Eklavya University, Damoh, MP

M.Sc. I Semester

Microbiology
Syllabus

Session 2020-21 onwards

School of Basic & Applied Science

EKLAVYA UNIVERSITY, DAMOH (M.P.)

Scheme of Examination M.Sc. (Microbiology) I Sem

For batch admitted in Academic Session 2023-24

Subject wise distribution of marks and corresponding credits

S. No.	Subject Name	Subject Code	Paper Name	Maximum Marks Allotted											Total Marks	Contact Periods Per week			Total Credits
				Theory Slot									Practical Slot						
				End Semester				Mid term Examination				Quiz/ Assignment/ Attendence	End Sem	Lab Work/ Sessional		L	T	P	
				P1	P2	P3	P4	P1	P2	P3	P4								
1	Common	MCOVI20S101	Comprehensive Viva											50	50	0	0	4	4
		MPRES20S101	Presentation											50	50	0	0	4	4
2	Microbiology	MMBIO20S101	Fundamentals of Microbiogy,Tools and Techniques (Paper- I)	30				15				5			50	3	0	0	3
		MMBIO20S102	Biochemistry (Paper- II)		30				15			5			50	3	0	0	3
		MMBIO20S103	Principles of Bioinstrumentation, Bioinformatics and Biostatistics (Paper- III)			30				15		5			50	3	0	0	3
		MMBIO20S104	Mycology and Phycology (Paper- IV)				30				15	5			50	3	0	0	3
		MMBIO20S105	Paper- I and II Practical I-Sitting (Practical - I)										30	20	50	0	0	2	2
		MMBIO20S106	Paper- III and IV Practical II- Sitting (Practical - II)										30	20	50	0	0	2	2

Induction programme of three weeks (MC): Physical activity, Creative Arts, Universal Human Values, Literary, Proficiencey Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations.

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ज्ञान प्राप्ते लक्ष्य संधानम्

School of Basic and Applied Scien

Class	M.Sc. (Microbiology)
Semester/Year	I Semester
Subject & Subject Code	Microbiology - MMBIO20S101
Paper	Fundamentals of Microbiogy,Tools and Techniques – 101
Max. Marks	30

Credit			Total Credits
L	T	P	
3	0	0	3

Course Objectives:

The candidate will gain knowledge about the structure of bacteria, fungi, algae, protozoa and viruses along with the basic principles of microscopy. Control of microbial growth by physical and chemical methods plus the use of antibiotics and their efficacy testing are emphasized. Cultivation of microbes is discussed. This course develops the concepts of research methodology involved in studying the different components of microbial cell and various techniques and instruments involved in product analysis.

Course Outcome:

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

1: Gain knowledge on various classes of microorganisms; their structure, extracellular and intracellular components, cultural characteristics and their growth conditions.

2: Know about the different parts and working mechanisms of basic light microscope electron microscopes with deep knowledge on the sample preparation and staining techniques.

3: Acquire knowledge on sterilization techniques with adequate information on sterile and aseptic conditions.

4: Know about different classes of antibiotics and their mode of actions, treatment strategies and detection of resistant forms of bacteria from clinical settings.

Student Learning Outcomes (SLO):

Students will:

1.Make observations, develop hypothesis, design and execute experiments using appropriate methods. They should be able to explain how the nature of science is applied to every day problems.

2. Laboratory Skills: Microbiology students would master the following laboratory skills: aseptic and pure culture techniques, preparation and viewing samples for microscopy, use appropriate methods to identify microorganisms, estimate the number of microorganisms in a sample, and use common lab equipment.

3.They would practice safe microbiology, using appropriate protective and emergency procedures.

4. Problem-Solving Skills: Microbiology students would be competent problem-solvers. They would be able to assess the elements of a problem and develop and test a solution based on logic and the best possible information.

5.Microbiology students would be able to analyze and interpretate results from a variety of microbiological methods, and apply these methods to analogous situations. They would use mathematical and graphing skills and reasoning to solve problems in microbiology.

6. Communication Skills: Microbiology students will demonstrate competence in written and oral communication.

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Unit	Syllabus	Periods
UNIT - I	Evolution of microbiology and its history. Scope of microbiology, Contribution of Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch, Stanley, Edward Jenner, Alexander Fleming, S.A. Waksman in development of Microbiology.	12
UNIT - II	Principle of sterilization. Physical control method of microorganisms growth. Heat, filtration and radiation. Chemical control of microorganisms: halogens, phenol and phenolic compounds, heavy metals, alcohols, ethylene oxide, aldehydes and hydrogen peroxide. Culturing of microorganisms- Nutritional requirements of microorganisms. Natural and synthetic media, defined, complex differential, selective and minimal media.	12
UNIT - III	Isolation techniques: Pour plate, spread plate, streak plate, serial dilution method and enrichment techniques. Methods of purification of Microbial cultures. Staining techniques: staining of fungi, negative staining, differential staining, Gram's staining, acid fast staining, spore staining, flagella staining and capsule staining. Maintenance and preservation of microbial cultures: Lyophilization, Cryopreservation and other methods.	12
UNIT - IV	Microscopy and microscopic techniques : A general knowledge of principle involved in various types of microscopy and their applications including light microscopy, dark field, phase contrast microscopy, fluorescence microscopy and electron microscopy. Principle and practice of micrometry.	12
UNIT - V	Concept of prokaryotic and eukaryotic cells. Basis of microbial classification–Morphological, Biochemical and Molecular basis. Microbial classification systems – Haeckel's three kingdom concept, Whittaker's five kingdom concept and three domain concept of Carl Woese.	12

