

  
**UNIVERSITY OF MYSORE**  
Estd. 1916

Vishwavidyanilaya Karyasoudha  
Crawford Hall, Mysuru- 570 005

No.AC2(S)/55/2024-25

Dated:20.07.2024

**Notification**

**Sub:-**Syllabus and Scheme of Examinations of Microbiology (UG) Programme (I & II Semester) from the Academic year 2024-25.

- Ref:-**1. Decision of Board of Studies in Microbiology (CB) meeting held on 10-06-2024.  
2. Decision of the Faculty of Science & Technology meeting held on 19-06-2024.  
3. Decision of the Academic Council meeting held on 28-06-2024.

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The Board of Studies in Microbiology (CB) which met on 10-06-2024 has resolved to recommend & approved the Syllabus and Scheme of examinations of Microbiology (UG) programme (I & II Semester) with effect from the Academic year 2024-25.

The Faculty of Science & Technology and Academic Council at their meetings held on 19-06-2024 and 28-06-2024 respectively has also approved the above said Syllabus and Scheme of examinations hence it is hereby notified.

The Syllabus and Scheme of Examinations content may be downloaded from the University Website i.e., [www.uni-mysore.ac.in](http://www.uni-mysore.ac.in).

  
**Registrar**  
Registrar  
University of Mysore  
Mysore

**To:**

1. All the Principal of affiliated Colleges of University of Mysore, Mysore.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS in Microbiology, Manasagangothri, Mysore.
4. The Dean, Faculty of Science & Technology, DOS in Mathematics, MGM.
5. The Director, Distance Education Programme, Moulya Bhavan, Manasagangothri, Mysuru.
6. The Director, PMEB, Manasagangothri, Mysore.
7. Director, College Development Council, Manasagangothri, Mysore.
8. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
9. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of Mysore, Mysuru.
10. Office Copy.



# **UNIVERSITY OF MYSORE, MYSURU**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**&**

**CONTINUOUS ASSESSMENT AND GRADING PATTERN (CGPA)**

**Based**

## **B. Sc. MICROBIOLOGY SYLLABUS**

**For**

**2024-25 onwards**

**Board of Studies in Microbiology  
Department of Studies in Microbiology  
University of Mysore  
Manasagangotri, Mysuru 570 006  
Karnataka, India**

**CBCS based Undergraduate Microbiology Syllabus for 2024-25 onwards**

**Proposed Semester-wise distribution of the course structure**

| <b>Paper code</b>                             | <b>Paper type</b>  | <b>Title of the paper</b>                            | <b>Credits Assigned</b> | <b>Instructional hours per week</b> |
|---|--------------------|--|-------------------------|-------------------------------------|
| <b>SEMESTER – I</b>                           |                    |  |                         |                                     |
|   | DSC: Theory-I      | Introduction to Microbiology and Microbial Diversity | <b>3</b>                | <b>3</b>                            |
|   | DSC: Prctical-I    | Introduction to Microbiology and Microbial Diversity | <b>2</b>                | <b>4</b>                            |
| <b>SEMESTER – II</b>                          |                    |  |                         |                                     |
|   | DSC: Theory-II     | Microbial Physiology and Microbial Genetics          | <b>3</b>                | <b>3</b>                            |
|   | DSC: Practical-II  | Microbial Physiology and Microbial Genetics          | <b>2</b>                | <b>4</b>                            |
| <b>SEMESTER – III</b>                         |                    |  |                         |                                     |
|   | DSC: Theory-III    | Molecular Biology and Recombinant Technology         | <b>3</b>                | <b>3</b>                            |
|   | DSC: Practical-III | Molecular Biology and Recombinant Technology         | <b>2</b>                | <b>4</b>                            |
| <b>SEMESTER – IV</b>                          |                    |  |                         |                                     |
|   | DSC: Theory-IV     | Environmental and Agricultural Microbiology          | <b>3</b>                | <b>3</b>                            |
|   | DSC: Practical-IV  | Environmental and Agricultural Microbiology          | <b>2</b>                | <b>4</b>                            |
| <b>SEMESTER – V<br/>(Any one of the DSE)</b>  |                    |  |                         |                                     |
|   | DSE: Theory-V      | Food and Industrial Microbiology                     |                         |                                     |
|   | DSE: Practical-V   | Food and Industrial Microbiology                     |                         |                                     |
|   | DSE- Theory-       | -  |                         |                                     |
|   | DSE- Practical-    | -  |                         |                                     |
|   | SEC- Theory-       | -  |                         |                                     |
| <b>SEMESTER – VI<br/>(Any one of the DSE)</b> |                    |  |                         |                                     |
|   | DSE: Theory-VI     | Immunology and Medical Microbiology                  |                         |                                     |
|   | DSE: Practical-VI  | Immunology and Medical Microbiology                  |                         |                                     |
|   | DSE- Theory-       | -  |                         |                                     |
|   | DSE- Practical-    | -  |                         |                                     |
|   | SEC- Theory-       | -  |                         |                                     |

