ರಾಯಚೂರು ವಿಶ್ವವಿದ್ಯಾಲಯ RAICHUR UNIVERSITY

DEPARTMENT OF MICROBIOLOGY
M.Sc. DEGREE (SEMESTER) COURSE UNDER CBCS SCHEME
SCHEME OF TEACHING AND EXAMINATION
(Effective from the academic year 2023-24 and onwards)

PAPER	Teaching Hours/week	Examination Hours	Marks	IA	Credits
I SEMESTER:					
1.1 HC Fundamentals of Microbiology	4	3	75	25	4
1.2 HC Cell Biology and Biochemistry	4	3	75	25	4
1.3 HC Bacteriology	4	3	75	25	4
1.4 SC Virology and Mycology	4	3	75	25	4
1.5 Practical Based on paper 1.1	4	3	35	15	2
1.6 Practical Based on paper 1.2	4	3	35	15	2
1.7 Practical Based on paper 1.3	4	3	35	15	2
1.8 Practical Based on paper 1.4	4	3	35	15	2
II SEMESTER:					
2.1 HC Microbial Physiology and Metabolism	4	3	75	25	4
2.2 HC Microbial Genetics and Molecular Biology	4	3	75	25	4
2.3 SCT Environmental Microbiology (A)	4	3	75	25	4
2.3 SCT Biophysics, Biostatistics and Bioinformatics (B)	4	3	75	25	4
2.4 OE Microbes in Human Welfare	2	2	35	15	2
2.5 Practical Based on paper 2.1	4	3	35	15	2
2.6 Practical Based on paper 2.2	4	3	35	15	2
2.7 Practical Based on paper 2.3 (A)	4	3	35	15	2
2.8 Practical Based on paper 2.3 (B)	4	3	35	15	2
III SEMESTER:					
3.1 HC Recombinant DNA Technology	4	3	75	25	4
3.2 HC Immunology and Immunotechnology	4	3	75	25	4
3.3 SCT Food and Dairy Microbiology (A)	4	3	75	25	4
3.3 SCT Microbial Enzymology (B)	4	3	75	25	4
3.4 OE Microbes and Environment	2	2	35	15	2
3.5 Practical Based on paper 3.1	4	3	35	15	2
3.6 Practical Based on paper 3.2	4	3	35	15	2
3.7 Practical Based on paper 3.3 (A)	4	3	35	15	2
3.8 Practical Based on paper 3.3 (B)	4	3	35	15	2
IV SEMESTER:					
4.1 HC Fermentation Technology and Bioprocess Engineering	4	3	75	25	4
4.2 HC Medical Microbiology and Diagnostics	4	3	75	25	4
4.3 HC Industrial Internship/Project – Dissertation	4	3	75	25	4
4.4 SC Agricultural Microbiology	4	3	75	25	4
4.5 Practical Based on paper 4.1	4	3	35	35	2
4.6 Practical Based on paper 4.2	4	3	35	35	2
4.7 Project colloquium and Viva	4	3	35	35	2
4.8 Practical Based on paper 4.4	4	3	35	35	2
TOTAL MARKS (I TO IV SEMESTERS)					

