DEPARTMENT OF MICROBIOLOGY
DOCTOR HARISINGH GOUR VISHWAVIDYALAYA, SAGAR (M.P.)
(A CENTRAL UNIVERSITY)

Under Graduate Curriculum Framework
Based on NEP-2020

B.Sc. Industrial Microbiology
Level 5

Semester I

Nature of Course	Course Code	Course Title	Credit
Discipline Specific Major	MIC-DSM-111	General Microbiology and Microbial Diversity (Theory)	4
	MIC-DSM-112	General Microbiology and Microbial Diversity (Practical)	2
Multi-Disciplinary Major	MIC-MDM-111	Biochemistry (Theory)	4
	MIC-MDM-112	Biochemistry (Practical)	2

Semester II

Nature of Course	Course Code	Course Title	Credit
Discipline Specific Major	MIC-DSM-211	Microbial Physiology and Metabolism (Theory)	4
	MIC-DSM-212	Microbial Physiology and Metabolism (Practical)	2
Multi-Disciplinary Major	MIC-MDM-211	Microbial Biotechnology (Theory)	4
	MIC-MDM-212	Microbial Biotechnology (Practical)	2

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DEPARTMENT OF MICROBIOLOGY
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B.Sc. Syllabus

Semester I

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Discipline Specific Major	MIC-DSM-111	General Microbiology and Microbial Diversity (Theory)	40	60	100

Course Objectives:
The major objective of this paper is to build a strong foundation in the development of microbiology, microbial diversity, industrial microbiology, techniques and instrument used in microbiology.

Course Learning Outcomes
Upon successful completion of the course, the student:

- Will be able to describe the contribution of some leading microbiologist.
- Will get knowledge about the microbial diversity. They will also gain the knowledge systems of classification, bacteriology, mycology and virology.
- To understand the concept and scope of industrial microbiology.
- To understand the concept of tools and techniques of microbiology laboratory.
- Will get an understanding about the types and applications of microbiological instruments

Unit 1 History of Development of Microbiology
Development of microbiology as a discipline, Spontaneous generation *vs* biogenesis. Contributions of Antony von Leeuwenhoek, Louis Pasteur, Elie Metchnikoff, Edward Jenner, Robert Koch, Joseph Lister, Alexander Fleming, Selman Waksman. Role of microorganisms in fermentation, Germ theory of disease, Development of various, golden era of microbiology, Establishment of fields of medical microbiology and immunology through the work of Paul Ehrlich.

Unit 2 Microbial Diversity
Systems of classification: Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three domain classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms. **Bacteriology:** Structure of different cell components of Eubacteria. Characteristic features, classification and importance of Actinomycetes, Mycoplasma and Cyanobacteria. **Mycology:** Morphological features, classification (taxonomy) and characteristics of (Slime moulds) Myxomycetes (Slime moulds), Oomycetes, Zygomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. **Virology:** General Morphological features and ultrastructure of viruses; Classification of viruses. Related viral agents, viroids and prions. Life cycle of RNA and DNA viruses. Lytic cycle, Lysogeny; one step growth curve.

Unit 3 Industrial Microbiology
Concept and scope. Nature and range of industrial products from microorganisms. Concept of industrial strains, Strain development. A general knowledge of microbes used in production of food, dairy, chemicals (solvents), bioactive molecules (antibiotics; enzymes).

Unit 4 Tools and Techniques in Microbiology
Culture media: preparation and types - defined, differential, selective and enrichment culture media. Isolation techniques: Pour plate, spread plate, streak plate, and serial dilution method.
Sterilization: Principle and methods of sterilization, physical and chemical agents of sterilization; Disinfectants, Antiseptics, Phenol coefficient.

Unit 5 Instrumentation in Microbiology: Microscopy and microscopic techniques: Principles and application of light microscopy, dark field, phase contrast, fluorescence and electron microscopy. Micrometry, Camera lucida. Methods of purification of microbial cultures. Maintenance and preservation of microbial cultures, Lyophilization, Cryopreservation etc. Principle, working and applications of spectrophotometer, pH meter. Centrifugation: types and applications, Design and use of fermenter.

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Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Discipline Specific Major	MIC-DSM-112	General Microbiology and Microbial Diversity (Practical)	2	60	100

List of Practicals

1. To study the Good Laboratory Practices and Biosafety in Microbiology Laboratory
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator
3. BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
4. Preparation of culture media for bacterial cultivation.
5. Sterilization of medium using Autoclave and assessment for sterility.
6. Sterilization of glassware using Hot Air Oven and assessment for sterility.
7. Sterilization of heat sensitive material by membrane filtration and assessment for sterility.
8. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.
9. Study of *Rhizopus*, *Penicillium*, *Aspergillus* using temporary mounts.
10. Gram's Staining technique.
11. Effect of antibiotics and antiseptics.