REFERENCE BOOKS –

1. Prescot, M.J., Harley, J.P. and Klein, D.A. Microbiology. 5th Edition WCB Mc Graw Hill, New York, (2002).
2. Tortora, G.J., Funke, B.R. and Case, C.L. Microbiology: An Introduction. Pearson Education, Singapore, (2004).
3. Alcomo, I.E. Fundamentals of Microbiology. VI Edition, Jones and Bartlett Publishers. Sudbury. Massachusetts, (2001).
4. Black J.G.Microbiology-Principlesand Explorations.JohnWiley&SonsInc.NewYork, (2002).
5. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.
6. Willey,Sherwood,Woolverton. Prescott,Harley, and Klein's Microbiology McGraw-Hill publication
7. Tortora,Funke,Case. Microbiology.Pearson Benjamin Cummings.
8. JACQUELYN G. BLACK. Microbiology Principles and explorations. JOHN WILEY & SONS, INC.
9. Madigan,Martinko, Bender,Buckley,Stahl.Brock Biology of Microorganisms. Pearson
10. Tom Besty,D.C Jim Koegh.Microbiology Demystified McGR

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School of Basic And Applied Sciences

Class	M.Sc. (Microbiology)
Semester/Year	I Semester
Subject & Subject Code	Microbiology - MMBIO20S102
Paper	Biochemistry – 102
Max. Marks	30

Credit			Total Credits
L	T	P	
3	0	0	3

Course Objectives:

This course deals with characteristics, properties and biological significance of the biomolecules of life. In depth knowledge of the energetic and regulation of different metabolic processes in microorganisms. From this course the students will know the structure-function relationship of these molecules found in microbial cell and their importance with regard to maintenance and perpetuation of the living systems.

Course Outcome:

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

1. Developed a very good understanding of various biomolecules which are required for development and functioning of a cell.
2. Developed knowladge about how the carbohydrates make the structural and functional components such as energy generation and as storage food molecules for the cells
3. Well conversant about multifarious function of proteins; are able to calculate enzyme activity and other quantitative and qualitative parameters of enzyme kinetics; also knowledge about lipids and nucleic acids.
4. Student are able to make buffers, study enzyme kinetics and calculate Vmax, Km, Kcat values.

Student Learning Outcomes (SLO):

Students will:

1.Be able to describe a standard carbohydrate and the different bonding patterns that lead to different attributes or uses.
2.Be able to describe the four classes of lipids and how each is used in a biological system.
3.Be able to explain how protein denaturation is performed, describe the structure-function relationship of a protein, and how this relates to the ability to catalyze reactions as an enzyme.
4.Describe the "Central Dogma of Biology."
5.Describe how are nucleic acids replicated.
6.Elaborate on the relationship between the primary sequence of DNA and the primary sequence of proteins, and explain what a gene or genome are.

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Unit	Syllabus	Perio
UNIT - I	**Carbohydrates :** Classification, structure, properties and functions. Homo and Hetero- polysaccharides. : Storage polysaccharides Starch and cellulose. **Amino Acids :** Classification, synthesis, structure and properties. **Proteins:** classification, synthesis, structure and properties. Structural and functional proteins. **Lipids :** Classification, structure and properties of fatty acids, triacylglycerols, phospholipids, wax, sterols, terpenes and prostglandins. Biological functions of lipids and lipoproteins.	12
UNIT - II	**Nucleic Acids:** Structure and synthesis of purines and pyrimidines. Nucleosides, Nucleotides. **DNA and RNA :** Structure, properties, synthesis and processing. Central Dogma, Concept of genes and their regulation. Operon concept, Role of CAP and cAMP.	12
UNIT - III	**Enzymes :** Classification, Mechanism of enzyme action. Constitutive and inducible enzymes. **Enzyme Kinetics:** Michalis- Menten Kinetics and Lineweaver –Burke plot. Regulation of enzyme synthesis, Repression. Factors affecting enzyme activity. Enzyme Inhibition. Reversible and Irreversible. Allosterism. Basic concepts of Vitamins. Hormones and Coenzymes.	12
UNIT - IV	**Metabolic pathways and their regulation :** Glycolysis, Gluconeogenesis, Citric Acid cycle. Anaerobic respiration. Oxidative phosphorylation, Respiratory chain complexes. Glycogen metabolism. **Fatty acid oxidation:** α and β pathways. Protein turnover and amino acid catabolism. Biosynthesis of amino acids, nucleotides and membrane lipids.	12
UNIT - V	**Transport of Molecules :** Active and passive diffusion. Membrane proteins. Cell Junctions, Signal transduction. **Bioenergetics :** Transduction and storage of energy. ATP generation. Metabolic coupling. Nitrogen Metabolism. Transamination and deamination reactions.	12

REFERENCE BOOKS –

1. Tortora, G.J., Funke, B.R and Case, C.L. Microbiology: An Introduction. Pearson Education, Singapore, (2004).
2. Stanbury, Biochemistry
3. Voet.Fundamentals of biochemistry Wiley
4. M.M. Cox, D. L. Nelson.Lehninger's principles of biochemistry. W H Freeman
5. Stryer. Biochemistry W H Freeman
6. Biochemistry, D Freifilder, W.H. freeman and company
7. Laboratory techniques in biochemistry and molecular biology, Work and Work
8. A Biologists guide to principles and techniques of practical biochemistry, K.W. KH Caulding, ELBS edition, 1986

