Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore

Shri Vaishnav Institute of Science

Choice Based Credit System (CBCS) in the light of NEP-2020

M. Sc Biotechnology

SEMESTER-I (2026-2028)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
				THEORY			PRACTICAL		L	T	P	CREDITS
			Marks	END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSBTC102	DC	Microbial Systems & Applications	Max	60	20	20	30	20	3	0	2	5
			Min	24	16		14	9				

Legends: L - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

The student will have the ability to:

1. Comprehend microbial fundamentals including growth, nutrition, microbial control methods, gene transfer mechanisms, and host–microbe interactions.
2. Examine the general characteristics of prokaryotic and eukaryotic microorganisms, emphasizing both conventional and molecular methods of characterization using modern techniques.
3. Understand the fundamentals of microbial growth and nutrition, along with methods for microbial control, gene transfer mechanisms, and host–microbe interactions.
4. Develop practical skills in enzymology and bioinstrumentation, enabling students to apply laboratory techniques for microbial analysis, enzyme kinetics, and biomolecular detection.

Course Alignment with UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, SDG 4, SDG 9, SDG 12

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Course Outcomes: After completion of the course, the student will be able to:

CO-1	Classify and differentiate microorganisms based on their diversity and taxonomic characteristics.
CO-2	Demonstrate and evaluate nutritional requirements, culture methods, and strategies to control microbial growth.
CO-3	Explain and apply techniques for cultivating and identifying viruses, while recognizing their diversity.
CO-4	Analyze and interpret bacterial gene transfer mechanisms and microbial interactions with hosts and the environment.

Teaching Pedagogy:

T1	Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2	ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

Assessment Tools

ATL-1	Quiz
ATL-2	Activity Based Learning
ATL-3	Midterm Exams

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ATL-4	Flip Class
ATL-5	Seminar Presentation
ATL-6	Assignments
ATL-7	Poster
ATL-8	Oral Viva-voce examination
ATL-9	Industrial Visit Report

Experiential learning: Project Based Learning (PBL) and Case Studies, and AI based practical components

Modules	Name	Experiment/ABL/PBL	Blooms Taxonomy
Module 1	AI Colony Counter Use apps like Colony Counter AI to quantify colonies on agar plates.	PBL and AI based practical component	Apply and analyse
Module 2	Microbial Growth Curve Analysis: Students culture	PBL and AI based practical component	Apply and analyse

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	bacteria, measure OD at intervals, and use AI-based curve-fitting apps to analyze growth kinetics.		
Module 3	COVID-19 Diagnostics Explore how RT-PCR and AI-enhanced imaging were used in pandemic response. different conditions.	Case study	All levels
Module 4	Hospital-Acquired Infections Explore how AI helps track resistant strains in clinical microbiology labs.	Case study	All levels
Module 5	Foodborne Pathogen Outbreaks Analyze case studies of Salmonella or E. coli outbreaks and AI's role in rapid detection.	Case study	All levels

Prerequisites: BSc standard Microbiology, knowledge of types of cells, cell structure, biomolecules etc.

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SYLLABUS:

Module	Descriptors/Topics	Hours	Assessment tools
I	**History, Microbial Diversity and classification** History of Microbiology and major contributions; Microbial diversity-structure and general characters and overview of classification of Bacteria, Archaea, Fungi and Algae, Protozoa. Bacterial Classification Systems; Advances in Bacterial Taxonomy using ribotyping, fatty acid profiling. Microbial evolution and physiological diversity; AI-driven genome sequencing and microbial taxonomy.	09	Quiz Mid-term Exam Assignment
II	**Characteristics of Bacteria** Nutritional uptake mechanism in bacteria; Nutritional classes of Bacteria; Culture Media, Microbial Growth; Bacterial Growth Curve; Methods of Measurement; Factors affecting bacterial growth: Temperature, Oxygen, pH, Osmotic concentration, and water activity, Batch and Continuous Culture; Synchronous and	09	Mid-Term Quiz Assignment

