



A Charutar Vidya Mandal Institution
V.P. & R.P.T.P. SCIENCE COLLEGE (AUTONOMOUS)
(Grant-in-Aid Institution)
Affiliated to Sardar Patel University
Vallabh Vidyanagar – 388120
(Bachelor of Science)(Undergraduate)
Syllabus effective from June 2026



B. Sc. (UG) Semester-V NEP (Autonomous)

Course Code	US05MAMIC01	Title of the Course	Bacterial Genetics
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	• The course is structured with the aim to fulfill the objective of introducing basic concepts of molecular biology to the under graduate students of Microbiology. • To impart detailed knowledge regarding flow of genetic information in prokaryotes, steps of central dogma of life, replication of genetic material, transcription and translation. • To know about mutations in genetic material and its repair mechanisms. • To make students understand that knowledge of molecular genetics helps to understand mechanisms of gene transfer among prokaryotes & evolution.
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Course Content		
Unit	Description	Weight age* (%)
1.	Gene structure and Replication in prokaryotes a) DNA as hereditary material b) Structure and chemistry of DNA c) Watson and crick model of DNA d) Forms of DNA e) Genetic structure of Bacteria f) DNA replication in prokaryotes: • Introduction • Semi conservative nature of DNA replication • Mechanism of DNA replication in <i>E.coli</i> • Models of DNA replication : Rolling circle model • Replication of linear chromosomes.	25%



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2.	Gene Expression a) Central Dogma of gene expression b) Transcription in bacteria: • Introduction • RNA polymerase (structural components and role) • Promoter • Mechanism of transcription in <i>E.coli</i> (initiation, elongation, rho factor dependent and factor independent termination of transcription) c) Concept of Teminism and RNA based RNA Synthesis d) Translation in bacteria: • Ribosome: structure and role • tRNA :structure and role • Genetic code: features (Triplet and non overlapping nature, Polarity, near universality, Initiation and termination cordons, Degeneracy, Wobble phenomenon) • Mechanism of protein synthesis in <i>E.coli</i> (activation of amino acids, charging of tRNA, Initiation , elongation and termination) e) Regulation of gene expression at the level of transcription initiation (Lactose operon)	25%
3.	Gene Variation (mutations) and repair. a) Introduction b) Types of mutation c) Spontaneous mutation : • Introduction • Evidence of spontaneous mutation(fluctuation test, replica plate technique) d) Chemical and physical mutagenic agents: • U.V. radiation, 5BU, Nitrous acid, EMS, Acridine dyes e) Detection and isolation of mutants : • Auxotrophic mutants, Antibiotic resistant mutants. f) Mutagenicity and carcinogenicity testing : (Ame'stest) g) DNA repair mechanisms: • Proofreading, Photo reactivation, Mismatch, Excision, Recombination and SOS.	25%



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4.	Gene transfer among bacteria a) Fundamentals of gene transfer • Zygote, Allele, Recombination, Horizontal and Vertical gene transfer, formation of merozygote and its fate. b) Bacterial plasmids: • General properties, functional types of plasmid, c) Transposable elements: • Insertion sequences, composite transposons, • Mechanism of transposition: simple and replicative transposition d) Gene transfer mechanisms: i) Transformation: • Introduction, Discovery • Competence, binding, uptake and integration of foreign DNA fragment • Mechanism of transformation in <i>Streptococcus pneumoniae</i>, <i>Neisseria gonorrhoea</i> and <i>Haemophilus influenzae</i> ii) Transduction: • Introduction, Discovery • Generalized and Specialized transduction iii) Conjugation: • Introduction, Discovery • Structure of F-plasmid Hfr strain, F' strain • Formation of mating pair and the outcome($F^+ \times F^-$,Hfr Conjugation, F' conjugation)	25%
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Teaching-Learning Methodology	The teaching- learning process will consist of lectures (large group) in which the teacher will use aids such as chalk as well as make power point presentation to introduce the topics encompassing the basic concepts of the subject. Model making of DNA and RNA structures, Seminars, poster presentations, Visualization of various mechanisms by showing educational videos from internet. Arranging debates in class. Performing experiments in laboratory.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weight age
1.	Internal Written / Practical Examination Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance	50%
2.	External University Examination	50%

