TUMKUR UNIVERSITY

REVISED CHOICE BASED CREDIT SYSTEM (CBCS)

1: 3 Major Pattern

B. Sc. MICROBIOLOGY CREDIT AND CURRICULUM STRUCTURE

(I and II Semester)

From the academic year

2024-25

Board of Studies in Microbiology

Department of Studies and Research in Microbiology

Tumkur University, Tumkur

Karnataka, India

Revised CBCS Scheme

B.Sc. Microbiology

Course Structure and Credit Pattern

(I and II Semester)

SEMESTER	DSC	Course Name	Teaching /Learning/Evaluation Pattern in hours/week			Credits
			L (Lecture)	T (Tutorial)	P (Practical)	
I Semester	DSC A1	Fundamentals Microbiology and Microbial Diversity	4	0	0	4
	DSC A2	Practical based on Fundamentals Microbiology and Microbial Diversity	0	0	4	2
II Semester	DSC A3	Microbial Physiology and Microbial Genetics	4	0	0	4
	DSC A4	Practical based on Microbial Physiology and Microbial Genetics	0	0	4	2

DSC: Discipline Specific Core

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I SEMSTER

DSC-A1: FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY:

PAPER I (60 hours: 4 hrs./week: credits 4)

Unit I: History of microbiology and microscopy **(15 hrs)**

1. **History of microbiology:** Scope and branches of Microbiology. Contributions of Anton Von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Edward Jenner and Alexander Fleming.
2. **Microscopy:** Working principle, construction and application of compound microscope, dark field microscope, phase contrast microscope, fluorescent microscope and scanning & transmission electron microscope.
3. **Study of instruments:** Principle, construction and applications of laminar air flow, incubator, pH meter, hot air oven, centrifuge, colorimeter and colony counter.

Unit II: Sterilization, Culture and Staining techniques **(15 hrs)**

1. **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 and phenols.
2. **Culture techniques:** Culture media and types; Methods of Isolation of pure cultures; Methods of cultivation of anaerobic microorganisms; Preservation of pure culture.
3. **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).

Unit III: Microbial diversity **(15 hrs)**

1. **Biodiversity:** Definition and levels, Bergey's Manual of Systematic Bacteriology. Comparison of bacteria, archaea and eukarya.
2. **Systems of classification:** Whittaker's five kingdom classification and Carl Woese's three domain classification. Classical and molecular characteristic used in microbial taxonomy.
3. **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.

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

Unit IV: Diversity of eukaryotes and Virology **(13 hrs)**

1. **Diversity of eukaryotes:** Structure, reproduction and importance of Algae (Spirogyra, Diatoms and Gracilaria), Fungi (Rhizopus, Aspergillus, Agaricus) and Protozoa (Euglena and Paramecium)
2. **Virology:** ICTV system of classification. General characteristics of viruses. Structure and importance of viruses. Structure and replication of viruses: Bacteriophages-T4 phage, cyanophages-LPP-1, Pshytophagineae-TMV, Zoophagineae-Polio, Subviral particles- viroids, virusoids and prions.

DSC-A2: FUNDAMENTALS OF MICROBIOLOGY AND MICROBIAL DIVERSITY

(30 hours: 4 hrs./week: credits 2)

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

1. Microbiological laboratory standards and safety protocols.
2. Study of simple and compound microscopes.
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, Centrifuge).
4. Applications of basic microbiological tools (Pipettes, Micropipette, Inoculation loop and needle, Spreader).
5. Cleaning and sterilization of glassware and preparation of media-nutrient broth, nutrient agar and potato dextrose agar.
6. Preparation of stains and mordant -methylene blue, crystal violet, safranin, nigrosine, 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- Anabaena and Spirulina.
12. Study of Algae- Diatoms and Gracilaria.
13. Study of Fungi-Rhizopus, Aspergillus and Agaricus.
14. Study of Protozoa-Euglena and Paramecium.
15. Study of T4 phage, TMV and Corona virus

Text Books / References

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. 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-A3: BASIC BIOCHEMISTRY, MICROBIAL PHYSIOLOGY AND MICROBIAL GENETICS

PAPER II (60 hours: 4 hrs./week: credits 4)

Unit 1: Basic Biochemistry **(15 hrs)**

1. Introduction- Properties of water, acids, bases, pH and Buffers.
2. A brief account of the properties, classification and importance of carbohydrates, lipids and proteins.
3. Introduction, properties, nomenclature and classification of enzymes.
4. Mechanism of an enzyme reaction, Factors affecting enzyme activity. isozymes, ribozymes, enzyme unit, specific activity, Michaelis-Menton equation, Lineweaver burk plot.
5. Allosteric enzymes -Properties and mechanism, Allosteric Regulation, Covalent Modification, Feedback Inhibition, Isozymes and Zymogens.

UNIT II: Microbial Physiology **(15 hrs)**

1. Concept of free energy, Enthalpy, Standard Free Energy change of reaction, Entropy, Law of thermodynamics; Open and Closed system; Structure and properties of ATP, Standard Free energy change of hydrolysis of ATP and other high energy compounds biological oxidation-reduction reactions; Structure and Function of NAD and FAD.
2. Glycolysis, TCA, HMP and ETS, oxidative phosphorylation, pentose phosphate pathway. Anaerobic respiration, chemoautotrophy oxidation of inorganic compounds -N, S, Fe and H.
3. Fermentation – Fermentative modes in microorganisms – alcoholic, Lactic acid – hetero and homo lactic acid fermentation.
4. Bacterial photosynthesis – photosynthetic pigments of prokaryotes, Types of bacterial photosynthesis- Cyclic and non-cyclic photophosphorylation, Oxygenic and anoxygenic photosynthesis.
5. Microbial Nutrition and types; Microbial Growth: Factors affecting the growth, Bacterial Growth curve; Continuous and Synchronous growth; Counting of bacteria: Viable count-SPC, DMC, turbidometry

UNIT III: Microbial Genetics **(15 hrs)**

1. Fundamentals of Genetics, Genomic organization in prokaryotes and eukaryotes.
2. Nucleic acids: Chemical compositions of DNA & RNA, Watson & Crick model of DNA; Types of DNA: A, B, Z and H; Supercoiling of DNA, Single stranded and Circular DNA; Structure of RNA , Types of RNA- mRNA, rRNA and tRNA (Clover Leaf Model).
3. DNA replication in Prokaryotes: Semi-Conservative and dispersive methods, Rolling circle model and Cairn's model (Theta model), origin of replication; Primers and templates, replication fork, unidirectional and bidirectional replication.