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	Diauxic Growth. Bacterial genetics: mutation and recombination in bacteria, plasmids, transformation, transduction and conjugation; Operon concept (Lac, Trp, Gal, Ara)		
III	**Virology** Morphology and General Properties of Viruses, Viroids and Prions; Classification of Viruses; Plants and Animals Viruses: Ultra structure and Life Cycle of DNA, RNA and Retroviruses; Bacteriophages – Morphology, Genome Organization and Life Cycle of T4, T7, M13, Lambda Phage; Cultivation of Viruses in-ovo, in-vivo, ex-vivo / in- vitro, in plants and plant cell cultures; Virus identification.	08	Mid-Term Oral Viva-voce examination Presentation
IV	**Control of Microorganisms** Sterilization; Physical and Chemical Methods for Control of Microorganisms; Biological Control of Microorganisms; Antimicrobial agents and Mechanism of action of Antibacterial, Antiviral and Antifungal drugs; plant-based antimicrobials used in	08	Quiz Assignment Presentation

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	traditional healing, linked to microbial inhibition, Drug Resistance Mechanism; Antibiotic sensitivity testing methods.		
V	**Host-Microbe Interactions** Host-microbe interaction and their types, Role of Quorum sensing Rhizoshpere and Phyllosphere Microorganisms; Symbiosis in Legumes and Ruminants, Indigenous practices of composting, Plant Pathogens - Disease Symptoms, Transmission, Mechanism of Pathogenicity; Microbial Control of Insects; Bio-control Agents and Bio-pesticides. **Infectious Diseases in Humans** – Mechanism of Pathogenesis; Host-pathogen interaction, Evasion of Host Defenses, Machine learning models for rapid pathogen detection, Beneficial effects: Human microbiome, prebiotics and probiotics and IKS. **Microorganisms and Waste Management-** Waste Water treatment, solid waste management, Bioremediation	09	Quiz Assignment Oral Viva-voce examination
	Total Hours	**43**	

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Additional Resources

A. Value addition to course content/ Skill enhancement content:

a. *Microbiology and Industrial applications | SWAYAM, https://onlinecourses.nptel.ac.in/noc26_bt19/preview*

b. Microbial Biotechnology | SWAYAM
https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_bt20

c. Microbial Technology | SWAYAM
https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_ma05

B. Remedial classes for slow learners: As per the SVVV SOP for slow and fast learners.

Suggested Readings:

Text and Reference Books	• *Ananthanarayan, R., & Paniker, C. K. J. (2013). Ananthanarayan and Paniker's textbook of microbiology (10th ed.). Universities Press.* • *Seth, P. (2007). Biochemical analysis. Himanshu Publications.* • *Madigan, M. T., Martinko, J. M., Bender, K. S., Buckley, D. H., & Stahl, D. A. (2017). Brock biology of microorganisms (14th ed.). Pearson Education.* • *Powar, C. B. (2017). Cell biology. Himalaya Publishing House.* • *Bahadur, B. (2017). Essentials of biology & biotechnology. PharmaMed*

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	Press. • *Aneja, K. R. (2020). Experiments in microbiology, plant pathology, tissue culture and microbial biotechnology (5th ed.). New Age International Publishers.* • *Sequeira, M. G. (2020). Introduction to microbiology (3rd ed.). New Age International Publishers.* • *Black, J. G. (2015). Microbiology (9th ed.). Wiley India Pvt. Ltd.* • *Pelczar, M. J., Reid, R. D., & Chan, E. C. S. (1986). Microbiology (5th ed.). McGraw-Hill.* • *Dubey, R. C. (2023). Practical microbiology (4th ed.). S. Chand & Company Limited.*
Suggested e- resources (Websites/e-books)	• https://openstax.org/details/books/microbiology • Biology 2e | OpenStax • Notes - Microbe Notes

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Choice Based Credit System (CBCS) in the light of NEP-2020

Department of Life Science/Biotechnology

M.Sc. (Major - Biotechnology)

SEMESTER-I (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
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MSBTC103	DC	Cell Structure and Communication	Max	60	20	20	30	20	3	0	2	5
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COURSE OBJECTIVES:	
The student will have ability to:	
1.	Describe the structure, organization, and functions of prokaryotic and eukaryotic cells.
2.	Explain the principles and mechanisms of cell communication and signal transduction pathways.
3.	Interpret the fundamental concepts and molecular basis of cancer biology.
4.	Demonstrate basic cell biology techniques and their applications in biological research.