Essential reading

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9th Edition. McGraw Hill International.
3. Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T. Brown Publishers.
4. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company.
5. Stanier RY, Ingraham JL, Wheelis ML, and Painter PR. (2005). General Microbiology. 5th Ed. McMillan.
6. Naveen Kango (2013) Textbook of Microbiology, IK international publishers, New Delhi

Suggested Reading:

1. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. Pearson International Edition
2. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Ltd.

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B.Sc. Syllabus

Semester I

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Multi-Disciplinary Major	MIC-MDM-111	Biochemistry (Theory)	4	60	100

Course Objectives:
The main objective of this paper is to apply concepts and principles of biochemistry, importance of carbohydrates, nucleic acids and lipids. The major properties and structures of macromolecules.

Course Learning Outcomes:
Upon successful completion of the course, the student:
- Will get an in-depth knowledge about the bioenergetics and laws of thermodynamics.
- Attains knowledge about the classification, structure, properties and major functions of carbohydrates.
- Gets introduced to various biological functions of lipids and acquires knowledge about classification, structure, types of lipids and their transduction.
- Will have gained insight on amino acids and proteins. How these are necessary for various body functions. Also, they will gain concepts about the uses of amino acids and proteins.
- Will understand about the classification of enzymes, structure and mechanism of action.

Course Contents:

Unit 1 Bioenergetics
First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy and Entropy and mathematical relationship among them, Standard free energy change and equilibrium constant.

Unit 2 Carbohydrates
Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. Stereo isomerism of monosaccharides, epimers, mutarotation and anomers of glucose. Furanose and pyranose forms of glucose and fructose, Sugar derivatives, glucosamine, galactosamine, muramic acid, N- acetyl neuraminic acid, Disaccharides; concept of reducing and non-reducing sugars, Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin.

Unit 3 Lipids
Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacyl glycerols structure, functions and properties. Saponification Structural lipids. Phosphoglycerides: Building blocks, General structure, functions and properties.
Structure of phosphatidylethanolamine and phosphatidylcholine, Sphingolipids: building blocks.

Unit 4 Proteins
Functions of proteins, Primary structures of proteins: Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion.
Classification, biochemical structure and notation of standard protein amino acids Ninhydrin reaction. Natural modifications of amino acids in proteins hydrolysine, cystine and hydroxyproline, Structure and functions of naturally occurring glutathione and insulin and synthetic aspartame, Secondary structure of proteins: Peptide unit and its salient features. The alpha helix, the beta pleated sheet and their occurrence in proteins, Tertiary and quaternary structures of proteins.

Unit 5 Enzymes
Structure of enzyme: Apoenzyme and cofactors, prosthetic group-TPP, coenzyme, NAD, metal cofactors, Classification of enzymes, Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis. Allosteric mechanism, Definitions of terms – enzyme unit, specific activity and turnover number. Multienzyme complex: lactate dehydrogenase, Effect of pH and temperature on enzyme activity. Enzyme inhibition: competitive, non-competitive.

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B.Sc. Syllabus

Semester I

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Multi-Disciplinary Major	MIC-MDM-112	Biochemistry (Practical)	2	60	100

List of Practicals

1. Properties of water, Concept of pH and buffers, preparation of buffers and Numerical problems to explain the concepts.
2. Numerical problems on calculations of Standard Free Energy Change and Equilibrium constant.
3. Standard Free Energy Change of coupled reactions.
4. Qualitative/Quantitative tests for carbohydrates, reducing sugars, non reducing sugars.
5. Qualitative/Quantitative tests for lipids and proteins.
6. Study of protein secondary and tertiary structures with the help of models.
7. Study of enzyme kinetics – calculation of *V*max, Km, Kcat values.
8. Study effect of temperature, pH and Heavy metals on enzyme activity.
9. Estimation of any one vitamin.

Essential reading

1. Campbell, MK (2012) Biochemistry, 7th ed., Published by Cengage Learning.
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4th ed., Published by Churchill Livingstone.
3. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W.H. Freeman and Company.
4. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition. W.H. Freeman and Company.
5. Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's Microbiology by. 9th Ed., McGraw Hill.
6. Voet, D. and Voet J.G (2004) Biochemistry 3rd edition, John Wiley and Sons.