**DSC - Discipline Specific Course, DSE- Discipline Specific Elective,  
SEC- Skill Enhancement Course**

## SCHEME OF VALUATION

### MAXIMUM MARKS

| COURSE TYPE | C1     |     | C2     |     | C3     |     | TOTAL |
|-------------|--------|-----|--------|-----|--------|-----|-------|
|             | THEORY | LAB | THEORY | LAB | THEORY | LAB |       |
| DSC         | 10     | 5   | 10     | 5   | 80     | 40  | 150   |
| DSE         | 10     | 5   | 10     | 5   | 80     | 40  | 150   |
| SEC         | 5      | -   | 5      | -   | 40     |     | 50    |

**NOTE;**

1. C1 AND C2 WILL BE CONDUCTED FOR 20 MARKS (THEORY) WITH 1 HOUR DURATION, 10 MARKS (LAB) WITH CONTINUOUS ASSESMENT THROUGH RECORD VALUATION AND MARKS REDUCED TO ASSIGNED MARKS.
2. C3 WILL BE CONDUCTED FOR 80 MARKS (THEORY) WITH 3 HOUR DURATION, 40 MARKS (LAB) WITH 3 HOUR DURATION.
3. IN CASE OF SEC, C1 AND C2 WILL BE CONDUCTED FOR 10 MARKS WITH 30 MINUTES DURATION AND REDUCE TO ASSIGNED MARKS. C3 WILL BE CONDUCTED FOR 40 MARKS.

## I SEMESTER

### DSC-1: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

#### PAPER-I

48 (3hrs./week)

##### Unit I: **History of microbiology and microscopy**

12 hrs.

**History of microbiology:** Scope and branches of Microbiology. Contributions of Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner and E. J. Butler.  
**Systems of classification:** Whittaker's five kingdom classification and Carl Woese's three domain classification. Classical and molecular characteristic used in microbial taxonomy.

**Microscopy:** Working principle, construction and application of compound microscope, dark field microscope, phase contrast microscope, fluorescent microscope and scanning & transmission electron microscope.

##### Unit II: **Staining and sterilization techniques**

12 hrs.

**Staining techniques:** Chemical nature and types of microbiological stains. Methods of staining: simple (positive and negative), differential (Gram staining and acid fast staining) and structural (capsule, endospore).

**Sterilization techniques:** Physical methods: dry heat (hot air oven, incineration), moist heat (autoclave), filtration: filters (membrane filters and HEPA filter), radiation: UV and gamma radiation. Chemical methods: definition of terms- disinfectants, antiseptics, sanitizers, microbicides, microbiostatic. Mode of action and uses of alcohols, aldehydes, halogens, phenols (tabulation).

##### Unit III: **Microbial diversity**

12 hrs.

**Biodiversity:** Definition and levels, Bergey's Manual of Systematic Bacteriology. Comparison of bacteria, archaea and eukarya (tabulation).

**Cell organization:** Cell size, shape and arrangement, structure and functions of capsule, flagella, fimbriae, pili, cell wall, cell membrane, ribosomes, mesosomes, inclusion bodies, nucleoid and plasmids. Bacterial endospore-structure and formation.

**Diversity of prokaryotes:** General characteristics of Rickettsiae, Chlamydia, Mycoplasma, Spirochaetes, Actinomycetes. Cyanobacteria: occurrence, structure, reproduction and importance of *Microcystis*, *Anabaena* and *Spirulina*.

##### Unit IV: **Diversity of eukaryotes and viruses**

12 hrs.

**Diversity of eukaryotes:** Structure, reproduction and importance of Algae (*Spirogyra*, Diatoms and *Gracilaria*), Fungi (*Rhizopus*, *Penicillium*, *Agaricus*) and Protozoa (*Euglena* and *Paramecium*)

**Diversity of viruses:** ICTV system of classification. General characteristics of viruses. Structure and importance of viruses. Structure and replication of viruses: Bacteriophages-T4 phage, cyanophages-LLP-1, phytophagenae-BCMV, zoophagenae-Influenza. Subviral particles- viroids, virusoids and prions.