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School of Basic and Applied Sciences

Class	M.Sc. (Microbiology)
Semester/Year	I Semester
Subject & Subject Code	Microbiology - MMBIO20S103
Paper	Principles of Bioinstrumentation, Bioinformatics and Biostatistics – 103
Max. Marks	30

Credit			Total Credits
L	T	P	
3	0	0	3

Course Objectives:

Discuss the applications of biophysics and principle involved in bioinstruments .Describe the methodology involved in biotechniques .Describe the applications of bioinstrumentsThe course is aimed at introducing the students to the field of Bioinformatics and enable them understand the concepts of statistics in biology.To impart practical exposure upon Bioinformatics toole and data bases.

Course Outcome:

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

1.Recall and differentiate absorption and emission spectra. Identify the application of each region of EM spectrum for spectroscopy.
2.Recall and explain the techniques and underlying theory of UV- Visible, IR, NMR
3.Get introduced to the basic concepts of Bioinformatics and its significance in Biological data analysis.
4. Describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics.
5. Explain about the methods to characterise and manage the different types of Biological data.
6.Classify different types of Biological Databases.
7.Introduction to the basics of sequence alignment and analysis.
Overview about biological macromolecular structures and structure prediction methods.

Student Learning Outcomes (SLO):

At the end of course the students shall

1. Explain the electro-analytical techniques and spectroscopic techniques.
2. Describe the application and methodology involved in different types of chromatographic techniques.
3. Explain the principle involved in electrophoresis.
4. Know the theory behind fundamental bioinformatics analysis methods.
5. Be familiar with widely used bioinformatics databases.
6. Know basic concepts of probability and statistics.
7. Be able to describe statistical methods and probability distributions relevant for molecular biology data.

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Unit	Syllabus	Periods
UNIT - I	Principle of Spectrophotometry.NMR mass spectroscopy their applications. Principle,working and applications of DNA sequencer, Freeze Drying, Thermal cyclers (Real Time PCR), Microplate reader, Fluorimeter, Filtration systems. Principle and application of centrifuge and methods of isolation of cellular fractions of cell.	12
UNIT - II	Chromatographic techniques : types and uses of paper chromatography, thin layer chromatography, column chromatography, HPLC. Electrophoresis, their application in identification and purification of micro molecules such as protein and enzyme.	12
UNIT - III	History and Development of Bioinformatics; Biological information resources and data mining, data characteristics and presentation. Molecular databases (Sequence and structural); database searching (keyword and sequence homology searching using BLAST and FASTA) . Software for identification of microorganisms: PIVWIN, Biologue.	12
UNIT - IV	Computational Methods : Gene identification methods; data mining (Genome databases) and phylogenetic analysis; Predictive methods using nucleic acids and protein sequences. Gene identification; Programmes for sequence comparison and analysis. Bioinformatics software; Molecular structure drawing tool (Chemdraw) Application of Clustal W; OLIGO; Molecular modeling/ Docking (CA Che); Introduction to SQL (Sequence Query Language)	12
UNIT - V	Biostatics: Mean median and mode. Standard error, standard deviation. Dispersion. Basic idea of probability, Sampling methods, chi-square test and analysis of variance, Exponential and logarithmic functions.	12

REFERENCE BOOKS –

1. Mount D., Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press, New York. (2004).
2. Baxevanis, A.D. and Francis Ouellellette, B.F., Bioinformatics- A Practical Guide to the Analysis of Genes and Proteins. Wiley India Pvt Ltd. (2009). 3. Teresa K. Attwood, David J. Parry-Smith, Introduction to Bioinformatics. Pearson Education. (1999).
4. Jean-michel Claverie Cedric Notredame. Bioinformatics for Dummies. Publisher: Dummies (2007).
5. Arthur M. Lesk.Introduction to bioinformatics. Oxford University Press.(2004)
6. Dan E. Krane and Michael L. Raymer Fundamental Concepts of Bioinformatics (2002)
7. KRANE .Fundamental Concepts of Bioinformatics, (2003)
8. Teresa Attwood.Introduction to Bioinformatics . (2007)

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School of Basic and Applied Sciences

Class	M.Sc. (Microbiology)
Semester/Year	I Semester
Subject & Subject Code	Microbiology - MMBIO20S104
Paper	Mycology and Phycology – 104
Max. Marks	30

Credit			Total Credits
L	T	P	
3	0	0	3

Course Objectives: This course deals with detailed classification and identification of fungi and algae. Fungal and algal ecology in terrestrial, aquatic and extreme habitats . Applications of fungal enzymes and various primary and secondary metabolites.Applications of algae.

Course Outcome:

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

1. Describe useful and harmful activities of fungi and algae.
2. Identify commonly available fungi and algae and their characteristics.
3. Discuss how fungi and algae are used as biofertilizers in agriculture and as biopesticides.
4. Grow mushroom in the laboratory

Student Learning Outcomes (SLO):

Students will:

1. Apply the knowledge in fungal taxonomy, bioremediation and bioprospecting of secondary metabolites and industrially important fungal enzymes.
2. Demonstrate skills in laboratory, field and glasshouse work related to mycology and phycology.
3. Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies.
4. Learn importance of biofertilizer learn importance of microbiological production, single cell protein and algal biotechnology.