UNIT IV: Genetic Recombination and Mutations **(15 hrs)**

1. Genetic recombination in bacteria: Conjugation: F+ v/s F-, Hfr v/s F-, F' v/s F-: Transformation: Griffith Experiment and mechanism; Transduction: Generalized and Specialized.
2. Mutation: Molecular basis of mutations and Types: Point and frame shift mutation, Spontaneous and induced mutations; Mutagens: Physical mutagen – ultra violet radiations, X- rays v. biological mutagen – plasmids & transposons; Detection of mutations- replica plate method; Mutation repair- photoreactivation, excision repair, SOS repair.

DSC-A4:BASIC BIOCHEMISTRY, MICROBIAL PHYSIOLOGY AND MICROBIAL GENETICS

(30 hours: 4 hrs./week: credits 2)

PRACTICAL-II **(4hrs/week)**

1. Qualitative tests for Carbohydrates, Proteins & Lipids
2. Estimation of reducing sugar by DNS method
3. Estimation of Protein by Lowry's method
4. Biochemical tests- IMViC, Catalase, Oxidase, Gelatinase, Starch hydrolysis and sugar fermentation test.
5. Effect of variables on enzyme activity (amylase)- pH & temperature.
6. Measurement of growth by cell number using hemocytometer.
7. Microscopic examination of root nodules for bacteroids
8. Preparation of competent cells and demonstration of bacterial transformation.
9. Demonstration of bacterial conjugation by plate mating method.
10. Isolation of streptomycin resistant mutants by gradient plate method.
11. Effect of U.V. light on bacteria.
12. Problems on genetics
13. Charts on Genetic recombination in Bacteria -Conjugation - F+ v/s F-, Hfr+ v/s F-, F' v/s F- Transformation - Griffith's experiment and mechanism, Transduction - generalized and specialized.

Text Books / References

1. Freifelder David, Microbial Genetics, Narosa Publishing House, New Delhi.
2. Gerald Karp, Cell Biology, McGraw Hill Book Company, New York.
3. Moat A.G. and Foster S.w., Microbial Physiology, John Wiley and Sons, New York.
4. Nelson David L. and Cox.Michael M., Lehninger Principles of Biochemistry, Macmillan PresslWorth Publishers, New Delhi
5. Pelczar M.J., Chan E.C.S. and Krieg N.R, Microbioiogy, McGraw Hill BookCompany, New York.
6. Prescott Lansing M., Harley John P.and Klein Donald A., Microbiology, WCB McGraw: Hill, New York.
7. Salle A.J., Fundamental Principles of Bacteriology, Tata McGraw- Hili Publishing Company Limited, New Delhi.
8. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New

Delhi.

9. Stickberger M.W., Genetics, Prentice Hall of India Private Limited, New Delhi.
10. Voet D. and Voet J.G., Biochemistry, John Wiley and Sons, New York.
11. Lehninger's Principles of Biochemistry, D. Nelson & M. Cox, 5th edition, Macmillan Worth Publications
12. Concepts of Genetics 7th edition, Klug & Cummings, Pearson Education Publications
13. Genes IX, Lewin, Oxford Publications
14. Genetics – a molecular approach, Peter Russell, 3rd edition, Pearson Publications
15. Fundamental bacterial genetics, Nancy Trun& Janine Trempy, (2004), Blackwell Publications
16. Outlines Of Biochemistry, 5th edition, Eric E Conn , Paul K Stumpf ,George Bruening, Roy H. Doi John Wiley & Sons
17. Biochemistry Berg JM, Tymoczko JL, Stryer L. 6th edition, New York: W H Freeman
18. Biochemical Calculations, Irwin H. Segel, 2nd Edition John Wiley & Son

B.Sc. MICROBIOLOGY QUESTION PAPER PATTERN – THEORY

MAXIMUM MARKS: 80 **TIME: 3 HOURS**

PART – A

Answer any TEN questions: **10x2=20**

1.
2.
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PART – B

Answer any SIX questions. **6x5=30**

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20.

PART - C

Answer any THREE questions. **3X10=30**

21.
22.
23.
24.

Note: Equal weightage should be given to all the units while preparing the question paper.

B.Sc MICROBIOLOGY QUESTION PAPER PATTERN – PRACTICAL

MAXIMUM MARKS: 40 **TIME: 3 HOURS**

1. **Major Experiment:** 12 Marks
2. **Minor Experiment:** 08 Marks
3. **Spotters/Demonstrations:** 12 Marks
4. **Record Submission:** 04 Marks
5. **Viva-Voce:** 04 Marks

Note: Scheme of valuation specific to each semester has to be prepared by the BOE for each examination separately

Internal Assessment:

Internal tests:	5 Marks
Assignments/Project work/Seminar (Frontier areas of microbiology)	5 Marks
TOTAL:	10 Marks

Note: Students should be given a choice of picking a topic of their interest for project work and the teachers should guide them in making an informed choice.

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