



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. (Biotechnology) Semester VII

B. Sc. (Biotechnology) Semester VII

Course Code	US07HMABTE01	Title of the Course	Molecular Biology II
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	The objective of the course is to understand the biological functions of DNA, its organization and its expression
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Course Content		
Unit	Description	Weightage* (%)
1.	Unit 1: DNA physical properties, Topology & Protein Interactions - Helix parameters of B-, A-, Z- forms of DNA - DNA Denaturation, Renaturation & Cot curves - Supercoiling and mode of action of Topoisomerases - DNA-binding motifs (helix-turn-helix, zinc finger, leucine zipper); ssDNA binding proteins. - Molecular visualization using PyMOL/NCBI structure database.	25%,
2.	Unit 2: Genome Organization & DNA Replication - Prokaryotic genome: nucleoid structure, looping, and supercoiling - Eukaryotic genome: nucleosome organization, histones, chromatin condensation (heterochromatin vs euchromatin), nucleosome assembly post-replication - Eukaryotic replication: origins, licensing, polymerases α, δ, ϵ, telomeres Inhibitors of replication (e.g., aphidicolin, hydroxyurea, novobiocin); Case study – inhibitors as anticancer/antiviral agents.	25%



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Unit	Description	Weightage* (%)
3	Unit 3: Transcription & Translation - RNA polymerases (prokaryotic vs eukaryotic) - Promoter architecture: -10/-35 box, TATA box, CpG islands - Transcription initiation complex assembly in prokaryotes (σ factor) and eukaryotes (TFIID, TFIIF, etc.) - Elongation and termination (ρ-dependent/independent in bacteria; polyA signal in eukaryotes) - RNA processing: capping, splicing, polyadenylation, alternative splicing, RNA editing, In silico promoter prediction - tRNA structure, aminoacylation, wobble hypothesis - Ribosome structure (70S vs 80S) and functional sites - Genetic code: features, degeneracy, universality, exceptions - Translation mechanism: initiation (prokaryotic Shine-Dalgarno vs eukaryotic cap-dependent), elongation, termination, ribosome recycling	25%,
4	Unit 4: Regulation of Gene Expression - Prokaryotic regulation: operon concept (ara) – with mutational analysis - Global regulatory networks: stringent response, SOS response, cAMP-CRP, heat shock response - Eukaryotic regulation: chromatin re-modelling, transcription factors - Post-transcriptional regulation: RNAi, miRNA, alternative splicing regulation - Translational control: eIF2 phosphorylation, iron-responsive elements (IREs), Virtual lab simulation of lac operon	25%



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Teaching-Learning Methodology	• Lectures for theory concepts. • Interactive discussions for metabolic pathways and regulation. • Diagram-based explanation for structures and pathways. • Problem-solving sessions for biochemical reactions and energetics.
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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.	To understand the structural, topological features of DNA along with its biological functions.
2.	To understand the DNA- Protein interactions and their expressions.
3.	To understand the concept of transcription, translation
4.	To understand the regulation of gene to control its expression at various levels of cell cycle

● Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Molecular Biology of the Gene	Watson, J. D. et al.	7th Ed.. (2017)	Pearson



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2	Lewin's Genes XII.	Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T.	(2017)	Jones & Bartlett.
3	Molecular Biology: Genes to Proteins.	Tropp, B. E	4th Ed. (2012)	Laxmi Publications.
4	DNA Structure and Function.	Sinden, R. R.	(1994)	Gulf Professional Publishing.

● Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	Molecular biology NPTEL	https://nptel.ac.in/courses/102103341
2	Molecular visualization	https://pymol.org/
3	Virtual lab simulation (HHMI Biointeractive)	https://www.biointeractive.org/



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B. Sc. (Biotechnology) Semester VII

Course Code	US07HMABTE02	Title of the Course	Biochemistry and Metabolism
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	The objective of this course is to understand the basic concepts of bioenergetics and the fundamentals of cellular metabolism of carbohydrates, lipids, amino acids, and nucleic acids, as well as associated metabolic disorders.
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Course Content		
Unit	Description	Weightage* (%)
1.	Unit 1: Carbohydrates and Glycobiology Monosaccharides and derivatives of sugars; polysaccharides; glycosaminoglycans; proteoglycans; protein glycosylation and its significance; carbohydrates as informational molecules; the sugar code; glycolysis and gluconeogenesis; regulation of glycolysis; metabolic flux and its regulation by various metabolic pathways; pentose phosphate pathway and its importance in biosynthetic reactions; glycogen synthesis, breakdown, and regulation.	25%,
2.	Unit 2: Proteins and Amino Acids Amino acids and proteins: nomenclature, classification, structure, chemical and physical properties of amino acids and proteins; alkali titration of amino acids; sequence determination and characterization of proteins; confirmation of proteins including Ramachandran plots; denaturation of proteins; basic concepts of protein folding and stability; folding pathways; role of accessory proteins in protein folding;	25%