HC – Hard core, SC – Soft core, OE – Open Elective

Department: **Microbiology** Course: **M.Sc Microbiology**

Paper Code	Paper and Title	Credits	No of Hours/ week Theory/ Practical	Duration of Exam (SEE)	Marks		Total
					Internal 25	SEE 75	
HCT 1.1	Fundamentals of Microbiology	4	4	3	25	75	100
HCT 1.2	Cell Biology and Biochemistry	4	4	3	25	75	100
HCT 1.3	Bacteriology	4	4	3	25	75	100
SCT 1.4	Virology and Mycology	4	4	3	25	75	100
	Practical Based on paper 1.1	2	4	3	15	35	50
	Practical Based on paper 1.2	2	4	3	15	35	50
	Practical Based on paper 1.3	2	4	3	15	35	50
	Practical Based on paper 1.4	2	4	3	15	35	50
MICHCT21	Microbial Physiology and Metabolism	4	4	3	25	75	100
MICHCT32	Microbial Genetics and Molecular Biology	4	4	3	25	75	100
MICSCT21	Environmental Microbiology (A)	4	4	3	25	75	100
	Biophysics, Biostatistics and Bioinformatics (B)	4	4	3	25	75	100
MICOET21	Microbes in Human Welfare	2	2	2	15	35	50
	Practical Based on paper 2.1	2	4	3	15	35	50
	Practical Based on paper 2.2	2	4	3	15	35	50
	Practical Based on paper 2.3	2	4	3	15	35	50
MICHCT31	Recombinant DNA Technology	4	4	3	25	75	100
MICHCT32	Immunology and Immuno-technology	4	4	3	25	75	100
MICSCT33	Food and Dairy Microbiology (A)	4	4	3	25	75	100
	Microbial Enzymology (B)	4	4	3	25	75	100
MICOET31	Microbes and Environment	2	2	2	15	35	50
	Practical Based on paper 3.1	2	4	3	15	35	50
	Practical Based on paper 3.2	2	4	3	15	35	50
	Practical Based on paper 3.3	2	4	3	15	35	50
MICHCT4.1	Fermentation Technology and Bioprocess Engineering	4	4	3	25	75	100
MICHCT4.2	Medical Microbiology and Diagnostics	4	4	3	25	75	100
	Internship/Project – Dissertation	4	4	3	25	75	100
MICSCT4.1	Agricultural Microbiology	4	4	3	25	75	100
	Practical Based on paper 4.1	2	4	3	15	35	50
	Practical Based on paper 4.2	2	4	3	15	35	50
	Project colloquium and Viva	2	4	3	15	35	50
	Practical Based on paper 4.4	2	4	3	15	35	50

INTERNAL ASSEMENT PARAMETERS

I-IA TEST	II-IA TEST	ATTENDANCE REPORT	TOTAL
11 Marks	11 Marks	3 Marks 75-85% -->1 Mark 85-95% -->2 Marks Above 95% -->3 Marks	25 Marks

Program Specific Outcome for M.Sc. Microbiology:

PSO-1 In depth understanding of basic and applied aspects of microbiology and develop inclination towards own professional goals over a wide range of career options expanding from R&D, Industrial or Govt. sector or as an Entrepreneur.
PSO-2 To independently be able to formulate research projects on microbiology and allied interdisciplinary or multidisciplinary fields through literature search, finding research gaps and framing objectives in order to strive for innovation.
PSO-3 Uphold the responsibility as a global citizen maintaining professional and ethical values and ability to upgrade knowledge independently and act upon means of improvement for lifelong learning.

Paper – 1.1 HC: Fundamentals of Microbiology

1.	Historical Development and Major Milestones: Origin and Evolution of Microorganisms; Theories of Spontaneous generation; Biogenesis and Germ theory of disease; Contributions of Antonie van Leeuwenhoek, Edward Jenner, Joseph Lister, Louis Pasteur and Robert Koch. Microorganisms: Major groups of microorganisms; General characteristics of major groups of microorganisms; Types of Prokaryotes and Eukaryotes; comparative account of Prokaryotes and Eukaryotes; General structure and functions of cell membrane, membrane bound organelles and cell organelles.	**12 h**
2.	Distribution of Microorganisms: Distribution of microorganisms in soil, air and water; Ubiquitous nature of microorganisms. Microscopy: Working principle, construction and operation of different types- simple, compound, Phase contrast, Fluorescent and Electron microscopes. Sterilization and Disinfection: Principles, Types and techniques. Physical, Chemical, Radiation and Mechanical methods.	**12 h**
3.	Microbiological Media: Components, Preparations and Types-Basal, Special, Differential, Indicator, Enriched and Transport media. Pure culture techniques: Isolation of different microorganisms from different environments. Sample collection, preservation and enrichment. Different methods of isolation-pour plate, spread plate, serial dilution.	**12 h**
4.	Maintenance and Preservation of microbial cultures: Slant culture, stab culture, soil culture, mineral oil overlaying and glycerol preservation. Lyophilzation. Type culture collection centres-Indian and global-ATCC, MTCC and NCIM etc. Types and nature of Stains: Simple, Differential and Gram's staining. Identification and nomenclature of microorganisms: Different schemes of identification and phylogenetic relationships.	**12 h**

