MAHARSHI DAYANAND SARASWATI UNIVERSITY

BSc (3 year degree programme)
with BIOTECHNOLOGY

CURRICULUM 2023-24

B.Sc BIOTECHNOLOGY (3 year Degree Programme)
BATCH 2023-24 (Choice Based Semester System)
CURRICULUM

First Year

	DISCIPLINE SPECIFIC COURSES	DSC 1 Biotechnology	DSC2	DSC3	AEC	
SEM 1						
	BTC5101T-C Biomolecules : Structure and Function (4L)	4	4	4		
	BTC5102P-C Laboratory Practices and Analytical Techniques in Biochemistry (2P)	2	2	2	2	
Total credits		6	6	6	2	20
SEM 2						
	BTC5201T-C Introduction to Microbiology and Principles of asepsis (4L)	4	4	4		
	BTC5202P-C Biotechnological Skills & Aseptic Techniques(2P)	2	2	2	2	
Total credits		6	6	6	2	20

(i) Scheme for assessment of courses

All courses except for the Seminars/Workshop/Training in a UG program shall have continuous assessment which would include In Term Continuous (ITC) assessment (30% marks) by the course leader and an End of the Term (EOT) examination (70%) at the level of the University.

No student shall be permitted to repeat any course only for the purpose of improving the grade.

In-Term Continuous (ITC) Assessment: It is mandatory for all students to participate in all the in-term continuous assessment and course-related activities for award of the marks. Therefore, a schedule of ITC assessment shall be prepared by the Course Leader and informed to the students at the very beginning of the semester.

Method(s) of the ITC assessment must be such that they evaluate **those learning outcomes** of the course that might not be assessed in the End of the Term Examination. The process may include formative assessment followed by Test and/or Term paper and/or quizzes and/or assignments and/or case demos/study and/or presentations and/or write ups and/or reflections on a field trip/excursion/educational tour and/or viva voce and/or attendance etc.

In-term Continuous Assessment marks shall be displayed within a week from the date of conduct of examination and all corrected answer books with comments, if any, shall be shown to students.

An example is shown below:

S. No.	Item	Max Marks
1	Tests/Term Papers/Quizzes	10
2	Assignments (May include Case Demos/Presentations/Write ups/ Viva voce, reflections etc.)	10
3	Attendance (It helps in developing discipline amongst students)	10
	Total	30

Marks for attendance may be given as below:

Attendance (%)	Marks out of 10	Attendance (%)	Marks out of 10
75	1	86-88	6
76	2	89-91	7
77-79	3	92-94	8
80-82	4	95-97	9
83-85	5	98-100	10

End of the Term Assessment: No student who has less than 75% attendance in any course shall be permitted to attend the end-semester examination and s/he shall be given grade of FA-failure due to lack of attendance. S/He may repeat such course the next time it is offered.

Scheme of the End Semester question paper

The duration of the end semester examination shall be 3 hours.All Question Papers for the End Semester will be set out of a maximum of 70 marks.It will be divided in two parts i.e. Part A and Part-B.

Part-A will consist of 10 compulsory questions. There will be at least three questions from each unit and answer to each question shall be limited upto 50 words. Each question will carry two marks. Total 20 Marks.

Part-B will consist of 10 questions. At Least three questions from each unit be set and student will have to answer five question, selecting at least one question from each unit. The answer to each question shall be limited to 400 words. Each question carries 10 Marks. Total 50 Marks.

Practical examinations: Practical examination shall be of 50 marks. There will be a panel of examiners consisting of one external and one internal examiner.

Following is the distribution of marks in practical courses:

S. No.	Item	Maximum marks
1	Experimental work assigned during examination	25
2	Attendance	5
3	Record	10
4	Viva voce	10

Course Content

Semester I

BTC5101T-C Biomolecules : Structure and Function (4L)

Objectives:

1. To understand the atomic, molecular structures and bonding.
2. To understand the occurrence and structure of carbohydrates.
3. To correlate the protein functions with their native conformations.
4. To differentiate the different classes and forms of lipids.
5. To comprehend the basic characteristics of nucleic acids and enzymes.