Suggested Reading:

1. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed.,W.H. Freeman.
2. MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's Microbiology by. 9th Ed., McGraw Hill

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B.Sc. Syllabus

Semester II

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Discipline Specific Major	MIC-DSM-211	Microbial Physiology and Metabolism (Theory)	4	60	100

Course Objectives

The major objective of this paper is to introduce similarities between geometrical progression series and microbial growth, to impart in-depth knowledge about the microbial movement and its molecular aspect and also to give comprehensive account on the physiology and metabolism of anabolic and catabolic processes which are the fundamental aspects of the microbial life.

Course Learning Outcomes

Upon successful completion of the course, the student:

- Will get an in-depth understanding about the biochemical properties of cell membrane and transport system.
- Will get an in-depth knowledge about the photosynthetic microbes.
- The students will be able to understand about the different metabolic pathways.
- Will have gathered detailed information about the extremophiles.
- Will get detailed understanding about the biosynthesis of aromatic amino acids and phospholipids.

Course Contents

Unit 1 Biomembrane and Transport of solute

Biochemical properties of cell membrane. Difference between Archea and Eubacteria phospholipid. Diffusion gaseous exchange, Ficks law of diffusion, Osmosis, Plasmolysis Passive transport mechanism: structure and types of ion channel. Secondary active transport mechanism: Proton-pumps, Symport, Antiport and Uniport.

Unit 2 Photosynthetic Microbes

Photosynthetic microbes: Oxygenic photosynthetic bacteria: concept of PSI and PSII, Z-scheme, Non-cyclic photophosphorylation. Anoxygenic photosynthetic bacteria: Cyclic photophosphorylation. Difference between photosynthesis of Purple and Filamentous green bacteria, Cyanobacteria and Green sulphur bacteria. Calvin cycle.

Unit 3 Carbon and Energy Metabolism

Fundamentals pathways of Pyruvate formation (Embden-Meyerhof pathway (EMP) /glycolytic pathways, Pentose phosphate pathway (PPP) /hexose monophosphate shunt, Entner-Doudoroff pathway). TCA cycle. Electron transport chain (ETC): components of respiratory chain.

Unit 4 Extremophiles Physiology

Methanogenic bacteria their classification and the mechanism of CH_4 production. Halophilic bacteria and role of purple membrane. Hydrogen oxidation bacteria.

Unit 5 Nitrogen Metabolism

Introduction to biological nitrogen fixation, Ammonia assimilation. Assimilatory nitrate reduction, dissimilatory nitrate reduction, Nitrification and denitrification. Molecular adaptations in microbes for nitrogen fixation (free living aerobic, free living anaerobic and symbiotic microbes).

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B.Sc. Syllabus

Semester II

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Discipline Specific Major	MIC-DSM-212	Microbial Physiology and Metabolism (Practical)	2	60	100

List of Practicals

1. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with thegiven data
3. Effect of temperature on growth of *E. coli*
4. Effect of pH on growth of *E. coli*
5. Effect of carbon and nitrogen sources on growth of *E.coli*
6. Effect of salt on growth of *E. coli*
7. Demonstration of alcoholic fermentation
8. Demonstration of the thermal death time and decimal reduction time of *E. coli.*

Essential Readings

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
4. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition,McMillan Press.

Suggested Readings:

1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
2. Wiley JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

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B.Sc. Syllabus

Semester II

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Multi-Disciplinary Major	MIC-MDM-211	Microbial Biotechnology (Theory)	4	60	100

Course Objectives:

The course will provide a detailed understanding of microbial biotechnology. The purpose of this study is to introduce concepts of therapeutic and industrial biotechnology, and microbes used in biotransformations. The student will study the role of microbial products and their recovery methods and also able to understand RNAi method.

Course Learning Outcomes:

Upon successful completion of the course, the student:

- Is able to describe microbial biotechnology and applications.
- Is able to understand the recombinant microbial production processes and applications.
- Will be able to describe the various types of microbial based transformation methodology.
- Is able to explain basics of microbial based product purification and immobilization techniques.
- Will have learnt about RNAi and its applications.

Course Contents:

Unit 1 Microbial Biotechnology and its Applications

Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology.
Use of prokaryotic and eukaryotic microorganisms in biotechnological applications.
Genetically engineered microbes for industrial application: Bacteria and yeast.

Unit 2 Therapeutic and Industrial Biotechnology

Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine)
Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics Microbial biosensors.