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4.**

COURSE OUTCOMES:	
After completion of the course, the student will be able to:	
CO1	Explain and compare the structure, organization, and functions of major cellular components in prokaryotic and eukaryotic cells
CO2	Illustrate and analyze the mechanisms of cell signaling, communication, and signal transduction pathways involved in cellular responses
CO3	Interpret and evaluate the basic concepts of cancer biology, including the cellular and molecular events involved in carcinogenesis.
CO4	Apply and demonstrate fundamental cell biology techniques for the observation, analysis, and investigation of cellular processes.

TEACHING PEDAGOGY:	
T1	Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2	ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:	
ATL-1	Quiz
ATL-2	Activity Based Learning
ATL-3	Midterm Exams
ATL-4	Seminar Presentation
ATL-5	Assignments
AT1-6	Poster
AT1-7	Oral Viva-voce examination

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Department of Life Science/Biotechnology

M.Sc. (Major - Biotechnology)

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ATL7 Poster
ATL8 Oral Viva-voce examination
ATL9 Industrial Visit Report

PREREQUISITES:

Knowledge of Cell structure

SYLLABUS:

Module	Topics	Hours	Assessment Tools
I	**UNIT–I: Internal Organization of Cell** Basic concept of cells, chemical organization of cells; internal organization and compartmentalization of the eukaryotic cell. Structure and function of different intracellular organelles: Cytosol, Mitochondria, Chloroplast, Endoplasmic Reticulum, Golgi Body.	10	Quiz, Mid-term Exam, Assignment
II	**UNIT–II: Intracellular transport and Signaling** Intra-cellular transport (vesicular and membrane transport) at molecular level: transport of molecules between the Nucleus and the Cytosol, Transport of Proteins into Mitochondria, Chloroplasts, Peroxisomes, Endoplasmic Reticulum. Vesicular Traffic in the Secretary and Endocytic Pathway, Transport from ER through the Golgi apparatus, Transport from the Trans Golgi network. Membrane structure and transport – lipid bilayer and membrane proteins, Transport across membranes – active transport and passive transport, Na+ Ka+ pump, ATPase, ABC transporters, Ion channels	12	Quiz, Mid-term Exam Assignment

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Department of Life Science/Biotechnology

M.Sc. (Major - Biotechnology)

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III	**UNIT–III: Cell Communication and Extracellular Signaling** Overview of extracellular signaling, Basic concepts of Paracrine, endocrine, autocrine signaling, Extracellular matrix and cell junctions. Signaling at cell surface: second messengers cAMP, calcium, IP3 and their role in signal transduction. Cell surface receptors in signal transduction: G-protein coupled receptor, Ion channel receptors, Tyrosine kinase linked receptors, Receptors with intrinsic enzyme activity (RTK). Interaction and regulation of cell signaling pathway.	10	Quiz, Mid-term Exam Assignment
IV	**UNIT–IV: Cellular Processes and Cancer Biology** Cell cycle and its regulation; role of Cyclins, CDKs and checkpoints in cell cycle. Cell division: mitosis, meiosis and cytokinesis; Cell death: introduction to different modes of cell death Necrosis, Senescence, Apoptosis - Programmed cell death. Mutations, proto-oncogenes, oncogenes and tumor suppressor genes, biological carcinogens: physical, chemical, biological. Mutations and its types.	10	Quiz, Mid-term Exam Assignment

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V	**UNIT–V: Modern Methods for the study of Cell** FRAP, PAS reaction, Enhanced Chemiluminescence (ECL), freeze-etching, freeze-fracturing, Flow cytometry, FACS, Lab on Chip and Organ on chip concept. Applications of AI in cell biology techniques.	6	Quiz, Mid-term Exam Assignment
	Total Hours	**48**	

ADDITIONAL RESOURCES

A. **Value addition to course content/ Skill enhancement content:**
https://www.youtube.com/playlist?list=PLUl4u3cNGP60_JNv2MmK3wkOt9syvfQWY (MIT OCW)
https://www.youtube.com/watch?v=LMj16R29wTc&list=PLKtiwIJ8Q7rpHOuU0EN_zqtXwOmTINIMk

B. **Remedial classes for slow learners:**
As per the University SOP for slow and fast learners.

SUGGESTED READINGS:

Textbooks

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th Ed.). New York: Garland Science.
2. Cooper, G. M., & Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM ; Sunderland.
3. Gerald Karp, Cell Biology, 7th edition, (2014) . John Wiley & Sons., USA.
4. Lodish, H. F. (2021). Molecular Cell Biology (9th Ed.). New York: W.H. Freeman.

