



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

B.Sc. Microbiology Semester VII (Honours and Honours with research)

B. Sc. (Microbiology) Semester VII

Course Code	US07HMAMIC01	Title of the Course	Molecular Biology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	- The course is structured with the aim to fulfil 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 and eukaryotes, steps of central dogma of life, replication of genetic material, transcription and translation. - To develop deep conceptual clarity and research-oriented competency in molecular mechanisms of life, enabling students to pursue careers in research, biotechnology, healthcare, and academics, with emphasis on interdisciplinary learning, ethical practice, and lifelong learning.
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Course Content		
Unit	Description	Weightage* (%)
1.	Genome Organization and DNA Replication a) Prokaryotic genome organization: nucleoid structure, looping, and supercoiling b) Eukaryotic genome organization: nucleosome organization, histones, chromatin condensation (heterochromatin vs euchromatin), nucleosome assembly post-replication c) DNA replication in prokaryotes: initiation, replisome assembly, elongation, termination d) DNA polymerases (I, II, III) and proofreading e) Eukaryotic replication: origins, licensing, polymerases α , δ , ϵ , telomeres f) Inhibitors of replication (e.g., aphidicolin, hydroxyurea, novobiocin); Case study: inhibitors as anticancer/antiviral agents.	25%



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2.	Transcription and RNA Processing a) RNA polymerases (prokaryotic vs eukaryotic) b) Promoter architecture: -10/-35 box, TATA box, CpG islands c) Transcription initiation complex assembly in prokaryotes (σ factor) and eukaryotes (TFIID, TFIIF, etc.) d) Elongation and termination (ρ-dependent/independent in bacteria; polyA signal in eukaryotes) e) RNA processing: capping, splicing, polyadenylation, alternative splicing, RNA editing f) In silico promoter prediction	25%
3.	Genetic Code and Translation a) Aminoacyl t-RNA synthetases and charging of t-RNA. b) Ribosome structure (70S vs 80S) and functional sites c) Deciphering of genetic code; Mitochondrial and Chloroplast Genetic Code. d) Translation mechanism: initiation (prokaryotic Shine-Dalgarno vs eukaryotic cap-dependent), elongation, termination, ribosome recycling e) Post-translational processing of polypeptides and secretion. f) Protein folding and molecular chaperones, protein splicing, protein translocation and secretion in bacteria.	25%
4.	Regulation of Gene Expression a) Prokaryotic regulation: operon concept (lac, trp, ara) – with mutational analysis b) Global regulatory networks: SOS response c) Eukaryotic regulation: chromatin remodelling, transcription factors d) Post-transcriptional regulation: RNAi, miRNA, alternative splicing regulation e) Translational regulation: eIF2 phosphorylation, iron-responsive elements (IREs) f) Virtual lab simulation of lac operon	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	Weightage
1.	Internal Written / Practical Examination Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance	50%
2.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to:	
1.	Understand the importance of the master molecule “nucleic acid”, get knowledge of DNA and RNA structures, genome organization of prokaryotes and eucaryotes, gene structure and function.
2.	Explain DNA-protein interactions and their role in genome organization and expression.
3.	Describe the molecular organization of prokaryotic and eukaryotic genomes and chromatin dynamics
4.	Analyze the molecular mechanism, fidelity, and regulation of DNA replication in prokaryotes and eukaryotes
5.	Discuss the molecular details of transcription, translation, and their regulation across domains of life
6.	Design and interpret experiments to study gene structure, function, and expression.



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Suggested References:

Sr. No.	References
1.	Prescott L, Harley J P, and Klein D A, Microbiology, 9 th edition. Wm C.Brown - McGraw Hill, Dubuque, IA ltd.
2.	General Microbiology, by C.B. Powar and H.F. Dagainawala, volume-I, Himalaya Publishing House, Reprint-2002
3.	Molecular Biology of the Gene, by Watson, J. D. et al, 7th Ed. (2017) Pearson publication.
4.	Biochemistry by Lehninger, Nelson and Cox, 4 th Edition.
5.	Lewin's Genes XII, by Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T., 2017, Jones & Bartlett publication
6.	Molecular Biology: Genes to Proteins.byTropp, B. E, 4th Ed. (2012) Laxmi Publications
7.	DNA Structure and Function by Sinden, R. R.(1994), Gulf Professional Publishing
On-line resources to be used if available as reference material	



