Education to Excel

SBRR MAHAJANA FIRST GRADE COLLEGE (Autonomous)

Jayalakshmipuram, Mysuru – 570 012 Karnataka, INDIA

Affiliated to University of Mysore

Re-accredited by NAAC with 'A' Grade, College with Potential for Excellence

UG ☑ **PG** ☐

Syllabi of I and II Semester

B.Sc. – Microbiology

Choice Based Credit System - 2019

Credit Pattern for Courses

L: Lecture; T: Tutorial; P: Practical

Sem	Type	Course	L + T + P = Tot.
1	DSC	Introduction to Microbiology and Microbial Diversity	4 + 0 + 0 = 4
		Practical 1	0 + 0 + 2 = 2
2	DSC	Microbial Physiology and Molecular Biology	4 + 0 + 0 = 4
		Practical 2	0 + 0 + 2 = 2
3	DSC	Microbial Genetics and Recombinant DNA Technology	4 + 0 + 0 = 4
		Practical 3	0 + 0 + 2 = 2
4	DSC	Environmental and Agricultural Microbiology	4 + 0 + 0 = 4
		Practical 4	0 + 0 + 2 = 2
DSE Any one of the following			
5	DSE	Food and Industrial Microbiology	4 + 0 + 0 = 4
		Practical 5	0 + 0 + 2 = 2
		Microbial Biotechnology and Bioinformatics	4 + 0 + 0 = 4
		Practical 6	0 + 0 + 2 = 2
SEC Any one of the following			
5	SEC	Microbial Quality Control in Food and Pharmaceutical Industries	2 + 0 + 0 = 2
		Microbiological Analysis of Air and Water	2 + 0 + 0 = 2
DSE Any one of the following			
6	DSE	Immunology and Medical Microbiology	4 + 0 + 0 = 4
		Practical 7	0 + 0 + 2 = 2
		Advances in Microbiology, Biostatistics and Intellectual Property Rights	4 + 0 + 0 = 4
		Practical 8	0 + 0 + 2 = 2
SEC Any one of the following			
6	SEC	Microbial Diagnosis in Health Clinics	2 + 0 + 0 = 2
		Management of Human Microbial diseases	2 + 0 + 0 = 2

Credit means the unit by which the course work is measured. One hour session of Lecture or Tutorial per week for 16 weeks amounts to 1 credit. Two hours session of practical's per week for 16 weeks amounts to 1 credit per semester.

(DSC-1) INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

Course duration: 16 weeks with 4 hours of instruction per week.

I SEMESTER - Paper I
DSC-1:INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY
64 (4hrs/week)

Unit I: **History of Microbiology and Microscopy** **16 hrs**

History of Microbiology: Branches and scope of Microbiology. Theory of spontaneous generation and biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming and Edward Jenner. Systems of classification: Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility.

Microscopy: Light Microscopy-Different types of Microscopes, their construction and working principles. Simple microscopes (dissection microscope), Compound microscope (Types-Bright field, Dark field, Phase contrast and Fluorescence) Stereo microscope. Electron Microscope-Principle, construction and mode of operation of Scanning and Transmission electron microscope.

Unit II: **Techniques in Microbiology** **16 hrs**

Staining techniques for light microscopy: Types of microbiological stains and principles of staining. Simple staining (positive and negative), differential staining (Gram's staining and acid fast staining), structural staining (capsule, Cell wall and Endospore of bacteria), nuclear staining. Wet mounting method-Staining of algae and fungi. Hanging drop method.

Sterilization Techniques: Physical Methods; a)Heat- i)Dry heat (Hot Air Oven, Incineration) ii) Moist heat (Autoclave, Tyndallization) b) Filtration: Types of Filters (diatomaceous earth filters, Membrane filters and HEPA filter c)Radiation methods: UV radiation. Chemical methods: Definition of terms-disinfectants, antiseptics, Sanitizers, Microbicides, microbiostatic. Use and mode of action of alcohols, aldehydes, halogens, phenols, peroxides, heavy metals, Detergents: Quaternary ammonium compounds.