Reference Books

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of

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Choice Based Credit System (CBCS) in the light of NEP-2020

Department of Life Science/Biotechnology

M.Sc. (Major - Biotechnology)

SEMESTER-I (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME						L	T	P	CREDITS
			Marks	THEORY			PRACTICAL					
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSBTC103	DC	Cell Structure and Communication	Max	60	20	20	30	20	3	0	2	5
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

the Cell (6th Ed.). New York: Garland Science.

2. Cooper, G. M., & Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM ; Sunderland.
3. Gerald Karp, Cell Biology, 7th edition, (2014) . John Wiley & Sons., USA.
4. Lowish, H. F. (2021). Molecular Cell Biology (9th Ed.). New York: W.H. Freeman.

Suggested e- resources (Websites/e- books)

1. https://onlinecourses.nptel.ac.in/noc26_cs85/preview
2. https://www.youtube.com/watch?v=_2w9UX17m_k&list=PLbRMhDVUMngcwWkzVTm_kFH6JW4JCtAUM (NPTEL)

LIST OF PRACTICAL

- Study of mitosis and the cell cycle in onion root-tip cells.
- Cell counting and viability analysis.
- Preparation and visualization of blood smears for identification of different types of blood cells.
- Preparation of buccal smears for identification of Barr bodies.
- Isolation of chloroplasts from plant cells.
- Isolation of mitochondria from plant cells.
- Examination and analysis of histological slides.
- Isolation of peripheral blood mononuclear cells (PBMCs).

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MSBTC103	DC	Cell Structure and Communication	Max	60	20	20	30	20	3	0	2	5
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Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

Course Outcomes	Correlation with POs					Correlation with PSOs				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	1	2	3	2	3	2	1
CO2	2	2	2	1	2	3	2	2	2	2
CO3	1	3	3	2	2	2	3	3	3	3
CO4	1	2	2	2	3	3	2	3	3	3

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Program: M.Sc. (Biotechnology)

SEMESTER-I (2026-2028)

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			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSBTC104	DC	Advanced Molecular Biology and Gene Regulation	60	20	20	30	20	3	0	2	5
			24	16		14	09				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. To provide comprehensive knowledge of genome organization, chromatin structure, epigenetic regulation in prokaryotic and eukaryotic systems.
2. To develop a clear understanding of DNA replication, recombination, genome rearrangements, and molecular mechanisms
3. To impart knowledge of DNA damage, repair mechanisms, and mutation processes, along with their biological significance
4. To explain the mechanisms of gene expression, including transcription, RNA processing, genetic code, and translation, and their regulation in prokaryotes and eukaryotes.

Course Alignment with UNSDG:
The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4.**
Course outcomes: After completion of the course, the student will be able to:

CO-1	Explain and analyze genome organization, chromatin structure, epigenetic modifications, and genome dynamics in prokaryotic and eukaryotic systems.
CO-2	Apply the concepts of DNA replication, recombination, and genome rearrangements to interpret molecular mechanisms underlying genetic stability and variation
CO-3	Analyze different types of DNA damage, repair pathways, and mutation mechanisms, and evaluate their impact on genome integrity and disease
CO-4	Apply knowledge of transcription, RNA processing, and translation to interpret gene expression, and design strategies to study or manipulate gene regulation.

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Program: M.Sc. (Biotechnology)

SEMESTER-I (2026-2028)

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***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Teaching Pedagogy:

T1	Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2	ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

Assessment Tools

AT1-1	Quiz
AT1-2	Activity Based Learning
AT1-3	Midterm Exams
AT1-4	Seminar Presentation
AT1-5	Assignments
AT1-6	Poster
AT1-7	Oral Viva-voce examination

Prerequisites: Graduation with Life Science knowledge of practical theories, principles & applications.