Unit 3 Applications of Microbes in Biotransformations

Microbial based transformation of steroids and sterols
Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute

Unit 4 Microbial Products and their Recovery

Microbial product purification: filtration, ion exchange & affinity chromatography techniques Immobilization methods and their application: Whole cell immobilization

Unit 5 RNAi

RNAi and its applications in silencing genes, drug resistance, therapeutics and host pathogen interactions

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Semester II

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Multi-Disciplinary Major	MIC-MDM-212	Microbial Biotechnology (Practical)	2	60	100

List of Practicals

1. Study yeast cell immobilization in calcium alginate gels.
2. Study enzyme immobilization by sodium alginate method.
3. Pigment production from fungi (*Trichoderma / Aspergillus / Penicillium*)
4. Isolation of xylanase or lipase producing bacteria.
5. Study of algal Single Cell Proteins.
6. Isolation of PGPRs and phosphate solubilizing bacteria from soil

Essential reading

1. Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press.
2. Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
3. Gupta P.K. (2009) Elements of Biotechnology 2nd edition, Rastogi Publications,
4. Glazer A.N. and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press.
5. Glick B. R., Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press.
6. Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd Edition Sinauer associates, Inc.

Suggested Reading

1. Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press.
2. Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2nd edition., Elsevier Science

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Under Graduate Curriculum Framework
Based on NEP-2020
B. Sc. Industrial Microbiology
Level 6

Semester III

Nature of Course	Course Code	Course Title	Credit
Discipline Specific Major	MIC-DSM-311	Environmental Microbiology (Theory)	4
	MIC-DSM-312	Environmental Microbiology (Practical)	2
Multi-Disciplinary Major	MIC-MDM-311	Instrumentation and Biotechniques (Theory)	4
	MIC-MDM-312	Instrumentation and Biotechniques (Practical)	2

Semester IV

Nature of Course	Course Code	Course Title	Credit
Discipline Specific Major	MIC-DSM-411	Medical Microbiology (Theory)	4
	MIC-DSM-412	Medical Microbiology (Practical)	2
Multi-Disciplinary Major	MIC-MDM-411	Molecular Biology (Theory)	4
	MIC-MDM-412	Molecular Biology (Practical)	2

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Semester III

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Discipline Specific Major	MIC-DSM- 311	Environmental Microbiology (Theory)	4	60	100

Course Objectives

The objective of this paper is to understand the cross talk between microbes and the environment. This will be achieved by understanding the air, water and soil microflora. Also, it will provide insight into microbial interactions and applications of environmental biotechnology.

Course Learning Outcomes

CO 1. Will be introduced the role of microbes in soil and various biogeochemical cycles.
CO 2. Will get an in-depth knowledge about water microbiology and methods to get knowledge about large scale water purification and sewage treatment.
CO 3. Will get an in-depth understanding about the importance of indoor and outdoor air quality in terms of microbial load and their types.
CO 4. Will have gathered detailed information about the social interactions of microbes in environmental field and production of bioactive molecules enzymes and antibiotics.
CO 5. Will get understanding about the concept and role of environmental biotechnology.

Unit 1

Terrestrial Environment: Soil profile and soil microflora, Aquatic Environment: Microflora of fresh water and marine habitats. Soil as environment for microbial growth: Rhizosphere soil microorganisms. Rhizosphere effect. Role of microorganisms in mineral cycling (Nitrogen, Carbon, Phosphorus). Solid waste & its management using microbes as tool.

Unit 2

Water Microbiology: Distribution of Microorganisms in water. Methods of water purification. Concept of Biological oxygen demand, Bacterial contaminants in water: The coli form group and non-coliform groups. Sewage: Composition and its disposal, major groups of microorganisms in sewage, BOD, treatment of domestic and municipal sewage.

Unit 3

Air Microbiology: Air borne microorganisms and their significance in human health and plant disease development. Microorganisms in indoor and outdoor environment. Techniques for analysis of air borne microorganisms – The settling plate technique, slit type sampler, liquid impinger, sieve sampler (Anderson's sampler and cascade sampler); Filtration methods.

Unit 4

Types of Microbial interactions: commensalisms, neutralism, synergism and antagonism, symbiosis. Soil as source of industrially important microorganisms. Screening of soil microorganisms for bioactive molecules: enzymes and antibiotics.

Unit 5

Role of microorganisms in Bioremediation. Nature of industrial effluents of leather and pharmaceutical industries. Metagenomics, Microbiome, Superbug.

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Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Discipline Specific Major	MIC-DSM- 312	Environmental Microbiology (Practical)	2	60	100

List of Practicals

1. Isolation and identification of microbes (bacteria & fungi) from soil.
2. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
3. Isolation & identification of microorganisms present in Water systems.
4. MPN analysis of various water samples.
5. Enumeration of BOD of water samples.
6. Isolation & identification of microorganisms present in air using various air samplers.
7. Isolation and screening of soil microorganisms for the production of: enzymes and antibiotics
8. To isolate micro

Essential reading

1. Textbook of Microbiology by Dr Naveen Kango, IK International publishers, New Delhi
2. Prescott` Microbiology by Joanne Willey, Linda Sherwood and Christopher J. Woolverton
3. Brock Biology of Microorganisms by Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A. Stahl and Thomas Brock
4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
5. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14th edition. Pearson/ Benjamin Cummings
6. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
7. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.