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B.Sc. Microbiology Semester VII (Honours and Honours with research)

B.Sc. (Microbiology) Semester– VII

CourseCode	US07HMAMIC02	Title of the Course	Microbial Physiology
Total Credits Of the Course	4	Hours per Week	4

Course Objectives:	To make the students familiar with: • Microbial growth and microbial growth measurements and their kinetics • Nutritional requirements and photosynthesis • Cell division and differentiation • Quorum sensing in microbes
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Course Content		
Unit	Description	Weightage (%)
1.	Microbial Growth a) Microbial Growth: synthesis of macromolecules from elemental nutrients, supramolecules, cell components, and cells. b) Cell cycle in microbes and generation times c) Batch culture phases and their importance d) Continuous cultures e) Synchronous culture f) Factors influencing microbial growth. g) Measurement of Growth and their kinetics	25%
2.	Nutrition and Photosynthesis a) Nutrition: Elemental nutrient requirements of microbes; nutritional groups of bacteria; autotrophy, photoautotrophy and bacterial photosynthesis; chemoautotrophy and autotrophic metabolism; heterotrophy – photoheterotrophy and chemoheterotrophy, heterotrophic metabolism in bacteria;	25%



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	nutritional mutants and their use in metabolic studies. b) Photosynthesis: Oxygenic and anoxygenic photosynthesis, photosynthetic pigments, basic photochemistry of PS I and PS II and photosynthetic electron transport; modes of CO₂ fixation, halobacterial photosynthesis, sulphur, nitrogen and iron assimilating bacteria. Chloroplast-mediated electron transport; chemolithotrophic electron transport systems.	
3.	Cell Division and Differentiation a) Bacterial differentiation: endospore formation, physiological and genetic aspects of sporulation, Sporulation-inducing signals and events in sporulation b) Bacterial cell division: molecular mechanisms involved in the formation of the Z-ring, Cell division machinery. c) Yeast cell division: Growth and cell division coordination, Cell division events, molecular basis of cell cycle and control. d) Microbial stress responses: Oxygen toxicity, pH, Stringent response; Heat shock, Osmotic pressure, Osmolarity regulation in <i>E.coli</i> (Omp system), Phosphate assimilation in <i>E.coli</i> (Pho system), Nitrogen fixation in <i>Klebsiella</i> & <i>Rhizobium</i> (Ntr system).	25%
4	Microbial Metabolites and quorum sensing a) Bioluminescence: process, biochemistry, genetics and significance. b) Mechanism of action of antibiotics and mechanisms of drug resistance. c) Introduction to ayurvedic antimicrobials and their therapeutic applications d) Bacteriocins: Structure, Classification and physiological significance. e) Siderophores: structure, function and significance f) Bacterial biofilm: formation steps, dispersion and control strategies g) Quorum-sensing processes in Gram-positive and Gram-negative bacteria, quorum quenching, and its use in developing antimicrobial tools.	25%



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B.Sc. Microbiology Semester VII (Honours and Honours with research)

Teaching-Learning Methodology	The major teaching- learning consists of lectures and discussions (largegroup) in which the teacher makes a use of chalk and talk as well as powerpoint presentation and Video animation to introduce the learning objectives related to the basicconcepts of the subject. These sessions incorporate space for participationand involvement of students through questions. The student's participation in laboratory on related theoretical concept is also required.
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EvaluationPattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination (As perCBCSR.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Projects, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As perCBCSR.6.8.3)	25%
3.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to	
1.	Explain microbial growth and its measurements.
2.	Evaluate microbial metabolic pathways (fermentation, respiration, phototrophy, chemolithotrophy)
3.	Interpret microbial nutrition, photosynthesis, and metabolic regulation.
4.	Assess microbial interactions, antimicrobial resistance, and biofilm biology.
5.	Demonstrate applied aspects, including bioluminescence and nitrogen fixation, quorum sensing

Suggested References:	
Sr. No.	References
1	Microbial Physiology and Metabolism. D.R. Caldwell, 2 nd ed. 2008, Wm.C. Brown Publ
2	Microbial Physiology. A.G. Moat & J.W. Foster. 3 rd ed. (2003). John Wiley & Sons, Inc
3	Chemical Microbiology – An Introduction to Microbial Physiology. (InternationalEd.).Rose, A.H. 2008. Plenum Publishing Corporation
4	Physiology and Biochemistry of Prokaryotes. White, D. and Fuqua, C.4 th ed. 2011 Oxford University Press, NY. .
5	Microbial Physiology.A.G. Moat & J.W. Foster.3 rd ed. (2003). John Wiley & Sons, Inc



