

**KRANTIGURU SHYAMJI KRISHNA VERMA KACHCHH UNIVERSITY,
BHUJ.**

Year: 2026-2027



SYLLABUS (NEP)

**PG
M.Sc. Semesters: I
(ONE)**

MICROBIOLOGY

FACULTY OF SCIENCE

**Curriculum as per UGC Guideline
Framed according to National Education Policy (NEP) - 2020**



Structure of the Question Paper (Theory) for the University Exam

KACHCHH UNIVERSITY
FIRST YEAR PG M.Sc.; NEP SEMESTER-I (FIRST)
MICROBIOLOGY

PAPER NAME: Microbial Diversity and Evolution/ Molecular
Biology/Environmental Microbiology/Cell Biology

PAPER CODE: MJMB-101/102/103/MNMB-104.

Total Marks:50, passing standard : 20 marks (Time: 120 minutes)

PATTERN OF QUESTION PAPER
FOR SEMESTER END EXAMS

Questions	Section	Marks
Question – 1, Unit – I	(Descriptive - Essay type – Short notes <i>with internal option</i>) 2 out of 3	10 marks
Question – 2, Unit –II	–do–	10 marks
Question – 3, Unit – III	–do–	10 marks
Question – 4, (Unit- IV)	–do–	10 marks
Question – 5,(Unit I to IV)	(10 out of 12) 1 Marks Each	10 Marks

- The examination pattern of the university is around 50% external and 50% internal.
- Types of questions for Question 5 may be varied like: definitions / reasoning / drawing small figures/ label the figure / fill in the blanks / multiple choice questions/ one word answer / match the pairs etc.
- Project work/ Visit/ Tour/ Charts/ Model/ Given by teacher or as a part of Syllabus) will be mandatory for all the students.



KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-I (ONE)
 (Effective from June 2026-27 UNDER NEP-2020)
PAPER NAME: Microbial Diversity and Evolution
(PAPER CODE NO.: MJMB 101) Credit-4

Course Outcomes (COs): Upon completing this course, students will be able to learn the evolutionary relationships and taxonomic classifications of microbes, while distinguishing the structural, physiological, and ecological characteristics of major bacterial and archaeal groups.

UNIT-I	Microbial taxonomy and evolution (14h)	15 Hours
	1. Types of classification: Phenetic, Phylogenetic and Genotypic; Basis of each classification, advantages and limitation 2. Taxonomic ranks and Phylogenetic trees 3. Evolution of three domains of life and concept of microbial species 4. Microbial evolution processes 5. Bergey's Manual of systematic bacteriology	
UNIT-II	Characters of some important group of bacteria- 1	15 Hours
	1. Classification of archaea 2. Crenarchaeota: Pyrodictium, Sulfolobus 3. Euryarchaeota: Methanobacterium, Halobacterium 4. Cyanobacteria: anabaena	
UNIT-III	Characters of some important group of bacteria- 2	15 Hours
	1. Green sulfur and non-sulfur bacteria 2. Purple sulfur and non-sulfur bacteria 3. Firmicutes: Mycoplasma, Bacillus 4. Actinobacteria: Streptomyces, Frankia, Mycobacterium and Nocardia	
Unit-IV	Characters of some important group of bacteria- 3	15 Hours
	1. Alpha proteobacteria: Wolbachia, Rickettsia, Rhizobium,	



	Agrobacterium, Azospirillum. Acetobacter 2. Beta proteobacteria: Thiobacillus, Neisseria, Nitrosomonas 3. Gamma proteobacteria: Pseudomonas, Enterobacteriales (order) 4. Delta proteobacteria: Bdellovibrio 5. Epsilon proteobacteria: Helicobacter	
--	---	--

REFERENCE BOOKS:

1. Madigan, M.T., Bender, K.S., Buckley, D. H., Sattley, W.M, Stahl, D.A. (2018). Brock Biology of Microorganisms, 15th edition, Pearson. USA. **ISBN-13: 9780134261928**
2. Pelczar, M. J., Chan, E. C. S., Krieg, N. R. (2019). Microbiology. McGraw-Hill.
3. Tortora, G., Funke, B., Case, C., Weber, D., Bair, W. Microbiology: An Introduction. 13th edition, Addison-Wesley.



KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-I (ONE)
 (Effective from June 2026-27 UNDER NEP-2020)
PAPER NAME: MOLECULAR BIOLOGY
(PAPER CODE NO.: MJMB 102) Credit: 4

Course Outcomes (COs): Upon completing this course, students will be able to evaluate the structural organization of genes and chromosomes, apply the principles of classical and population genetics, and explain the molecular mechanisms of DNA replication and gene regulation in prokaryotes and eukaryotes.