Unit III: **Microbial Diversity** **16 hrs**

Bacteria: General characteristics of different groups Important archaeal and eubacterial groups. Classification in brief as per Bergey's Manual of Systematic Bacteriology. Cell organization: Cell size, shape and arrangement, capsule, flagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaebacterial cell wall. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids. Endospore: Structure, formation, stages of sporulation.

Study of the following in brief with examples: *Rickettsiae, Chlamydia, Spirochaetes, Actinomycetes, Mycoplasma*

Cyanobacteria: occurence, structure, reproduction of the following: *Microcystis, Spirulina, Anabaena.*

Unit IV: **Study of Viruses, Fungi, Algae and Protozoa** **16 hrs**

Viruses: General characteristics of viruses. Concept of viroids, virusoids and Prions. Structure of Viruses, Importance of viruses. Study of structure and replication of viruses: a)Bacteriophages-T4 phage b) Cyanophages c) Phytophagenae-TMV d) Zoophagenae-Influenza.

General characteristics,thallus structure, reproduction and economic importance: a)**Algae**-*Chlorella, Spirogyra, Diatoms* and *Gracilaria* b)**Fungi**: *Rhizopus, Saccharomyces, Aspergillus,* and *Agaricus and c)* **Protozoa**: General account, sturcture and reproduction of *Euglena, and Entamoeba*

SUGGESTED READING

1. Alexopoulas, C.J. and Mims, C.W., Introductory Mycology, Wile Eastern Limited, New Delhi.

2. Atlas, R. M. (1997). Principles of Microbiology. 2nd edition. WM.T. Brown Publishers.

3. Bold, H.C. and Wynne, M. J. Introduction to Algae, Prentice Hall of India Private Limited, New Delhi.

4. Bos, L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.

5. Brock, T.D.and Madigan, M.T. Biology of Microorganisms, Prentice Hall of India Private Ltd,New Delhi.

6. Cappucino. J. and Sherman, N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited.

7. Carter, J. and Saunders, V. (2007). Virology: Principles and Applications. John Wiley and Sons.

8. Dimmock, N. J., Easton, A. L and Leppard, K. N. (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.

9. Dubey, R. C. and Maheshawari, D.K, (2013) Text book of Microbiology, S Chand and company limited, Ramnagar, New Delhi.

10. 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.

11. Lansing, M. Prescott,John, P.Harley,Donald A.Klein. (2002). Microbiology, 5th edition WCB Mc Graw Hill, New york.

12. Levy, J. A., Conrat, H. F. and Owens, R. A. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.

13. Madigan, M. T., Martinko, J. M., Dunlap, P. V. and Clark, D. P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.

14. Michael, J.Pelczar, Jr.E.C. S. Chan and Moel (2001). Microbiology, Mc Graw Hill Book Company, New york).

15. Pelczar, M. J., Chan, E. C. S. and Krieg, N. R. (1993). Microbiology. 5th edition. McGraw Hill Book Company.

16. Srivastava, S. and Srivastava, P. S. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht.

17. Stanier, R. Y., Ingraham, J. L., Wheelis, M. L. and Painter, P. R. (2005). General Microbiology. 5th edition McMillan.

18. Tortora, G. J., Funke, B. R. and Case, C. L. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.

19. Versteeg, J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.

20. Wagner, E. K., Hewlett, M. J. (2004). Basic Virology. 2nd edition. Blackwell Publishing.

I SEMESTER - PRACTICAL - I (4hrs/week)

INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

Course duration: 16 weeks with 4 hours of instruction per week

1. Microbiology good laboratory practices and biosafety.

2. Study the principle and applications of important instruments (autoclave, hot air oven, incubator, inoculation chamber, Inoculation loop, Inocultion needle, membrane filter, laminar air flow system,) used in the microbiology laboratory.

3. Study of simple and compound microscopes, their handling including oil immersion objective.

4. Preparation of stains, mordant and mounting media- Methylene blue, Crystal violet, Safranin, Nigrosin, Carbol Fuchsin, Malachite green, Grams iodine, Cotton blue.