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B.Sc. Microbiology Semester VII (Honours and Honours with research)

B.Sc. (Microbiology) Semester VII

Course Code	US07HMAMIC03	Title of the Course	Microbiology Practical VII
Total Credits of the Course	04	Hours per Week	08

Course Content based on core theory papers		
Sr.No	Practical Section-1	Weightage* (%)
1.	Isolation and characterization of pure culture from natural sample.	100%
2.	Growth curve of <i>E. coli</i> and determination of specific growth rate constants determination generation time of <i>E.coli</i> , and Ks on different substrates (glucose, lactose, glycerol)	
3.	Study Effect of Salt concentration and Effect of Sugar concentration on growth of bacteria. (comparison of three different bacteria)	
4	Isolation of halophilic, alkalophilic, thermophilic and acidophilic bacteria from proper natural sources.	
5	Study effect of temperature and effect of pH on growth of bacteria. (comparison of three different bacteria)	
6	Demonstration of quorum sensing	
7	Isolation of genomic DNA from <i>E. coli</i>	
8	Isolation of plasmid DNA from <i>E. coli</i> (alkaline lysis method)	
9	Quantification of nucleic acids by UV spectrophotometry and its separation by agarose gel electrophoresis	
10	Induction and assay of beta-galactosidase	



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No	Practical Section-2	
1	Orientation to the Microbiology laboratory, general laboratory safety and good laboratory practices.	
2	Biochemical calculations and Preparation of reagents	
3	Determination of λ max and validation of Beer-Lamberts law.	
4	Estimation of DNA by DPA method	
5	Estimation of RNA	
6	Estimation of proteins by Bradford's Method	
7	Separation of amino acids by thin layer chromatography and HPTLC	
8	Correlation of bacterial cell density by absorbance and standard plate count	

Teaching-Learning Methodology	By practical batches. Giving students concepts, guidance and demonstration to perform specific practical.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%
3.	University Examination	50%



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Course Outcomes: Having completed this course, the learner will be able to

1.	Demonstrate safe microbiology laboratory practices, perform biochemical calculations, and prepare reagents and solutions accurately for experimental work
2.	Perform spectrophotometric analysis and interpret spectral and analytical data for biomolecular characterization
3.	Isolate and characterize pure microbial cultures from natural samples
4.	Validate growth curve of bacteria and determine generation time.
5.	Analyze the effect of physical and chemical environmental conditions on microbial growth.
6.	Isolate, analyse purity and quantify genomic DNA and plasmid DNA from bacteria with high purity.
7.	Learn estimations of biologically important molecules.

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.
4.	Microbiology: A Laboratory Manual, James G. Cappuccino, Natalie Sherman, 12th Ed., 2020, Pearsonpublication.
5.	Principles and Techniques of Biochemistry and Molecular Biology, Keith Wilson, John Walker, 8th Ed., 2018, Cambridge University Press.



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B.Sc. Microbiology Semester VII (Honours and Honours with research)

B. Sc. (Microbiology Minor) Honours Semester VII

Course Code	US07HMIMIC01	Title of the Course	Good laboratory practices (GLP) and Good manufacturing practices (GMP)
Total Credits of the Course	2	Hours per Week	2

Course Objectives:	To make the students familiar with: • Good laboratory and good manufacturing practices • Guidelines for manufacturing facilities • Concept of Quality control and assurance
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CourseContent

Unit	Description	Weightage *(%)
1.	Introduction of GLP and GMP a) Amendments and Historical Development of GLP, Definition of GLP based on OECD Guideline, Objective of GLP. b) Criteria to fulfil GLP compliance: Infrastructure, Personal, Equipment, Chemical and Reagents, Good Housekeeping, Safety measures, Reference standard and working standard, Microbiology media and culture, Internal and external audits, Storage and Archival of data. c) Introduction to GMP and cGMP and Guideline for manufacturing facilities d) Introduction to Pharmacopoeia: IP, BP and USP e) Preparation of SOPs f) Concept of Quality control and Quality assurance g) Concept of method Validation: Accuracy, Intraday and interday Precision, Linearity, Repeatability, Robustness, Specificity, and Sensitivity (LOD and LOQ). h) Laboratory accreditation: ISO / IEC 17025: 2017, NABL, GLP, FDA, WHO, FESSAI	50%