UNIT-I	Genes and Chromosomes	15 Hours
	1. Fine structure of Gene, Split Genes, Overlapping Genes, Pseudogenes, Non- coding Genes and multi-gene families. 2. Structure and organization of eukaryotic Chromosomes: Basic structure, Heterochromatin, Euchromatin, Histones, DNA, Nucleosome morphology and higher level organization (Super coiled loops, domains and scaffolds in eukaryotic chromosome), C-value Paradox 3. Giant Chromosomes: Polytene and Lampbrush chromosomes 4. Genomic organization of Prokaryotic & Eukaryotic cells	
UNIT-II	Classical Genetics	15 Hours
	1. Mendelian inheritance: Inheritance patterns & Laws of Heredity 2. Gene Interaction: Allelic Interaction (Dominance, Incomplete Dominance & Co-Dominance), Non-allelic Interaction (Supplementary, Complementary & Duplicative genes, Epistasis) 3. Linkage & Linkage Maps	
UNIT-III	Population Genetics And Replication	15 Hours
	1. Sex Determination and Extra Chromosomal Inheritance 2. Genetic polymorphism, Genetic Drift & Hardy Weinberg Law of equilibrium 3. Mechanism of Replication process in Prokaryotic & Eukaryotic DNA, Fidelity of Replication, Telomere Synthesis-Role of	



	Telomerase, Inhibitors of Replication	
UNIT-IV	Regulation of Gene expression in Prokaryotes & Eukaryotes	15 Hours
	1. Operon concept- Inducible and repressible systems(His Operon) Attenuation & Termination 2. Chromatin modification & Gene expression - Histone acetylation & Deacetylation 3. Gene silencing- DNA Methylation, RNAi pathway (si RNA and mi RNA)	

Reference Books:

1. Watson, J. D., Baker, T. A., Bell, S. B., Gann, A., Levine, M., & Losick, R. (2008). Molecular biology of the gene. 6th edn. New York: Pearson Education.
2. Lewin, B. (2008). genes IX. Mc Graw-Hill Interamericana
3. Griffiths, A. J. F., Gilbert W. M., Lewontin, R.C. & Miller, J. H. (2002). Modern Genetic Analysis, Integrating Genes and Genomes. 2nded, W.H.Freeman
4. Brown, T. A. (2006). Genomes. Garland science
5. Weaver, W. (19100). Molecular biology: Origin of the Term. Science.
6. Winnacker, E. L. (1987). From genes to clones: introduction to gene technology. VCH Verlagsgesellschaft.
7. Brooker, R. J. (1999). Genetics: Analysis and Principles. Addison-Wesley.
8. Friefelder, D. (1985). Essentials of Molecular Biology. Jones and Bartlett.
9. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J. D., & Grimstone, A.V. (1995). Molecular Biology of the Cell. 3rd edn. Trends in Biochemical Sciences, 20(5), 215-215.



KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-I (ONE)
 (Effective from June 2026-27 UNDER NEP-2020)
PAPER NAME: ENVIRONMENTAL MICROBIOLOGY
(PAPER CODE NO.: MJMB-103) Credit: 4

Course Outcomes (COs): Upon completing this course, students will be able to evaluate the biological mechanisms, technologies, and systems used in aerobic and anaerobic waste treatment, while applying microbial strategies such as bioremediation, bioaugmentation, and phytoremediation for environmental cleanup.		
UNIT-I	Principles of Waste Treatment	15 Hours
	Biochemistry and Microbiology of inorganic phosphorus and nitrogen removal. Suspended growth technologies: Activated sludge, oxidation ditches, waste stabilization ponds. Fixed film technologies: Trickling filters, rotating biological contactors, fluidized bed and submerged aerated filters	
UNIT-II	Techniques of Waste Treatment	15 Hours
	1. Toxicity testing in waste water treatment plants using microorganisms. 2. Anaerobic digestion: microbiological and biochemical fundamentals, factors influencing anaerobic digestion. 3. Anaerobic waste water treatment systems: RBC, UASB, anaerobic filters. Merits and demerits of anaerobic treatment of waste.	
UNIT-III	Bioremediation MEOR Bioaugmentation	15 hours
UNIT-IV		15 Hours
	Biostimulation Phytoremediation Remediation of Oil Spills	



REFERENCE BOOKS:

1. Microbiology, Pelczar, M. J. Chan, E.C.S., Krig, N.R., McGraw – Hill Book Co.
2. Biotechnology-Rehm and Reid.
3. Waste water microbiology by G. Bitton
4. Biodegradation and bioremediation by M. Alexander
5. Waste water treatment for pollution control, 2nd edition. Arceivala
6. Environmental Biotechnology by H. Jordening and Josef Winter .
7. Comprehensive Biotechnology Vol-4, Murray Moo Young.



KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-I (ONE)
 (Effective from June 2026-27 UNDER NEP-2020)
PAPER NAME: CELL BIOLOGY
(PAPER CODE NO.: MNMB-104) Credit: 4

Course Outcomes (COs): Upon completing this course, students will be able to analyze the molecular mechanisms of cell signalling and cell cycle regulation, evaluate the genetic basis and diagnostic methods of cancer, and explain the structural and functional dynamics of the endomembrane system and cytoskeleton.