Course Outcomes:

1. At the completion of the course, the student would be able to
2. Recognize the different classes and forms of carbohydrates and their occurrence in the ecosystem.
3. Interpret the functions of proteins relative to their native structures.
4. Describe the various forms of lipids and their functions relative to their location.
5. Utilize the structure of nucleic acids for the understanding of central dogma of life.
6. Interpret the mechanism of enzyme actions and kinetics.

Unit 1: Thermodynamics and Bioenergetics: First and second laws of thermodynamics, enthalpy, entropy, free energy change, standard free energy change, equilibrium constant and spontaneous reactions. Coupled reactions and additive nature of standard free energy change.

Carbohydrates: Monosaccharides: aldoses and ketoses, epimers, mutarotation and anomers of glucose, Haworth projection formulae for pyranose form of glucose, furanose form of fructose, chair and boat forms of glucose, sugar derivatives- glucosamine, galactosamine, muramic acid, Nacetyl neuraminic acid. Disaccharides: concept of reducing and non-reducing sugars, Haworth projections of maltose, lactose, and sucrose. Polysaccharides: storage polysaccharides-starch and glycogen, structural polysaccharides- cellulose, peptidoglycan and chitin.

Unit 2: Lipids: Introduction to storage and structural lipids. Storage lipids: triacylglycerols, building blocks, fatty acids structure and properties, essential fatty acid, saponification. Structural lipids: phosphoglycerides- building blocks, structure of phosphatidylethanolamine and phosphatidylcholine; sphingolipids- building blocks, structure of sphingosine, ceramide, general structure and functions of sphingomyelin, cerebroside and ganglioside. Introduction to lipid micelles, monolayers, bilayers and liposomes.

Unit 3: Proteins: The building blocks-amino acids: classification, biochemical structure and notation of standard protein amino acids, general formula of amino acids. Concept of zwitterion, titration curve of amino acid and its significance. Ninhydrin reaction. Non-protein amino acids: beta-alanine, Dalanine and D- glutamic acid. Oligopeptides: structure and functions of glutathione, aspartame, insulin. Protein structure: primary, secondary- peptide unit salient features, α helix, β sheet, β turn, tertiary and quaternary- human hemoglobin as an example.
Forces involved in protein folding.

Enzymes: Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors, coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes, activation energy and transition state, enzyme activity, specific activity, common features of active sites, enzyme specificity: types & theories, Clinical

significance-inborn errors (phenyl ketone urea).

Suggested Reading:

1. Berg, J.M., Tymoczko, J.L., Gatto, G.J., and Stryer, L. (2019). Biochemistry. 9th edition. W.H. Freeman and Company, UK.
2. Campbell, M.K., Farrell, S.O. and McDougal, O.M. (2017). Biochemistry. 9th edition. Cengage Learning, USA.
3. Nelson, D.L. and Cox, M.M. (2017). Lehninger Principles of Biochemistry. 7th edition. W.H. Freeman and Company, UK.
4. Voet, D. and Voet, J.G. (2016). Biochemistry. 5th edition. John Wiley and Sons, UK.
5. Robert K. Murray, Daryl K. Granner and Victor W. Rodwell, “Harper’s Illustrated Biochemistry”. McGraw Hill Education (Asia), 2006.
6. Jeremy M. Berg, John L. Tymozko and LubertStryer, “Biochemistry”, Fifth edition, W.H. Freeman and Company, New York, 2002.

BTC5102P-C Laboratory Practices and Analytical Techniques in Biochemistry (2P)

Course Objectives:

1. To educate students about the importance of laboratory safety and instill good laboratory practices. They should also learn how to handle chemicals, dispose of waste, and maintain a clean and organized laboratory environment.
2. To enable students to develop essential laboratory skills, including accurate documentation of lab records glassware handling and measurements, ensuring precision and minimizing errors.
3. To introduce students to key analytical techniques commonly used in laboratories, such as titration and spectrophotometry. They should also understand the applications and limitations of these techniques in scientific research and experimentation.