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3.	Unit 3: Nucleic Acid and Lipid Metabolism Degradation of purines and pyrimidines; biosynthesis and regulation of purine and pyrimidine nucleotides; de novo and salvage pathways; biosynthesis of ribonucleotides, inhibitors of nucleic acid biosynthesis; disorders of nucleic acid metabolism; lipids as signals, cofactors, and pigments; fatty acid biosynthesis; biosynthesis of triacylglycerols and sphingolipids; biosynthetic pathways for steroids, and prostaglandins; ketone bodies; cholesterol biosynthesis; bile acids and salt formation	25%
4.	Unit 4: Metabolism and Energetics. Basic concepts of metabolism; central role of ATP in metabolism; carbon fuels and their oxidation; concept of energy-rich compounds and intermediates; common types of reactions involved in metabolism; oxidative phosphorylation and electron transport chain; regulation of metabolic energy balance and integration of catabolic and anabolic pathways.	25%

Teaching-Learning Methodology	- Lectures for theory concepts. - Interactive discussions for metabolic pathways and regulation. - Diagram-based explanation for structures and pathways. - Problem-solving sessions for biochemical reactions and energetics.
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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%



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Course Outcomes: Having completed this course, the learner will be able to	
1.	Applying concepts of carbohydrate metabolism and glycobiology to analyse metabolic pathways, flux, and regulation.
2.	Demonstrating understanding of amino acids and proteins by analysing structure, properties, folding, and stability using biochemical tools.
3.	Evaluating nucleic acid metabolism, including biosynthesis, degradation, regulation, and associated disorders.
4.	Analysing lipid metabolism and biosynthetic pathways to understand their roles in cellular signalling and physiological functions.
5.	Applying and analysing the principles of metabolism and energetics to interpret energy transformations and integration of metabolic pathways

● Suggested Learning Materials Books:

Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Lehninger's Principles of Biochemistry	David L. Nelson and Michael M. Cox	8 th (2021)	W.H. Freeman and Co.
2	Voet's Biochemistry	Voet. D & Voet. J.G	Adapted Edition (2021)	John Wiley & Sons, Inc
3	Biochemistry: The Chemical Reactions of Living Cells (2-Volume Set)	David E. Metzler and Carol M. Metzler.	2003	Academic Press (Elsevier)
4	Principles of Biochemistry	Zubay G. L	4 th ed. 1998	McGraw-Hill.
5	Biochemistry	Jeremy M. Berg, John L. Tymoczko, Lubert Stryer	7 th ed. (2010)	W. H. Freeman and Co.



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● Online Resources (Open Source)

Sr. No.	Description of Resource(s)	Weblink
1	Overview and Integration of Cellular Metabolism	https://onlinecourses.nptel.ac.in/noc24_cy47/preview
2	Metabolism	https://onlinecourses.nptel.ac.in/noc25_cy07/preview https://onlinecourses.nptel.ac.in/noc22_bt22/preview
3	Energetics	https://nptel.ac.in/content/storage2/courses/102103012/pdf/mod3.pdf



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B.Sc. (Biotechnology) Semester VII

Course Code	US07HMABTE03	Title of the Course	Biotechnology Practical (Major)
Total Credits of the Course	04	Hours Per Week	08

Course Content based on core theory papers		
No	Practical Section-1	Weightage* (%)
1.	Orientation to the laboratory, general laboratory safety and good laboratory practices (GLP).	100%
2.	Isolation of DNA from blood.	
3	Isolation of chloroplast DNA.	
4	Agarose gel electrophoresis of DNA/ RNA.	
5	Beta-galactosidase assay for studying induction of the lac operon.	
6	Study of DNA denaturation and renaturation by thermal treatment/UV absorbance.	
7	Isolation of total RNA from plant cells.	
8	Study of the effect of a DNA-replication inhibitor on microbial growth.	
9	Determination of concentration and purity of isolated DNA by UV spectrophotometry.	
No	Practical Section-2	
1	Biochemical calculations and Preparation of reagents	
2	Estimation of sugar by anthrone method.	



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3	Titration of amino-acid and determination of pKa of Glycine.	
4	Separation of proteins by SDS-PAGE.	
5	Estimation of cholesterol by colorimetric method.	
6	Study of yeast fermentation and estimation of carbon dioxide production.	
7	Study of enzyme kinetics and determination of K_m and V_{max} .	
8	Study of enzymatic hydrolysis of starch by amylase.	
9	Determination of acid value of oil/fat.	

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 good laboratory practices and laboratory safety, perform biochemical calculations, and prepare reagents and solutions accurately for molecular biology and biochemical experiments.
2.	Isolate, quantify and analyse nucleic acids from biological samples using appropriate molecular biology techniques, including spectrophotometry and agarose gel electrophoresis.
3.	Perform quantitative biochemical estimations and physicochemical analyses of biomolecules using colorimetric, titrimetric and electrophoretic methods, and interpret the experimental results.
4.	Investigate molecular and biochemical processes such as gene regulation, DNA denaturation and replication, fermentation and enzyme activity/kinetics through laboratory experiments and analyse the resulting experimental data.