5-7. Preparation of micororganisms for light microscopic observation-simple (direct and indirect) staining, differential staining (Gram staining), Structural staining (cell wall, endospore of bacteria).

8. Observation of bacterial motility by Hanging drop method.

9. Microscopic measurements of microorganisms/spores using stage and ocular micrometer.

10. Study of Cyanobacteria- *Microcystis, Spirulina, Anabaena*

11-12. Study of *Rhizopus, Saccharomyces, Aspergillus, Agaricus* using temporary mounts
13-14 Study of *Chlorella, Spirogyra, Diatoms and Gracilaria* using temporary mounts

15. Study of the following protozoans using permanent mounts/photographs: *Euglena* and *Entamoeba*

16. Display of photographs of microscopes and scientists mentioned in the theory – Simple and Compound Microscope, Phase contrast, fluorescent, TEM, SEM, Alexander Fleming, Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner.

II SEMESTER

DSC-2: MICROBIAL PHYSIOLOGY AND MOLECULAR BIOLOGY

Paper II **64 (4hrs/week)**

Unit I: **Microbial Nutrition** **16 hrs**

Bacterial Nutrition: Major nutritional types of microorganisms, Nutritional requirements of microorganisms, Uptake of nutrients-passive, facilitated, active transport. Bacterial growth: Growth rate and generation time (Definition), growth curve-phases of growth and their significance, Physical and chemical factors affecting growth. Measurement of growth by cell number and cell mass.

Cultivation of Bacteria: a) Culture Media-Synthetic and non-synthetic-solid, liquid and semi-solid media, Special media-Enriched, Selective, transport, differential, enrichment media. b) Cultivation of aerobic and anaerobic bacteria. c) Pure culture Techniques- Serial dilution, pour plate, spread plate, streak plate. Colony characteristics. d) Maintenance and preservation of pure cultures.

Unit II: **Microbial Metabolism** **16 hrs**

Chemoheterotrophic Metabolism: Aerobic respiration: Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain. Anaerobic respiration**:** Fermentation-Alcohol fermentation and Pasteur effect; Lactate fermentation.

Phototrophic Metabolism and Nitrogen and Lipids metabolism: Photosynthesis: photosynthetic microorganisms, oxygenic and anoxygenic types, light as a source of energy, photosynthetic pigments and apparatus in prokaryotes. Mechanism of photosynthesis in bacteria. Comparative account of photosynthesis in prokaryotes and eukaryotes. Nitrogen Metabolism: Biological nitrogen fixation-symbiotic and asymbiotic nitrogen fixation, nodule formation. A brief account on lipid metabolism-biosynthesis of triglycerides, β-oxidation.

Unit III: **Genetic material** **16 hrs**

Structure and types: Historical of genetics. Chromosomes: prokaryotic and eukaryotic organization. Watson and Crick model of DNA, DNA types, Organelle DNA - mitochondria and chloroplast DNA. Types of RNA, structure and its functional importance.

DNA Replication: DNA replication in prokaryotes -Enzymes and proteins involved in DNA replication; DNA polymerases, DNA ligase, primase. General Mechanism, Modes of replication. Various models of DNA replication including rolling circle, Θ (theta) mode of replication.

Unit IV: **Gene Expression and regulation** **16 hrs**

Transcription: Transcription- Definition, promoter- concept and strength of promoter, RNA Polymerase and the transcription unit. Post-transcriptional processing- Split genes, concept of introns and exons, RNA splicing, concept of alternative splicing, polyadenylation and capping, RNA interference: si RNA, miRNA and its significance. Transcriptional regulation at initiation with example from lac operons.

Translation: Gene-Protein relationship: One gene one enzyme and one gene- one polypeptide concept, colinearity of genes and proteins. Genetic code-features, Wobble hypothesis. Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides in both prokaryotes and eukaryotes.

SUGGESTED READINGS

1. Becker, W. M., Kleinsmith, L. J., Hardin, J. and Bertoni, G. P. (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco.

