॥ सा विद्या या विमुक्तये ॥

स्वामी रामानंद तीर्थ मराठवाडा विद्यापीठ, नांदेड

'ज्ञानतीर्थ', विष्णुपुरी, नांदेड – ४३१ ६०६ (महाराष्ट्र राज्य) भारत

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

'Dnyanteerth', Vishnupuri, Nanded - 431 606 (Maharashtra State) INDIA

Established on 17th September, 1994, Recognized By the UGC U/s 2(f) and 12(B), NAAC Re-accredited with'B++' grade

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विज्ञान व तंत्रज्ञान विद्याशाखे अंतर्गत राष्ट्रीय शैक्षणिक धोरण २०२० नुसार पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्याबाबत.

प रि प त्र क

या परिपत्रकान्वये सर्व संबंधितांना कळविण्यात येते की, दिनांक २७ मे २०२५ रोजी संपन्न झालेल्या मा. विद्यापरिषद बैठकीतील विषय क्रमांक १६/६१–२०२५ च्या ठरावानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील राष्ट्रीय शैक्षणिक धोरण–२०२० नुसारचे पदवी द्वितीय वर्षाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यास मा. विद्यापरिषदेने मान्यता प्रदान केली आहे. त्यानुसार विज्ञान व तंत्रज्ञान विद्याशाखेतील बी. एस्सी द्वितीय वर्षाचे खालील विषयाचे अभ्यासक्रम (Syllabus) शैक्षणिक वर्ष २०२५–२६ पासून लागू करण्यात येत आहेत.

01	B.Sc. Agriculture Microbiology	11	B.Sc. Physics
02	B.Sc. Botany	12	B.Sc. Seed Technology
03	B.Sc. Dairy Science	13	B.Sc. Horticulture
04	B.Sc. Electronics	14	B.Sc. Statistics
05	B.Sc. Environmental Science	15	B.Sc. Biochemistry
06	B.Sc. Fishery Science	16	B.Sc. Analytical Chemistry
07	B.Sc. Food Science	17	B.Sc. Agrochemical & Fertilizers
08	B.Sc. Geology	18	B.Sc. Industrial Chemistry
09	B.Sc./B.A. Mathematics	19	B.Sc. Industrial Microbiology
10	B.Sc. Microbiology		

सदरील परिपत्रक व अभ्यासक्रम प्रस्तुत विद्यापीठाच्या **www.srtmun.ac.in** या संकेतस्थळावर उपलब्ध आहेत. तरी सदरील बाब ही सर्व संबंधितांच्या निदर्शनास आणून द्यावी, ही विनंती.

'ज्ञानतीर्थ' परिसर,
विष्णुपुरी, नांदेड – ४३१ ६०६.
जा.क्र.:शै–१/एनइपी/विवत्रंविपदवी/२०२५–२६/११६
दिनांक ०५.०६.२०२५

सहाय्यक कुलसचिव
शैक्षणिक (१–अभ्यासमंडळ) विभाग

प्रत : माहितीस्तव तथा कार्यवाहीस्तव.
१) मा. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
२) मा. प्र. कुलगुरू महोदयांचे कार्यलय, प्रस्तुत विद्यापीठ.
३) मा. आधिष्ठाता, विज्ञान व तंत्रज्ञान विद्याशाखा, प्रस्तुत विद्यापीठ.
४) मा. संचालक, परीक्षा व मुंल्यमापन मंडळ, प्रस्तुत विद्यापीठ.
५) मा. प्राचार्य, सर्व संबधित संलग्नित महाविद्यालये, प्रस्तुत विद्यापीठ.
६) सिस्टीम एक्सपर्ट, शैक्षणिक विभाग, प्रस्तुत विद्यापीठ. याना देवून कळविण्यात येते की, परिपत्रक अभ्यासक्रम संकेतस्थळावर प्रसिध्द करण्यात यावेत.

COURSE STRUCTURE

As Per National Education Policy- 2020

B. Sc. Second Year

Subject: Biochemistry

- ❖ Teaching scheme
- ❖ Examination Scheme
- ❖ Syllabus

To be Implemented from

Academic Year 2025-2026

B. Sc. Second Year Semester III *(Level 5)*

Sub. Code: BCH

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs./ week)	
			Theory	Practical	Total	Theory	Practical
Optional 1	**SBCHCT1201**	**Enzymology**	02	--	**08**	02	--
	SBCHCT1202	**Food Biochemistry**	02			02	
	SBCHCP1201	**Practical Based on SBCHCT1201**	-	02			04
	SBCHCP1202	**Practical Based on SBCHCT1202**		02			04
Optional 2	SBCHMT1201	**Food Microbiology**	02	--	**04**	02	--
	SBCHMP1201	**Practical Based on SBCHMT1201**	-	02			04
Generic Electives *(from other Faculty)*	SBCHGE1201	**Basic Concept of Nutrition**	02	--	**02**	04	--
Vocation Based Course (related to Major)	SBCHVC1201	**Biochemistry Laboratory Skill-III**	--	02	**02**	--	04
Ability Enhancement Course	AECENG1201	L1- Compulsory English	02	--	**02**	02	--
Ability Enhancement Course	AECMIL1201	Marathi/Hindi/Urdu/Kanadi/Pali	02	-	**02**	02	
Community Engagement Services (CES)	CCCXXX1201	Basket-6	-	02	**02**	--	04
Total Credits			**12**	**10**	**22**	**14**	**20**