Suggested Reading:

1. Okafor, N (2011). Environmental Microbiology of Aquatic & Waster systems. 1st edition, Springer, New York
2. Barton LL & Northup DE (2011). Microbial Ecology. 1st edition, Wiley Blackwell, USA Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.

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Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Multi-Disciplinary Major	MIC-MDM-311	Instrumentation and Biotechniques (Theory)	4	60	100

Course Objectives

The objective of this course is to acquaint students with the fine details of instrumentation, biotechniques and bioinformatics. Students will be trained in instrumentation, bioinformatics tools as well as use of bioinformatics in biological studies.

Course Learning Outcomes

CO 1. Will be able to understand different microscopy principles and applications.
CO 2. Understands the concept of fermenter design and applications.
CO 3. Will be able to understand various instruments and their use in microbiological field.
CO 4. Acquires knowledge about spectrophotometer and its applications.
CO 5. Know about variety of databases information and role of bioinformatic tools.

Unit 1

History and developments in Microscopy. Concept of magnification, resolution, numerical aperture, Raleigh's criteria. Microscopy: Different parts of light microscope. Principle, components and applications of Brightfield, Darkfield and Phase contrast Microscopy. Types and applications of Staining.

Unit 2

Fermentation equipment: Design and construction of fermenters, shaking device, aeration device, monitoring of fermentation process; Solid state fermentation; Methods used in Downstream processing of microbial fermentation.

Unit 3

Principle and applications of spectrophotometry, microplate reader, flow-cytometer, DNA sequencer and thermocycler (PCR). Principle, applications and types of centrifuges. Cellular fractionation

Unit 4

Principle of spectrophotometry, working of spectrophotometer, colorimeter; ELISA plate reader, Microplate reader, Applications of spectrophotometer in qualitative and quantitative analysis

Unit 5

Bioinformatics and its applications. Biological databases, BLAST, FASTA, CLUSTAL W. databank (PDB and gene bank), accessing information.

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Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Multi-Disciplinary Major	MIC-MDM-312	Instrumentation and Biotechniques (Practical)	2	60	100

List of Practicals

1. To visualize the various types of microorganisms by using different microscopic techniques
2. To perform solid (SSF) and submerged fermentation.
3. To see design and working of fermenter
4. To amplify a single gene of interest by PCR
5. To perform qualitative and quantitative analysis of compounds using spectroscopy
6. Bioinformatics data mining/ primer designing/ BLAST/ Alignment

Essential Readings

1. Bioinformatics and Systems Biology by Marcus F., Springer Nature
2. Introduction to Bioinformatics by Lesk A.M. Oxford University Press
3. Applied Bioinformatics: An Introduction by Selzer P.M., Marhofer R.J., Koch O., Springer,
4. Bioinstrumentation by Webster JG, Wiley
5. Principles of Instrumental Analysis, by Skoog D.A., Holler F.J., Crouch S.R. 7th Edition
6. Fundamentals of Information Technology by Leon, A. and Leon, M. Vikas Pub House & Leon Press Chennai.
7. Biochemistry Laboratory Techniques by Chaykin, S.

Suggested Readings

1. Fundamentals of Computers by C. Xavier, New Age Publishers, New Delhi.
2. Introduction to Bioinformatics by Parrysmith and Attwood.

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Dept. of Microbiology
Dr. H. S. Gour V. V., Sagar

16.12.23

DEPARTMENT OF MICROBIOLOGY
DR. HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Multi-Disciplinary Major	MIC-DSM- 411	Medical Microbiology (Theory)	4	60	100

Course Objectives

The objective of this course is to understand the epidemiology, pathogenicity, diagnosis and control of important bacterial, fungal, viral and diseases related to medical microbiology.

Course Learning Outcomes

CO 1. Will be able to gather information about immune system, antigens and antibodies.
CO 2. Will have gained insight on important bacterial diseases and control.
CO 3. Will gain insight on immunodiagnostics and immunotherapy.
CO 4. Will be able to apply understand fungal diseases (Mycoses) and control measures.
CO 5. Will be able to gained insight about different viral diseases and their control.

Unit 1

Immunology and concept of antigens and antibodies. Immunoglobulins: Structure and properties of immunoglobulin classes. Antigen-Antibody reaction by precipitation, agglutination and complement fixation. Hybridoma technology for monoclonal antibodies.