5.	Working principle and operation of instruments used in microbiology laboratory- Autoclave, Laminar air flow system, Incubator, pH meter, Spectrophotometer, Electrophoretic Unit, Centrifuge, Chromatography, X-ray diffraction crystallography; NMR and Mass spectroscopy. Safety measures of microbiological laboratory, Levels of laboratory and good laboratory practices.	**12 h**

After successful completion of this course students are expected to be able to:

CO-1: Understand the origin and evolution of microorganisms, theories of spontaneous generation, biogenesis, and germ theory of disease.

CO-2: Describe the contributions of Antonie van Leeuwenhoek, Edward Jenner, Joseph Lister, Louis Pasteur, and Robert Koch to microbiology.

CO-3: Compare and contrast prokaryotes and eukaryotes in terms of their general structure and functions of cell membrane, membrane-bound organelles, and cell organelles.

CO-4: Explain the distribution of microorganisms in soil, air, and water and their ubiquitous nature.

CO-5: Describe the working principle, construction, and operation of different types of microscopes such as simple, compound, phase contrast, fluorescent, and electron microscopes.

CO-6: Demonstrate pure culture techniques such as isolation of different microorganisms from different environments using sample collection, preservation, enrichment methods such as pour plate method, spread plate method or serial dilution method.

CO-7: Identify different types and nature of stains such as simple stain, differential stain or Gram's stain.

Prescribed Books:

1. Booth, C. (2019). Methods in microbiology (5th ed.). Elsevier.
2. Pingond, A. (2019). Biochemical methods (3rd ed.). Wiley VCH Publ.
3. Pommerville, J. C. (2021). Fundamentals of microbiology (2nd ed.). Bartlett Series.
4. Stanier, R. Y., Adelberg, E. A., & Ingraham, J. L. (1976). General microbiology (4th ed.). MacMillan Publ.
5. Lammert, J. M. (2019). Techniques in microbiology: A student handbook (2nd ed.). Pearson.
6. Madigan, M. T., Martinko, J. M., Bender, K. S., Buckley, D. H., & Stahl, D. A. (2022). Brock biology of microorganisms (16th ed.). Pearson.
7. Atlas, R. M., & Bartha, R. (1998). Microbial ecology: Fundamentals and applications (4th ed.). Benjamin Cummings.
8. Pelczar Jr., M.J., Chan, E.C.S., & Krieg, N.R.(1986). Microbiology: Concepts and applications (2nd ed.). McGraw Hill Book Co.
9. Davis, B.D., Dulbecco, R., Eisen, H.N., & Ginsberg, H.S.(1990). Microbiology Vol I &II(4th ed.). Himalaya Publ.
10. Cappuccino, J.G., & Sherman, N.(2019). Microbiology: A Laboratory Manual(12th ed.). Pearson Education Inc.

Reference Books:

1. Tortora, G. J., Funke, B. R., & Case, C. L. (2016). Microbiology: An Introduction. Pearson.
2. Engelkirk, P., & Burton, G. (2019). Microbiology for the Healthcare Professional. Jones & Bartlett Learning.
3. Prescott, L. M., Harley, J. P., & Klein, D. A. (2017). Microbiology. McGraw-Hill Education.

Digital References/ Study material:

https://archive.nptel.ac.in/course.html
https://archive.nptel.ac.in/courses/102/103/102103015/
https://onlinecourses.swayam2.ac.in/cec19_bt11/preview

Practical Based on paper 1.1 Fundamentals of Microbiology

1. Safety Measures in Microbiology laboratory
2. Microscopy – Compound, Dark field, Phase contrast, Fluorescent, Electron, (SEM and TEM).
3. Sterilization technique – physical methods and chemical methods.
4. Preparation of media and stains for microbial work.

