



KADI SARVA VISHWAVIDYALAYA
B.Sc Semester 4 (Microbiology Subject's Syllabus)

KADI SARVA
VISHWAVIDYALAYA,
GANDHINAGAR



B.Sc. Curriculum as Per NEP
Microbiology Subject Syllabus
Semester 4

W.E.F. June 2024



KADI SARVA VISHWAVIDYALAYA
B.Sc Semester 4 (Microbiology Subject's Syllabus)
Microbiology Major Course - 8

MBM233-2C - Enzymology and Microbial Metabolism

LEARNING OUTCOMES:

- Students will gain knowledge about the structure, function, properties, mechanisms, inhibition and regulations of bacterial enzymes as well as their role in metabolism.
- Students will understand the concept of microbial metabolism and various enzymatic reactions involved in metabolic fate of the microorganisms.
- Students will understand the metabolic pathways of the microorganisms on the basis of their source of energy and nutrition.

TEACHING AND EVALUATION SCHEME:

Subject Code	Subject Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Theory Hrs Per Week		Hrs.	Max Marks		
					*CCE	*SEE	
MBM233-2C	Enzymology and Microbial Metabolism	4	4	2.5	50	50	100

Unit I: Enzymes-I

Teaching Hours: 15 (Weightage 25%)

- General Introduction, Physical and Chemical properties of Enzymes
- Structure of enzymes: Active site, Prosthetic group, Apo enzyme, Holoenzyme, Co-enzymes, co-factors.
- Nomenclature and classification of enzymes. IUB system of enzyme classification (1hr)
- Localization of enzymes: Extra cellular and intra cellular
- Mechanism of enzyme action: Transition state theory, Lock and Key and Induced fit model
- Factors affecting enzyme activity.

Unit 2: Unit-II: Enzymes-II

Teaching Hours: 15 (Weightage 25%)

- Enzyme Kinetics- MM Equation (2hr)
- Transformation of MM plot into linear plot(1hr)
- Inhibition of enzyme activity: Competitive, noncompetitive and uncompetitive.
- Irreversible Inhibition(4hr)
- Regulation : Types of regulatory mechanisms: Feedback inhibition, energy linked control, precursor activation, zymogen activation, covalent modification and allosterism (5hr)



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Unit III: Introduction to Metabolism and Carbohydrate metabolism

Teaching Hours: 15 (Weightage 25%)

- An overview of metabolism: Anabolism, Catabolism
- Primary and Secondary metabolites. Role of precursor metabolites in cell metabolism.
- Respiratory and fermentative metabolism:
 - Basic concept of respiration, types of respiration,
 - Basic concept of fermentative metabolism.
- Carbohydrate metabolism:
 - Glycolysis and its regulation
 - TCA cycle and its regulation
 - PPP pathways and its regulation
 - Gluconeogenesis
 - Electron transport chain order and organization of carriers, proton gradient, respiratory controls and oxidative phosphorylation,
 - ATP- synthesis

Unit IV: Lipid, Protein and nucleic acid metabolism: Teaching Hours: 15 (Weightage 25%)

- Lipid metabolism:
 - β oxidation of fatty acids,
 - Ketone bodies –formation and degradation,
- Protein and Amino acid metabolism:
 - Degradation of amino acid.
 - Urea cycle.
 - Nitrogen balance
 - Regulation of amino acid metabolism in microbial system.
- Nucleic acid metabolism:
 - Biosynthesis and degradation of purines and pyrimidines.
 - Structure and Function of Ribonucleotide reductase.

*CCE: Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

*SEE: Semester End Evaluation

Reference Books:

1. Microbiology, Authors- Pelczar, Chan and Kreig.
2. Microbiology- an Introduction- (8th Edn), Authors- Tortora, G.J., Funke, B.R., Case, C.L.
3. General Microbiology, Authors- Stainer, Ingharam, Wheelis and Painter.
4. Biology of Microorganisms, Authors- Brock and Madigan.
5. Fundamental Principles of Bacteriology, Author- A.J. Salle.



