AC – 28/03/2025

Item No. – 6.3 (N) (4b) Sem III &IV

As Per NEP 2020

University of Mumbai

Syllabus for Minor Vertical 2		
Faculty of Science		
Board of Studies in Biotechnology		
Second Year Programme in Minor (Biotechnology)		
Semester	**III & IV**	
Title of Paper	**Sem.**	**Total Credits 4**
I) Basics in Food Science	**III**	**2**
II) Practicals based on Basics in Food science		**2**
Title of Paper		**Credits**
I) Introduction to Molecular Biology	**IV**	**2**
II) Introduction to Molecular Biology Practicals		**2**
From the Academic Year		**2025-26**

Sem- III

Syllabus
B.Sc. (Biotechnology)
(Sem- III)

MINOR

Course I: Title of Paper: Basics in Food Science

Sr.No.	Heading	Particulars
1	**Description the course:** **Including but not limited to:**	This syllabus covers the study of food science, nutrition, and the processes involved in food production, preservation, and safety. It includes topics such as food processing, and the impact of technology on food innovation. Students will explore the principles behind food design, health considerations, and sustainability practices, aiming to equip them with the knowledge to work in the food industry and contribute to developing healthier and more efficient food solutions.
2	**Vertical:**	Minor
3	**Type:**	Theory
4	**Credits:**	2 credits
5	**Hours Allotted:**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives(CO):** CO1: To learn the historical development of food technology CO2: To understand the importance of nutrients in food CO3: To learn about various aspects of food processing and preservation along with adulteration	
8	**Course Outcomes (OC):** Learner will be able to ● to understand the scope of food technology and its role in modern society ● To know the main components of food and their nutritional value ● To learn about food processing and preservation methods ● To comprehend skills of detecting adulteration in common foods	
9	**Modules:-** **Module 1: Introduction to food science, nutrients and food processing**	

	1. Definition of food technology, historical development of food technology, importance of food technology. **(2 lectures)** 2. Nutrients in food: Carbohydrates, proteins, fats, vitamins, minerals, fiber and water, macronutrients and micronutrients.**(6 lectures)** 3. Overview of food processing (e.g., grinding, cooking, pasteurization), The concept of unit operations in food processing.**(7 lectures)**	
	Module 2: Adulteration of common foods and food preservation techniques	
	1. Adulteration: Definition, types, means of adulteration, methods to detect food adulterants in milk, oil, grain, sugar, spices and condiments.**(5 lectures)** 2. Methods of food preservation: Freezing, Canning, Drying, Salting, Fermentation, Role of preservatives and additives. Advantages and disadvantages of preservation methods.**(10 lectures)**	
10	**Text Books** 1. Suri, S. & Malhotra, A. (2014). Food Science Nutrition and Safety. Delhi: Pearson India Ltd, 2. Sethi, P. & Lakra, P. (2015). Aahar Vigyan, Poshan Evam Suraksha. Delhi: Elite Publishing House Pvt. Ltd, 3. Srivastava, S.S. (2011). Phal Parirakshan. Lucknow: Kitab Mahal 4. Srivastava, R.P. & Kumar, S. (2005). Fruit and Vegetable Preservation. Lucknow: International Book Distributing Co 5. Potter, N., & Hotchkiss, J.H. (2006). Food Science. Delhi: CBS Publishers, 6. Lal, G., Siddhapa, G.S., & Tandon, G.L. (2009). Preservation of Fruits and Vegetables. New Delhi: Indian Council of Agriculture Research	
11	**Reference Books**	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60% (Refer format of Question paper Below)**
13	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