## I SEMESTER

### INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

#### PRACTICAL-I

(4hrs/week)

1. Microbiological laboratory standards and safety protocols.
- 2-3. Working principle and operation of basic equipment of microbiological laboratory (Autoclave, Hot air Oven, Incubator, laminar air flow system, colony counter, pH meter, Spectrophotometer, Colorimeter, Vortex mixer, Magnetic stirrer).
4. Applications of basic microbiological tools (Pipettes, Micropipette, Inoculation loop and needle, Spreader).
5. Study of simple and compound microscopes.
6. Preparation of stains and mordant -methylene blue, crystal violet, safranin, nigrosin, carbol fuchsin, malachite green, Gram`s iodine and cotton blue.
7. Simple (direct and indirect) staining of bacteria.
8. Gram staining and endospore staining.
9. Observation of bacterial motility by hanging drop method.
10. Measurement of microbial cell size by micrometry
11. Study of cyanobacteria-*Microcystis*, *Anabaena* and *Spirulina*.
12. Study of Algae-*Spirogyra*, Diatoms and *Gracilaria*.
13. Study of Fungi-*Rhizopus*, *Penicillium* and *Agaricus*.
14. Study of Protozoa-*Euglena* and *Paramecium*.
15. Study of T4 phage, BCMV and Influenza virus.

## **Text Books / References**

1. Alexopoulos, C. J. and Mims, C.W., *Introductory Mycology*, Wile Eastern Limited, New Delhi.
2. Atlas, R. M. (1997). *Principles of Microbiology*. 2nd edition. W. M. T. Brown Publishers.
3. Bold, H. C. and Wynne, M. J. *Introduction to Algae*, Prentice Hall of India Private Limited , New Delhi.
4. Brock, T. D. and Madigan, M. T. *Biology of Microorganisms*, Prentice Hall of India Private Ltd, New Delhi.
5. Cappucino. J. and Sherman, N. (2010). *Microbiology: A Laboratory Manual*. 9th edition. Pearson Education Limited.
6. Carter, J. and Saunders, V. (2007). *Virology: Principles and Applications*. John Wiley and Sons.
7. Dimmock, N. J., Easton, A. L and Leppard, K. N. (2007). *Introduction to Modern Virology*. 6th edition, Blackwell Publishing Ltd.
8. Dubey, R. C. and Maheshawari, D. K, (2013) *Text book of Microbiology*, S Chand and company limited, Ramnagar, New Delhi.
9. Flint, S. J., Enquist, L. W., Krug, R. M., Racaniello, V. R. and Skalka, A. M. (2004). *Principles of Virology, Molecular biology, Pathogenesis and Control*. 2nd edition. ASM press Washington DC.
10. Lansing, M. Prescott, John, P. Harley, Donald A. Klein. (2002). *Microbiology*, 5th edition WCB Mc Graw Hill, New york.
11. Madigan, M. T., Martinko, J. M., Dunlap, P. V. and Clark, D. P. (2014). *Brock Biology of Microorganisms*. 14th edition. Pearson International Edition.
12. Michael, J. Pelczar, Jr. E. C. S. Chan and Moel (2001). *Microbiology*, Mc Graw Hill Book Company, New york).
13. Pelczar, M. J., Chan, E. C. S. and Krieg, N. R. (1993). *Microbiology*. 5th edition. McGraw Hill Book Company.
14. Srivastava, S. and Srivastava, P. S. (2003). *Understanding Bacteria*. Kluwer Academic Publishers, Dordrecht.
15. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L. and Painter, P. R. (2005). *General Microbiology*. 5th edition McMillan.
16. Tortora, G. J., Funke, B. R. and Case, C. L. (2008). *Microbiology: An Introduction*. 9th edition. Pearson Education.
17. Versteeg, J. (1985). *A Color Atlas of Virology*. Wolfe Medical Publication.
18. Wagner, E. K., Hewlett, M. J. (2004). *Basic Virology*. 2nd edition. Blackwell Publishing.

## II SEMESTER

### DSC-2: MICROBIAL PHYSIOLOGY AND MICROBIAL GENETICS

#### PAPER-II

48 (3hrs./week)

#### Unit I: Microbial nutrition

12 hrs.

**Bacterial nutrition:** Introduction to bioenergetics. Nutritional requirements and major nutritional types of microorganisms, Uptake of nutrients-passive transport, facilitated diffusion, active transport, group translocation and iron uptake. Prototrophs and auxotrophs. Bacterial growth curve-phases of growth and their significance, factors affecting microbial growth. Measurement of growth by cell number and cell mass.

**Cultivation of bacteria:** Culture media and their types. Pure culture techniques and colony characteristics of bacteria. Methods of preservation of microorganisms- slant culture, stab culture, mineral oil overlaying, glycerol stock preservation, cryopreservation and lyophilization.