Unit 2

Epidemiology, pathogenicity, diagnosis & Control of important bacterial diseases: Tuberculosis, Anthrax, Typhoid, Diphtheria, Leprosy. Antibiotics, Vaccines and their use in diseases control. Drug resistance in bacteria.

Unit 3

Immunodiagnostics and immunotherapy in virology – Serological methods for detection and quantitation of viruses including Hepatitis, Influenza, HIV and others. Immuno-assays: SRID, ELISA, ELISA-PCR, RIA, Western Blotting, Immunofluorescent and their application. Immune deficiencies and autoimmunity.

Unit 4

Causation, diagnosis and treatment of the Fungal diseases: Important human diseases caused by fungi (Mycoses); Fungal Dermatitis, Allergies, Aspergillosis. Host defenses & control against fungi.

Unit 5

General account of viral diseases, Herpes, Orthomyxovirus (Influenza), Paramyxo (Mumps & Measles), Oncoviruses, HIV-AIDS, SARS. Diagonosis and treatment of viral diseases

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Dept. of Microbiology
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Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Multi-Disciplinary Major	MIC-DSM- 412	Medical Microbiology (Practical)	2	60	100

List of Practicals

1. Widal, VDRL and Blood grouping to understand Ag-Ab reactions
2. Simple and differential staining to show bacterial colony from blood/stool samples.
3. Screening of antibiotics.
4. MIC & drug resistant calculation by disc diffusion
5. Culture of Virus
6. Experiments to define immunodiagnostics of important diseases.

Essential Readings

1. Microbiology: Principles and Explorations, 9th Edition (2015) by Black J.G., Black L.J., Wiley
2. Brock Biology of Microorganisms, 14th Edition by Michael TM., John M, Kelly S.B., Daniel H.B., (2017)
3. Kuby Immunology, 8th Edition, by Punt J., Stranford S., Jones P., Owen J.A
4. Roitt's Essential Immunology, 13th Edition (2017) by Delves P.J., Martin S.J., Burton D.R. and Roitt I.M. Wiley-Blackwell.
5. Cellular and Molecular Immunology 10th Edition by Abbas A, Lichtman A., Pillai S. - February 19, 2021
6. Text book of Microbiology by Ananthanarayan. R. and. Paniker C.K.J. 12th Edition (2022)
7. Text Book of Medical Microbiology by Chaapra. H.L.
8. Mackis and Mccontney Practical Medical Microbiology Edited by Coffee, Dugmiol, Fraser and Marmion.

Suggested Readings

1. Microbiology Including Immunology and Molecular Genetics. III Ed. By Davis.. Dulbecco, Eisen and Ginsberg.
2. Medical Laboratory Manual for Tropical Countries. Vol. II by Cheesbrough, M.
3. Essentials of Clinical Immunology 7th Edition by Misbah S.A., Spickett G.P., Dalm V.A.S.H. Wiley-Blackwell (2006).
4. Immunobiology: The Immune System in Health and Disease, 6th Revised edition by Charles A. Janeway, Paul Travers, Mark Walport and Mark J. Shlomchik, Churchill Livingstone; (2004).

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Dr. H. S. Gour V. V., Sagar
डॉ. हरीसिंह गौर विश्वविद्यालय, सागर

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DEPARTMENT OF MICROBIOLOGY
DR. HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University)

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Multi-Disciplinary Major	MIC-MDM- 411	Molecular Biology (Theory)	4	60	100

Course Objectives

The course will provide a detailed understanding of methods used in molecular biology. The purpose of this study is to introduce the student to the advanced concepts in electrophoresis, proteomics, cloning strategies and various detection methods.

Course Learning Outcomes

CO 1. Will be able to describe applications of PCR, DNA fingerprinting, cloning etc.
CO2. Will be able to describe types and applications of electrophoresis.
CO 3. Will be able to explain basics of cloning and application of genomics.
CO 4. Will gain an account of principle of biocatalysis and enzymology.
CO 5. Will be able to learn protein and enzyme purification techniques.

Unit 1

Isolation of DNA, genomic DNA and RNA, amplification of DNA using PCR and real time PCR, Southern and Northern blotting, DNA fingerprinting, principles of cloning, cloning vectors

Unit 2

Types of electrophoresis, factors affecting electrophoretic mobility of charged particle, Gel electrophoresis, Isoelectric point, Isoelectric focusing, applications of electrophoresis. Native and SDS-PAGE, Western blotting,

Unit 3

Basics of cloning, Restriction Enzymes, Vectors, Transformation, Transfection, Selectable Markers, Reporter Genes, applications of genomics.