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Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Module	Descriptors/Topics	Hours	Assessment tools
I	**Genome Organization and Dynamics:** Organization of prokaryotic and eukaryotic genome; Chromatin organization and remodeling, Chromosome, Centromere, Telomere; Gene clusters, Gene families, Super-families, Pseudogenes; Genome size and C-value paradox; Cot curve analysis; Repetitive and non-repetitive DNA sequences, Palindromes; Satellite DNA; DNA melting and buoyant density; Cot ½ and Rot ½ values; Organization of mitochondrial genome; Organization of chloroplast genome; Transposable elements of Eukaryotes, SINES and LINES, Retrotransposons; Nucleosome phasing; DNase I hypersensitive sites; DNA methylation and Imprinting.	10	Quiz Mid-term Exam Assignment
II	**DNA Replication, Rearrangements and Recombination:** Mechanism of replication of Prokaryotic and Eukaryotic DNA; DNA polymerases, replication of viral DNA, rolling circle model; Inhibitors of replication; Complete and segmental duplication of genomes; Insertion, Deletion and Translocation of sequences; Homologous Recombination and Site-specific Recombination; Models for homologous recombination-Holliday junction, Non-homologous End Joining, Proteins involved in recombination- RecA, RuvA, B, C.	12	Mid-Term Quiz Assignment
III	**DNA Damage, Repair and Mutations:** DNA damage- alkylation, deamination, oxidation, UV radiation;	12	Mid-Term Oral Viva-

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Program: M.Sc. (Biotechnology)

SEMESTER-I (2026-2028)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME					L	T	P	CREDITS
			THEORY			PRACTICAL					
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSBT104	DC	Advanced Molecular Biology and Gene Regulation	60	20	20	30	20	3	0	2	5
			24	16		14	09				

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	Repair mechanisms- photo reactivation, nucleotide excision repair, post-replication repair, mismatch repair and SOS repair; Spontaneous and Induced mutations- Physical and Chemical mutagenesis; Molecular mechanisms of mutagenesis- Transition, Transversion, Frame Shift, Mis-sense and Non-sense mutations. **AI-based approaches for classification of mutations, modeling DNA repair pathways, and studying the impact of genetic variations in disease such as cancer**		voce examination Presentation
IV	**DNA Transcription in Prokaryotes and Eukaryotes:** DNA Transcription in Prokaryotes and Eukaryotes Mechanism of transcription in prokaryotes- initiation, elongation, termination; Mechanism of transcription in eukaryotes; Post transcriptional modifications of mRNA- Processing of tRNA and rRNA; Inhibitors of transcription; Transcriptional and post transcriptional gene silencing, RNAi pathway (siRNA and miRNA).	8	Quiz Assignment Presentation
V	**Genetic Code and Translation:** Genetic Code and Translation Correspondence of amino acid sequence in proteins; Properties of genetic code- universal code, degeneracy and redundancy, Wobble hypothesis; Mechanism of translation, assembly of ribosomal subunits, t-RNA structure; Mechanism of initiation, elongation and termination; Co- and post-translational modifications.	8	Quiz Assignment Oral Viva-voce examination
	Total Hours	48	

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***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Additional Resources

A. Value addition to course content/ Skill enhancement content:

https://www.youtube.com/playlist?list=PLYcLrRDaR8_cpMqa1bbUwD2T39RJA6_o3

https://www.youtube.com/playlist?list=PL3kN4iWWCHdoPPOpcVrwfAbhFc7lMKYRC

B. Remedial classes for slow learners: As per the University SOP for slow and fast learners.

Suggested Readings:

Reference Books	• Alberts, B., Johnson, A. D., Lewis, J.,Morgan D., Raff, M., Roberts, K., & Walter, P. (2015). Molecular Biology of the Cell. (6th Ed.). New York: Garland Science. • Brown, T. A. (2017). Genomes 4. (4th Ed.). Wiley Publishers (Asia Pvt Ltd). • Freifelder, D. (2012). Molecular Biology. (5th Ed.). Narosa Publishing House, India.

