VIJAYANAGARA SRI KRSIHNADEVARAYA UNIVERSITY
JNANASAGARA CAMPUS, BALLARI-583105

BACHELOR OF SCIENCE IN MICROBIOLOGY

PROPOSED SYLLABUS FOR I and II SEMESTER

2024-2025 Onwards

Department Name: Microbiology
Semester - I

Course Title: Introduction to Microbiology and Microbial Taxonomy	**Course Code:** 24MJMICR1L
Total Contact Hours: 56	**No. of Credits:** 4
L:T:P- 4:0:0	
Internal Assessment Marks: 20	**Duration of SEE:** 3 Hours
Semester End Exam Marks:	**80**

Course Outcomes (COs):

At the end of the course, students will be able to:

1. CO1.Group animals on the basis of their morphological characteristics/structures
2. CO2. DemonstratecomprehensiveidentificationabilitiesofNon-Chordatediversity
3. CO3.ExplainstructuralandfunctionaldiversityofNon-Chordates
4. CO4.Develop understanding on the diversity of life with regard to protists non-chordates and chordates.

Unit	Description	Hours
1	**History of Microbiology:** Spontaneous generation vs. biogenesis. Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming. golden era of microbiology, Contributions of Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A.Waksman in soil microbiology. Contributions of Paul Ehrlich, Elie Metchnikoff, Edward Jenner in medical microbiology. History, origin, development and evolution of viruses. **Sterelization and disinfection:** Principles, Types and techniques of sterilization and disinfection. Physical sterilization (dry heat and moist heat), chemical sterilization, filtration and radiation sterilization, pasteurization, Disinfection and fumigation.	12
2	**Culture media:** Components of culture media, Preparations and types of culture media. Basal media, complex media, differential media, selective media. Indicator, enriched and transport media. **Staining techniques:** Nature and types of Stains. Principles, mechanism, method and types of staining Simple, Differential, Gram staining, Acid fast staining, Vital staining, negative staining. Staining for capsule, cell wall, endospore, inclusion bodies and flagella. **Pure culture techniques:** Isolation of different microorganisms from different environments. Sample collection, preservation and enrichment. Different methods of isolation-pour plate, spread plate and serial dilution techniques. Working principle and operation of instruments used in microbiology laboratory-Autoclave, Laminar air flow system, Incubator, Hot air oven, Orbital shaker, pH meter,	16

	Spectrophotometer, Centrifuges, refrigerators, deep freezers.	
3	**Taxonomy of microbes:** Biodiversity of microorganisms, types of biodiversity. The concept of microbial species. Microbial systematics, classification systems, major characteristics used nucleic acid, serology, chemical composition and phylogenetic mode of classification. Numerical taxonomy, cluster analysis and construction of taxonomy groups based on dendrograms, similarity matrix. International codes, rules, recommendations, construction of names in bacterial nomenclature and its role in taxonomy. Salient features of Bergy's Manual of Systematic Bacteriology. Taxonomy of viruses: Salient features of viral classification- Baltimore classification of viruses, ICTV, classification of viruses and phages. General characteristics, classification and economic importance of Archaebacteria, Actinobacteria, cyanobacteria bioluminescent bacteria. General characteristics, growth, multiplication and life cycle of Mycoplasma, Rickettsiae and Chlamydia. **Morphology and ultra structure of Bacteria:** Size, shape and arrangement - structure, chemical composition of cell wall of archaebacteria, gram-negative bacteria, gram-positive bacteria and acid fast bacteria, Fine structure, composition and function of cell membrane, capsule, flagella, pili, gas vesicles, ribosomes, mesosomes, reserve food materials, magnetosomes, phycobilisomes and nucleoid. Reproduction in Bacteria, Bacterial endospore formation, germination and induction of endospores.	12
4	General Structure of viruses and phages. Configuration and symmetry of viruses- helical and icosahedral, Physical and chemical components - capsomere, capsid, matrix and envelop; Viral genome, nucleoprotein organization, multiplication of viral genomes. Translocation and distribution of viruses in plants; different modes of transmission of plant viruses - Structure and life cycle of some important plant viruses. Dissemination of animal viruses - direct and indirect contacts, through vectors; Structure and life cycle of some of the important animal viruses. Oncogenic viruses, satellite virus, satellite RNA, Prions, and viriods. Bacteriophages, cyanophages, mycophages and phycophages, replication of phages, significance and applications. Cultivation and detection of viruses and phages. General Characteristics and classification of fungi distribution of fungi. Fine structure of hypha, mycelium and yeast, structure and composition of fungal walls, plasma membrane, septa, cytoskeleton. Modes of nutrition, fungal adaptations for nutrient capture. **Reproduction in fungi:** Vegetative reproduction, asexual reproduction, Sexual reproduction - planogametic copulation, gametangial contact, gametangial copulation, spermatogamy, somatogamy, Economic importance of fungi: Life cycle of economically important yeasts and molds.	**12**

	General characteristics and classification of algae with distinguishing characteristics up to class level, economic importance of algae.	

