure and principle. 08 marks.
(Demonstration 4 marks ; procedure and principle 4 marks)
(demonstration of microbes from air by petriplate exposure method / gravity slide method / measurement of DO) Alkalinity of H₂O/ acidity of water / CO₂ content of water/BOD/COD).
3. Identify the microorganism in the material C _____ with label diagram. 06 marks
(minimum of 04 microorganism to be recorded)
(Gravity slide / exposed agar plates to air / different of sample of pond water / sewage water)
(1.5 marks for each).
4. Write critical notes on D,E, and F _____ 3 x3=09 marks
(Equipments / photographs / Anderson sampler / rotorod sampler / cylindrical spore trap / Hirst spore trap / Durham's tube / colorimeter / clarifier / clariflocculator / septic tank / Imhoff tank, cess pool tank / trickling filter / oxidation ponds / activated sludge process, Burkhard sampler, Impinger) (Identification-1mark, diagram with reasons-2marks).
5. Class record 05 marks
6. Viva Voce 05 marks

Note: The candidate must submit the duly certified practical record at the time of first appearance, without which he/ she will not be permitted to take practical examination

Fifth Semester:

Paper VI: Agricultural Microbiology and Biotechnology

45 hrs.

Unit-I. Agricultural Microbiology: Microorganisms in agriculture. Biofertilizers, *Rhizobium*, *Azotobacter*, *Azospirillum*, PSB, Cyanobacteria, Mycorrhiza, Rhizosphere and Rhizoplane, PGPR, Microbial biopesticide, (*Bacillus thuriengensis*, NPV, *Trichoderma*). 13 hrs

Unit-II. Role of metabolites in disease development (Toxins, hormones, enzymes). Defence mechanism (Structural and Biochemical). A study of the symptoms, etiology, epidemiology and control of the following plant diseases : Tobacco Mosaic Virus, Sandal spike, Citrus canker, Downy mildew of grapes, Tikka disease of groundnut, Blast of rice, coffee rust. 12 hrs

Unit-III. Biotechnology: Definition, Scope and importance, PCR and blotting techniques, Brief account and protocol of microbial production of insulin, Gene therapy, use *Agrobacterium* for the production of transgenic plants, Production of recombinant vaccines (Hepatitis B surface antigen), Hybridoma technology, Microbial enzymes 20 hrs.

B.Sc. V Semester Microbiology

Practical VI: Agricultural Microbiology and Biotechnology

1. Study of Rhizosphere and rhizoplane microflora (fungi and bacteria), isolation, culturing and Identification.
2. Isolation and cultivation of *Rhizobium* from legume root nodule and observation of bacterioids.
3. Isolation, *Azotobacter*, *Azospirillum*, and phosphate solubilizing bacteria (PSB).
4. Examination of *Anabena* in *Azolla*.
5. Study of sandal spike and citrus canker.
6. Study of downy mildew of grape
7. Study of tikka disease of groundnut.
8. Study of coffee rust
9. Demonstration of antagonism between microorganisms.
10. Demonstration of antimicrobial activity of plant extract.
11. Demonstration of caking of grains.
12. Demonstration of *Aspergillus* in groundnut by blotter method.
13. Demonstration of charts/photographs concerned with biotechnology syllabus like gene therapy, transgenic plants, recombinant vaccines strategies, microbial insecticides. Hybridoma technology, PCR and blotting techniques.
14. Field visit

B.Sc. V Semester Microbiology
Scheme of Practical Examination
Practical VI: Agricultural Microbiology and Biotechnology

Time : 03 hours

Max. Marks:40

1. Prepare a temporary slide of the material **A**. Identify the same with labeled diagram and reasons. 09 marks.
(Preparation-05 marks; label diagram- 02 marks and reason-02 marks)(Tikka disease of groundnut / citrus canker / downy mildew of grapes / blast of rice / coffee rust).
2. Prepare a temporary slide of the material **B**. Identify the same with labelled diagram and reasons. 06 Marks.
(Observation of bacteroides/Examination of *Anabena* in *Azolla*/Isolation of *Rhizobium*, *Azotobacter*, *Azospirillum*, PSB/caking of grains/standard blotter method/demonstration of antagonism/antimicrobial activity of plant extracts).
3. Identify the slides /materials/charts **C,D,E,F** and **G** with label diagrams and reasons. 5x3 =15 Marks
(Identification 1 marks; labeled diagram and reasons 2 marks)
(*Aspergillus* in groundnut by blotter method / caking of grains / antimicrobial activity of plant extracts / Charts of transgenic plants, animals/effect of plant extracts/Microbial insecticides/recombinant vaccines/gene therapy charts/Hybridoma, PCR and blotting techniques).
4. Class record 05 Marks
5. Viva Voce 05 Marks

Note: The candidate must submit the duly certified practical record at the time of first appearance, without which he / she will not be permitted to take practical examination.