5. Preparation of culture media – broth, semisolid, and solid media.
6. Study of Instruments – Autoclave, Hot air Oven, Incubator, Laminar airflow, Centrifuge, pH meter, Colorimeter, Spectrophotometer.
7. Isolation of different groups of microorganisms by various methods
   a. Isolation of pure culture microorganism and cultivation
   b. Isolation and enumeration of microorganisms by serial; dilution methods.
8. Calibration of Microscope and Micrometry
9. Staining of different groups of microorganisms-
   a. Simple and Negative Staining
   b. Differential staining – Gram staining. Acid fast staining,
   c. Structural Staining - flagellar staining, Endospore staining, capsule staining and cell wall staining
10. Camera Lucida
11. Study of motility of cells by hanging drop technique
12. Effect Temperature and pH on growth curve of bacteria (*E.coli*)

1.2 HC CELL BIOLOGY AND BIOCHEMISTRY	
Course Credits: 4	**Total No. of Hours: 60** **No. of Teaching Hours per Week: 4 Hrs**

Unit 1: a) Evolution of cell: **10 Hrs**

Cell as a unit of living organism, Cell organelles, structure of prokaryotic cell,\Cell cycle in bacteria, fungi and eukaryotes, endosymbiotic theory. Plasma membrane: structure and organization of plasma membrane, models if plasma membrane, membrane structure and transport mechanisms; membrane channels and pumps. cell signalling and signal transduction pathways; Molecular motors.

b) Bio-molecules **10 Hrs**

Chemical and physical foundations of biomolecules, water, water as solvent, theories of acids, bases and buffers, Stanley Miller experiment

Amino acids: Classification, chemical reactions and physical properties; biosynthesis and catabolism; principles of thermodynamics; Bioenergetics and energy metabolism in cells.

Unit 2: Nucleotides, lipids and carbohydrates **10 Hrs**

Chemistry of carbohydrates: Definition, Classification, Structure and general properties, inter conversion of monosaccharide's. Importance and properties of glucose; Disaccharides fructose, sucrose, lactose, maltose; Polysaccharides starch, celluolose, dextrins, hemicellulose, gellans, pulluans, lignins, agar and bacterial cell wall polysaccharides.

Nucleotides; biosynthesis and catabolism Classification, structure and function; synthesis and oxidation of fatty acids Vitamins; structure and functions.

Unit 3: a) Protein **08 Hrs**

Proteins Qualitative detection methods of protein structure of protein chemical reaction, classification.

b) Lipids: Properties classification, chemical reaction detection methods

Unit –4: Enzymes: **10 Hrs**

Classification, nomenclature, general properties principles of catalytic power and specificity of enzymes, kinetics, coenzymes, activator inhibitors, isoenzymes, multi-enzyme complex, allosteric enzymes, mechanism of enzyme action.

Unit -5: Biochemical techniques: **12 Hrs**

a. Centrifugation techniques: Basic principles of sedimentation. Methods and applications of density-gradient centrifugation, preparative centrifugation, ultracentrifugation.

b. Chromatographic techniques: General principles and techniques. Methods and applications of paper chromatography, thin-layer chromatography, exclusion

chromatography affinity chromatography, ion-exchange chromatography, HPLC, Gas- liquid chromatography. MALDI-TOF, LC-MS/MS.

c. Electrophoretic techniques: General principles and applications of electrophoresis and isoelectric focusing.

d. Spectroscopic techniques: General and laws of radiation, colorimetry, ultraviolet-visible spectrophotometry.

e. Radio isotopic techniques: General principles, nature of radio activity, detection and measurement of radioactivity, applications of radioisotopes in biological investigation.

Course Outcome for M.Sc. Microbiology:

After successful completion of this course students are expected to be able to:

CO-1 Overview of major biomolecules –carbohydrates, lipids, proteins, amino acids, nucleic acids, classification, structure, function of the above mentioned biomolecules

CO-2 Describe the concepts of electrolytes and electrolytic dissociation, pH and its biological significance, buffers, Henderson-Hasselbalch equation, biological buffer systems and their importance.