#### Unit II: Microbial metabolism

12 hrs.

**Introduction to enzymes:** Nomenclature and classification, structure of enzyme, mechanism of enzyme action. Lock and key model and induced fit theory. Enzyme inhibition and regulation.

**Chemotrophic metabolism:** Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway. Krebs cycle. Electron transport chain. Fermentation- Alcohol and lactose fermentation

**Phototrophic metabolism:** Photosynthetic microorganisms, light harvesting pigments, photophosphorylation, CO<sub>2</sub> fixation pathways: Calvin cycle. **Nitrogen metabolism:** Biological nitrogen fixation- nodulation in leguminous plants, nitrogenase, leghaemoglobin, ammonia assimilation. GOGAT cycle.

#### Unit III: DNA as genetic material and Bacterial genetics

12 hrs.

**DNA as a genetic material:** Griffith experiment, Avery, MacLeod and McCarty experiment, Hershey and Chase experiment to prove DNA carries the genetic information. Fraenkel-Conrat experiment. Structure and organization of chromosomes in prokaryotes. Plasmid-types.

**Bacterial genetics:** Genome organization of *Escherichia coli*. Mechanism of genetic exchange in bacteria: Bacterial transformation- Principle and types of transformation mechanisms in prokaryotes. Bacterial Conjugation: U-tube experiment, F<sup>+</sup> x F<sup>-</sup> conjugation, F' x F<sup>-</sup> conjugation, Hfr x F<sup>-</sup> conjugation, Transduction: Generalized and specialized transduction.

#### Unit IV: Genetics of Viruses and Fungi

12 hrs.

**Genetics of viruses:** Genetic recombination in phages, Heterozygosity in phages. Phenotypic mixing, Genotypic mixing. Genetic basis of lytic-lysogenic switch in phage lambda.

**Genetics of fungi:** Life cycle of *Neurospora*, ordered tetrad analysis in *Neurospora*, unordered tetrad analysis in yeast, two point and three point test cross.

**Mutation:** Nature and types, Mutagenic agents: physical and chemical mutagens, repair of mutated DNA: Photoreactivation and SOS repair. Transposable elements in prokaryotes.



## SEMESTER-II

### MICROBIAL PHYSIOLOGY AND MICROBIAL GENETICS

#### PRACTICAL-II

(4hrs/week)

1. Cleaning and sterilization of glassware and preparation of media-nutrient broth, nutrient agar and potato dextrose agar.
2. Preparation of physiological saline and serial dilution.
3. Estimation of CFU count by spread plate/pour plate method and study of colony characteristics of bacteria.
4. Cultivation of microorganisms on agar plate (point inoculation) and broth inoculation.
5. Isolation and preservation of bacterial cultures by streak plate, agar slants and stab culture.
6. Effect of temperature and pH on microbial growth.
7. Effect of salt and carbon source on microbial growth.
8. Measurement of growth by cell number using hemocytometer.
9. Microscopic examination of root nodules for bacteroids.
10. Demonstration of lactose fermentation.
11. Preparation of competent cells and demonstration of bacterial transformation.
12. Demonstration of bacterial conjugation by plate mating method.
13. Study of survival curve of bacteria after exposure to ultraviolet (UV) light.
14. Isolation of streptomycin resistant mutants of *Escherichia coli* by gradient plate method.
15. Study of culture media, hemocytometer, gaspak jar, Griffith experiment, plasmid, transformation, conjugation and transduction in bacteria, life cycle of *Neurospora* and transposable elements using photographs and model.

## Text Books / References

1. Brock, T. D. and Madigan, M. T.,(2012). Biology of Microorganisms, Prentice hall of India Pvt. Ltd, New Delhi.
2. Gardner, E. J., Simmons, M. J., Snustad, D. P. (2008). Principles of Genetics. 8th Ed. Wiley-India.
3. Gottschalk, G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.
4. Klug, W. S., Cummings, M. R., Spencer, C. and 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. Lansing, M., Prescott, J., Ohn, P., Harley, Donald A. Klein, (2002) Microbiology, 5<sup>th</sup> ed. WCB Mc Graw Hill, New York.
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8. Maloy, S. R., Cronan, J. E. and Friefelder, D. (2004) Microbial Genetics 2nd edition. Jones and Barlett Pub.
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10. Nelson David, L and Cox Michael, M., Lehninger, (2008) Principles of Biochemistry, Macmillan Press, Worth Publishers, New Delhi.
11. Pierce, B. A. (2011) Genetics: A Conceptual Approach, 4th Ed., Macmillan Higher Education Learning.
12. Primrose, S. B. and Twyman, R. M. (2008). Genomics: Applications in human biology. Blackwell Publishing, Oxford, U.K.
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15. Stanier, R. Y., Ingrahm, J. I, Wheelis, M. L. and Painter, P. R. (1987). General Microbiology. 5th edition, McMillan Press.
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## **SCHEME OF PRACTICAL EXAMINATION**