UNIT-I	Cell signalling	15 Hours
	1. Molecular basis of signal transduction: Basics of signal molecules, receptors and transduction 2. Signaling through G-Proteins: GPCR, mechanism, role of cAMP in bacterial toxins 3. Enzyme linked cell surface receptors: Types of receptor, mechanism, MAP kinase pathway and JAK STAT pathway. 4. Secondary messenger system: cAMP, cGMP, DAG, IP ₃ and Ca ⁺⁺	
UNIT-II	Cell cycle, its regulation and apoptosis	
	1. Molecular aspects of cell cycle: phases of cell cycle, mitosis and meiosis 2. Regulation of cell cycle events & check points 3. Role of protein kinase in cell cycle: CDK-cyclins, CDK activating kinases, CDK inhibitors, phosphorylation and dephosphorylation of MPF, anaphase promoting complex. 4. Phenomena of Apoptosis: Basic introduction, morphological changes.	
UNIT-III	Molecular biology of cancer	15 Hours
	1. Basic introduction of tumor and cancer, characteristics of cancer cells 2. Genetic basis of cancer: tumor suppressor genes (p53, retinoblastoma) and their functions	



	3. Genetic basis of cancer: proto-oncogenes, conversion of proto-oncogenes to oncogenes, viral oncogenes. 4. Early detection & molecular diagnosis of cancer: biochemical assay, pap smear, histopathology, ames test, comet assay, mammogram, DNA fragmentation assay and nanotechnology. 5. Cancer treatment present & future: surgery, radiation, chemotherapy.	
UNIT-IV	Endo-membrane system and cytoskeleton	15 Hours
	1. Structure and function of microbodies, golgi body, lysosomes & endoplasmic reticulum 2. Microtubules: Structural organization and dynamics, role of tubulin, cilia and flagella. 3. Microfilaments: G and F actin, dynamics of actin assembly, functional role of actin filaments. 4. Motor Proteins: dynein, kinesin and myosins; mechanism of muscle contraction 5. Intermediate filaments.	

REFERENCE BOOKS:

1. Cooper, G. M., & Hausman, R. E. (2013). *The cell: A Molecular Approach*. 6th Edition. Sunderland: Sinauer Associates Inc.
2. Karp, G. (2013). *Cell and Molecular Biology: Concepts and Experiments*. 4th Edition. John Wiley & Sons.
3. Albert, B., Johnson, A., Lewis, J., Raff, M. (2016). *Molecular biology of the cell*. 6th Edition. Garland Science.
4. Berk, A., Zipursky, S., & Lodish, H. (2013). *Molecular Cell Biology*. 5th Edition. New York: W.H. Freeman.
5. Watson, J. D., Baker, T. A., Bell, S. B., Gann, A., Levine, M., & Losick, R. (2014). *Molecular Biology of the Gene*. 7th Edition. New York: Pearson Education
6. Jocelin E.K., Elliott S.C., Stephen T.K. (2018). *Lewin's Genes XII*. 12th Edition. Jones and Bartlett.



KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-I (ONE)
(Effective from June 026-27UNDERNEP-2020)
PAPER NAME: COMBINE PRACTICAL
Practical/ Lab course (PAPER CODE NO.: MJMB 105-P) Credit:4

MARKS: EXTERNAL EVALUATION: 75, INTERNAL EVALUATION: 75.
TOTAL MARKS: 150

1. Isolation of extremophiles from saline soil
2. Diauxic growth curve
3. Determination of thermal death point (TDP) and thermal death time (TDT)
4. Determination of phenol coefficient
5. Determination of Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) of given antibiotic on different organisms
6. Determination of acid number from fat sample
7. Study of different types of DNA and RNA using micrographs and model / schematic representations.
8. Study of semi-conservative replication of DNA through micrographs / schematic representations.
9. Isolation of genomic DNA from E. coli.
10. Estimation of RNA using colorimeter (orcinol reagent) or UV spectrophotometer (A260 measurement).
11. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
12. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).
13. Gravimetric Analysis of Waste water (TS,TDS,TSS)
14. Estimation of acidity and Alkalinity of wastewater
15. Estimation of Hardness
16. Estimation of Conductivity and pH of water sample
17. Estimation of sulphate and phosphate
18. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.
19. Isolation of microbes (bacteria & fungi) from soil (28°C & 45°C).
20. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
21. Assessment of microbiological quality of water.
22. Determination of BOD of waste water sample.
23. Isolation of Rhizobium from root nodules.
24. NESTROF (Naked Eye Single Tube Red Cell Osmotic Fragility Test) - Screening Test For β -Thalassemia Trait
25. Study of various stages of mitosis from onion root tip cells



26. Effect of colchicines on the DNA content of cell.
27. Study of different stages of meiosis in flower bud of Tradescantia spp
28. Localization of protein by Mercuric Bromophenol Blue
29. Localization of Lipid by Sudan Black B
30. Study of Karyotyping
31. Study of permanent slides of the Chick embryo
32. Staining of Golgi Apparatus Using Neutral Red Stain
33. Staining of Mitochondria in Human Cheek Epithelial cells
34. Isolation of mitochondria from sprouted mung bean source

References:

1. Patel R.J. and Patel R.K. (2016) Experimental microbiology Volume I, 9th Edition. Aditya,
2. Patel R.J. and Patel R.K. (2017) Experimental microbiology Volume II, 9th Edition. Aditya,
3. Cappuccino J.G. (2016) Microbiology; A Laboratory Manual, 11th Edition. Pearson Edition (Singapore) Pvt. Ltd., (ISBN: 978-9333050190)
4. APHA, 2012
5. Trivedi and Gohil,

Note: Journal are to be signed regularly by concern teacher and finally certified before the Internal/external test. If students does not bring the certified journal at the exam , he/she will not be allowed for the exam.