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Unit	Syllabus	Periods
UNIT - I	History and development of mycology. Structure and cell differentiation in fungi. General Characteristics of Slime moulds, Zoosporic fungi (Chytridiomycota. Hyphochytridiomycota, Oomycota) Zygomycetes and Trichomycetes. Life cycle of Stemonites, Synchytrium, Phytophthora, Rhizopus.	12
UNIT - II	General characteristics of Ascomycetes and Endomycetes. General Characteristics of yeast and filamentous ascomycetes (Loculoascomycetes, Pyrenomycetes,Discomycetes and Plectomycetes) General Characteristics of Uredinales ustilaginales and Agaricales. Life cycle of Saccharomyces, Penicillum, Aspergillus, Neurospora, Puccinia, Ustilago, Agaricus , Pleurotus .	12
UNIT - III	Heterothallism in fungi, Lichens: (ascolichens, basidiolichens, deuterolichens) General characteristics and classification of Deuteromycetes. Morphological features of Alternaria, Curvularia, Helminthosporium, Fusarium, Humicola and Microsporum.	12
UNIT - IV	Classification of algae, algal nutrition, morphological variation and features of reproduction. Characteristic features of different groups of algae (green algae, diatoms, Euglenoids, brown and red algae). Algal ecology and algal biotechnology.	12
UNIT - V	Importance of blue green algae as biofertilizers. Algae as food and fodder, Algal blooms and their remediation. Algae as source of single cell protein- Chlorella, Spirulina, Algal toxicity.	12

REFERENCE BOOKS –

1. Alexopoulus, C.J., Mims,C.W. and Blackwel, M, Introductory Mycology. John Wiley, New York.
2. Mehrotra, R.S. and K.R.Aneja An Introduction to Mycology. New Age InternationalB Press, New Delhi.
3. Webster, J. Introduction to fungi. Cambridge University Press. Cambridge, U.K. (1985).
4. Bessey E.A. Morphology and Taxonomy of fungi. Vikas Publishing House Pvt. Ltd., New Delhi.
5. Jhon Webster and R W S Weber. Introduction to Fungi. Cambridge University Press 2007.
6. A. V. S. S. .Sambamurty. A Textbook of Algae. I.K. International Publishing House Pvt. Limited, 2010
7. H.D. Kumar and H.N. Singh.A Textbook on Algae (Macmillan international college edition)

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School of Basic and Applied Sciences

Class	M.Sc. (Microbiology)				
Semester/Year	I Semester				
Subject & Subject Code	Practical Microbiology - MMBIO20S105				
Paper	Paper- I and II, Practical- I Sitting	L	T	P	Total C.
Max. Marks	50= (30+20)	0	0	2	2

PRACTICALS

1 Microbiology Laboratory rules : Basic rules of a microbiology Laboratory.

2 Basic Requirements of a microbiology laboratory: common glassware, Cleaning of glassware.

3 Tools in microbiology laboratory, Disposal of Laboratory wastes and culture.

4 Sterilization Techniques of glass wares.

5 Preparation of culture media : Solid / liquid.

6 Isolation techniques: Streak plate method, pour plate method, spread plate method and serial dilution agar plate method.

7 Isolation of microorganisms (Bacteria, Fungi, Actinomycetes) from soils and their enumeration using serial dilution method.

8 Isolation of bacteria from water/waste water and their enumeration.

9 Staining Technique of fungi and simple and differential staining of bacteria including Gram's staining, spore staining, flagella staining and capsule staining.

10 Microscopy and Micrometry of fungal propagules and camera Lucida drawing of morphological features of fungi.

11 Method of culture preservation and maintenance.

12 Perform Slide Culture Technique.

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School of Basic and Applied Sciences

Class	M.Sc. (Microbiology)				
Semester/Year	I Semester				
Subject & Subject Code	Practical Microbiology - MMBIO20S106				
Paper	Paper- III and IV, Practical- II Sitting	L	T	P	Total C.
Max. Marks	50= (30+20)	0	0	2	2

PRACTICALS

1 Isolation of aquatic fungi using bait technique.

2 Purification of cultures using hyphal tip method/serial dilution method.

3 Microscopic examination of fungi, cyanobacteria and eubacteria.

4 Chromatographic techniques for identification of sugar, proteins, amino acids, fatty acids.

5 Knowledge of software used in classification of microorganisms.

6 Analysis of data by statistical methods : chi-square test, variance, t-test.

7 Isolation and identification of algae from soil.

8 Quantitative estimation of sugar by (DNS) dinitrosalicylic acid reagent method.

9 Quantitative estimation of protein by Lowry's method.

10 Purification of protein through electrophoresis.

11 Experiments on calculation of mean/median/mode of the experimental data.

12 Experiments on cultivation of edible mushrooms.

13 Identification of actinomycetes using probabilistic identification of bacteria (PIB) Win software.

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Eklavya University, Damoh, MP

M.Sc. II Semester

Microbiology
Syllabus

Session 2020-21 onwards

School of Basic & Applied Science

EKLAVYA UNIVERSITY, DAMOH (M.P.)