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6. Introduction to Microbiology, Authors- Ingraham and Ingraham.
7. Enzymes- Palmer
8. Enzymology- Devsena
9. Elementary Microbiology, Author- H. A. Modi
10. Textbook of Microbiology, Authors- Dubey and Maheshwari.
11. Microbiology, A Practical Approach. Authors- Patel and Phanse
12. Experiments in Biotechnology. Authors- Nighojkar and Nighojka
13. General Microbiology, Authors- Powar and Daginawala.
14. Fundamentals in Microbiology, Authors- Frobisher and Hinsdinn.
- 15. Microbiology, Author- S.S. Purohit.**
- 16. Microbiology, Author- R.P.Singh.**



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Microbiology Major Course -9

MBM234-2C - Molecular Genetics of Prokaryotes

LEARNING OUTCOMES:

- Enabling the students to acquire the basic understanding of microbial genetics and their genome organization.
- Enabling the students to know and understand the basics of replication, transcription, translation and regulation of gene expression in prokaryotes.
- Students will acquire basic knowledge of gene transfer and simple outline of how the gene can be transferred from one to the other organism and knowledge on mutation and repair mechanism.

TEACHING AND EVALUATION SCHEME:

Subject Code	Subject Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Theory Hrs Per Week		Hrs.	Max Marks		
					*CCE	*SEE	
MBM234-2C	Molecular Genetics of Prokaryotes	4	4	2.5	50	50	100

Unit1: Introduction of Genetics

Teaching Hours: 15 (Weightage25%)

➤ **Nature of Genetic material**

- Understanding of terms: Gene, allele, genotype, phenotype, intron, exon, cistron, recon, muton, plasmid, chromosome, genome, zygote, merozygote, CRISPR.
- Experimental proof for Nucleic acid as genetic material: Work of Griffith; Avery, McCarty and MacLeod; Hershey and Chase

➤ **Gene structure and function**

- Chemistry of DNA, Watson and Cricks model of DNA structure
- Typical gene structure, functions of gene

Unit2: DNA replication and gene transfer

Teaching Hours: 15 (Weightage25%)

➤ **DNA Replication**

- Semi conservative nature, Meselson and Stahl's experiment
- Molecular mechanism: Strand separation, formation of leading and lagging strand, formation of Okazaki fragments and their removal, proof reading.
- Post-replicative modifications and their significance.

➤ **Gene Transfer**

- Fundamentals of Horizontal and vertical gene transfer, merozygotic system
- Transformation: Competence, DNA uptake in Gram positive and Gram negative bacteria
- Transduction: Generalized and restricted transduction
- Conjugation: Role of sex factor, transfer of genes during $F^+ \times F^-$, $Hfr \times F^-$ and sexduction
- Transposable elements: General Characteristics, Transposition, Insertion sequences (IS) and Tn elements.



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Unit 3: Gene Expression in Prokaryotes

Teaching Hours: 15 (Weightage 25%)

- **Transcription**
 - Initiation, role of enzyme, sigma factor, promoter, operator
 - Elongation
 - Termination: Rho dependent and Rho independent
- **Genetic Code:** Characteristics - Triplet nature, polarity, degeneracy, near universality and Wobble phenomenon
- **Translation:**
 - Initiation, 70 S initiation complex
 - Elongation: recognition, peptidyl transfer, translocation
 - Termination
 - Fate of ribosomes, polysome system, polycistronic RNA
- **Regulation of Gene Expression:**
 - Negative inducible control - lac operon
 - Negative repressible control - trp operon

Unit-4: Mutation & Repair

Teaching Hours: 15 (Weightage 25%)

- **Introduction**
 - Spontaneous and induced mutations, proof for spontaneity of mutation by replica plate method
 - Effect at DNA level, transition, transversion, insertion, deletion, development of A-P Sites
- **Molecular basis of mutation**
 - Chemical mutagenesis: 5-bromouracil, nitrous acid and acridine orange
 - Physical mutagenesis: Ultraviolet radiations
 - Biological Mutagenesis: Phage Mu,
- **Consequences of mutation**
 - Forward - silent, missense, nonsense, frame shift
 - Reverse – true reversion, suppressions (intragenic and extragenic only)
- **Repair mechanisms**
 - Direct repair: Photoreactivation, removal of A-P sites
 - Indirect repair: Excision repair, mismatch repair
 - SOS regulatory system

*CCE: Continuous and Comprehensive Evaluation: It consists of Assignments /Seminars/ Presentations /Quizzes/Surprise Tests.