Course Outcomes:
Having completed this course, the learner will be able to:
Understand the importance of the master molecule “nucleic acid”, get knowledge of DNA and RNA structures, genome organization of prokaryotes, gene structure and function.
Understand about mechanism of prokaryotic DNA replication and machinery of DNA replication.
Gets knowledge regarding Central Dogma of gene expression and all steps of the central dogma in detail like transcription, translation, replication and reverse transcription. Know about regulation of gene expression.
Understand about various RNAs, Ribosome, genetic code and their role in protein synthesis.
Understand how mutations and repair of genetic material influence evolutionary process. And will get information regarding chemical and physical mutagenic agents, types of mutations and DNA repair.
Understand recombination of bacteria. Understand about the three well known mechanisms by which the genetic material is transferred among the microorganisms namely transformation transduction and conjugation.
Are able to describe different types of plasmids and transposable elements and understand the consequences of recombination



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Suggested References:

- Prescott L, Harley J P, and Klein D A, Microbiology, 9th edition. Wm C.Brown - McGraw Hill, Dubuque, IA ltd.
- General Microbiology, by C.B. Powar and H.F. Dagainawala, volume-I, Himalaya Publishing House, Reprint-2002
- Principles of Molecular Biology by Veer Bala Rastogi Revised and enlarged 2nd edition, MEDTECH.
- Biochemistry by Lehninger, Nelson and Cox, 4th Edition.
- Principles of Microbiology 2nd edition– R.M. Atlas



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B.Sc.(Microbiology)Semester– V

Course Code	US05MAMIC02	Title of the Course	Microbial Metabolism
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	To make the students familiar with: • Microbial Metabolism • Principle of Thermodynamics • The structure, Role and Different modes of ATP generation in bacteria. • The enzymes, enzyme kinetics and their regulation. • The introduction of the Biochemical pathways for degradation and biosynthesis of Carbohydrate, Lipid & Proteins as well as biosynthesis of peptidoglycan • Photo phosphorylation and CO₂Assimilation
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Course Content		
Unit	Description	Weight age (%)
1.	Principles of bioenergetics a) Biochemical thermodynamics b) ATP (Structure and role) c) Biochemical mechanisms of ATP generation: -Oxidative phosphorylation:- ETC: organization, components and mechanism of oxidative phosphorylation includes- Chemiosmotic theory, ATP Synthase & Rotational catalysis d) Substrate level phosphorylation e) Photo phosphorylation (cyclic and non-cyclic)	25



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2.	Enzymology: a) Enzyme Kinetics i. Definition : Zero and First order reaction ii. Substrate saturation curve: Michaelis -Menten Equation- Equilibrium and Steady state assumption, significance of M-M equation iii. Definition of K_m, Turn over number (K_{cat}), Specificity constant(K_{cat}/K_m) iv. Double reciprocal plot b) Regulation of enzyme action: i. Allosteric, Covalent modification, Feedback inhibition ii. Enzyme inhibition : Reversible-(Competitive, Non-Competitive, Uncompetitive and Mixed), Irreversible iii. Introduction to Zymogen and Isoenzymes iv. Multi substrate reactions	25
3.	Catabolism a) Introduction i. Introduction to Metabolism, Catabolism and Anabolism ii. Role of precursor metabolites in metabolism b) Carbohydrate Catabolism : i. EMP pathway, Regulation of Glycolysis, PP Pathway, ED pathway ii. TCA cycle and its energetic, Regulation of TCA, Anaplerotic reactions, Glyoxylate cycle c) Lipid Catabolism: i. α, β and ω oxidation of fatty acids ii. Beta oxidation of saturated fatty acids-Palmitic acid and its energetic. d) Protein Catabolism: i. Deamination: - Oxidative deamination, Transamination, Stickland reaction ii. Urea cycle e) Fuelling reaction in Anaerobic chemotrophs: Anaerobic respiration, Fermentation	25



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4	Anabolism a) Introduction i. Strategies of biosynthesis ii. Methods of studying intermediary metabolism (Use of Biochemical mutants, Pulse labeling technique) b) Carbohydrate Biosynthesis:- i. Gluconeogenesis , ii. Reductive TCA cycle iii. Calvin-Benson cycle c) Lipids Biosynthesis:- i. Biosynthesis of saturated fatty acid d) Biosynthesis of amino acids:- i. Aromatic family e) Biosynthesis of peptidoglycan	25
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Teaching- Learning Methodology	The major teaching- learning consists of lectures and discussions (large group) in which the teacher makes a use of chalk and talk as well as power point presentation and Video animation to introduce the learning objectives related to the basic concepts of the subject. These sessions incorporate space for participation and involvement of students through questions. The student's participation in laboratory on related theoretical
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weight age
1.	Internal Written / Practical Examination Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance	50%
2.	University External Examination	50%