Scheme of Examination M.Sc. (Microbiology) II Semester

For batch admitted in Academic Session 2023-24

Subject wise distribution of marks and corresponding credits

S. No.	Subject Name	Subject Code	Paper Name	Maximum Marks Allotted											Total Marks	Contact Periods Per week			Total Credits
				Theory Slot									Practical Slot						
				End Semester				Mid term Examination				Quiz/ Assignment/ Attendance	End Sem	Lab Work/ Sessional		L	T	P	
				P1	P2	P3	P4	P1	P2	P3	P4								
1	Microbiology	MMBIO20S201	Bacteriology and Virology (Paper- I)	30				15				5			50	3			3
		MMBIO20S202	Microbial Physiology (Paper- II)		30				15			5			50	3			3
		MMBIO20S203	Immunology and Medical Microbiology (Paper- III)			30				15		5			50	3			3
		MMBIO20S204	Agricultural Microbiology (Paper- IV)				30				15	5			50	3			3
		MMBIO20S205	Paper- I and II Practical I-Sitting (Practical - I)										30	20	50			2	2
		MMBIO20S206	Paper- III and IV Practical II- Sitting (Practical - II)										30	20	50			2	2

Induction programme of three weeks (MC): Physical activity, Creative Arts, Universal Human Values, Literary, Proficiencey Modules, Lectures by Eminent People, Visits to local Areas, Familiarization to Dept./Branch & Innovations.

Class	M.Sc. (Microbiology)
Semester/Year	II Semester
Subject & Subject Code	Microbiology - MMBIO20S201
Paper	Bacteriology and Virology – 201
Max. Marks	30

Credit			Total Credits
L	T	P	
3	0	0	3

Course Objectives:

This course explores bacteriology- the study of bacteria that infect all types of living organisms on earth.This course explores Virology- the study of Viruses that infect all types of living organisms on earth.Study about benefical and harmful forms of life.

Course Outcome:

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

1. Describe characteristics of bacterial cells, cell organelles, cell wall composition and various appendages like capsules, flagella or pili.
2. Differentiate a large number of common bacteria by their salient characteristics; classify bacteria into groups.
3. Describe the nutritional requirements of bacteria for growth; developed knowledge and understanding that besides common bacteria there are several other microbes which grow under extreme environments.
4. Perform basic laboratory experiments to study microorganisms; methods to preserve bacteria in the laboratory; calculate generation time of growing bacteria.
5. Understood what are viruses and the chemical nature of viruses, different types of viruses infecting animals, plants and bacteria (bacteriophages)
6. Understanding about the biology of bacteriophages.
7. Gained knowledge of a variety of plant viruses and animal viruses.

Student Learning Outcomes (SLO):

Students will:

1.Understand the architecture of viruses
2.Know the methods used in studying viruses
3.Discern the replication strategies of representative viruses from the seven Baltimore classes
4.Comprehend the intricate interaction between viruses and host cells.
5.Describe characteristics of bacterial cells, cell organelles, cell wall composition and various appendages like capsules, flagella or pili.
6.Differentiate a large number of common bacteria by their salient characteristics; classify bacteria into groups.
7.Describe the nutritional requirements of bacteria for growth; developed knowledge and understanding that besides common bacteria there are several other microbes which grow under extreme environments.
8.Perform basic laboratory experiments to study microorganisms; methods to preserve bacteria in the laboratory; calculate generation time of growing bacteria.

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Unit	Syllabus	Period
UNIT - I	Identification of bacteria – cultural, biochemical and molecular basis for identification. Classification and salient features of bacteria according to Bergey's manual of determinative bacteriology. Components of Eubacteria - cell wall, cytoplasmic membrane, capsule, flagella, pili, nucleoid and other cytoplasmic inclusions. endospore, Bacterial transport system.	12
UNIT - II	Archaebacteria- Classification, Characteristic features and importance. Actinomycetes- Classification, Characteristic features and importance. Molicutes, Spirochetes, Chlamydia and Rickettsia. Recombination in bacteria- Conjugation, Transformation and Transduction.	12
UNIT - III	General morphology and ultra structure of viruses. Related viral agents: Viroids and Prions. Cultivation of viruses in embryonated eggs, experimental animals and Cell culture. Identification and Assay of viruses. Serological methods for Haemagglutination. Complement fixation, IFA, ELISA, RIA.	12
UNIT - IV	General idea of plant viruses, Animal viruses: classification and nomenclature. Life cycles of viruses: Herpes, adeno and SV 40, Picorna, orthomyxo, paramyxo and adenovirus. Oncoviruses, cell transformation.	12
UNIT - V	Bacteriophage: Classification morphology and ultrastructure with special reference to T- phages, X174, M 13 and Mu phage. One step growth curve, Lytic and lysogenic cycles of bacteriophages. Bacteriophages in applied microbiology and biotechnology.	12

REFERENCE BOOKS –

1. Prescott, M.J.,Harley,J.P.andKlein,D.A.Microbiology. 5th Edition WCB Mc Graw Hill, New York, (2002).
2. Tortora, G.J., Funke ,B.R. and Case, C.L. Microbiology : An Introduction. Pearson Education, Singapore, (2004).
3. Alcomo,I.E.FundamentalsofMicrobiology.VIEdition, JonesandBartlettPublishers.Sudbury.Massachusetts, (2001).
4. Black J.G.Microbiology-Principlesand Explorations.JohnWiley&SonsInc.NewYork, (2002).
5. Tom Besty,D.C Jim Koegh.Microbiology Demystified McGRAW-HILL.1. Pelczar M., Chan E.C.S. and Krieg, N.R. Microbiology. Tata Mc Grew Hill Publishing Co. Ltd., New Delhi.
2. Stainier R.V., Ingraham, J.L., Wheelis, M.L. and Painter P.R. The Microbial World. Printice-Hall of India (Pvt.) Ltd., New Delhi
3. Ellen Strauss, James Strauss.Viruses and Human Disease 2nd Edition. Academic Press
4. Christopher Burrell Colin Howard Frederick Murphy. Fenner and White's Medical Virology 5th Edition.Academic Press.
5. Bernard N. Fields.Fields Virology Lippincott Williams & Wilkins
6. S. Jane Flint. Principles of Virology.American Society for Microbiology.