Suggested References:				
Sr. No.	References			
Sr. No.	Title	Author(s)	Edition/Year	Publisher
1	Standard Methods of Biochemical Analysis.	Thimmaiah S. K.	(2012)	Kalyani Publishes, New Delhi, India
2	An introduction to practical Biochemistry	David T. Plummer		McGraw Hill book company
3	Biochemical Methods	S. Sadasivam and A. Manickam	2 nd	New Age International (P) Limited, Publishers, India
4	Principles and Techniques of Biochemistry and Molecular Biology	Keith Wilson & John Walker	8th (2018)	Cambridge University Press



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5	Biophysical Chemistry (Part II: Techniques for the Study of Biological Structure and Function)	Charles R. Cantor & Paul R. Schimmel	1980 (reprint)	W.H. Freeman
6	Practical Biochemistry: Principles and Techniques	Keith Wilson & John Walker	7th (2010)	Cambridge University Press
7	Protein Purification: Principles and Practice	Robert K. Scopes	3rd (1994)	Springer
8	Gel Electrophoresis of Proteins and Nucleic Acids	R. Westermeier	4th (2016)	Walter de Gruyter
9	Introduction to Spectroscopy	Donald L. Pavia	5th (2015)	Cengage Learning
10	Laboratory Safety for Chemistry Students	Robert H. Hill & David C. Finster	2nd (2016)	Wiley
11	Biotechnology Procedures & Experiments Handbook	S. Harisha	2007	Infinity Science Press LLC



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B. Sc. (Biotechnology) Semester VII

Course Code	US07HMIBTE01	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: 1. Good laboratory and good manufacturing practices 2. Guidelines for manufacturing facilities 3. Concept of Quality control and assurance
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Course Content		
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 inter-day Precision, Linearity, Repeatability, Robustness, Specificity, and Sensitivity (LOD and LOQ). h) Laboratory accreditation: ISO / IEC 17025: 2017, NABL, GLP, FDA, WHO, FSSAI	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 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. Seminars, poster presentations, Arranging debates in class. Performing experiments in laboratory. Audio-visual learning using videos/models of tissue culture and genetic engineering techniques. Industrial or laboratory visits to tissue culture laboratories/research centers wherever feasible.	
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%



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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. Pharma Med Press / BSP Books.
7	Research Methodology for biological sciences by N. Gurumani, (2021) ISBN 10, MJP publishers, Chennai.



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B. Sc. (Biotechnology) Semester VII

Course Code	US07HMIBTE02	Title of the Course	Biotechnology Practical (Minor)
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, endo toxin 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	
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.	Evaluate the microbiological quality of pharmaceuticals and environments using growth promotion tests, sterility testing, bio burden 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., PharmaMed 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. Chandras hekhhar Panda.
5	Good Laboratory Practices and Compliance Monitoring. Trupti Patil-Dongare. PharmaMed 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, VolI and II



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Course Code	US07HMABTE04	Title of the Course	Molecular Cell Biology
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	To introduce to various microscopy tools and their use in observations of cell. To understand the various organelles of cell , its structure and functions. To understand the concept of cell-cell communications and its importance during various pathways. To understand the concept of programmed cell death and its implications
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Course Content		
Unit	Description	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 & 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 & Signaling • 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 Signaling: Receptors (GPCR, RTK, ion channels), second messengers (cAMP, IP3/DAG, Ca²⁺), MAPK/ERK, PI3K/Akt pathways, signaling in development & differentiation.	25%



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4.	Cell Division Cycle, Death & 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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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. Seminars, poster presentations, Visualization of various mechanisms by showing educational videos from internet. Arranging debates in class. Performing experiments in laboratory. Practical demonstrations: For enzyme assays, immobilization techniques, and computational tools
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Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical ExaminationInternal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments,	50%
2.	University Examination	50%



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

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|----|---|
| 1. | To choose the relevant microscopy tools and micrometry for understanding the cell |
| 2. | Analyze the structure and function of cell organelles and extracellular components. |
| 3. | Understand the cell-cell communication and cancer biology. |

Suggested References:

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.

● Online Resources (Open Source)

Sr.	Description of Resource(s)	Weblink
1	Microscope simulator	https://myscope.training/TEM_simulator.html
2	Virtual Microscope Laboratory	https://virtuallabs.nmsu.edu/micro.php
3	Laboratory Xchange: Virtual Simulation lab	https://www.labxchange.org/library?t=Tag



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. (Biotechnology) Semester VII

B.Sc. (Biotechnology) Semester- VII

Course Code	US07HSEBTE01	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.	A. 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 B. Methods of Data Collection: Collection of primary data, observation method, Interview method, collection of data through questionnaires, collection of data through schedules, difference between questionnaires and schedules, some other method of data collection, collection of secondary data, selection of appropriate method for data collection.	50 %



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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.



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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