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2.	Quality control - Quality Control Testing in Microbiology: Media Preparation and Quality Check, Positive and Negative Controls. - Quality control of finished Product and API: Bioburden, Pyrogen Testing and its Significance and Sterility testing. - Quality control of Water: Biological and chemical analysis of water - Biological assay of vitamin and antibiotic - Clean room and Environmental monitoring Laboratory Safety: - Biohazardous agents - Risk groups and biosafety levels - Laboratory infections and routes of exposure - Safety measures like personal safety, laboratory practices, cleaning of laboratory, - Basic requirements of laboratory, essential biosafety equipment's, disposal of biohazardous waste, - Other hazards: chemical hazards, fire hazards, electrical and noise hazards, radiation hazards.	50%
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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 powerpoint 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 concept is also required.
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written and Practical Examination (As per CBCSR.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Projects, Viva-voce, Quizzes, Seminars, Assignments, Practical Attendance (As per CBCSR.6.8.3)	25%
3.	University Examination	50%



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Course Outcomes: Having completed this course, the learner will be able to	
1.	Explain and apply the principles of GLP, GMP, cGMP, pharmacopoeia standards, laboratory accreditation systems, quality frameworks, and regulatory guidelines.
2.	Evaluate and apply analytical validation parameters.
3.	Interpret microbiological quality control procedures to ensure the safety, potency, and compliance of pharmaceutical products.
4	Understand data integrity, safety, documentation as per OECD GLP principles

Suggested references:	
1.	Biopharmaceuticals Biochemistry and Biotechnology Authors-Gary Walsh
2.	Hugo and Russel's Pharmaceutical Microbiology: Authors Stephen P. Denyer, Norman A. Hodges, Sean P. Gorman, and Brendan F. Gilmore. Wiley-Blackwell
3.	Pharmaceutical Biotechnology Authors-S. P.Vyas and D.V. Kohli
4.	A Text Book of pharmaceutical quality assurance. Mahendra Singh, Priyesh Pankaj, Tulsi Das. Imprint Shashwat Publication, India.
5.	Current Good Manufacturing Practices (cGMP) for Pharmaceutical Products. Chandrashekhar Panda.
6	Good Laboratory Practices and Compliance Monitoring. Trupti Patil-Dongare. PharmaMed Press / BSP Books.
7	Research Methodology for biological sciences by N. Gurumani, (2021) ISBN 10, MJP publishers, Chennai.



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B.Sc. Honours (Microbiology Minor) Semester VII

Course Code	US07HMIMIC02	Title of the Course	Microbiology Practical in GLP and GMP
Total Credits of the Course	02	Hours per Week	04

No	Practical	Weightage* (%)
1.	Lab Safety & PPE: Identify bio safety levels, spill management, MSDS reading, fire extinguisher demonstration.	100%
2	Documentation Practices: Maintain lab notebook, SOP writing, logbook entry, error correction	
3	Calibration & Validation: Calibrate micropipettes by gravimetric method, pH meter calibration, autoclave validation using biological/chemical indicators, to validate accuracy of pipettes, pH meter and weighing machine.	
4	Aseptic Technique and Sterility Testing: Perform sterility test of media as per IP, evaluate the sterility of a given medical sample by detecting Microbial Limit Test (MLT): TAMC (total aerobic microbial count), TYMC (total yeast and Mold count), specific pathogens as per IP/USP <61>, <62>	
5	Environmental Monitoring: Perform active air sampling, passive settle plates, surface monitoring in lab. Particle count demonstration for Viable/non-viable monitoring, assess the microbiological quality of air in a Laminar Air Flow unit through environmental monitoring techniques	
6	Quality Control of Media and Reagents: Prepare nutrient agar, check pH, sterility, growth promotion test with *E. coli* ATCC 8739	



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7	Handling of Reference Standards: Receipt, storage, usage log of microbial cultures. Prepare working stock from ATCC culture	
8	Clean room Entry-Exit & Gowning: Practice Grade D/C gowning procedure, hand washing validation with glow gel.	
9	Water System Testing: Test purified water for pH, conductivity, TOC (total organic carbon), bio burden, endotoxin by LAL gel-clot method, determine the microbial load present in a water sample using the membrane filtration technique. /MPN technique	
10	Cleaning Validation: Swab test of equipment surface, rinse water analysis.	
11	Media Fill / Aseptic Process Simulation: Perform broth fill in vials using aseptic technique, incubate and check for growth Process simulation.	
12	Mini-project: Design SOP for "Handling of incubators" or "Autoclave operation"	