CO-3 Understanding the laws of thermodynamics, concepts of entropy, enthalpy and free energy changes and their application to biological systems and various biochemical studies and reactions.

CO-4 Conceptual knowledge of aerobic and anaerobic respiration and various intermediary mechanisms involved, oxidative phosphorylation properties, structure, function of enzymes, Application of enzymes in large scale industrial processes.

References:

1. Stryer, L. (2022). Biochemistry (9th ed.). W. H. Freeman & Co.
2. Nelson, D. L., & Cox, M. M. (2022). Lehninger Principles of Biochemistry (8th ed.). W. H. Freeman & Co.
3. Moat, A. G., Foster, J. W., & Spector, M. P. (2022). Microbial Physiology (5th ed.). Wiley-Blackwell.
4. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2021). Molecular Biology of the Cell (7th ed.). Garland Science.
5. Karp, G. (2019). Cell and Molecular Biology: Concepts and Experiments (8th ed.). Wiley.
6. De Robertis, E. M., & De Robertis, E. M. F. (2019). Cell and Molecular Biology (11th ed.). Oxford University Press.
7. Lodish, H., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, D., & Darnell Jr., J. E. (2016). Molecular Cell Biology (8th ed.). W.H.Freeman.

Practical Based on paper 1.2 Cell Biology and Biochemistry

1. Cell count using haemocytometer
2. Preparations of temporary mount and study the different stages of Mitosis (Onion root tip).
3. Study of meiosis in onion flower buds.
4. Depicting nature of cellular membranes: Osmosis, Hypertonicity, Hypotonicity, Isotonicity
5. Instrumentation: Spectrophotometer, Electrophoresis, Centrifuges, Micropipettes, Chromatographic techniques: Column, HPLC, GLC, GC-MS and NMR.
6. Demonstration of Beer-Lambert's Law.
7. Determination of pH using Indicators.
8. Determination of pKa value of acetate buffer.
9. Titration of strong acid with strong base.
10. Titration of weak acid and weak base.
11. Titration of mixture of strong and weak acids.
12. Titration curves of amino acids.
13. Separation of amino acids from thin layer chromatography

Paper-1.3 HC: Bacteriology

1.	Introduction: Origin, Discovery and Evolution of Bacteria. Morphology and ultrastructure 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 and phycobilisomes, bacterial nucleic acids and genome organization.	**12 h**
2.	Principles, mechanism, method and types of differential staining: Acid fast staining, Vital staining, negative staining, capsule, cell wall, endospore, inclusion bodies and flagella staining. Bacterial systematic: classification systems, major characteristics used, nucleic acid, serology, chemical composition and phylogenetic mode of classification. Use of catabolic and anabolic keys. Numerical Taxonomy, cluster analysis and construction of taxonomy groups based on dendrograms and similarity matrix. International codes, rules, recommendations, construction of names in bacterial nomenclature and its role in taxonomy. Diagnostic procedures, keys and schemes. Salient features of Bergy's Manual of Systematic Bacteriology; Characteristics of major groups of bacteria.	**12 h**
3	Reproduction in bacteria: Binary cell division, septum formation, planes of cell division, other forms of bacterial reproduction control of cell division. Bacterial endospore: Spore forming bacteria-formation, properties and germination of endospores, induction of endospore formation. Archaebacteria: General characteristics and classification; Extremophilic nature; Type studies - adaptations, role of archaebacteria in the evolution of microbial world and their economic importance.	**12 h**
4	General characteristics, classification, diversity, distribution and economic importance of Actinobacteria and Cyanobacteria. Bioluminescent bacteria: Characteristics and examples, mechanism of bioluminescence, applications. Mycoplasma: General characteristics and examples, growth and multiplication, their significance.	**12 h**
5	Rickettsia and Chlamydia: General characteristics and examples, life cycle, growth and multiplication, their significance. Diversity of bacteria: Concept, Significance and conservation of biodiversity; Methods of assessing bacterial diversity, Culturable and non-culturable bacteria	**12 h**

After successful completion of this course students are expected to be able to:

CO-1:Understand the basic concepts of microbial diversity and how the microbe concept emerged.