Expected Outcomes

1. Students will demonstrate knowledge of laboratory safety protocols and understand the importance of good laboratory practices, ensuring a safe and productive working environment relevant to the industrial scenario.
2. Students will be able to apply basic analytical techniques used in laboratory experiments and will demonstrate proficiency in instrument handling, calibration, data analysis, and

Practicals

1. Safety and Lab Equipment Orientation:Familiarize students with the layout of the laboratory, safety guidelines, emergency procedures, and location of safety equipment (fire extinguishers, eyewash stations, etc.). Introduce students to common laboratory materials such as pipettes, wash bottles, balances, centrifuges, and microscopes. MSDS and their use in laboratory, safety signs

Introduce the laboratory glassware (desiccator, Petri plates, pipettes and their types, Haffkin bottles, Durham tubes, Erhlenmeyer flasks, separating funnels, volumetric flasks, vacuum filtration flasks, distillation unit etc. Demonstrate proper glassware washing procedures, draining and drying

Laboratory Glassware Handling and Measurements: Provide students with a variety of laboratory glassware (Petri plates, beakers, flasks, graduated cylinders, volumetric flasks) and instruct them on proper handling techniques. Discuss different classes of glasswares and plasticwares and their importance and usage in the biotechnology lab

2. Teach students how to accurately measure volumes using different glassware and reinforce good pipetting skills. Perform Calibration of volumetric apparatus using water for precise measurements and calibration.

   Solution Preparation and Dilution Techniques: Guide students through the process of preparing different types of solutions (e.g., stock solutions, serial dilutions), need of stock solutions, Introduce the concepts of molarity, normality, percent solutions with accurate concentrations. Emphasize the importance of labeling solutions correctly and calculating dilution factors.Perform Preparation of some standard alkali and acid solutions.
3. pH Measurement and Adjustment: Demonstrate the use of pH meters, pH paper/strips and universal indicator for measuring the pH of solutions. Instruct students on how to adjust pH using appropriate acids or bases.

   Study the effect of end point determining tools (pH meter, conductivity meter and chemical indicator) in a strong acid strong base titration and their accuracy and precision analysis.
4. Buffers and their buffering capacity by monitoring pH change on adding strong acid or base
5. Demonstrate the principles of solid-liquid and liquid-liquid extraction techniques by extracting plant pigments from spinach leaves. Discuss the choice of solvents based on their properties that affects the efficiency and selectivity of extraction. Compare and discuss the extraction efficiency and yield obtained from the solid-liquid and liquid-liquid extraction techniques. Relate the principles of extraction demonstrated in this exercise to their relevance in various biological and biochemical applications
6. Microscopy Techniques: Introduce students to the parts and functions of a light microscope. Provide prepared microscope slides and samples for students to observe and practice focusing, adjusting magnification, and using different objective lenses. Calculation of magnification of a microscope. Importance of refractive index and numerical aperture in resolution and magnification

   Prepare a slide of any biological material and observe after staining. Discuss stains and dyes and their need in microscopy
7. Spectrophotometry: Introduce students to spectrophotometers and their use in measuring the absorbance of substances at specific wavelengths. Guide students

in preparing samples, setting up the instrument, and recording absorbance readings. Demonstrate its application in measuring the absorbance of a copper sulphate solution at a specific wavelength. Preparation of a standard curve and estimation of concentration in an unknown solution. Discuss laws applicable to spectrophotometric measurements

8. Verification of Beer's Law Spectrophotometrically
9. Estimation of protein by Lowry method
10. Determination enzyme activity (amylase/ protease).
11. Determination of Iodine number of a fat
12. Estimation of RNA by Orcinol method
13. Estimation of DNA by diphenyl amine method
14. Sugar estimation in samples by anthrone method
15. Reducing sugars DNS method
16. Demonstrate the principle of chromatography and separate different plant pigments /Amino acids /sugars using paper chromatography or TLC.