Course II

Title of Paper: Practicals based on Basics in Food science

Sr.No.	Heading	Particulars
1	**Description the course : Including but Not limited to:**	This basic food science course provides students with hands-on learning experience in fundamental food science techniques. Students will learn to conduct moisture content determination, protein, pigment and analysis of various other parameters and microbiological assessment.
2	**Vertical :**	Minor
3	**Type :**	Practical
4	**Credits :**	2 credits
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives (CO):** CO 1. To develop a comprehensive understanding of the fundamental principles of food science. CO 2. To develop practical culinary skills. CO 3. To learn about the role of microorganisms and adulterants in food spoilage and quality respectively.	
8	**Course Outcomes (OC):** Learner will be able to OC 1. Analyse various parameters in food samples. OC 2. To prepare a variety of foods. OC 3. To check the microbiological quality and presence of adulterants in milk.	
9	1. Determination of soluble proteins in food sample by Folin Lowry method. 2. Determination of acidity and pH in food samples/beverages. 3. Determination of moisture content of food sample. 4. Study of microbiological quality of milk by MBRT. 5. Sauerkraut preparation. 6. Preparation of jam / jelly. 7. Determination of adulterants in milk and milk products. 8. Determination of pigments in food samples. 9. Estimation of gluten content in food samples. 10. Recipes from millets. 11. Assignment/ Report writing on the Cultivation of mushrooms. 12. Assignment on Good manufacturing practice (GMP) of food.	
10	**Text Books**	

11	**References:** 1. A Food Technology Laboratory Manual | Kerala Agricultural University (page no. 31, 26, 39, 44-47) 2. Fermented Foods Guideline - 3.2 Sauerkraut.pdf 3. Experiments In Food Science Laboratory Manual, Volume 2 | Mississippi State University Extension Service 4. Food Adulteration Testing Manual (14 Edition).pdf (Page no 7) 5. https://www.wbhealth.gov.in/FoodSafety/pdfs/DART_Book_04_05_2017.pdf 6. https://egyankosh.ac.in/bitstream/123456789/45880/1/Experiment-5.pdf 7. scielo.br/j/cta/a/wZcnk5YWxzwSYHCB9y6MtJc/?format=pdf&lang=en 8. https://egyankosh.ac.in/bitstream/123456789/12050/1/Experiment-7.pdf	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60% (Refer format of Question paper Below)**
13	**Continuous Evaluation through: (Refer format of Question paper Below)**	

Sem. - IV

SEMESTER IV
Syllabus
B.Sc. (Biotechnology)

Minor

Course I

Title of Paper : Introduction to Molecular Biology

Sr.No.	Heading	Particulars
1	**Description the course : Including but Not limited to:**	This course offers a comprehensive introduction to the basic building blocks of life, focusing on carbohydrates, amino acids, proteins, and nucleic acids. Students will explore the classification, general formulae, and properties of carbohydrates, along with the structural and chemical characteristics of amino acids and proteins, including peptide bonding and three-dimensional conformation. The course also delves into the structure and composition of DNA and RNA, highlighting Watson and Crick's double-helix model and the various types and functions of RNA. Designed for students in biological sciences, this course emphasizes the molecular basis of life, providing the groundwork for advanced studies in biochemistry, molecular biology, and biotechnology.
2	**Vertical :**	Minor
3	**Type :**	Theory
4	**Credits :**	2 credits
5	**Hours Allotted :**	30 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives(CO):** By the end of the course, students will be able to: 1. Understand the Basics of Biomolecules: Recognize the structure, classification, and properties of essential biomolecules, including carbohydrates, amino acids, and nucleic acids, and appreciate their biological significance. 2. Explore Protein Structure and Function: Analyze the chemical and physical properties of amino acids, understand peptide bonds, and investigate the three-dimensional structure of proteins. 3. Comprehend Nucleic Acid Structure: Examine the composition and structure of DNA and RNA, understand Watson and Crick's model of DNA, and explore the types and functions of RNA. 4. Learn Molecular Biology Processes: Grasp the central dogma of molecular biology by understanding the processes of transcription and translation in prokaryotes, including initiation, elongation, and termination.	