Teaching-Learning Methodology	- By practical batches. Giving students concepts, guidance and demonstration to perform specific practical. - Visit to Industry/GLP lab: 1-day visit + report submission
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EvaluationPattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	25%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	25%



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3.	University Examination	50%
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Course Outcomes: Having completed this course, the learner will be able to

1.	Evaluate the microbiological quality of pharmaceuticals and environments using growth promotion tests, sterility testing, bioburden assessment, and air quality monitoring.
2.	Apply and create microbiological assay techniques to determine the potency of antibiotics and vitamins.
3.	Apply analytical techniques for pharmaceutical products and validation methods for laboratory instruments.

Suggested References:

Sr. No.	References
1.	Practical Manual of Pharmaceutical quality assurance by Hussain S., Pharma Med Press, 2023
2.	Microbiology: A Practical Approach – Dr Bhavesh Patel and Dr Nandini Phanse
3.	Experimental Microbiology - Rakesh J.Patel& Kiran R. Patel, Volume I& II
4	Current Good Manufacturing Practices (cGMP) for Pharmaceutical Products. Chandrashekhar Panda.
5	Good Laboratory Practices and Compliance Monitoring. Trupti Patil-Dongare. Pharma Med Press / BSP Books.
6	Practical Microbiology by Dubey R.C. and D.K. Maheshwari 4 th edition, S. Chand publication
7	Indian Pharmacopoeia 2022, Indian Pharmacopoeia Commission, Gaziabad, Vol I and II



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B.Sc. (Microbiology) Semester– VII

Course Code	US07HMAMIC04	Title of the Course	Molecular Cell Biology
Total Credits of the Course	4	Hours per Week	4

Course Objectives:	- To enable students to apply advanced microscopic and cytometric techniques for cell analysis. - To develop conceptual understanding of organelle structure-function relationships in health and disease. - To integrate knowledge of cell signaling, cytoskeleton, and extracellular matrix with physiological outcomes. - To foster analytical skills in cell cycle regulation, cell death mechanisms, and cancer biology. - To inculcate research orientation and ethical awareness in cell biology studies
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Unit	Course Content	Weightage %
1	Advanced Techniques in Cell Biology - Microscopy: Bright field, dark field, phase contrast, DIC, fluorescence (widefield & confocal), super-resolution microscopy (STED, PALM, STORM). - Electron Microscopy: SEM, TEM, sample preparation, immunogold labeling. - Scanning Probe Microscopy: AFM, STM – principles and biological applications. - Flow Cytometry and Cytophotometry: Principles, sorting, FACS, applications in cell cycle, apoptosis, and surface markers. - Emerging Tools: Live-cell imaging, single-cell analysis, and AI in image analysis. - Virtual lab module on microscope simulation.	25%



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2	Structural Organization of Cell & Extracellular Matrix Nucleus: Nuclear lamina, pore complex, nucleocytoplasmic transport. Endomembrane System: ER (rough/smooth), Golgi, lysosomes, protein sorting, vesicular transport (COP-coated, clathrin-mediated). Energy Organelles: Mitochondria (dynamics, mtDNA, ROS), chloroplasts (thylakoid, stroma, photosynthesis overview), peroxisomes. Extracellular Matrix & Cell Walls: Composition (collagen, elastin, integrins), plant cell wall (cellulose, pectin, lignin), bacterial cell wall (peptidoglycan – relevance to microbiology). Cell-Cell Interactions: Adhesion proteins (cadherins, selectins), tight junctions, gap junctions, plasmodesmata, desmosomes.	25%
3	Cell Membrane, Cytoskeleton and Signalling Plasma Membrane: Fluid mosaic model, lipid rafts, transport mechanisms (passive, active, ABC transporters, ion channels). Endocytosis & Exocytosis: Phagocytosis, pinocytosis, receptor-mediated endocytosis (clathrin and caveolae). Cytoskeleton: - Actin: polymerization, treadmilling, myosin motors, cell movement. - Microtubules: structure, dynamic instability, kinesin/dynein, cilia/flagella (9+2 arrangement, IFT). - Intermediate filaments: types, nuclear lamins. Cell Signalling: Receptors (GPCR, RTK, ion channels), second messengers (cAMP, IP3/DAG, Ca²⁺), MAPK/ERK, PI3K/Akt pathways, signalling in development and differentiation.	25%
4	Cell Division Cycle, Death and Cancer Biology Cell Cycle: Phases (G₁, S, G₂, M), CDKs/cyclins, checkpoint control (p53, Rb), APC/C, cytokinesis. Programmed Cell Death: Apoptosis (extrinsic/intrinsic pathways), caspases, Bcl-2 family, necroptosis (RIPK1/RIPK3), pyroptosis. Cancer Biology: - Types (carcinoma, sarcoma, leukemia /lymphoma). - Hallmarks of cancer. - Oncogenes (Ras, Myc) and tumor suppressors (p53, BRCA1/2). - Role of telomerase, metastasis, and tumor microenvironment.	25%