*SEE: Semester End Evaluation

Reference Books:

1. Genetics a Conceptual Approach Author- B. Lewin.
2. Genes XI, Author- B. Lewin.
3. Willey, Joanne M; Sherwood, Linda; Woolverton, Christopher J; Prescott, Lansing M. (2008). Prescott Harley Kleins Microbiology. 7th edition. McGraw-Hill Higher Education.
4. Principles of Genetics, Authors- Gardner, Simmons and Snustad.
5. Concepts of Genetics, Authors- Klug and Cummings.
6. Microbial Genetics, Authors- Freifelder.
7. Genetics, Authors- Arora and Sandhu.



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Microbiology Major Course -10

MBM235-2C - Microbiology Practical- IV

LEARNING OUTCOMES:

- Students will understand the concept of nutrition and metabolism in the bacteria.
- Students will develop an understanding of the enzyme activity and various parameters affecting to the enzyme activity.
- Students will gain knowledge on methods on mutagenesis.

TEACHING AND EVALUATION SCHEME:

Subject Code	Subject Title	Teaching Scheme	Credits	Examination Scheme			Total Marks
		Practical Hrs Per Week		Hrs.	Max Marks		
					CCE	SEE	
MBM235-2C	Microbiology Practical- IV	8	4	5	50	50	100

Unit-1	Teaching Hours : 60	(Weightage: 50%)
<ol style="list-style-type: none">1. Carbohydrate metabolism test: Sugar fermentation test, M-R test, V-P test, Citrate utilization test, TSI test,2. Nitrogen Utilization test: Indole, H₂S, Phenyl alanine, Ammonia3. Enzyme detection test: Amylase, Protease, lipase, catalase, urease, nitrate reductase, oxidase, Dehydrogenase, gelatinase, Deaminase, Decarboxylase4. Estimation of activity of enzymes like amylase, acid phosphatase5. Effect of pH on enzyme activity.6. Effect of temperature on enzyme activity.7. Effect of substrate concentration on enzyme activity.8. Effect of enzyme concentration on enzyme activity		
Unit 2	Teaching Hours : 60	(Weightage: 50%)
<ol style="list-style-type: none">1. To study UV survival in <i>E.coli</i>.2. To isolate UV induced lac- Mutants.3. To Isolate Pigment Mutants of <i>Serratia</i> sp.4. Isolation of antibiotic resistant mutants by gradient plate technique.5. Isolation of Streptomycin resistant mutant by Replica plate method.6. To isolate bacterial Genomic DNA.7. To isolate fungal Genomic DNA.		

Reference Books:

- Rakesh Patel. Experimental Microbiology. Delhi Aditya Book Centre.



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Microbiology Minor Course – Semester 4

MBE221-2C - Analytical Techniques in Microbiology-I

LEARNING OUTCOMES:

- Students will learn the principles and applications of different analytical techniques.
- They will also learn the core aspects of instrumentation involved in conducting experimental research in the fields of biosciences.

TEACHING AND EVALUATION SCHEME:

Subject Code	Subject Title	Teaching Scheme Per Week		Credits	Examination Scheme			Total Marks
		Theory Hrs Per Week	Practical Hrs Per Week		Hrs.	Max Marks		
						CCE	SEE	
MBE221-2C	Analytical techniques in Microbiology- I	2	4	4	2.5	50	50	100

Unit 1: Spectrophotometry ➤ Properties of EMR ➤ Electromagnetic spectrum ➤ Interaction of EMR with matter: absorption, emission, fluorescence ➤ UV-Visible Spectroscopy: Principle, Instrumentation and Application ➤ Atomic Absorption Spectroscopy: Principle, Instrumentation and Application ➤ Flame Photometry: Principle, Instrumentation and Application	Teaching Hours: 15
Unit 2: Centrifugation ➤ Definition: Centrifugation, Basic Components of centrifuge, Types of rotors ➤ Basic Principles of Sedimentation, Sedimentation Coefficient and Factors affecting rate of sedimentation ➤ Types of Centrifuges : Benchtop, Clinical, High speed and Analytical ➤ Ultracentrifugation <ul style="list-style-type: none"> • Introduction • Analytical Centrifuge: Introduction, components and applications of Analytical Centrifuge • Preparative Centrifuge: Introduction, Types: Differential centrifugation and Density Gradient Centrifugation (Rate Zonal and Isopycnic) and applications of Preparative Centrifuge. 	Teaching Hours: 15
Practicals 1. Determination of λ (Absorption Maxima -wavelength selection) 2. Quantitative estimation of DNA by DPA method. 3. Quantitative estimation of RNA by Orcinol method. 4. Isolation and Detection of Mitochondria from Leaves. 5. Isolation and Detection of Chloroplast from Leaves. 6. Estimation of Potassium by Flame Photometry.	Teaching Hours: 60