CO-2:Understand the structural similarities and differences among various physiological groups of bacteria/archaea.

CO-3:Understand the methods of assessing bacterial diversity.

Prescribed Books:

1. Frost, W. D., &McCampbell, E. F. (2010). Textbook of general bacteriology (2nd ed.). Bibliobazaar.
2. Woodford, N., & Johnson, A. P. (2013). Molecular bacteriology (1st ed.). Springer.
3. Struthers, J. K., &Westram, R. P. (2018). Clinical bacteriology (2nd ed.). Manson Publishing Ltd.

4. Holt, J. G., Krieg, N. R., Sneath, P. H. A., Staley, J. T., & Williams, S. T. (Eds.). (1994). Bergey's manual of determinative bacteriology (9th ed.). Lippincott Williams & Wilkins.
5. Salle, A. J. (1974). Fundamental principles of bacteriology (1st ed.). Tata McGraw Hill Education.
6. Gillespie, S. H., &Hawkey, P. M. (2018). Principles and practice of clinical bacteriology (2nd ed.). John Wiley & Sons.
7. Meynell, G. G., & Meynell, E. (2000). Theory and practice of experimental bacteriology (2nd ed.). Cambridge University Press.
8. Hawkey, P., & Lewis, D. (1990). Medical bacteriology (1st ed.). Oxford University Press.
9. Krieg, N.R., Staley, J.T., Brown, D.R., Hedlund, B.P., Paster, B.J., Ward, N.L., Ludwig,W., &Whitman,W.B.(Eds.).(2010). Bergey's manual of systematic bacteriology: Volume 3: The Firmicutes (2nd ed.). Springer.
10. Madigan, M.T., Martinko,J.M., Bender,K.S., Buckley,D.H., &Stahl,D.A.(2015). Brock biology of microorganisms (14th ed.). Pearson Education Inc.

Reference Books:

1. Mahon, C. R., Lehman, D. C., &Manuselis, G. (2014). *Textbook of diagnostic microbiology* (5th ed.). Saunders
2. Murray, P. R., Rosenthal, K. S., &Pfaller, M. A. (2015). *Medical microbiology* (8th ed.). Elsevier/Mosby
3. Brooks, G. F., Carroll, K. C., Butel, J. S., & Morse, S. A. (2013). *Jawetz, Melnick &Adelberg's medical microbiology* (26th ed.). McGraw-Hill Medical

Practical Based on paper 1.3 Bacteriology

1. Isolation of microorganism: Serial dilution, pure culture techniques
2. Isolation of antibiotic producing microorganisms from soil and determination of the antimicrobial spectrum of the isolates.
3. Isolation of enzyme producing microorganisms from soil
4. Culturing and cultural characteristics of microorganisms:
5. Autotrophic - Benecks broth, Chu's medium
6. Heterotrophic- Nutrient agar, glucose peptone media
7. Selective - MRS, actinomycetes agar
8. Enriched - Dorsetts egg growth medium, chocolate agar
9. Differential - MacConkey, Blood agar, EMB, DCA
10. Staining techniques: Simple, Differential: acid-fast, endospore, capsule, cell wall, cytoplasmic inclusion vital stains: flagella, spore and nuclear staining.
11. Biochemical tests for identification of Bacteria: Catalase, oxidase, IMViC, motility, gelatinace test, urease, levan formed from glucose, H_2S in TSIA and lead acetate paper, coagulase, optochin sensitivity, lecithinase, nitrate reduction, acid and gas from Carbohydrates (glucose, arabinose, inosital, lactose, maltose, mannitol, rhamnose, salicin, trehalose, sucrose, xylose, fructose), ONPG acid, hippurate hydrolysis, chitin, starch, casein, Tween 80 hydrolysis, pectin, arginine hydrolysis, lysine decarboxylase, ornithine, esculin hydrolysis. Identification of bacteria by API system.
12. Bacterial growth measurement (cell count, turbidometry, plate count) 12. Isolation of bacteriophages from sewage