Lists of Practical

S.No	Topic	Course Outcomes
1	Isolation of plasmid DNA from *E.coli*	CO1
2	Isolation of DNA from plant cells	CO1
3	Estimation of DNA concentration by Diphenylamine (DPA) Method.	CO2
4	Determination of purity and concentration of DNA - Spectrophotometric method.	CO3
5	DNA analysis by electrophoresis.	CO4
6	Isolation of mRNA and analysis by agarose gel.	CO4

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Course Articulation Matrix (Mapping of COs with POs)

Course Outcomes	Correlation with POs					Correlation with PSOs				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	1	1	3	2	3	2	1
CO2	3	3	2	1	2	3	3	3	2	2
CO3	2	3	3	2	2	2	3	3	3	3
CO4	3	3	2	2	3	3	3	3	3	3

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M. Sc Biotechnology

SEMESTER-I (2026-28)

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			Marks	THEORY			PRACTICAL		L	T	P	CREDITS
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSBTC101	DC	Biochemistry and Metabolism	Max	60	20	20	30	20	3		2	5
			Min	24	16		14	9				

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit; ***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

COURSE OBJECTIVES:

The student will have ability to:

1. Conferring basic knowledge about structure and functions of biomolecules
2. Understanding of how enzymes and metabolites in the living system work to synthesize different biomolecules and produce energy.
3. Comprehensive knowledge about biochemical pathways involved in intermediary metabolism Understanding
4. regulation of carbohydrate, protein, lipid, and nucleic acid.

COURSE ALIGNMENT WITH UNSDG:

The course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4**.

COURSE OUTCOMES:

After completion of the course, the student will be able to:

CO1 Understand structural and functional fundamentals of carbohydrate, protein, lipid, and nucleic acid.
CO2 Recognize the major metabolic processes in the living system.
CO3 Identify the mechanism and the importance of enzymes functions.

TEACHING PEDAGOGY:

T1 Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2 ABL activities, Assignments, Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

ATL1 Quiz
ATL2 Activity Based Learning
ATL3 Midterm Exams
ATL4 Seminar Presentation
ATL5 Assignments
ATL6 Poster
ATL7 Oral Viva-voce examination

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PREREQUISITES:

Basic knowledge of biological molecules and their functions.

SYLLABUS:

Module	Descriptors/Topics	Hours	Assessment Tools
I	Chemical composition of living matter. Properties of water and aqueous environment. Carbohydrates: Stereoisomerisms and classification of monosaccharaides. Di, tri and polysaccharides, their functions in energy storage and cell structure; Glyco-conjugates; glycoproteins, proteoglycans and glycolipids. Lipids: Structure of fatty acids and complex lipids. Functions of complex lipids as components of membrane and storage molecules; Structure and functions of Terpenes and steroids	12	Quiz; Assignments Mid-Term Exams
II	Amino acids: Structure, properties and classification. Proteins: primary, secondary, tertiary and quaternary structure; Ramchandran plot and Protein folding. Nucleic acids: Structure and properties of DNA and RNA; A, B and Z form of DNA.	10	Quiz; Assignments Mid-Term Exams
III	Vitamins and co-enzymes: Structure, regulation of biochemical reactions and function of water soluble vitamins; Fat soluble Vitamins A, D, E and K.	10	Quiz; Assignments Mid-Term Exams
IV	Glycolysis, citric acid cycle and energy generation;	08	Quiz; Assignments Mid-Term Exams

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	Pentose phosphate pathway and its regulation. Gluconeogenesis, glycogenesis and glycogenolysis, glyoxylate and Gamma aminobutyrate shunt pathways, Cori cycle, Entner-Doudoroff pathway, glucuronate pathway. Lipid Metabolism: biosynthetic pathway for triacylglycerols, phosphoglycerides, sphingomyelin and prostaglandins. Hydrolysis of triacylglycerols and oxidation of fatty acids. Metabolism of cholesterol and its regulation. Ketone bodies biosynthesis.		
V	Protein metabolism: Synthesis and degradation of amino acids – transamination and deamination reactions. Urea cycle and metabolic disorders.	08	Quiz; Assignments Mid-Term Exams
	Total Hours	**48**	

ADDITIONAL RESOURCES

A. **Value addition to course content/ Skill enhancement content:**
https://www.youtube.com/watch?v=haO3ChM2wUs&list=PLyqSpQzTE6M-JgOPBvDus1CRmpR6Pwq1W

B. **Remedial classes for slow learners:**
As per the University SOP for slow and fast learners.

SUGGESTED READINGS:

Textbooks

1. DL. Nelson, M Cox *Lehninger Principles of Biochemistry* (8th Ed.), W H Freeman & Co. 2021
2. JL Jain *Fundamentals of Biochemistry* 6th Ed., S. Chand Publication, 2005.