	5. Decode Genetic Information: Understand the nature of the genetic code, the wobble hypothesis, and the molecular mechanisms governing the flow of genetic information.	
8	**Course Outcomes (OC):** Learner will be able to 1. Define and classify carbohydrates and describe their general formulas and properties. 2. Explain the structures, classifications, and physical and chemical properties of amino acids. 3. Analyze the formation of peptide bonds and describe the three-dimensional structure of proteins. 4. Summarize the composition, structure, and biological significance of DNA and RNA. 5. Illustrate Watson and Crick's model of DNA and explain the structural differences between DNA and various types of RNA.	
9	**Modules:-** **Module 1: Building block molecules of life**	
	Introduction, definition, general formula & Properties. Classification of carbohydrates. **(3 Lectures)** Amino acids: General introduction, Classification and structures, properties (physical & chemical), Peptide bond, Three-dimensional Structure of proteins. **(6 Lectures)** The Composition and structure DNA, Watson and Crick's model, Structure of RNA, Types of RNA **(6 Lectures)**	
	Module 2: Central Dogma	
	Transcription Process in Prokaryotes : Promoters and Enhancers; Initiation of Elongation and Termination of Transcription. **(6 Lectures)** Nature of Genetic Code. Wobble Hypothesis. **(3 Lectures)** Translation in Prokaryotes: Initiation, Elongation, Translocation, Termination **(6 lectures)**	
10	**Text Books** 1. Lehninger , Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and company, NY 2. iGenetics- Peter Russell -Pearson Education	
11	**Reference Books** 1. Dubey, R. C. (2014). Advanced biotechnology. S. Chand Publishing. 2. Satyanarayana U. and Chakrapani U. (2007). Biochemistry. 3rd Edition. Books and Allied (P) Ltd.	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60%** **(Refer format of Question paper Below)** (Refer format of Question paper)

13	**Continuous Evaluation through:** Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.(at least 3)	

Course II
Title of the paper: Introduction to Molecular Biology Practicals

Sr.No.	Heading	Particulars
1	**Description the course : Including but Not limited to:**	This practical-based course provides students with hands-on experience in preparing various types of solutions and calibrating essential laboratory equipment. Participants will explore spectrophotometry techniques to analyze light absorption and gain skills in identifying key biomolecules through simple tests. Additionally, the course introduces students to biological databases and bioinformatics tools for retrieving and comparing DNA and protein sequences, equipping them with valuable skills for modern biological research.
2	**Vertical :**	Minor
3	**Type :**	Practical
4	**Credits :**	2 credits
5	**Hours Allotted :**	60 Hours
6	**Marks Allotted:**	50 Marks
7	**Course Objectives(CO):** 1. Learn to prepare different types of solutions (normal, molar, and percentage) and practice using and calibrating tools like pipettes and weighing balances to ensure accurate measurements. 2. Understand how to find the maximum light absorption (lambda max) of substances using a colorimeter and understand the relationship between concentration and light absorption through Beer-Lambert's law. 3. Gain hands-on experience in estimating key biomolecules such as amino acids, proteins, carbohydrates, and DNA through simple laboratory tests. 4. Get familiar with biological databases like GenBank and UniProt to find DNA and protein sequences and learn how to compare these sequences using online tools for alignment.	
8	**Course Outcomes (OC):** Learner will be able to 1. accurately prepare normal, molar, and percentage solutions and demonstrate capability in calibrating laboratory tools such as pipettes and weighing balances, ensuring reliable and precise measurements in experimental procedures. 2. determine the maximum light absorption (lambda max) of various substances using a colorimeter and apply Beer-Lambert's law to analyze the relationship between concentration and light absorption. 3. analysis of key biomolecules, including amino acids, proteins, carbohydrates, and DNA, through practical laboratory tests.	