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School of Basic and Applied Sciences

Class	M.Sc. (Microbiology)
Semester/Year	II Semester
Subject & Subject Code	Microbiology - MMBIO20S202
Paper	Microbial Physiology – 202
Max. Marks	30

Credit			Total Credits
L	T	P	
3	0	0	3

Course Objectives:

1. To learn and understand the microbial diversity in the living world.
2. To know the various physical and chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.
3. To understand, learn and gain skills of isolation, culturing and maintenance of pure culture.
4. To know various Culture media and their applications.
5. To understand microbial metabolism starting from anabolism to catabolism.

Course Outcome:

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

1. The student develops understanding of the laws of thermodynamics, concepts of entropy, enthalpy and free energy changes and their application to biological systems and various biochemical studies and reactions.
2. Conceptual knowledge of aerobic and anaerobic respiration and various intermediary mechanisms involved, oxidative phosphorylation.
3. Discuss the biosynthesis and the degradation pathways involved in the physiology of microbes.

Student Learning Outcomes (SLO):

Students will:

1. Describe how microorganisms are used as model systems to study basic biology, genetics, metabolism and ecology.
2. Explain why microorganisms are ubiquitous in nature; inhabiting a multitude of habitats and occupying a wide range of ecological habitats.
3. Demonstrate that microorganisms have an indispensable role in the environment, including elemental cycles, biodegradation, etc.

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Unit	Syllabus	Period
UNIT - I	Basic aspects of bioenergetics. First and second law of thermodynamics. Concept of free energy, ATP as a high energy compound. Electron transport (Dolin's electron transport system) and oxidative phosphorylation.	12
UNIT - II	Autotrophic and heterotrophic modes of nutrition. Nutritional requirements of different groups of microorganisms including keratinophilic, coprophilic and thermophilic microorganisms. Physiology and importance of specialized groups of microorganisms: psychrophilic, thermophilic, osmophilic, xerophilic, halophilic, acidophilic and barophiles microorganisms. Specific metabolic pathways for generation of hydrogen, methane and flourensence.	12
UNIT - III	Microbial growth : Mathematical nature and expression of growth phase, growth curve of bacteria. Generation time. Measurement of growth : cell mass, cell number and cell constituents. Bacterial growth in batch and continuous cultures, chemostats and turbidostats, synchronous growth. culture of anaerobic bacteria.	12
UNIT - IV	Photosynthetic microorganisms: Purple bacteria, green bacteria and Cyanobacteria. A general account of bacrerial photosynthesis and photo metabolism. Basis of chemoautotrophy: sulphar, iron and hydrogen bacteria. Fermentation of carbohydrates. Modes of aerobic and anaerobic respiration. Fixation of molecular Nitrogen: nitrification and denitrification. Microbial leaching	12
UNIT - V	Factors affecting growth of microorganisms. Mechanism of antibacterial action. Antibiotics and drugs affecting: cell wall, cell membrane, inhibition of DNA synthesis and protein synthesis. Drug resistance in bacteria. Radiation sensitivity.	12

REFERENCE BOOKS –

1. Stanier, Ingraham, Wheelis and Painter. The Microbial world. Mc Millan Educational Ltd., London.
2. Moat and Foster, Microbial Physiology. Wiley.
3. Umbreit. Essentials of Bacterial Physiology.
4. Skokatch. Bacterial Physiology and Metabolism.
5. Kushner, D.J. Microbial life in Extreme Environments. Academic Press.
6. Pawar. C.B. Cell Biology.
7. Sturart. Harris and Harris. The control of Antibiotic Resistance in Bacteria.
8. Franklin and Snow, Biochemistry of Antimicrobial Action. Chapman and Hall, New York.
9. Philipp. G. Mannual of Methods for General Bacteriology.
10. David T. Plummer. An Introduction to Practical Biochemistry.
11. Subba Rao, N.S. Soil Microorganisms and Plant Growth.
12. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.
13. Willey,Sherwood,Woolverton. Prescott,Harley, and Klein's Microbiology McGraw-Hill publication
14. Tortora,Funke,Case. Microbiology.Pearson Benjamin Cummings.
15. Jacquelyn G. black. Microbiology Principles and explorations. John Wiley and Sons, INC.
16. Madigan,Martinko, Bender,Buckley,Stahl.Brock Biology of Microorganisms. Pearson
17. Tom Besty,D.C Jim Koegh.Microbiology Demystified McGRAW-HILL.
18. J. R. Sokatch Bacterial Physiology and Metabolism.Academic Press
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EKLAVYA UNIVERSITY
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School of Basic and Applied Sciences

Class				M.Sc. (Microbiology)
Semester/Year				II Semester
Subject & Subject Code				Microbiology - MMBIO20S203
Paper				Immunology and Medical Microbiology – 203
Max. Marks				30
Credit			Total Credits	
L	T	P	3	
3	0	0		

Course Objectives:

The candidate will gain knowledge about immunity, organs of immunity and cells involved; Types of antigens and properties; immunoglobulin – types; MHC and its significance; hypersensitivity reactions. The candidate will gain hands-on knowledge and acquire adequate skill required to perform precipitation reactions and purify immunoglobulins and detect antigens via western blotting. The candidate will gain knowledge about the pathogenesis, identification, and treatment of bacterial, fungal and viral diseases.