Paper-1.4 SC: Virology and Mycology

1.	Introduction to Virology: History, origin, development and evolution of viruses. General structure of viruses: configuration and symmetry- helical and icosahedra; Physical and chemical components - capsomere, capsid, matrix and envelop; Viral genome, nucleoprotein organization, multiplication of viral genomes, one step growth. Isolation, purification and cultivation of viruses, Detection of viruses- physical, biological, immunological and molecular methods. Taxonomy of viruses: Salient features of viral classification- Baltimore classification of viruses, ICTV classification of viruses,	**12 h**

2.	Phages: Bacteriophages, cyanophages, mycophages and phycophages-General characteristics, isolation, identification and cultivation, replication of phages, classification significance and applications. Plant viruses: General characteristics; Isolation, identification, cultivation classification; Translocation and distribution of viruses in plants; different modes of transmission of plant viruses -Structure and life cycle of some important plant viruses; Type studies and significance of plant viruses.	**12 h**
3.	Animal viruses: General characteristics; Isolation, Identification and cultivation and Classification; Dissemination of animal viruses - direct and indirect contacts, through vectors; zoonotic infections, Structure and life cycle of some of the important animal viruses; Type studies and significance of animal viruses. Oncogenic viruses: Definition, general characters, types, transmission, propagation, and mechanism of cell transmission. Sub viral particles; characteristics and their significances: satellite virus, satellite RNA Prions, and viriods.	**12 h**
4.	Introduction to Mycology: General characteristics of fungi and classification of fungi with distinguishing characteristics up to class level, distribution of fungi. Fungal structure: 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 (apical growth, enzyme secretion, defense of territory).	**12 h**
5.	Reproduction in fungi: Vegetative reproduction- fragmentation, fission, budding, spawns, sclerotia, rhizomorphs; Asexual reproduction- endospores, conidia, oidia, chlamydospores, pycniospores, ascospores, basidiospores, uredospores and telutospores; Sexual reproduction - planogametic copulation, gametangialcontact, gametangial copulation, spermatogamy, somatogamy; reduction of sex in fungi. Diversity, taxomony and Economic importance of fungi: Life cycle of economically important yeasts, molds, Mycorrhiza and Lichens.	**12 h**

After successful completion of this course students are expected to be able to:

CO-1: Understand the structure, characteristics, and classification of viruses and fungi.

CO-2: Describe the characteristics and diseases caused by pathogenic viruses and fungi.

CO-3: Understand basic laboratory techniques in mycology, isolate fungus from clinical samples for disease diagnosis, understand different methods of virus cultivation, and understand collection, transportation, and preservation methods of clinical specimens.

Reference Books:

1. Benson's Microbiological Application: Lab Manual in General Microbiology by A.E. Brown (15th ed.). (2022). McGraw Hill
2. Jawetz's Medical Microbiology by GF Brooks (28th ed.). (2020). McGraw Hill
3. Fraenkel-Contrat H. edited; Virology (2nd ed.). (2019). Academic Press
4. AnejaK.R., Experiments in Microbiology (6th ed.). (2017). New Age International
5. Cappuccino Sherman's Microbiology- A Laboratory Manual (12th ed.). (2016). Pearson Education India
6. Topley and Wilson's Microbiology and Microbial infections, Vol-2: Virology (10th ed.). (2010). Wiley-Blackwell
7. Dubey RC & Maheshwari DK, Practical Microbiology (3rd ed.). (2011). S Chand & Co Ltd
8. Mathuew's Plant Virology by Roger Hull (5th ed.). (2020). Academic Press, U.K
9. George Agrios; Plant pathology (6th ed.). (2005). Elsevier Academic Press, New York.
10. Sullia SB &Shantharam S, General Microbiology (3rd Ed.). (2019). Oxford & IBH Publ., New Delhi.