Semester II
BTC5201T-C Introduction to Microbiology (4L)

Objectives

1. Understand the basic principles and concepts of microbiology
2. Explore microbial structure and function
3. Investigate microbial growth and control
4. Understand
5. Study microbial diversity and classification

Learning outcomes

By the end of the course the student will be able to

1. Demonstrate a fundamental understanding of the principles, concepts, and scope of microbiology.
2. Describe the structure, function, and metabolic processes of microorganisms.
3. Analyze the factors influencing microbial growth and apply microbial control methods.
4. Classify microorganisms based on their phylogenetic relationships and ecological roles.
5. Understand the nutritional requirements of microorganisms
6. Have a good understanding of the microbial world

Unit 1

Prokaryotic and eukaryotic cell structure- Cell membrane, cell wall, and cytoplasmic structures Flagella, pili, and other cellular appendages

Microbial Diversity and Classification- Classification systems: binomial nomenclature, taxonomy, and phylogenetic relationships, Major groups of microorganisms: bacteria, viruses, fungi, and protozoa- Features distinguishing different groups (e.g., cell type,

reproduction, mode of nutrition)

Unit 2
Microbial Growth- Phases of microbial growth: lag phase, exponential phase, stationary phase, death phase
Environmental Factors Affecting Microbial Growth -Temperature requirements and microbial growth ranges, pH and its effects on microbial growth, Oxygen requirements and different types of microorganisms based on oxygen tolerance
Microbial Growth Control and Sterilization Techniques- Physical methods of control: heat, filtration, radiation, Chemical methods of control: disinfectants, antiseptics, antibiotics
Sterilization techniques: autoclaving, dry heat, ethylene oxide

Unit 3
Nutritional Requirements of Microorganisms
Macronutrients: carbon, nitrogen, phosphorus, sulfur, oxygen, and hydrogen
Micronutrients: trace elements required by microorganisms
Growth factors: vitamins, amino acids, and nucleotides
Nutritional Strategies of Microorganisms- Autotrophs and heterotrophs: different carbon sources for microbial growth, Chemotrophs and phototrophs: energy sources for microbial metabolism Mixotrophs and facultative organisms: versatility in nutrient utilization
Culture Media and Growth Conditions- Types of culture media, Enrichment culture techniques and isolation of microorganisms

Suggested Readings

1. Black, 2016.Text book of microbiology. Freeman Publishers

Reference Books

2. Pelczar MJ, Chan ECS and Krieg. NR. Microbiology, Tata MCGraw Hill Edition, New Delhi,India
3. Ananthanarayan, CK Jayaram Panikars. Text book of Microbiology, 2005, Orient BlackswanPublishers

BTC5202P-C Biotechnological Skills & Microbiological Techniques(2P)

1. To familiarize students with the importance and implementation of SOPs and GMP in a laboratory or manufacturing setting.
2. General laboratory safety, good laboratory practices, biosafety measures (first-aid practices to be followed in case of burn, acid spills and injury), safety symbols, lab safety equipments (fire extinguisher, fume hood, safety glasses), classes of laboratory chemicals, maintenance and handling of chemicals (Labels, Quality - LR/ AR/ Molecular biology grade/ HPLC grade; Expiry date; Precautions for use), Disinfectants, Biocontainment, Disposal of hazardous chemicals, radioactive and biological waste, Laboratory waste management.
3. Calculate cell size using micrometer.

4. Calculate number of cells (pollen/spores) using haemocytometer.
5. To optimize the concentration of plant growth regulators for callus induction in plant tissue culture.
6. To propagate plantlets through the process of shoot multiplication using plant tissue culture techniques.
7. To preserve plant germplasm using cryopreservation techniques.
8. Practical session on biosafety practices and the proper use of PPE, including lab coats, gloves, masks, and safety glasses. Students practice donning and doffing PPE correctly and understand their importance in maintaining aseptic conditions and personal safety.

9. Demonstrate different sterilization techniques used in aseptic practices. Introduce to the concept of dry heat, wet heat, filtration, tyndallization, pasteurization).
10. Culture media preparation for plant tissue culture/ animal cells/bacteria and Media sterilization by autoclaving, plating and subculturing, aseptic transfer of microbial cultures
11. Demonstrate ubiquity of microorganisms
12. Surface sterilization of leaves and or stem segments using disinfectants like bleach or ethanol or mercuric chloride and comparative analysis of their microbial content before and after sterilization
13. Bacterial enrichment and isolation using the streak plate method
14. Effectivity of UV sterilization and subsequent photoreactivation.
15. Antimicrobial susceptibility testing