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Reference Books:

1. Principles and techniques of biochemistry & molecular biology by Keith Wilson & John Walker
2. Instrumental methods of analysis by B. Sivasankar
3. Biophysical chemistry: Principle and techniques by Upadhyay & Nath
4. Instrumental methods of analysis by Willard, Merritt, Dean & Settle
5. Instrumental analysis by D.A. Skoog, Holler & Crouch
6. Physical Biochemistry by David Freifelder
7. Instrumental Methods of Chemical Analysis by Chatwal G and Anand, S.
8. Chemical analysis and Instrumentation by B.k.Sharma



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Microbiology SEC (Skill Enhancement Course) – Semester 4

SEC265-2C- Food Microbiology

LEARNING OUTCOMES:

- Acquire & remember the microbes causing food intoxications and food infections.
- Understand the significance and activities of microorganisms in food the role of intrinsic and extrinsic factors on growth and survival of microorganisms and attain information on microbial food spoilage.
- Understand the principles in traditional food preservation techniques.

TEACHING AND EVALUATION SCHEME:

Subject Code	Subject Title	Teaching Scheme		Credits	Examination Scheme			Total Marks
		Per Week			Hrs.	Max Marks		
		Theory Hrs Per Week	Practical Hrs Per Week			CCE	SEE	
SEC265-2C	Food Microbiology	2	0	2	2	25	25	50

<p>Unit 1 Introduction to food microbiology and Fermented foods Teaching Hours: 15</p> <ul style="list-style-type: none"> ➤ Introduction to food microbiology, Scope of food microbiology ➤ Historical development of food science and technology. ➤ Classification of food in relation to shelf life. ➤ Food as substrate for microorganisms ➤ Microbiology of fermented milk - Starter lactic cultures, ➤ Fermented milk products: Curd, Yogurt, Butter and Cheese, other fermented foods: Idli, Bread. ➤ Nutritional value of fermented foods. ➤ Microorganisms as food: Single Cell Protein, Edible Mushrooms. ➤ Probiotics: definition and uses.
<p>Unit 2 Microbial Food Spoilage, food poisoning and Preservation Teaching Hours: 15</p> <ul style="list-style-type: none"> ➤ Significance of Microorganisms in Foods. ➤ Microbial food spoilage <ul style="list-style-type: none"> • Importance of food spoilage • factors affecting growth and survival of microorganisms in food, • Natural sources of microbial contamination of food, different types of spoilages, • microbes involved in food spoilage: meat, poultry, vegetables, canned foods and dairy products; • Methods for detection of microorganisms in food: Meat, Dairy, Sea foods, Vegetables: Physical, Chemical, Immunological and Biochemical assays.



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- **Food poisoning**
 - Definition of food poisoning, food infections and toxications.
 - Causative agents, foods involved symptoms and preventive measures.
 - Food intoxications: *Staphylococcus aureus*, *Clostridium botulinum*
 - Important microbes secreting toxins, chemical nature of important toxins; Mycotoxins.
 - Food borne infections: *Bacillus cereus*, *Escherichia coli*, *Shigella*, *Listeria monocytogenes*.
- **Food preservation:**
 - Introduction to preservation, types of preservation, natural and artificial preservative agent, class I, II and III preservative agents,
 - Methods of preservation:
 - Physical methods of food preservation: High and Low temperature, Pasteurization, types (canning, drying); High pressure and Irradiation.
 - Chemical methods of food preservation: salt, sugar, organic acids, SO₂ and antibiotics

Reference Books:

1. Essentials of Food Microbiology. Edited by John Garbult. Arnold International Students Edition.
2. Microbiology, Authors- Pelczar, Chan and Kreig.
3. Microbiology of Foods by John C. Ayres. J. OrwinMundt. William E. Sandinee. W. H. Freeman and Co.
4. Bacterial Pathogenesis A Molecular Approach. 2nd Edition.2001 by Abigail A.Salyersand Dixie D. Whitt. ASM Publications.
5. Food Microbiology: Fraizer
6. Frazier WC and West off DC. (1988) Food microbiology, TATA McGraw Hill Publishing Company Ltd. New Delhi.
7. Adams MR and Moss MO. (1995). Food Microbiology, The Royal Society of Chemistry, Cambridge.
8. Biotechnology by R.C. Dubey, S. Chand publishers