References:

1. Jefreey C Pommerville, 2011, Fundamentals of Microbiology, Bartlett Series.

2. Roger Y. Stanier, 1987, General Microbiology, MacMillan Publ.

3. Lammart JM, 2006; Techniques in Microbiology – a student handbook, amzon.com.

4. Madigan MT et al, 2008; Brock – Biology of Microorganisms, amzon.com.

5. Atlas RM, 1995; Principles of Microbiology, Mosby Yearbook Missouri

6. Pelczar, Chan & Kreig, 1982; Microbiology, McGraw Hill Book Co, New York

7. Phylogenetic Identification and In situ detection of Individual Microbial Cells without Cultivation, Microbiological Reviews 59, 143-169.

8.Cook T. (2002) Microbial Biodiversity: Saving Bacteria to save ourselves, Harvard Science Review, 26-28.

9. W D Frost and E. F. McCampbell, 2010; Text Book of General Bacteriology, Bibliobazaar, Publ.

10. Bergey's Manual of Systematic Bacteriology. 9th Edn. Lippincott Williams, Wilkin Bacteriology.

11. A.J. Salle, 1974; Fundamental Principles of Bacteriology, Tata McGraw Hill Edition.

12.Brock Biology of Microorganisms by Madigan, Martinko and Parker. 2005 al Inc.

13. RC Dubey and D K Maheswari, A text book of Microbiology, S.Chand and company ltd.

14. A Mani et al Microbiology. SARAS publication.2017.

Question Paper Pattern for UG Semester Major

Paper Code:	**Paper Title:**		
Duration of Exam	**3Hours**	Max Marks	**80**
Instruction:	**Answer all the sections**		

Section-A

……..	**20 Marks**
I. Answer any TEN of the following questions (10x2=20) 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.	

Section-B

……	**20 Marks**
II. Answer any **FIVE** of the following questions (5X4=20) 13. 14. 15. 16. 17. 18.	

Section-C

……	**40 Marks**

III. Answer any Four of the following questions	**(4X10=40)**
19.	
20.	
21.	
22.	
23.	

Department Name: Microbiology

Semester - I

Course Title: Introduction to Microbiology and Microbial Taxonomy	**Course Code:** 24MJMICR1P
Total Contact Hours: 56	**No. of Credits:** 2
L:T:P- 0:0:2	
Internal Assessment Marks: 10	**Duration of SEE:** 3 Hours
Semester End Exam Marks:	**40**

Course Outcomes (COs):

At the end of the course, students will be able to:

CO1At the end of the course the student should be able to:

CO2 Understand basics of classification of non-chordates.

CO3 Learn the diversity of habit and habitat of the species.

CO4 Develop the skills to identify different classes and species of animals.

CO5 Know uniqueness of a particular animal and its importance

CO6 Enhancement of basic laboratory skill like keen observation and drawing.

CO7 To demonstrate comprehensive identification abilities of chordate diversity

CO8. Able to explain structural and functional diversity of chordate diversity

CO9. To understand evolutionary relationship amongst chordates

CO10. To take up research in biological sciences.

CO11To realize that very similar physiological mechanisms are used in very diverse organisms.

CO12 To Get a flavor of research by working on project besides improving their writing skills. It will further enable the students to think and interpret individually.

List of Experiments / Programs (For a Lab Course)

Sl.No	Experiment / Program
1.	Distrubution of microbes from air, soil and water samples and Cultural characteristics of bacteria, fungi and actinomycetes.
2.	Aseptic transfer of bacteria, fungi and actinomycetes.
3.	Differential staining: Gram staining and acidfast staining.
4.	Special staining of endospores, capsule, flagella, volutin granules and glycogen granules.
5.	Microbial motility tests by Hanging Drop method.
6.	Biochemical tests for identification of Bacteria: Catalase, oxidase, IMViC, motility, gelatin test, urease, levan formed from glucose, H2S in TSIA and lead acetate paper, coagulase, acid and gas from glucose, arabinose, inositol, lactose, maltose, mannitol, rhamnose, salicin, trehalose, sucrose, xylose, fructose, chitin, starch, casein, Tween 80 hydrolysis, pectin, arginine dehydrolysis, lysine decarboxylase, ornithine, esculin hydrolysis.
7.	Staining of Fungi by lacto phenol cotton blue
8.	Study of spores of Fungi/actinomycetes by slide culture technique.
9.	Isolation of fungi from soil: Dilution plate method or warcup method or stamping method.
10.	Isolation of Epiphytic and endophytic fungi by washing method or implant method or impression method or maceration method.
11.	Isolation of bacteriophages from sewage.
12.	Isolation of plant viruses from sap.
13.	Isolation and identification of microscopic algae and protozoa from soil and water
Refe13.rences	