References:

- Environmental Microbiology: PD Sharma; Narosa Pub. House
- Soil Microorganisms: Subba Rao; Oxford and IBH publishing Co.
- General Microbiology: Powar and Dagainwala; Himalaya Publishing House
- Microbiology- Fundamentals and Applications: SS Purohit; Agro Botanica
- Biotechnology- Expanding Horizons: BD Singh; Kalyani Publishers
- A Text Book of Biotechnology: RC Dubey; S. Chanda and Co. Ltd.
- Elements of Biotechnology: PK Gupta; Rastogi Pub.
- Plant pathology: Mehrotra RS; Tata McGraw Hill publishing Co. Ltd.
- Agricultural Microbiology: Rangaswamy and Bhagyaraj; Prentice Hall India Pvt. Ltd.
- Diseases of crop plants in India: Rangaswamy; Prentice Hall India Pvt. Ltd.
- Microbiology and Plant pathology: PD Sharma; Rastogi Pub.

SIXTH SEMESTER:

Paper VII: Food, Dairy and Industrial Microbiology

45 hrs.

Unit-I.

1. Food Microbiology:

- i. Classification of food, Food as a substrate for microorganisms. Principles of food contamination, factors affecting growth of microbes in food. spoilage and preservation – low temperature, high temperature - boiling, autoclaving, high osmotic pressure, chemical preservatives and irradiation.
- ii. Microbial examination of food – Direct microscope count (DMC) and Standard plate count (SPC).
- iii. Microorganisms as a food – single cell protein (SCP), Spirulina, Mushroom cultivation.
- iv. Food poisoning – Staphylococcal food poisoning, botulism, Salmonellosis, Aflatoxins.

15 hrs

Unit-II.

2. Dairy Microbiology: Composition and types of milk.

- i. Sources of microbial contamination of milk- Types of microorganisms in milk – bacteria, fungi and yeast.
- ii. Microbial examination of milk – Rapid platform tests, Standard plate count (SPC), Direct microscopic count (DMC), reductase test and phosphatase test.
- iii. Biochemical activities of microorganisms in milk – souring, proteolytic activity, gassy fermentation, lactic acid fermentation.
- iv. Methods of preservation of milk and milk products. Pasteurization and sterilization.
- v. Fermented milk products (Cheese, Yoghurt), starter cultures, probiotics.

10 hrs.

Unit-III.

3. Industrial Microbiology:

- i. Microorganisms in industry, Screening and characterization of industrially important microorganisms, stock culture and types, strain improvement and preservation.
- ii. Raw materials used in industrial fermentation. Fermentation process – Batch, fed-batch and continuous fermentation; surface, submerged and solid substrate.
- iii. Types and components of fermentors.
- iv. Major microbial products: Downstream and Upstream process, Industrial production of ethyl alcohol, acetic acid (vinegar), citric acid, vitamin B₁₂, Penicillin and amylase.
- v. Cell and enzyme Immobilization technique

20 hrs.

Sixth Semester:

Paper VIII: Immunology and Medical Microbiology 45 hrs.

1. Immunology: 20 hrs.

- a. Immunity: Definition, History and early theories of immunity, classification- Innate- levels, factors affecting and mechanisms, Acquired- types with characteristics and examples.
- b. Cells and organs of immune system.
- c. Antigens; Types and Immunological properties.
- d. Immunoglobulins: Definition, basic structure, classes and importance of immunoglobulins.
- e. Antigen-Antibody reactions, characteristics, principle (Lattice hypothesis), types- precipitation, agglutination, RIA, ELISA, CFT and immunofluorescence, blood grouping.
- f. Immune response: Definition, Primary and secondary antibody response, selective and instructive theories, immunological memory.
- g. Hypersensitivity; Definition, types (Type I and Type IV in detail)
Autoimmunity- Definition, theories and types with example.
Immunodeficiency: Definition and types (in brief)
- h. Vaccines: Definition and types, National immunization schedule.

2. Medical Microbiology: 20 hrs

Infection: Definition, types, sources and methods of transmission, pathogenecity and virulence, microbial factors predisposing, pathogenicity. Microbial human diseases with special reference to its etiology. pathogenesis, clinical features, epidemiology, laboratory diagnosis, prophylaxis and treatment of the following – Tuberculosis, syphilis, candidiasis, malaria, AIDS and Hepatitis-B.