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Course Outcomes :Having completed this course, the learner will be able to	
1.	Conceptualize their understanding of Microbial Metabolism
2.	Understand the Principle of Thermodynamics
3.	Describe the structure, role and different modes of ATP generation in bacteria.
4.	Gain knowledge of Enzymes, Enzyme kinetics and their regulation.
5.	Understand the Biochemical pathways for degradation and biosynthesis of carbohydrate, lipid & proteins and also biosynthesis of peptidoglycan
6.	Understand the photo phosphorylation and CO ₂ Assimilation

Suggested References:	
1.	Biochemistry by Lehninger, Nelson and Cox (4 th edition)
2.	Principles of Biochemistry by Zubey G. L.(1 st edition)
3.	General microbiology by Stanier R.Y. (5 th edition)
4.	Biochemistry, by U. Satyanarayan (5 th edition)
5.	Microbiology by Pelczar, Kreig & Chan (5 th edition)
6.	Enzymes Biochemistry, Biotechnology, Clinical chemistry by T. Palmer (2 nd edition)
7.	Outline of Biochemistry by Conn and Stump (5 th edition)
On-line resources to be used if available as reference material	



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B.Sc. (Microbiology) Semester V

Course Code	US05MAMIC03	Title of the Course	Microbiology Practical
Total Credits of the Course	04	Hours per Week	08

Course Objectives:	- Some basic techniques to study mutation, are given with the aim to full fill the objective of introducing basic concepts of molecular biology to the under graduate students of Microbiology. - To conceptualize their understanding of Microbial Metabolism, qualitative and quantitative analysis of bio molecules through various fundamental techniques like titrimetric estimation, colorimetric estimations and chromatographic techniques are kept. - To gain knowledge of enzymes, enzyme kinetics, enzyme assays, exercise is introduced.
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Course Content based on core theory papers		
No	Practical Section-	Weight age (%)
1.	Study of microbicidal effect of UV rays	100%
2.	Isolation of anantibiotic resistant mutant bacterium. (gradient/ replica/ grid plate technique)	
3	Isolation of pigment less mutant of <i>Serratia marcescens</i> using UV radiations as mutagen	
4.	Isolation of <i>lac</i> — mutants of <i>Escherichia coli</i> using UV radiations as mutagen.	
5	Reducing sugar(Glucose/ Jaggery) estimation by Cole's method	
6	Reducing sugar (Glucose) estimation by DNS method	
7.	Protein estimation by Folin's method	
8	Separation and identification of amino acids by Thin layer Chromatography (TLC) and determination of Rf value.	
9	Substrate saturation curve: study of Km and Vmax for invertase. (Group experiment)	
10	Study of Minimum inhibitory concentration (MIC) of an antibiotic for a well isolated bacterium.	



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No	Practical Section-2
11	Study of Biochemical reactions Based on Carbon source 1. Oxidative and fermentative breakdown of glucose 2. Fermentation of Sugars: Glucose, Lactose, 3. Glucose break down products: Methyl red test, Voges Proskauer's test 4. Citrate utilization test
12	Study of Biochemical reactions Based on Nitrogen source 1. Indole production test 2. H ₂ S production test 3. Urea utilization test 4. Casein hydrolysis test 5. Gelatin Hydrolysis test 6. Deamination test 7. Ammonia production test 8. Nitrate reduction test
13	Study of Biochemical reactions : Other tests 1. Catalase test 2. Dehydrogenase test 3. Oxidase test

Teaching-Learning Methodology	• By briefing them with the theoretical aspects as well as providing them with the protocol (Aim, Requirements and Procedure) of the experiment to be performed using chalk and duster as well as power point presentation. • Students are trained for microscope observations and its handling. • Demonstrations of the practical are also carried out and care is taken for aseptic handling and skill development for microbiological work in the laboratory
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Evaluation Pattern		
Evaluation of practical at University level requires evaluation for minimum three exercises for Performance, well documented certified Journal and a viva voce.		
Sr. No.	Details of the Evaluation	Weight age
1	Internal Written / Practical Examination (As per CBCS R.6.8.3) Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Journal, Attendance (As per CBCS R.6.8.3)	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Understand effect of mutagenic agents, phenotypic change and the event of mutations. Will get information and experience regarding chemical and physical mutagenic agents
2.	Will get skills for analysis of bio molecules and enzyme assays. Also gets concept of metabolism of various compounds and develops idea regarding metabolic diversity in bacteria.
3.	Skills are developed for estimations of various compounds by titrimetric and colorimetric methods.

Suggested References:	
Sr. No.	References
1.	Practical protocols and guidelines given in laboratories.
2.	Microbiology : A Practical Approach – Dr Bhavesh Patel and Dr Nandini Phanse
3.	Experimental Microbiology - Rakesh J.Patel& Kiran R. Patel, Volume I& II