Unit 4

Classification and nomenclature of enzymes, Characteristics of enzymes. Mode of action and kinetics of enzyme catalyzed reactions (Km, V_{max}). Types and Mechanism of enzyme inhibition, Microbial sources of enzymes.

Unit 5

Purification Techniques- Precipitation, chromatographic separation-gel filtration, anion and cation exchange, zymography.

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Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Multi-Disciplinary Major	MIC-MDM- 412	Molecular Biology (Practical)	2	60	100

List of Practicals

1. Restriction digestion of Plasmid DNA.
2. Isolation of Plasmid DNA from *E. coli* cells.
3. Measurement of DNA quantity by Spectrophotometer.
4. PCR amplification of DNA
5. Isolation of genomic DNA.
6. Visualization of DNA on agarose gel.
7. Separation of proteins by PAGE.
8. Estimation of enzyme activity (amylase)
9. Detection of enzymes on gels (Zymography).

Essential Readings

1. Wilson and Walkers Principles and Techniques of Biochemistry and Molecular Biology, 8th Edition, by Hofmann, A. and Clokie S. Cambridge University Press
2. Molecular Biology Techniques: A Classroom Laboratory Manual, by Miller H.B., Carson S., Witherow D.S., Elsevier Science
3. Biochemistry, by by J.M. Berg, Stryer L., Tymoczko J., Gatto G., 9th Edition, W.H. Freeman.
4. Lehninger Principles of Biochemistry, by Nelson D.L., Cox M., Freeman, W.H.
5. Principles of Genetics by Gardner, Simmons, Snustad, 8th edition, Wiley
6. Freifelders, Essentials of Molecular Biology, by Malacinski G.M., 4th Edition Jones and Bartlett

Suggested Readings

1. Molecular Cloning: A Laboratory Manual (Vol III) by Green and Sambrook
2. Biophysical Chemistry, Principles and Techniques by Upadhyay, Upadhyay, and Nath.

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DEPARTMENT OF MICROBIOLOGY
DR. HARISINGH GOUR VISHWAVIDYALAYA, SAGAR
(A Central University/ A+ accredited by NAAC)

Under Graduate Curriculum Framework
Based on NEP-2020
B. Sc. Industrial Microbiology

Level 7

Semester V

Nature of Course	Course Code	Course Title	Credit
Discipline Specific Major	MIC-DSM-511	Soil and Agriculture Microbiology	4
	MIC-DSM-512	Soil and Agriculture Microbiology	2

Semester VI

Nature of Course	Course Code	Course Title	Credit
Discipline Specific Major	MIC-DSM-611	Food and Dairy Microbiology	4
	MIC-DSM-612	Food and Dairy Microbiology	2

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B.Sc. Syllabus
(2024-25)
Semester V

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Discipline Specific Major	MIC-DSM-511	Soil and Agriculture Microbiology (Theory)	4	60	100

Course Objectives:
The major objective of this paper is to build a strong knowledge in the development of soil and agricultural microbiology, to demonstrate understanding of essential facts, concepts of microbiology.

Course Learning Outcomes
Upon successful completion of the course, the student:

- Will be able to describe the properties of soil and associated microflora.
- Will get depth knowledge about biofertilizers, PGPR, role of microbes in soil fertility and crop production.
- To understand the concept of phytopathogenesis and production of biopesticide using microbes.
- To understand the concept of microbiology at plant-soil interface. They will also get knowledge about biodegradation and decomposition of organic wastes.
- Will get an understanding about the various transformations of C, N, S, P and Fe in soil.

Unit I
Soil structure and microbes: Different types, structure, and composition of soils. Soil as a microbial habitat. Introduction to culturable and unculturable soil microbiota. Factors influencing distribution, activity, and population of soil microflora. Humus formation.

Unit II
Biofertilizers (Agriculturally important beneficial microorganisms): free living, symbiotic (Rhizobial, Mycorrhizal, Actinorhizal), associative and endophytic nitrogen fixers including cyanobacteria. Plant growth promoting rhizobacteria. Role of microbes in soil fertility and crop production. Plant response to biofertilizers application.

Unit III
Biological control of phytopathogens and their mechanism. *Trichoderma* sp. and *Pseudomonas* fluorescens as biocontrol agents. Biopesticide production and application: Bacterial, fungal and viral.

Unit IV
Microbiology at plant-soil interface: rhizosphere, rhizoplane, phyllosphere. Disease suppressive soils. Biodegradation of chemical pesticides. Organic matter decomposition.

Unit V
Microbial transformations of carbon, nitrogen, sulphur, phosphorus and iron in soil. Soil enzyme activities and their importance. Siderophores and antimicrobials.