PRACTICAL EXAM PATTERN

There will be a five exercise in each practical, as under total 15 Marks.

1. Practical exercise (40 marks)
2. Spotting (15 marks)
3. Viva (10 marks)
4. Journal (10 marks)



KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-I (ONE)
 (Effective from June 2026-27 UNDER NEP-2020)
PAPER NAME: Research Methodology-1
(Course code: SEC-106) Credit: 2

Course Outcomes (COs): Upon completing this course, students will be able to design scientific experiments and collect data using standard research methodologies, while effectively writing, formatting, and presenting research proposals, papers, and theses using key publication metrics.		
UNIT-I	Research methodology	15 Hour
	1. Characteristics and types of scientific research 2. Basics of research methodology 3. Research and Experimental design 4. Method of Data collection	
UNIT-II	Scientific deliveries	15 Hours
	1. Scientific Deliveries and Communications: Writing Research proposal, Paper, Thesis, Report and Citations Citations, H-Index, I10-Index, Impact factor and selection criteria of scientific journals for research publications 2. Presenting scientific research: Power point presentations, Posters, Flyers, etc. 3. Publication processes, Review Processes and Significance of scientific communications	

REFERENCE BOOKS:

1. Statistics in biology, Vol. 1 by Bliss, C.I.K. (1967) Mc Graw Hill, New York.
2. Practical Statistics for experimental biologist by Wardlaw, A.C. (1985).
3. Statistical Methods in Biology - 2000 by Bailey, N.T. J. English Univ. Press.
4. Biostatistics - 7th Edition by Daniel
5. Fundamental of Biostatistics by Khan
6. Biostatistical Methods by Lachin



7. Statistics for Biologist by Campbell R.C. (1974) Cambridge University Press, UK.
8. Day R.A. 7th Edition. How to write and publish a scientific paper
9. Raiyani, Jagdish R. (2012). Research Methodology: Theory and Techniques. New Century Publications ISBN: 97881710082944
10. Kothari, C. R., Garg, Gaurav. (2019). Research Methodology: Methods and Techniques. (4th ed.) New Age International Publishers, New Delhi, ISBN: 9386649225

**PATTERN OF QUESTION PAPER
FOR SEMESTER END EXAMS
PAPER NAME: Research Methodology-2
PAPER CODE: MNMB-106**

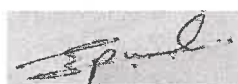
Total Marks: 25, passing standard: 10 marks (Time: 90 minutes)

Questions	Section	Marks
Question – 1 Unit – I	(Descriptive - Essay type – Short notes <i>with internal option</i>) 2 out of 3	10 marks
Question – 2 Unit – II	–do–	10 marks
Question – 3 (Unit I to II)	(05 out of 6) 1 Marks Each	05 Marks

- The examination pattern of the university is around 50% external and 50% internal.
- Types of questions for Question 3 may be varied like: definitions / reasoning / drawing small figures/ label the figure / fill in the blanks / multiple choice questions/ one word answer / match the pairs etc.



Dr. Aparna Singh
Member, BOS, Microbiology
KSKV Kachchchh University, Bhuj



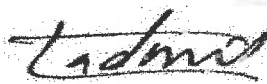
Dr. Rakesh Panchal
Member, BOS, Microbiology
KSKV Kachchchh University, Bhuj



Dr. Rajesh Chaudhari
Member, BOS, Microbiology
KSKV Kachchchh University, Bhuj



Dr. K. Karthikeyan
Member, BOS, Microbiology
KSKV Kachchchh University, Bhuj



Dr. Hadmat Gadhvi
Member, BOS, Microbiology
KSKV Kachchchh University, Bhuj

Dr. Rajesh Patel

Member, BOS, Microbiology

KSKV Kachchchh University, Bhuj



DEAN
FACULTY OF SCIENCE
KSKV KACHCHH UNIVERSITY
BHUJ KACHCHH-370001



**KRANTIGURU SHYAMJI KRISHNA VERMA KACHCHH UNIVERSITY,
BHUJ.**

Year: 2026-2027



SYLLABUS (NEP)

PG

**M.Sc. Semesters: II
(TWO)**

MICROBIOLOGY

FACULTY OF SCIENCE

**Curriculum as per UGC Guideline
Framed according to National Education Policy (NEP) - 2020
With effect from June-2026 (and thereafter)**

- **Credit framework and course code for PG M.Sc. First Year
(SEM-II) Microbiology Programme)**