Digital References/ Study material:

https://archive.nptel.ac.in/course.html
https://archive.nptel.ac.in/courses/102/103/102103015/
https://onlinecourses.swayam2.ac.in/cec19_bt11/preview

Practical Based on paper 1.4 Virology and Mycology

1. Isolation of plant viruses from sap.
2. Isolation of lipolytic microbes from soil-plate method and estimation of total lipid
3. Isolation of slime molds, fungi from water, soil, air, cereals and cereal based products.
4. Staining of fungi (Lactophenol cotton blue).
5. Isolation of fungi from plant material: Epiphytic fungi, washing method, implant method, impression method, maceration method; endophytic fungi.
6. Growth measurement of fungi- linear and biomass.
7. Effect of environmental (pH, temperature) and nutritional factors (carbon, nitrogen sources) on growth of fungi.
8. Screening for antibiotic producing microbes (antibacterial, antifungal)
9. Study of fungal metabolites
10. Measurement of concentration of fungal conidia by Haemocytometer.
11. Measurement of fungal cells by Micrometer.
12. Study of the following representative genera: *Aspergillus, Penicillium, Fusarium, Neurospora, Saccharomyces, Erysiphae, Polyporus, Agaricus, Puccinia, Ustilago, Alternaria, Drechslera, Saprolegnia, Rhizopus, Trichoderma* and symbiotic fungi-Lichens.

Paper-2.1 HC: Microbial Physiology and Metabolism

1.	Microbial Nutrition: Classification of organisms based on Carbon source, energy source and electron source, Macro and Micronutrients. Microbial growth: Phases of growth, factors influencing growth, Measurement of growth, Continuous and Synchronous growth.	**12 h**
2.	Microbial Photosynthesis: Light Energy, Photolysis of Water, Photosynthetic Pigments, Cyclic and Non-Cyclic Photophosphorylation, Calvin's Cycle. Biological Oxidation: Electron Transport System, Oxidative Phosphorylation, Mechanism and Inhibitors of oxidative phosphorylation. Energetics of Oxidative Phosphorylation.	**12 h**
3.	Fermentation Reactions: Types of fermentation reactions, Homo and Hetero-fermentation pathways; Alcohol and Lactic acid fermentation pathways. Bioenergetics: Laws of thermodynamics, Free energy, Enthalpy, Entropy, High energy compounds, Oxidations and Reductions, Redox potential. Carbohydrate metabolism: Glycolysis-significance, energetics and regulation. Glycogenesis, glycogenolysis, gluconeogenesis-Significance, regulations; TCA cycle-significance, energetics and regulations. Glyoxylate cycle. Amphibolic nature of TCA cycle. HMP shunt.	**12 h**
4.	Lipid Metabolism: Fatty acid oxidation (β-oxidation), energetics of palmitic acid oxidation. Ketone bodies, ketogenesis, utilization of ketone bodies, overproduction of ketone bodies (Ketonemia, ketonuria, ketosis), extra mitochondrial biosynthesis of long fatty acids (palmitate), significance and regulation. Synthesis of triacylglycerols, metabolism of phospholipids and glycolipids. Biosynthesis and degradation of cholesterol.	**12 h**

Model Theory QP

First Semester M.Sc. Degree Examination 2023
Microbiology
(CBCS)
1.1 HC Fundamentals of Microbiology

Time: 3 Hours Max. Marks: 75

PART A

1. Write short notes on any **TEN** of the following: **(10X2=20)**

a) ..

b) …

c) ..

d) ..

e) ..

f) ..

g) ..

h) ..

i) …

j) ..

k) ..

l) ..

PART B

Write explanatory notes on **any FIVE** of the following (not exceeding 3 pages each): **(5X5=25)**

2. ..

3. **..**

4. ..

5. ..

6. ..

7. ..

PART C

Answer **any THREE** of the following (not exceeding 5 pages each): **(3X10=30)**

8. ..

9. ..

10. ..

11. ..

12. …