Formative Assessment for Practical	
Assessment Occasion/type	**Marks**
Test/Presentation/Project/Seminars	5
Laboratory Performance/Participation	5
Total	**10 Marks**

B.Sc. I Semester Practical Examination

Time: 3 hours **Max. Marks: 40**

1. Major Experimentation 12 marks
2. Minor experiment 08 marks
3. Spotting/Identification 10 marks
4. Record Book 5 marks
5. Viva 5 marks

Department Name: Microbiology
Semester – II

Course Title: Microbial physiology and genetics.	**Course Code:** 24MJMICR2L
Total Contact Hours: 56	**No. of Credits:** 4
L:T:P-4-0-0	
Internal Assessment Marks: 20	**Duration of SEE: 3** Hours
Semester End Exam Marks:	**80**

Course Outcomes (COs):

At the end of the course, students will be able to understand:

1.CO1. The structure and function of the cell organelles

2. CO2. The chromatin structure and its location

3. CO3. The basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form a new organisms.

4.CO4. How a cell communicates with its neighbouring cells.

5. CO5. After successful accomplishment of the course, the learners will be able to acquire better understanding and comprehensive knowledge regarding most of the essential aspects of Molecular Biology subject which in turn will provide a fantastic opportunity to develop professional skill related to the field of molecular biology.

6. CO6 To obtain the knowledge about the tissues and organs.

Unit	Description	Hours
1	**Microbial nutrition** **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.	16
2	**Microbial metabolism** **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 ammonia assimilation. GOGAT cycle.	14

3	**DNA as genetic material and Bacterial genetics** 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^+ x F^- conjugation, F′ x F^- conjugation, Hfr x F^- conjugation, Transduction: Generalized and specialized transduction.	14
4	**Genetics of Viruses and Fungi** **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.	**12**

1. References:

2. Nelson & Cox: Leininger‘s Principles of Biochemistry: McMillan (2000)
3. Zubay et al: Principles of Biochemistry: WCB (1995)
4. Voet & Voet: Biochemistry Vols l & 2: Wiley (2004)
5. Murray et al: Harper‘s Illustrated Biochemistry: McGraw Hill (2003) Elliott and Elliott: Biochemistry and Molecular Biology: Oxford University Press .
6. Bailey Text Book of Histology. 1971 16th edition. Wilfred M. Copenhaver Richar P. Bung and Mary bartell Bunge. The William and Wilkings Company Baltimore.
7. Histology 979. 8th Arthur W. Ham. David H. Cormark. J. B. Lippincot. Co. Philadelphia.

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Question Paper Pattern for UG Semester Major

Paper Code:	**Paper Title:**		
Duration of Exam	**3 Hours**	Max Marks	**80**
Instruction:	**Answer all the sections**		

Section-A

……..	**20 Marks**

I. Answer any TEN of the following questions (10x2=20)

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

Section-B

……	**20 Marks**

II. Answer any **FIVE** of the following questions (5X4=20)

13.

14.

15.

16.

17.

18.

Section-C

……	**40 Marks**

III. Answer any Four of the following questions	**(4X10=40)**
19.	
20.	
21.	
22.	
23.	

Department Name: Microbiology
Semester - II

Course Title: Microbial physiology and genetics.	**Course Code:** 24MJMICR2P
Total Contact Hours: 56	**No. of Credits:** 2
L:T:P-0:0:4	
Internal Assessment Marks: 10	**Duration of SEE:** 3 Hours
Semester End Exam Marks: 40	

Course Outcomes (COs):

At the end of the course, students will be able to:

1. **CO1.** Use simple and compound microscopes
2. **CO2.** Prepare stained slides to observe the cell organelles.
3. **CO3.** Be familiar with the basic principle of life, how a cell divides leading to the growth of an organism and also reproduces to form new organisms.
4. **CO4.** How chromosomal aberrations are inherited in humans by pedigree analysis in families. The antigen-antibody reaction.
5. **CO5.** They can perform techniques involved in molecular biology and diagnosis of diseases.

List of Experiments / Programs (For a Lab Course)

Sl.No	Experiment / Program
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.

References:

1. Brock, T. D. and Madigan, M. T.,(2012). Biology of Microoragnisms, 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.
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5. Krebs, J., Goldstein. E., Kilpatrick, S. (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning.
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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.
13. Reddy, S. R. and Reddy, S. M. (2005). Microbial Physiology. Scientific Publishers India.
14. Russell, P. J. (2009). Genetics- A Molecular Approach. 3rd Ed, Benjamin Cummings
15. Stanier, R. Y., Ingrahm, J. I, Wheelis, M. L. and Painter, P. R. (1987). General Microbiology. 5th edition, McMillan Press.
16. Willey, J. M., Sherwood, L. M. and Woolverton, C. J. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

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Assessment Occasion/type	**Marks**
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