Course Outcome:

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

1. Conceptualized the protective role of the immune system of the host and developed an understanding of the basic components as well as the mechanisms underlying the immune system and its response to pathogenic microorganisms.
2. Conduct experiments for growing common bacteria in different microbiological media, antibiotic sensitivity determination and antigen antibody reaction (precipitation test in the agarose)
3. Define, describe and use the fundamental terms and concepts of modern microbiology as evidenced by the ability to present, discuss and answer questions about a scientific article in the field of microbiology.
4. Learn immune diagnostic tests and assays against pathogens.

Student Learning Outcomes (SLO):

Students will:

1. Compare and contrast innate and adaptive immunity.
2. Describe which cell types and organs present in the immune response.
3. Illustrate various mechanisms that regulate immune responses and maintain tolerance.
4. Exemplify the adverse effect of immune system including Allergy, hypersensitivity and autoimmunity.
5. Apply basic techniques for identifying antigen-antibody interactions.
6. Use knowledge of the fundamental terms and concepts of microbiology.
8. Perform basic microbiological lab techniques.
9. Identify blood groups and types
10. Diagnose syphilis by performing TPHA test
11. Analyze the components of human sera by performing agarose and polyacrylamide gel electrophoresis

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Unit	Syllabus	Perio
UNIT - I	History of Immunology. Structures, composition and functions of cells and organs involved in immune system. Host parasite relationships: microbial infections, virulence and host resistance. Immune responses- innate and acquired immunity. Immunohematology: bloodgroups, blood transfusion and Rh incompatibilities.	12
UNIT - II	Antigens: structure, properties and types of antigens.Haptens and adjuvants. Vaccines and toxoids. Immunoglobulins: structure, properties and types of antibodies. Theories of antibody production. Antigen- antibody reactions: *In vitro* methods: agglutination, precipitation complement fixation, immunofluorescence. ELISA. RIA; *In vivo* methods: skin tests and immune complex tissue demonstration. Application of these methods in diagnosis of microbial diseases.	12
UNIT - III	Bacteriology: Important diseases caused by Corynebacterium, Pneunocci, Staphylococci, Neisseria, Clostridia, Enterobacteriaceae, Vibrio, Mycobacteria, Actinomycetes, Spirochetes, Rickettsia, Chlamydia and Oral microbiology.	12
UNIT - IV	Mycology and Virology: Host defenses against fungi and viruses. Important human diseases caused by fungi and viruses with special reference to their prevalence in local slum areas and cure. Clinical forms: Epidemiology, diagnosis and treatment of the mycoses.	12
UNIT - V	Sterilization and disinfection. Chemotherapy of bacterial and fungal diseases. Control of viral infection. Antibiotics, Vaccines and their use in diseases control and therapy.	12

REFERENCE BOOKS –

1. Ananthanarayan R and Paniker CKJ. Textbook of Microbiology. 7th Edition. University Press Publication. (2005).
2. Brooks GF, Carroll KC, Butel JS and Morse SA. Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication. (2007).
3. Goering R, Dockrell H, Zuckerman M and Wakelin D. Mims Medical microbiology. 4th edition. Elsevier. (2007).
4. Bernard, Davis B. Dulbecco, Eisen and Ginsberg. Microbiology including immunology and molecular Genetics. 3rd Edition
5. Roitt I. Essential Immunology. 10th Ed. Blackwell Science.
6. Kuby. Immunology. 4th edition. W. H. Freeman & company.
7. Ellen Strauss, James Strauss. Viruses and Human Disease 2nd Edition.Academic Press
8. Christopher Burrell Colin Howard Frederick Murphy.Fenner and White's Medical Virology 5th Edition.Academic Press
9. Patrick R. Murray PhD, Ken S. Rosenthal PhD,Michael A. Pfaller MD.Medical microbiology. Elsvier
10. Jawetz.Medical microbiology.Mc. Graw Hill
11. Kenneth, J. Ryan.Medical microbiology, Sherri's an introduction to infectious diseases.Mc. Graw Hill

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School of Basic and Applied Sciences

Class	M.Sc. (Microbiology)
Semester/Year	II Semester
Subject & Subject Code	Microbiology - MMBIO20S204
Paper	Agricultural Microbiology – 204
Max. Marks	30

Credit			Total Credits
L	T	P	3
3	0	0	

Course Objectives:

1. To impart in-depth information on soil and agriculture.
2. To make the students understand the role of microbes in agriculture.
3. To give an overview on plant microbe interaction. To understand infection process and control measures.
4. To know the importance of biofertilizers and biopesticides.
5. To make the students to know about various techniques involved in biofertilizers and biopesticides production.