Year	Semester	Course Code	Paper Title	Credits	Marks CA UA		Total
First Year	II						
		MJMB 201 (Theory)	Recombinant DNA Technology	4	50	50	100
		MJMB 202 (Theory)	Bacterial Genetics	4	50	50	100
		MJMB 203 (Theory)	Analytical Techniques	4	50	50	100
		MJMB 204	Agriculture Microbiology	4	50	50	100
		MJMB 205	Combine Practical	4	75	75	150
		SEC 206	Research Methodology-2	2	25	25	50
		Total Credits		22			600



Structure of the Question Paper (Theory) for the University Exam

**KACHCHH UNIVERSITY
FIRST YEAR PG M.Sc.; NEP SEMESTER-I (FIRST)
MICROBIOLOGY
PAPER NAME: Recombinant DNA Technology/Bacterial
Genetics/Analytical Techniques/Agriculture Microbiology
PAPER CODE: MJMB-201/202/203/204.**

Total Marks:50, passing standard: 20 marks (Time: 120 minutes)

**PATTERN OF QUESTION PAPER
FOR SEMESTER END EXAMS**

Questions	Section	Marks
Question – 1, Unit – I	(Descriptive - Essay type – Short notes <i>with internal option</i>) 2 out of 3	10 marks
Question – 2, Unit –II	–do–	10 marks
Question – 3, Unit – III	–do–	10 marks
Question – 4, (Unit- IV)	–do–	10 marks
Question – 5,(Unit I to IV)	(10 out of 12) 1 Marks Each	10 Marks

- The examination pattern of the university is around 50% external and 50% internal.
- Types of questions for Question 5 may be varied like: definitions / reasoning / drawing small figures/ label the figure / fill in the blanks / multiple choice questions/ one word answer / match the pairs etc.
- Project work/ Visit/ Tour/ Charts/ Model/ Given by teacher or as a part of Syllabus) will be mandatory for all the students.



KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-II (TWO)
 (Effective from June 2026-27 UNDER NEP-2020)
PAPER NAME: RECOMBINANT DNA TECHNOLOGY
(PAPER CODE NO.: MJMB-201) Credit: 4

Course Outcomes (COs): Upon completing this course, students will be able to apply core genetic engineering enzymes and diverse cloning vectors to design recombinant DNA molecules, while implementing advanced screening selection and library analysis methodologies to isolate specific target clones.

UNIT-I	ENZYMES INVOLVED IN GENETIC ENGINEERING	15 Hours
	1. Endo and Exo Nuclease: Classification, Mechanisms of enzyme action and role in Genetic engineering 2. Restriction Endonuclease :Classification, Mechanisms of enzyme action and role in Genetic engineering 3. Ligases –Classification, Mechanism of enzyme action and role in Genetic engineering 4. Additional enzymes – DNA Polymerase, RNA Polymerase, Alkaline Phosphatases, Reverse transcriptase, Polynucleotide phosphorylase, polynucleotide kinases.	
UNIT-II	GENE CLONING VECTORS AND TOOLS	15 Hours
	1. Plasmid: Basic biology, Natural and Synthetic plasmid, Role of Plasmid in Genetic engineering. 2. Phages: Basic biology and Role of Bacteriophage in Genetic engineering. Example of bacteriophage vector - Lambda phage vectors 3. Artificial vectors :Cosmids, Phagemids, BAC, YAC, Shuttle vector 4. Expression Vector – Vectors to facilitate protein purification, promote solubilization of expressed proteins 5. Adaptors, Linkers, Homopolymer tailing	
UNIT-III	SCREENING, SELECTION & ANALYSIS OF RECOMBINANTS-1	15 Hours



	1. Basic techniques for screening and selection of the clones:- use of chromatography 2. substrate, Insertional inactivation, Complementation of defined mutation 3. Sequence-dependent screening: Screening by hybridization, Screening by PCR	
UNIT-IV	SCREENING, SELECTION & ANALYSIS OF RECOMBINANTS-2	15 HRS
	1. Screening expression libraries : Immunological screening, South-Western and North- Western screening 2. Functional cloning: Functional complementation, Screening by 'gain of function', Differential screening. 3. Positional cloning, Chromosome walking and jumping	

REFERENCE BOOKS:

1. S.B. Primrose, R.M. Twyman and R.W.Old.(2001) Principles of Gene Manipulation. 6th Edition, S. University Press.
2. J. Sambrook and D.W. Russel.(2001) Molecular Cloning: A Laboratory Manual, Volume 1-3, CSHL
3. Brown TA.(2006).Gene Cloning, 3rd ed. Garland Science.



KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-I (ONE)
 (Effective from June 2026-27 UNDER NEP-2020)
PAPER NAME: BACTERIAL GENETICS AND GENOMICS
(PAPER CODE NO.: MJMB 202) Credit: 4

Course Outcomes (COs): Upon completing this course, students will be able to analyze the molecular mechanisms of bacterial recombination and DNA repair systems, while demonstrating a comprehensive understanding of traditional and next-generation genome sequencing technologies.