### **I SEMESTER**

#### **PRACTICAL-I: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY**

**Duration: 3 hours**

**Max. Marks: 40**

**I. Stain the given material A by.....method. Write the principle and procedure. Leave the preparation for evaluation. 12 Marks**

(Direct staining / Indirect staining / Gram staining / Endospore staining)

(Preparation-5 Marks, Principle-2 Marks, Procedure- 3 Marks and Result-2 marks)

**II. Identify the materials B, C and D with labeled diagrams and reasons. 3x4=12 Marks**

(One material each from Cyanobacteria, Algae and Fungi)

(Identification- 1 Mark, Diagram and Reasons- 3 Marks)

**III. Measure the size of the microbial cell E using stage and ocular Micrometer. 05 Marks**

(Calibration factor- 1 Marks, Principle and procedure- 3 Marks and Result- 1 Mark)

**IV. Write critical notes on F, G and H. 3x2=06 Marks**

(Microbiologists / Microscopes / Stains / Disinfectants / Laboratory equipment)

(Identification- 1 Mark, Comments- 1 Mark)

**V. Viva-voce**

**05 Marks**

## SCHEME OF PRACTICAL EXAMINATION

### II SEMESTER

#### PRACTICAL-II: MICROBIAL PHYSIOLOGY AND MICROBIAL GENETICS

**Duration: 3 hours**

**Max. Marks: 40**

**I. Demonstrate or perform the experiment A giving principle and procedure. Record the result. 12 Marks**

(Serial dilution / Pour plate / Spread plate / Streak plate / Point inoculation / Measurement of growth by cell number using haemocytometer)

(Demonstration-5 Marks, Principle and Procedure- 5 Marks and Result-2 Marks)

**II. Perform or demonstrate the experiment B giving principle and procedure. Record the result. 12 Marks**

(Demonstration of bacterial conjugation by plate mating method / UV survival curve of bacteria / Gradient plate method)

(Demonstration-5 Marks, Principle and Procedure- 5 Marks and Result-2 Marks)

**III. Conduct the experiment C. Record and interpret the result. 05 Marks**

(Effect of temperature / pH / salt / carbon source on microbial growth / Study of colony characteristics / Microscopic examination of root nodules for bacteroids / Demonstration of lactose fermentation)

(Performance - 2 Marks, Principle and Procedure- 2 Marks and Result-1 Mark)

**IV. Write critical notes on D, E and F. 3x2=06 Marks**

(Culture media, Griffith experiment, Hershey and Chase experiment, plasmid, transformation, conjugation and transduction in bacteria, life cycle of *Neurospora*, transposable elements and result of the experiments)

(Identification- 1 Mark, Comments- 1 Mark)

**V. Viva-voce**

**05 Marks**

**QUESTION PAPER PATTERN OF THEORY EXAMINATION**

**I and II SEMESTER B. Sc. MICROBIOLOGY  
(For 2024-25 onwards)**

**Duration: 3 Hours**

**Max. Marks: 80**

**Instructions:** *Answer all questions.*

*Draw neat labeled diagrams wherever necessary.*

**I. Answer any eight of the following (10 questions to be asked):**

**2×8=16**

2 questions from Unit 1  
3 questions from Unit 2  
2 questions from Unit 3  
3 questions from Unit 4

Question paper pattern-1

**OR**

3 questions from Unit 1  
2 questions from Unit 2  
3 questions from Unit 3  
2 questions from Unit 3

Question paper pattern-2

**II. Answer any four of the following (6 questions to be asked):**

**6 ×4=24**

1 question from Unit 1  
2 questions from Unit 2  
1 question from Unit 3  
2 questions from Unit 4

Question paper pattern-1

**OR**

2 questions from Unit 1  
1 question from Unit 2  
2 questions from Unit 3  
1 question from Unit 4

Question paper pattern-2

**III. Answer any four of the following (6 questions to be asked):**

**10×4=40**

2 questions from Unit 1  
1 question from Unit 2  
2 questions from Unit 3  
1 question from Unit 4

Question paper pattern-1

**OR**

1 question from Unit 1  
2 questions from Unit 2  
1 question from Unit 3  
2 questions from Unit 4

Question paper pattern-2

**Note: Weightage given to each unit is 29±1 Marks**