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- Assessment and Evaluation**

Sr. No.	Assessment/Evaluation	Component	Weightage (%)
1	Continuous Internal Evaluation	Seminars, Assignments, Quizzes, Class Regularity,	50
2	End-Semester Examination	Written Exam/Practical Exam Project Evaluation (Report, Presentation, Viva)	50

- Suggested Reference Books:**

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Molecular Biology of the Cell.	Alberts, B. et al.	7th Ed. (Indian reprint) (2022)	W. W. Norton
2	The Cell: A Molecular Approach	Cooper, G.M.	8th Ed (2019)	ASM Press
3	Molecular Cell Biology	Lodish, H. et al.	9th Ed (2021)	W H Freeman
4	Cell Biology, Genetics, Molecular Biology.	Verma, P.S. & Agrawal, V.K.	(2020)	S. Chand
5	Cell Biology	Purohit, S.S.	(2018)	Agrobios.



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B.Sc. (Microbiology) Semester– VII

Course Code	US07HSEMIC01	Title of the Course	Research methodology I
Total Credits of the Course	2	Hours per Week	2

Course Content		
Unit	Description	Weightage*
1.	Introduction to Research and Research Design a) Introduction to research, Types of research. Research Process: Identification of the Research problem, defining the research problem. b) Literature review or literature collection: Need for review literature, research reading, discriminative reading, consulting source material. c) Research Design: Meaning of Research Design, Need for research Design, Features of a Good Design, and Important Concepts Relating to Research Design, Different Research Designs.	50 %
2.	Sampling and sampling designs a) Need for sampling. b) Census and sample survey, implications of sample design, steps in sample design. c) Criteria for selecting a sampling procedure and characters of good sample design, Types of sample designs. Experimental design: a) Introduction, observation, hypothesis and Null-hypothesis. b) Types of experimental designs c) Basic principles of experiments: experimental unit and sampling unit, discrimination, replication of experiments, generalization, controls, randomization, measurements and experimental errors, avoiding bias	50 %



SARDAR PATEL UNIVERSITY

Vallabh Vidyanagar

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

B.Sc. Microbiology Semester VII (Honours and Honours with research)

Teaching-Learning Methodology	Use of multimedia technology for delivering Lecture, Group discussion, writing practices of their project works, case study of various research papers
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Evaluation Pattern

Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written Examination	25%
2.	Internal Continuous Assessment in the form of Projects, Viva-voce, Quizzes, Seminars, Assignments, Attendance	25%
3.	University Examination	50%

Course Outcomes: Having completed this course, the learner will be able to

1.	Understand research process and identification of research problem for study.
2.	Apply appropriate methods of data collection while selecting suitable techniques for effective research execution
3.	learn about research and experimental designs

Sr. No.	Suggested References:
1.	Research Methodology: Methods and Techniques — Kothari, C. R., & Garg, G. (2014). 3rd ed. New Delhi: New Age International Publishers.
2.	Study and Communication Skills for the Biosciences — Johnson, S., & Scott, J. (2008). (3rd ed.). Oxford: Oxford University Press.
3.	Research Methodology for biological sciences by N. Gurumani, (2021) ISBN 10, MJP publishers, Chennai.
4.	Research Methodology by D K Bhattacharyya, 1 e, Excel Books, New Delhi, 2003
5.	How to Research by Loraine Blaxter, Christina Hughes and Molcolm Tight, Viva Books Pvt.Ltd., New Delhi.