UNIT-I	Recombination	15 Hours
	1. Types and models for homologous recombination 2. Molecular mechanism of homologous recombination 3. Molecular mechanism of site-specific recombination 4. Biological roles of homologous and site-specific recombination	
UNIT-II	DNA repair	15 Hours
	1. Cre-Lox system and its role in molecular biology 2. Methyl directed mismatch repair 3. Nucleotide excision repair 4. Base excision repair	
UNIT-III	DNA sequencing techniques-1	15 Hours
	1. Recombination repair 2. SOS inducible repair 3. Specific repair for oxidative DNA damage 4. Maxam and Gilbert method of DNA sequencing	
UNIT-IV	DNA sequencing techniques-2	15 HRS
	1. Sangar's di-deoxy or chain termination sequencing 2. Next generation sequencing: Pyrosequencing, Nanopore sequencing 3. Next generation sequencing: Illumina sequencing and Sequencing by ligation 4. Whole genome sequencing: Shotgun and single cell genome sequencing	



REFERENCE BOOKS:

1. Microbiology, Pelczar, M. J. Chan, E.C.S., Krig, N.R., McGraw – Hill Book Co.
2. Microbiology by J.G. Black, 2002
3. Introduction to Microbiology by J. L. Ingraham and C. A. Ingraham, 2000.
4. Text book of Environmental studies for Undergraduate courses. Erach Bharucha. UGC, Universities Press, Orient Longman Pvt. Ltd.
5. Microbial Ecology, R Campbell. Johan Wiley and Sons.
6. Modi. H. A. (2014) A Handbook of Elementary Microbiology, Shanti Prakashan, (ISBN: 978-93- 50100-1515)
7. Pommerville J.C. (2014) Alcamo's Fundamental of Microbiology, 15th Edition, Jones & Barlett Pvt. Ltd., (ISBN: 978-0-07-462320-6)
9. Medigan M., et al., (2015) Brock Biology of Microorganisms, 14th Edition, Pearson education Ltd., (ISBN: 978-1-292-01831-7)
15. Introduction to Microbial World: Ritesh Tandel, Komal Chawda& Kalpesh Sorthia.



KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-II (TWO)
 (Effective from June 2026-27 UNDER NEP-2020)
PAPER NAME: ANALYTICAL TECHNIQUES
(PAPER CODE NO.: MJMB-203) Credit: 4

Course Outcomes (COs): Upon completing this course, students will be able to apply the fundamental principles and operational mechanisms of advanced spectroscopic, centrifugal, electrophoretic, and chromatographic techniques to analyze, separate, and quantify biological macromolecules.

UNIT-I	SPECTROSCOPY	15 Hours
	1. Electromagnetic Radiation: Basic Principles, Interaction of Electromagnetic Radiation with matter, Physical Phenomena of interaction 2. UV-Visible spectroscopy, Atomic Absorption Spectroscopy & Atomic Emission Spectroscopy, Infrared (IR) Spectroscopy and Raman Spectroscopy, 3. Mass spectrometry (MALDI-TOF) 4. Magnetic Resonance (NMR), Electron Spin Resonance (ESR). 5. X-ray Diffraction (XRD) and Crystallography, CD, ORD Spectroscopy	
UNIT-II	CENTRIFUGATION &	15 Hours
	1. Centrifugation: Basic principles; Settling time and velocity, Types of rotor, Sedimentation coefficient, RCF; 2. Types of centrifuges 3. Preparative centrifugation 4. Analytical centrifugation	
UNIT-III	ELECTROPHORESIS	
	1. Electrophoresis: Basic Principles of electrophoresis; Support Media; Modes of electrophoresis 2. Electrophoretic methods for Nucleic Acid Analysis: Agarose gel electrophoresis, Pulsed field gel electrophoresis, Polyacrylamide gel electrophoresis (PAGE), Denaturing PAGE 3. Electrophoretic methods for Protein Analysis: SDS-PAGE, Gradient gel, Isoelectric focusing (2D Electrophoresis), High/Low voltage electrophoresis,	



	Capillary electrophoresis; Disc gel electrophoresis	
UNIT-IV	CHROMATOGRAPHY TECHNIQUES	15 Hours
	1. Chromatography: Theory and principles. 2. Definition of key terms: Retention time, Peak shape, Band broadenings, Column efficiency, Theoretical plate model (HETP), Rate Theory, Resolution, Selectivity. 3. Partition theory: Retention & differential migration mechanism, Equilibrium between two phases, Properties of solvents (MP), Stationary phase and Supporting phase. 4. Planar & Column Chromatography: TLC, HPTLC, Paper chromatography, Normal and Reverse-phase, Gel permeation, Ion exchange, Adsorption, Partition and Affinity chromatography. 5. Analytical Chromatography: Quantitative Biochemical Measurements, GC/ GLC, HPLC, UHPLC and FPLC, GC-MS, LC-MS Criteria of protein purity.	