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Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Discipline Specific Major	MIC-DSM-512	Soil and Agriculture Microbiology (Practical)	2	60	100

Practical Syllabus:

1. Determination of soil microbial population.
2. Demonstration of different types of microbial interactions in soil.
3. Demonstration of organic matter decomposition by soil microflora.
4. Measurement of Phosphate solubilization.
5. Study of rhizosphere effect.

Essential reading

1. Sylvia D.M., Fuhrmann, J.J., Hartel P.J. and Zuberer D.A. (2005) Principles and Applications of Soil Microbiology, 2nd Edn. Pearson, Prentice Hall.
2. Subba Rao N.S. (2001) Soil Microorganisms and plant growth, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Glick B.R. (2015) Beneficial Plant Bacterial Interactions, Springer.
4. Paul E.A. (Ed.) (2015) Soil Microbiology, Ecology and Biochemistry, 4th Edn, Academic Press.
5. Madigan M.T., Bender K.S., Buckley D.H., Sattley W.M. and Stahl D.A. (2017) Brock Biology of Microorganisms, 15th Edn. (Global Edn.), Pearson Education.

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Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Discipline Specific Major	MIC-DSM-611	Food and Dairy Microbiology (Theory)	4	60	100

Course Objectives:
The main objective of this course is to current trends and concepts related to food and dairy products (fermented food), food adulteration, laboratory testing and preventive measures of food borne illness.

Course Learning Outcomes
Upon successful completion of the course, the student:

- Will be able to understand the properties of food and associated microorganism.
- Will get detailed knowledge about principles of food preservation.
- Will be able to understand the concept of fermented foods and spoilage of food using microbes.
- Will get detailed knowledge about fermented dairy products and their health benefits.
- Will get a knowledge about the food infections and food intoxication.

Unit I
Food as a substrate for microorganisms. Natural microflora on food: Bacterial genus (*Lactobacillus*, *Salmonella*), Fungal genus (*Aspergillus*, *Mucor*), Yeast genus (*Saccharomyces*, *Pichia*). Concept of Prebiotics and Probiotic. Methods of microbial enumeration in food (microscopic, CFU count, MPN, MRBT).

Unit II
Principles of physical methods of food preservation: Temperature, Pasteurization (HTST), Canning. Principles of chemical methods of food preservation: Salts and sugar, Organic acids, SO2.

Unit III
Fermented food: Types of microorganisms, fermentation process and production of A) Dahi B) Idli and Dosa, C) Saeurkraut, D) Soy sauce.
Microbial spoilage of foods: Protein rich food (meat, milk), perishable food (fruits, vegetables), canned food.

Unit IV
Dairy microbiology: Natural microflora and sources of contamination of milk. Functional Dairy Products: Definition, fermented milk products, functional dairy products, and therapeutic applications. Health benefits of functional fermented dairy products: such as dahi, kefir, cheese, koumiss, Yakult. Probiotics, Prebiotics.

Unit V
Definition of food infections and food intoxication. Causative agents of food infection: Bacterial (*Salmonella* sp., *E. coli*, *Campylobacter jejuni*), Viral (Rotavirus, Hepatitis A, Poliovirus), Fungal (toxic mushroom, *Aspergillus*). Causative agents of food intoxications:

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Staphylococcus aureus, *Clostridium botulinum* and mycotoxins. Microbial techniques in detecting food-borne pathogens and toxins e.g. ELISA, PCR.

Nature of Course	Course Code	Course Title	Course Credit	Contact Hours	Marks
Discipline Specific Major	MIC-DSM-612	Food and Dairy Microbiology (Practical)	2	60	100

Practical Syllabus:

1. MBRT of milk samples and their standard plate count.
2. Isolation of food borne bacteria from food products.
3. Isolation of food borne fungi from food products.
4. Microscopic examination of mushrooms.
5. Effect of temperature on the spoilage of food products.
6. Isolation of storage fungi from stored food products.

Essential reading:

1. Frazier W.C. and Westhoff D.C. (2008) Food Microbiology, 4th Edn. Tata McGraw Hill Publishing Co., New Delhi.
2. Bamforth C.W. (2005) Food, Fermentation and Microorganisms, Blackwell Science.
3. Doyle M.P. and Buchanan R.L. (Ed.) (2013) Food Microbiology: Fundamentals and Frontiers, 4th Edn. ASM press.
4. Jay J.M., Loessner M.J. and Golden D.A. (2005) Modern Food Microbiology, 7th Edn. Springer Publishers.
5. Robinson R.K. (2002) Dairy Microbiology: Milk and Milk Products, 3rd Edn. Wiley Publishers.
6. Bibek Rey. 1996. Fundamentals of Food Microbiology. CRC Press, London

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