2. Brock, T. D. and Madigan, M.T.,(2012). Biology of Microoragnisms, Prentice hall of India Pvt. Ltd, New Delhi.

3. De Robertis, E. D. P. and De Robertis, E. M. F. (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia.

4. Gardner, E. J., Simmons, M. J., Snustad, D. P. (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.

7. Krebs, J., Goldstein. E., Kilpatrick, S. (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.

8. Lansing, M., Prescott,J.,Ohn, P., Harley,Donald A.Klein,(2002) Microbiology,5th ed. WCB Mc Graw Hill, New york.

9. Madigan, M. T. and Martinko, J. M. (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.

10. Moat, A. G. and Foster, J. W. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.

11. Nelson David, L and Cox Michael, M., Lehninger,(2008) Principles of Biochemistry, Macmillan Press, Worth Publishers, New Delhi.

12. Reddy, S. R. and Reddy, S. M. (2005). Microbial Physiology. Scientific Publishers India.

13. Sambrook, J. and Russell, D. W. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.

14. Stanier, R. Y., Ingrahm, J. I, Wheelis, M. L. and Painter, P. R. (1987). General Microbiology. 5th edition, McMillan Press.

15. Willey, J. M., Sherwood, L. M. and Woolverton, C. J. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

SEMESTER-II
MICROBIAL PHYSIOLOGY AND MOLECULAR BIOLOGY
PRACTICAL-II (4hrs/week)

1. Cleaning and sterilization of glassware.
2. Preparation of media-nutrient broth, nutrient agar, potato dextrose agar, Czapek dox agar, MacConkey's agar.
3. Cultivation of microorganisms on agar plate (point inoculation) broth, anaerobic cultivation (gaspak method).
4. Preparation of physiological saline and serial dilution.
5. Estimation of CFU count by spread plate method/pour plate method and study of colony characteristics.
6. Isolation of pure cultures of bacteria by streak plate methods
7. Maintenance and preservation of bacterial cultures on fresh agar slants, overlaying with mineral oil, stab culture
8. Effect of temperature & pH on growth of microorganisms.
9. Effect of carbon source on growth of microorganisms.
10. Measurement of growth by cell mass using tubidometer/ photocolorimeter/ spectrophotometer.
11. Measurement of growth by cell number using Haemocytometer.
12. Study of root nodules for bacteroids
13. Acid and gas production from carbohydrates-demonstration of fermentation of lactose.
14. Starch hydrolysis & Gelatin hydrolysis.
15. Catalase activity.
16. Study of different types of DNA, RNA, semi-conservative replication of DNA, transcription, translation, Colony counter, Photocolorimeter.

Description of the paper

Sem	Type	Course	L + T + P = Tot.
1	DSC	Introduction to Microbiology and Microbial Diversity	4 + 0 + 0 = 4
		Practical 1	0 + 0 + 2 = 2
2	DSC	Microbial Physiology and Molecular Biology	4 + 0 + 0 = 4
		Practical 2	0 + 0 + 2 = 2
3	DSC	Microbial Genetics and Recombinant DNA Technology	4 + 0 + 0 = 4
		Practical 3	0 + 0 + 2 = 2
4	DSC	Environmental and Agricultural Microbiology	4 + 0 + 0 = 4
		Practical 4	0 + 0 + 2 = 2
DSE Any one of the following			
5	DSE	Food and Industrial Microbiology	4 + 0 + 0 = 4
		Practical 5	0 + 0 + 2 = 2
		Microbial Biotechnology and Bioinformatics	4 + 0 + 0 = 4
		Practical 6	0 + 0 + 2 = 2
SEC Any one of the following			
5	SEC	Microbial Quality Control in Food and Pharmaceutical Industries	2 + 0 + 0 = 2
		Microbiological Analysis of Air and Water	2 + 0 + 0 = 2
DSE Any one of the following			
6	DSE	Immunology and Medical Microbiology	4 + 0 + 0 = 4
		Practical 7	0 + 0 + 2 = 2
		Advances in Microbiology, Biostatistics and Intellectual Property Rights	4 + 0 + 0 = 4
		Practical 8	0 + 0 + 2 = 2
SEC Any one of the following			
6	SEC	Microbial Diagnosis in Health Clinics	2 + 0 + 0 = 2
		Management of Human Microbial diseases	2 + 0 + 0 = 2

Scheme of Valuation for Practical's

C1 and C2 are internal tests to be conducted during 8th and 16th weeks respectively of the semester. C3 is the semester-end examination conducted for 3 hours. The student will be evaluated on the basis of skill, comprehension and recording the results.