REFERENCE BOOKS:

1. Sambrook, J., Fritsch, E. F., & Maniatis, T. (1989). *Molecular cloning* (Vol. 2, pp. 14-9). New York: Cold spring harbor laboratory press.
2. Blau, K., & King, G. S. (Eds.). (1993). *Handbook of derivatives for chromatography* (Vol. 2). New York: Wiley.
3. Kindt, T. J., Goldsby, R. A., Osborne, B. A., & Kuby, J. (2007). *Kuby immunology*. Macmillan.
4. Hayat, M. A. (1974). *Principles and techniques of scanning electron microscopy. Biological applications. Volume 1*. Van Nostrand Reinhold Company.



KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-II (TWO)
 (Effective from June 2026-27 UNDER NEP-2020)
PAPER NAME: Agricultural Microbiology
(PAPER CODE NO.: MNMB 204) Credit: 4

Course Outcomes (COs): Upon completing this course, students will be able to evaluate the role of microorganisms in soil fertility and plant-microbe interactions, analyze the molecular mechanisms of biological nitrogen fixation, and demonstrate proficiency in the mass production and application of biofertilizers and biopesticides.

UNIT-I	Microbes and Soil Fertility	15 Hours
	1. Physical and Chemical properties of soil 2. Role of Microbes in soil fertility 3. Soil fertility Evaluation and Improvement 4. Interactions among soil microorganisms 5. Organic Farming	
UNIT-II	Plant Microbe Interaction	
	1. Rhizosphere Microorganisms : Phyllosphere, Spherosphere and Rhizoplane 2. Methods of Enumeration, Rhizosphere Effect 3. Factors affecting Rhizosphere Microorganisms 4. Positive and Negative outcomes of plant microbe interaction 5. PGPR, Siderophore, Mycorrhiza and VAM	
UNIT-III	Biological Nitrogen Fixation	15 Hours
	1. Nitrification, Dinitrification 2. Symbiotic Nitrogen Fixation (<i>Rhizobium</i> , <i>Frankia</i>) 3. Asymbiotic Nitrogen Fixation (<i>Azotobacter</i> , <i>Azospirillum</i>) 4. Nitrogenase enzyme, <i>nif</i> genes and Molecular mechanism of Nitrogen fixation 5. Role of nodulin genes in nodule development and symbiosis 6. Genetic engineering of BNF	
UNIT-IV	Biofertilizers and Biopesticides	15 Hours
	1. Biofertilizers – Types, Production and Quality control 2. Cultivation and mass production of Bioinoculants –	



	Azotobacter, Rhizobium, Azospirillum, Cyanobacteria, Azolla and Phospahte Solubilizing Microorgansms – Production and applications 3. Carrier based inoculants 4. Biopesticides – Types and applications (<i>Pseudomonas Fluorescence</i>, <i>Bacillus thuringiensis</i>, <i>Trichoderma harzianum</i>, <i>Trichoderma viridae</i>, <i>Nuclear Polyhedrosis Virus</i>)	
--	--	--

REFERENCE BOOKS:

- Atlas, R.M., Bertha, R. (1997). Microbial Ecology, 4th Edition: Benjamin Cummings publication
- Pelczar, M.J., Chan, E.C.S. and N.R. Kreig (1993). Microbiology, 5th Edition. New Delhi: Tata Mc Graw Hill Publishing co. Ltd.
- Alexander, M. (1977). Introduction to soil microbiology, 2nd edition. Wiley publication.
- Purohit, S.S. (2007). Microbiology-Fundamentals and Applications, 6th Edition. New Delhi: Agrobios Publications.
- Rangaswami, G., Mahadevan, A. (2004). Diseases of Crop plants in India: PHI publication.
- Prescott, M.J., Harley, J.P., Klein, D.A. (2002). Microbiology, 5th Edition. New York: WCB Mc Graw Hill publication.



KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-II (TWO)
(Effective from June 2026-27 under NEP-2020)

PAPER NAME: Combine Practicals

Practical/Lab course (Course code: MJMB-205-P) Credit: 4

EXTERNAL EVALUATION: 75, INTERNAL EVALUATION: 75. [TOTAL MARKS: 150]

1. Isolation of chromosomal DNA from plant cells
2. Isolation of chromosomal DNA from E.coli
3. Qualitative and quantitative analysis of DNA using spectrophotometer and agarose gel Electrophoresis.
4. Plasmid DNA isolation
5. Restriction digestion of DNA/ Plasmid DNA
6. Preparation of Competent cells
7. Transformation of competent cells.
8. Demonstration of PCR.
9. Estimation of protein concentration by Folin Lowry method
10. TLC separation of amino acids
11. Separation of DNA by agarose gel electrophoresis.
12. Separation of components of a given mixture using a laboratory scale centrifuge using various rotors.
13. Understanding density gradient centrifugation with the help of virtual lab..
14. Using spectrophotometer to DETERMINE LABDA max for an unknown sample and calculation of extinction coefficient.
15. Understanding NMR spectroscopy with the help of virtual lab / video
16. Preparation of Master and Replica Plates.
17. Study the effect of chemical (HNO₂) and physical (UV) mutagens on bacterial cells.
18. Study survival curve of bacteria after exposure to ultraviolet (UV) light.
19. Isolation of Plasmid DNA from E. coli.
20. Demonstration of Bacterial Conjugation.
21. Demonstration of bacterial transformation and transduction.
22. Demonstration of AMES test.
23. To estimate microbial growth through Turbid metric
24. To isolate plant growth promoting rhizobia (PGPR) from root nodule
25. To isolate PGPR free living nitrogen fixer Azotobacter from soil
26. To isolate PGPR phosphate solubilizing bacteria (PSB) from soil sample
27. To isolate high cellulose degrading bacteria from soil sample
28. Production of liquid bio-fertilizers



Note: Journal are to be signed regularly by concern teacher and finally certified before the Internal/external test. If students

do not bring the certified journal at the exam, he/she will not be allowed for the exam.