	4. navigate biological databases like GenBank and UniProt to retrieve DNA and protein sequences, and utilize online tools for sequence alignment, thereby gaining essential skills in bioinformatics for analyzing genetic information.	
9	**Practicals**	
	1. Preparation of Normal, Molar and percentage solution (%W/W, %V/V, %W/V) 2. Calibration and accuracy of glass pipettes /micropipettes 3. Calibration of Weighing Balance, percentage error calculation. 4. Determination of Lambda max using colorimeter 5. Verification of Beer Lambert's law 6. Quantitative estimation of Amino Acid/ Protein 7. Quantitative estimation of carbohydrate. 8. Isolation of DNA from a suitable source. 9. Visualization of isolated DNA using suitable method. 10. Quantitative estimation of DNA . 11. Introduction to Biological Databases: GenBank, EMBL, PDB. 12. Retrieve a sequence from Databases: Retrieve a DNA sequence from GenBank. 13. Retrieve a sequence from Databases: Retrieve a Protein sequence from UniProt, PDB. 14. Nucleotide sequence alignment: Pairwise and Multiple Sequence Alignment of nucleotide sequences using BLASTn and Clustal Omega	
10	**Text Books** 1. Biophysical chemistry: Principles and Techniques (2016) Himalaya Publishing House 2. Biochemical Methods, S. Sadasivam and A. Manickam.	
11	**Reference Books and links** 1. Fundamentals of Analytical Chemistry(2022)10th edition -Douglas Skoog, Donald West, Cengage Technology Edition 2. https://blast.ncbi.nlm.nih.gov/Blast.cgi 3. https://www.ebi.ac.uk/ 4. https://www.ebi.ac.uk/Tools/msa/clustalo/ 5. https://www.rcsb.org/ 6. https://www.uniprot.org/	
12	**Internal Continuous Assessment: 40%**	**Semester End Examination: 60% (Refer format of Question paper Below)**
13	**Continuous Evaluation through: (Refer format of Question paper Below)**	

Evaluation Pattern

MINOR

Theory	Credits	No. of Hours	Marks
Theory: Paper 1	2	30	50
Practicals	2	60	50

Theory Paper

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End semester examination
Continuous Evaluation through: Quizzes, Class Tests, presentation, project, role play, creative writing, assignment etc.	As per paper pattern	1 hour

Practicals

Internal Continuous Assessment: 40% (20 Marks)	Semester End Examination: 60% (30 Marks)	Duration for End semester examination
Viva/ assignment/ objective question test (15 Marks), Overall performance (5 Marks)/ Any 1(Major) or 2 practicals (Minor) (N/2) to be performed and assessed = 20 Marks	One experiment (25 marks for experiment and 5 Marks for Journal = 30 Marks)	3h 30 minutes

QUESTION PAPER PATTERN
(External and Internal)

Paper pattern as per scheme 1

Theory

Internal

Internal Continuous Assessment =20
Quizzes/MCQ/ Class tests/ Project/ Assignments/ oral presentation(poster /powerpoint (any three)

External

Format of Question Paper: 30 marks			
Q. No.	Description	Module	Marks
1	MCQ/Do as directed (Any 5 of 10)	1 and 2	05
2	Answer in Brief/ Long Answer Questions/Justify/Discuss /Long answer question Any 2 of 4	1	10
3	Answer in Brief/ Long Answer Questions/Justify/Discuss /Long answer question Any 2 of 4	2	10
4	Application Based Question (Can be divided in sub questions with internal options)	1 & 2	5
		Total	30

Practical - 2 credit course

Internal

Viva/ assignment/ objective question test (15 Marks), Overall performance (5 Marks)/ Any 1(Major) or 2 practicals (Minor) (N/2) to be performed and assessed = 20 Marks

Practical- Semester end examination

One experiment (25 marks for experiment) or 1 major experiment 15 marks and 1 minor experiment- 10 marks and 5 Marks for Journal = 30 Marks)
Duration-3 h 30 minutes

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 - 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Sign of the BOS Chairman
Dr. Varsha Kelkar-Mane
Chairman BOS in Biotechnology

Sign of the Offg. Associate Dean
Dr. Madhav R. Rajwade
Faculty of Science & Technology

Sign of the Offg. Dean
Prof. Shivram S. Garje
Faculty of Science & Technology