Course Outcome:

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

1. Develop a clear understanding of the multifarious roles of microorganisms in soil, in association with plants and thus in the field of agriculture.
2. Develop basic concepts of causation of diseases in plants by the different types of microorganisms namely bacterial, fungal and viral.
3. Gain knowledge of important plant diseases, their etiology, salient characteristics and control measures.
4. Develop skills to analyze the diseased plant samples in the laboratory and are able to identify the salient features of the disease-causing microbe and the lesions produced on the plant part.

Student Learning Outcomes (SLO):

Students will:

1. Understand the role of microbes in the different cycles and their role in agriculture.
2. Understand biological nitrogen fixation in symbiotic and non symbiotic associations with plants.
3. Know the value, production, application and crop response of biofertilizers and biopesticides.
4. Have an indepth knowledge on biopesticides and their role in pest control.
5. Skilled on study of microbes in Biofertilizers and gain the knowledge on Isolation of Bacteria, Fungi, Algae and Actinomycetes from soil.

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Unit	Syllabus	Perio
UNIT - I	Plant Pathology: Pathogenesis, factors affecting plant disease development, casual agents, disease cycle and etiology of important diseases of cereals crops (wheat, maize, paddy),oil seed crops (groundnut, soybean) and pulses (Arhar). Role of Enzymes and Toxins in plant diseases.	12
UNIT - II	Disease resistance in plants: Structural and chemical protection, absence of nutrients, common antigens. Defensive mechanisms: historical accumulation of nutrients and toxic substances. Synthesis of phenolic and non-phenolic substances.	12
UNIT - III	Plant disease control: Principles protection of crops against diseases, avoidance of pathogen and elimination of pathogen. Plant quarantine regulation in India. Physical methods of plant disease control, chemical control of plant diseases. Topical and systemic chemotherapy.	12
UNIT - IV	Biofertilizers and Biopesticides: Applications in agriculture. Mass production: Rhizobium and algal biofertilizers, phosphate solubilizing microorganisms. Biological Control: Principle and practice of biological control. Principle of organic farming, concept of integrated pest management and integrated agriculture management.	12
UNIT - V	Microbiology of stored products: Spoilage of cereal grains and oil seeds during storage.Methods of controlling storage losses in cereal grains and oil seeds. Problem of mycotoxins in agricultural commodities and their control. Microbiology of biogas production and organic manuring.	12

REFERENCE BOOKS –

1. Agrios,G.N.Plant pathology. Harcourt Asia Pvt.Ltd. (2000).
2. Buchanan.B.B.,Gruissem, W.and Jones,R.L Biochemistry and Molecular Biology of Plants. I.K. International Pvt.Ltd. (2000).
3. Mehrotra R S and Ashok Agrawal. Plant Pathology. Tata Mc Graw Hill ,6th reprint (2006).
4. K. S. Bilgrami, H. C. Dube. A textbook of modern pathology. 6th Edition,Vani Educational Books, a division of Vikas, (1984).
5. Plant Pathology.Elsevier Science Publishing Co Inc 2005.George Nicholas Agrios.
6. K.R. Aneja Experiments in Microbiology, Plant Pathology and Biotechnology . New Age Publications 2017

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School of Basic and Applied Sciences

Class	M.Sc. (Microbiology)				
Semester/Year	II Semester				
Subject & Subject Code	Practical Microbiology - MMBIO20S205				
Paper	Paper- I and II, Practical- I Sitting	L	T	P	Total C.
Max. Marks	50= (30+20)	0	0	2	2

PRACTICALS

1 Study of colonial characters of bacteria.

2 Differential staining of bacteria : Gram's staining and simple staining.

3 Bacterial identification based on biochemical characteristics: indole production test, MRVP test, citrate utilization, catalase test, to differentiate among members of enterobacteriaceae on the basis of sugar fermentation (TSIA), phosphate solubilization test.

4 Isolation of bacteriophages : plaque formation.

5 Drug sensitivity test study.

6 Determination of minimum inhibitory concentration (MIC) of an antibiotic.

7 Isolation of keratinophilic fungi from soil by keratin Bait technique.

8 Isolation of Rhizobium from soil/root nodules.

9 Determination of growth curve of bacteria.

10 Effect of temperature on bacterial growth.

11 Determination of thermal death point (TDP) and thermal death time (TDT) of an organism.

12 Germicidal effect of U.V. light on bacterial growth.

13 Effect of heavy metals or oligodymamic action of bacteria.

14 Filter paper disc method for enaluation of antiseptic.

15 Measurement of Fungal growth by colony diameter method.

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School of Basic and Applied Sciences

Class	M.Sc. (Microbiology)				
Semester/Year	II Semester				
Subject & Subject Code	Practical Microbiology - MMBIO20S206				
Paper	Paper- III and IV, Practical- II Sitting	L	T	P	Total C.
Max. Marks	50= (30+20)	0	0	2	2

PRACTICALS

1 Study of the blood grouping Rh typing.
2 Heamocytometery : RBC/WBC/spore count.
3 Determine the bleeding time and clotting time.
4 Widal test for identification of Typhoid.
5 VDRL test for identification of syphilis.
6 Detection of specific antigen by using ELISA technique.
7 Study of immunological cells by smear preparation.
8 To study percentage of hemoglobin in given blood sample.
9 Identification of fungi.
10 Isolation of storage fungi by blotter technique.
11 Isolation of phosphate solubilising microorganisms form soil.
12 Isolation of fungal pathogens from soil/diseased plants.

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