3. Antibiotics: Definition and classification, sources of antimicrobial spectrum, mode of action of the following antibiotics- Penicillin, Streptomycin, Tetracycline, Antibiotic resistance, Multidrug resistance. 05 hrs.

B.Sc. VI Semester Microbiology

Practical VII: Food, Dairy, Industrial Microbiology, Immunology and Medical Microbiology

1. Citric acid production by *Aspergillus niger* and its estimation.
2. Preparation of wine from grape.
3. Estimation of alcohol by (alcoholometry) specific gravity method.
4. Isolation of microorganisms from spoiled fruits and vegetables.
5. Microscopic examination of milk (DMC).
6. Turbidity test for boiled and raw milk.
7. Methylene blue reduction test (MBRT) and Resazurin reduction test
8. Demonstration of Invertase activity in yeast.

9. Estimation of Lactic acid and Lactose in milk.
 10. Determination of blood groups
 11. RPR test, Widal, Tridot, Hepacard, Immunodiffusion (radial and double diffusion in agar)
 12. Antibiotic sensitivity test.
 13. Demonstration of AFB in sputum.
 14. Observation of human pathogens- *Staphylococci*, *Streptococci*, *Candida*, *Plasmodium*.
 15. Food preservatives: sugar, salt, vinegar, benzoic acid.
 16. Primary screening for antibiotic production (Crowded plate technique) and enzymes (amylase and protease)
 17. Production of amylase and its activity
- Note: Visit to food processing industry, milk dairy, local distillery, pathological laboratory, gobar gas plant.**

**B.Sc. VI Semester Microbiology
Scheme of Practical Examination
Practical VII: Food, Dairy, Industrial Microbiology, Immunology and Medical
Microbiology**

Time: 03 hours

Max. Marks:40

1. Perform / demonstrate the experiment A _____ with procedure and principles. 06 marks.
(Conduction / demonstration 3 marks; procedure and principle 3 marks)
(Isolation of microorganisms from utensils/ spoiled fruits / spoiled vegetables/ estimation of grades of milk /estimation of alcohol by specific gravity method/ citric acid estimation/amylase activity/Primary screening for antibiotics and enzymes).
2. Conduct the test for B _____ with procedure and record the results. 06 marks
(Conduction 3 marks ; procedure and results 3 marks)
(Turbidity test for boiled milk / and raw milk / MBRT /RRT/ direct microscopic examination of milk /estimation of lactose in milk/ estimation of lactic acid in milk).
3. Prepare/demonstrate/conduct/estimate C _____giving procedure and principles 06 marks.
(demonstration 3 marks; procedure and principle 3 marks)
(Perform/Demonstration WIDAL/RPR//blood grouping/agglutination).
4. Write critical notes on D, E, F and G 4x3=12 marks
(Human pathogens slides, immunology kits, spoiled fruits, dairy microbiology tests(MBRT/RRT), Industrially important products, bakers yeast, food preservatives(Salt, sugar, vinegar, benzoic acid) antibiotic sensitivity test, Tridot, WIDAL, RPR slides, AFB, Tuberculin syringae, Wine).
5. Class record 05 marks
6. Viva Voce 05 marks

Note: The candidate must submit the duly certified practical record at the time of first appearance, without which he / she will not be permitted to take practical examination.

References:

- Immunology: CV Rao; Narosa Pub.
- Text of Microbiology: Ananthanarayanan and Paniker; Orient Longmen Ltd.
- Text of Microbiology: Chakraborty; New Central Book Agency (P) Ltd.
- Food Microbiology: Frazier and Westhoff; Tata McGraw Hill
- Food Microbiology: Adams and Moss; New Age International Pvt. Ltd.
- Industrial Microbiology: Patel; MacMillan pub.
- Industrial Microbiology: LE Cassida; New Age Pub.
- Principles of Fermentation Technology: Standbary, Whitaker and Hall; Aditya Books Pvt Ltd.
- Dairy Microbiology: Parihar and Parihar; Agrobios (India).

Theory Question Paper Pattern for B.Sc. Microbiology (Semester) Examination

Time: 03 hrs.

Max. Marks: 50

Note: All sections are compulsory.

Section A

Choose the correct answer

05x01=05

- 1.
- 2.
- 3.
- 4.
- 5.

Section B

05x01=05

Answer in a word or phrase

- 6.
- 7.
- 8.
- 9.
- 10.

Section C

Answer any FOUR of the following

04x05=20

- 11.
- 12.
- 13.
- 14.
- 15.
- 16.

Section D

Answer any TWO of the following

02x10=20

- 17.
- 18.
- 19.