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Reference Books

1. Lubert Stryer, Jeremy M. Berg, John L. Tymoczko , Gregory J. Gatto Jr. *Biochemistry* (9th Ed.)– W. H. Freeman & Co 2019.
2. Zubey G. L. Parson. W. W *Principles of Biochemistry* - Brown (William C.) Co, U.S.1995

Suggested e- resources (Websites/e- books)

1. https://www.youtube.com/watch?v=haO3ChM2wUs&list=PLyqSpQzTE6M-JgOPBvDus1CRmpR6Pwq1W
2. https://www.youtube.com/watch?v=bMcnUYp8x8E&list=PLBUibmA0dbhug-1OAKZBohydS42lSRjxs

LIST OF PRACTICAL

	Title	CO Mapping
1.	Qualitative (Molisch test) and Quantitative estimation (DNS method) of Carbohydrate	CO1
2.	Qualitative (Biuret test) and Quantitative estimation (Lowry method) of Protein	CO1
3.	Qualitative (Sudan III/IV staining) and Quantitative estimation (Bligh and Dyer method) of Lipid	CO1
4.	Qualitative and Quantitative estimation of Nucleic acid (Diphenylamine (DPA) Method)	CO2
5.	Estimation of blood glucose by GOD-POD method	CO2
6.	Estimation of amino acid TLC & Paper Chromatographic techniques	CO3
7.	Estimation of Lipid peroxidation assay (MDA estimation).	CO3
8.	Estimation of Catalase activity by enzyme kinetic method.	CO3

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Choice Based Credit System (CBCS) in the light of NEP-2020

M. Sc Biotechnology

SEMESTER-I (2026-28)

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME									
			Marks	THEORY			PRACTICAL		L	T	P	CREDITS
				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSBTC101	DC	Biochemistry and Metabolism	Max	60	20	20	30	20	3		2	5
			Min	24	16		14	9				

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COURSE ARTICULATION MATRIX (MAPPING OF COs WITH POs)

Course Outcomes	Correlation with POs					Correlation with PSOs				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	2	1	1	1	2	2	3	2	1
CO2	1	3	2	1	2	2	3	3	2	2
CO3	2	2	3	2	2	2	3	3	3	3
CO4	1	3	2	2	3	3	3	3	3	3

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M.Sc. (Major - Biotechnology)

SEMESTER-I (2026-28)

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				END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
MSBTC103	DC	Cell Structure and Communication	Max	60	20	20	30	20	3	0	2	5
			Min	24	16		14	9				

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COURSE OBJECTIVES:

The student will have ability to:

1.	Describe the structure, organization, and functions of prokaryotic and eukaryotic cells.
2.	Explain the principles and mechanisms of cell communication and signal transduction pathways.
3.	Interpret the fundamental concepts and molecular basis of cancer biology.
4.	Demonstrate basic cell biology techniques and their applications in biological research.

COURSE ALIGNMENT WITH UNSDG:

The Course aims to fulfill the United Nations Sustainable Development Goals, **SDG 4.**

COURSE OUTCOMES:

After completion of the course, the student will be able to:

CO1	Explain and compare the structure, organization, and functions of major cellular components in prokaryotic and eukaryotic cells
CO2	Illustrate and analyze the mechanisms of cell signaling, communication, and signal transduction pathways involved in cellular responses
CO3	Interpret and evaluate the basic concepts of cancer biology, including the cellular and molecular events involved in carcinogenesis.
CO4	Apply and demonstrate fundamental cell biology techniques for the observation, analysis, and investigation of cellular processes.

TEACHING PEDAGOGY:

T1	Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry-based teaching
T2	ABL activities, Assignments, Flip Class/ Seminars, Quizzes, Oral Viva-voce examination

ASSESSMENT TOOLS:

ATL-1	Quiz
ATL-2	Activity Based Learning
ATL-3	Midterm Exams
ATL-4	Seminar Presentation
ATL-5	Assignments
AT1-6	Poster
AT1-7	Oral Viva-voce examination

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PREREQUISITES:

Knowledge of Cell structure

SYLLABUS:

Module	Topics	Hours	Assessment Tools
I	**UNIT–I: Internal Organization of Cell** Basic concept of cells, chemical organization of cells; internal organization and compartmentalization of the eukaryotic cell. Structure and function of different intracellular organelles: Cytosol, Mitochondria, Chloroplast, Endoplasmic Reticulum, Golgi Body.	10	Quiz, Mid-term Exam, Assignment
II	**UNIT–II: Intracellular transport and Signaling** Intra-cellular transport (vesicular and membrane transport) at molecular level: transport of molecules between the Nucleus and the Cytosol, Transport of Proteins into Mitochondria, Chloroplasts, Peroxisomes, Endoplasmic Reticulum. Vesicular Traffic in the Secretary and Endocytic Pathway, Transport from ER through the Golgi apparatus, Transport from the Trans Golgi network. Membrane structure and transport – lipid bilayer and membrane proteins, Transport across membranes – active transport and passive transport, Na+ Ka+ pump, ATPase, ABC transporters, Ion channels	12	Quiz, Mid-term Exam Assignment

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III	**UNIT–III: Cell Communication and Extracellular Signaling** Overview of extracellular signaling, Basic concepts of Paracrine, endocrine, autocrine signaling, Extracellular matrix and cell junctions. Signaling at cell surface: second messengers cAMP, calcium, IP3 and their role in signal transduction. Cell surface receptors in signal transduction: G-protein coupled receptor, Ion channel receptors, Tyrosine kinase linked receptors, Receptors with intrinsic enzyme activity (RTK). Interaction and regulation of cell signaling pathway.	10	Quiz, Mid-term Exam Assignment
IV	**UNIT–IV: Cellular Processes and Cancer Biology** Cell cycle and its regulation; role of Cyclins, CDKs and checkpoints in cell cycle. Cell division: mitosis, meiosis and cytokinesis; Cell death: introduction to different modes of cell death Necrosis, Senescence, Apoptosis - Programmed cell death. Mutations, proto-oncogenes, oncogenes and tumor suppressor genes, biological carcinogens: physical, chemical, biological. Mutations and its types.	10	Quiz, Mid-term Exam Assignment

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V	**UNIT–V: Modern Methods for the study of Cell** FRAP, PAS reaction, Enhanced Chemiluminescence (ECL), freeze-etching, freeze-fracturing, Flow cytometry, FACS, Lab on Chip and Organ on chip concept. Applications of AI in cell biology techniques.	6	Quiz, Mid-term Exam Assignment
	Total Hours	**48**	

ADDITIONAL RESOURCES

A. **Value addition to course content/ Skill enhancement content:**
https://www.youtube.com/playlist?list=PLUl4u3cNGP60_JNv2MmK3wkOt9syvfQWY (MIT OCW)
https://www.youtube.com/watch?v=LMj16R29wTc&list=PLKtiwIJ8Q7rpHOuU0EN_zqtXwOmTINIMk

B. **Remedial classes for slow learners:**
As per the University SOP for slow and fast learners.

SUGGESTED READINGS:

Textbooks

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of the Cell (6th Ed.). New York: Garland Science.
2. Cooper, G. M., & Hausman, R. E. (2013). The Cell: a Molecular Approach (6th Ed.). Washington: ASM ; Sunderland.
3. Gerald Karp, Cell Biology, 7th edition, (2014) . John Wiley & Sons., USA.
4. Lodish, H. F. (2021). Molecular Cell Biology (9th Ed.). New York: W.H. Freeman.

Reference Books

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2014). Molecular Biology of

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the Cell (6th Ed.). New York: Garland Science.

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Suggested e- resources (Websites/e- books)

1. https://onlinecourses.nptel.ac.in/noc26_cs85/preview
2. https://www.youtube.com/watch?v=_2w9UX17m_k&list=PLbRMhDVUMngcwWkzVTm_kFH6JW4JCtAUM (NPTEL)

LIST OF PRACTICAL

- Study of mitosis and the cell cycle in onion root-tip cells.
- Cell counting and viability analysis.
- Preparation and visualization of blood smears for identification of different types of blood cells.
- Preparation of buccal smears for identification of Barr bodies.
- Isolation of chloroplasts from plant cells.
- Isolation of mitochondria from plant cells.
- Examination and analysis of histological slides.
- Isolation of peripheral blood mononuclear cells (PBMCs).

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