PRACTICAL EXAM PATTERN

There will be a five exercise in each practical, as under total 15 Marks.

- 1. Practical exercise (40 marks)**
- 2. Spotting (15 marks)**
- 3. Viva (10 marks)**
- 4. Journal (10 marks)**



**KSKV KACHCHH UNIVERSITY, BHUJ – KACHCHH
FIRST YEAR PG M.Sc.: NEP: SEMESTER-II (TWO)**

(Effective from June 2026-27 UNDER NEP-2020)

PAPER NAME: Research Methodology-2

(PAPER CODE NO.: SEC 106) Credit: 2

Course Outcomes (COs): Upon completing this course, students will be able to apply sampling and data presentation techniques, compute measures of central tendency and variability, and perform correlation, regression, and statistical significance tests (such as ANOVA, t-test, and Chi-square) to analyze biological data.

UNIT-I	Introduction to Biostatistics	15 Hours
	1. Basic definitions and applications. 2. Sampling: Representative sample, sample size, sampling bias and sampling techniques. 3. Data collection and presentation: Types of data, methods of collection of primary and secondary data, 4. Methods of data presentation, graphical representation by histogram, polygon, ogive curves and pie diagram.	
UNIT-II	Measures of central tendency	15 Hours
	1. Measures of central tendency: Mean, Median, Mode. 2. Measures of variability: Standard deviation, standard error, range, mean deviation and coefficient of variation. 3. Correlation and regression: Positive and negative correlation and calculation of Karl Pearson's co-efficient of correlation. 4. Linear regression and regression equation and multiple line a regression, ANOVA, one- and two-way classification. 5. Calculation of an unknown variable using regression equation. 6. Tests of significance: Small sample test (Chi-square t test, F test), large sample test (Z test) and standard error.	



REFERENCE BOOKS:

1. Statistics in biology, Vol. 1 by Bliss, C.I.K. (1967) Mc Graw Hill, New York.
2. Practical Statistics for experimental biologist by Wardlaw, A.C. (1985).
3. Statistical Methods in Biology - 2000 by Bailey, N.T. J. English Univ. Press.
4. Biostatistics - 7th Edition by Daniel
5. Fundamental of Biostatistics by Khan
6. Biostatistical Methods by Lachin
7. Statistics for Biologist by Campbell R.C. (1974) Cambridge University Press, UK.
8. Day R.A. 7th Edition. How to write and publish a scientific paper
9. Raiyani, Jagdish R. (2012). Research Methodology: Theory and Techniques. New Century Publications ISBN: 97881710082944
10. Kothari, C. R., Garg, Gaurav. (2019). Research Methodology: Methods and Techniques. (4 th ed.) New Age International Publishers, New Delhi, ISBN: 9386649225

**PATTERN OF QUESTION PAPER
FOR SEMESTER END EXAMS
PAPER NAME: Research Methodology-2
PAPER CODE: MNMB-206**

Total Marks:25, passing standard: 10 marks (Time: 90 minutes)

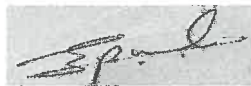
Questions	Section	Marks
Question – 1 Unit – I	(Descriptive - Essay type – Short notes <i>with internal option</i>) 2 out of 3	10 marks
Question – 2 Unit –II	–do–	10 marks
Question – 3 (Unit I to II)	(05 out of 6) 1 Marks Each	05 Marks

- The examination pattern of the university is around 50% external and 50% internal.
- Types of questions for Question 3 may be varied like: definitions / reasoning / drawing small figures/ label the figure / fill in the blanks / multiple choice questions/ one word answer / match the pairs etc.





Dr. Aparna Singh
Member, BOS, Microbiology
KSKV Kachchh University, Bhuj



Dr. Rakesh Panchal
Member, BOS, Microbiology
KSKV Kachchh University, Bhuj



Dr. Rajesh Chaudhari
Member, BOS, Microbiology
KSKV Kachchh University,



Dr. K. Karthikeyan
Member, BOS, Microbiology
KSKV Kachchh University, Bhuj



Dr. Rajesh Patel
Member, BOS, Microbiology
KSKV Kachchh University, Bhuj



Dr. Hadmat Gadhi
Member, BOS, Microbiology
KSKV Kachchh University,



Dr. Ritesh Tandel
Chairmen, BOS, Microbiology
KSKV Kachchh University, Bhuj



DEAN
FACULTY OF SCIENCE
KSKV KACHCHH UNIVERSITY
BHUJ-KACHCHH 370001