The students have to compulsorily submit the practical record during C1 and C2. For C3, the record has to be certified by the Head of the Department.

- The student is evaluated for 10 marks in C1 and C2 as per the following scheme:
  Experiment 10

  The marks scored is then normalized for 5.
- The student is evaluated for 40 marks in C3 as per the following scheme:

Heading	Marks
Experiment	35
Record	05
Total	40

The experiment portion of evaluation is carried out as per the following scheme:

I SEMESTER

PRACTICAL-I: INTRODUCTION TO MICROBIOLOGY AND MICROBIAL DIVERSITY

Duration: 3 hours **Max. Marks: 35**

I. Write critical notes on A, B and C. 3x3=09 Marks

(Scientists/ Microscopes/ Stains/ Disinfectants/ Laboratory equipments)
(Identification – 01 Mark, Reasons – 02 Marks)

II. **Stain the given material D by…….. method. Write the principle and procedure. Leave the preparation for evaluation. 06 Marks**

(Direct staining/ indirect staining/ Gram staining/ Cell wall or Endospore staining)
(Preparation-2 Marks, Principle - 01 Mark, Procedure- 01 Mark, Reasons - 02 Marks)

III. Measure the given Microorganism E using Ocular and Stage Micrometer. 07 Marks

(Procedure – 03 Marks, Calibration -02 Marks, Result – 02 Marks)

IV. Identify the material F by preparing a temporary mount. 05 Marks

(Any One material from Cyanobacteria /Algae / Fungi – Preparation - 01 Mark, Identification - 01 Mark, Diagram - 01 Mark & Reasons - 02 Marks)

V. Identify the slides G, H, I and J with labelled diagrams and reasons. 04x2=08 Marks

(One from Cyanobacteria, Algae, Fungi, Protozoa)
(Identification- 01 Mark, Diagram and Reasons- 01 Mark)

II SEMESTER
PRACTICAL-II: MICROBIAL PHYSIOLOGY AND MOLECULAR BIOLOGY

Duration: 3 hours **Max. Marks: 35**

I. Write critical notes on A, B and C. 3x3=09 Marks

(Photocolorimeter, Colony Counter, DNA and RNA types, DNA replication, Transcription, Translation, Agar Slant/ Stab)
(Identification – 01 Mark, Reasons – 02 Marks)

II. Demonstrate or perform the experiment D. Record and interpret the result. 10 Marks

(Lactose fermentation / Starch hydrolysis / Effect of temperature on microbial growth / Catalase test / Gram Staining - *Bacteroids*)
(Demonstration - 04 Marks, Principle- 01 Mark, Procedure - 02 Marks, Results- 02 Marks, Interpretation- 01 Mark)

III. Demonstrate or perform the experiment E giving principle and procedure. Record the result. 10Marks

(Serial dilution / pour plate / spread plate / streak plate / point inoculation)
(Demonstration-04 Marks, Principle- 01 Mark, Procedure- 02 Marks, Results- 02 Marks, Interpretation- 01 Mark)

IV. Interpret the results of the experiment F and its significance. 06 Marks

(Gelatin hydrolysis / Effect of pH on Microbial growth / Effect of carbon source on microbial growth / Colony characteristics)
(Result – 02 Mark, interpretation- 02 Marks, Significance- 02 Marks)

Question Paper Pattern

DSC Courses:

Max Marks: 80 **Time: 3 hours**

I. Answer the following **[4×15=60]**

1. Long answer questions; Answer **any one** out of 2 1 × 15 = 15
2. Long answer questions; Answer **any one** out of 2 1 × 15 = 15
3. Long answer questions; Answer **any one** out of 2 1 × 15 = 15
4. Long answer questions; Answer **any one** out of 2 1 × 15 = 15

II. Answer any **four** out of **six** **[4×05=20]**

5.
6.
7.
8.
9.
10.