B. Sc. Second Year Semester III *(Level 5) Sub. Code: BCH*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject(1)	Course Code (2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average ofT1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Optional 1	**SBCHCT1201**	**Enzymology**	10	10	10	40	--	--	50
	SBCHCT1202	**Food Biochemistry**	10	10	10	40	-	-	50
	SBCHCP1201	**Practical Based on SBCHCT1201**	-	-	-	-	20	30	50
	SBCHCP1202	**Practical Based on SBCHCT1202**	-	-	-	-	20	30	50
Optional 2	SBCHMT1201	**Food Microbiology**	10	10	10	40	--	--	50
	SBCHMP1201	**Practical Based on SBCHMT1201**	--	--	--	--	20	30	50
Generic Elective	SBCHGE1201	**Basic Concept of Nutrition**	10	10	10	40	--	--	50
Vocational Based Course	SBCHVC1201	**Biochemistry Laboratory Skill-III**	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1201	L1- Compulsory English	10	10	10	40	--	--	50
Ability Enhancement	AECMIL1201	Marathi/Hindi/Urdu/Kanadi/Pali	10	10	10	40	--	--	50
Community Engagement Services (CC)	CCCXXX1201	Basket 6	--	--	--	--	20	30	50

B. Sc. Second Year Semester IV *(Level 5.5)*

Sub. Code: BCH

Teaching Scheme

	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs./ week)	
			Theory	Practical	Total	Theory	Practical
Optional 1	**SBCHCT1251**	Genetics	02	--	**08**	02	--
	SBCHCT1252	Molecular Biology	02			02	
	SBCHCP1251	**Practical Based on** SBCHCT **1251**	-	02			04
	SBCHCP1252	**Practical Based on** SBCHCT **1252**		02			04
Optional 2	SBCHMT1251	Immunology	02	--	**04**	02	--
	SBCHMP1251	**Practical Based on** SBCHMT **1251**	-	02			04
Generic Electives *(from other Faculty)*	**SBCHGE1251**	**Diet therapy**	02	--	**02**	02	--
Vocational Based Course (related to Major)	**SBCHVC1251**	**Biochemical Techniques**	--	02	**02**	--	04
Ability Enhancement Course	AECENG1251	L1- Compulsory English	02	--	**02**	02	--
AbilityEnhancement Course	AECMIL1251	Marathi/Hindi/Urdu/Kanadi/Pali	02	--	**02**	02	--
VEC	VECEVS1251	Environmental studies	02	-	**02**	02	
Total Credits			**14**	**08**	**22**	**14**	**16**

B. Sc. Second Year Semester IV *(Level 5.5) Sub. Code: BCH*

Examination Scheme

[20% Continuous Assessment (***CA***) and 80% End Semester Assessment (***ESA***)]

(For illustration we have considered a paper of 02 credits, 50 marks, need to be modified depending on credits assigned to individual paper)

Subject(1)	Course Code(2)	Course Name (3)	Theory				Practical		Total Col (6+7) / Col (8+9) (10)
			Continuous Assessment (CA)			ESA			
			Test I (4)	Test II (5)	Average of T1 & T2 (6)	Total (7)	CA (8)	ESA (9)	
Optional 1	**SBCHCT1251**	Genetics	10	10	10	40	--	--	50
	SBCHCT1252	Molecular Biology	10	10	10	40	-	-	50
	SBCHCP1251	**Practical Based on** SBCHCT **1251**	-	-	-	-	20	30	50
	SBCHCP1252	**Practical Based on** SBCHCT **1252**	-	-	-	-	20	30	50
Optional 2	SBCHMT1251	Immunology	10	10	10	40	--	--	50
	SBCHMP1251	**Practical Based on** SBCHMT **1251**	--	--	--	--	20	30	50
Generic Elective	**SBCHGE1251**	**Diet therapy**	10	10	10	40	--	--	50
Vocational Based Course	**SBCHVC1251**	**Biochemical Techniques**	--	--	--	--	20	30	50
Ability Enhancement Course	AECENG1251	L1- Compulsory English	10	10	10	40	--	--	50
AbilityEnhancement	AECMIL1251	Marathi/Hindi/Urdu/Kanadi /Pali	10	10	10	40	--	--	50
VEC	VECEVS1251	Environmental studies	10	10	10	40	--	--	50

Syllabus for B. Sc. Second Year

Subject: Biochemistry

Semester – III

As Per National Education Policy- 2020

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - III)

Major Core Theory Course

Course Code – SBCHCT1201

Title of the Course: ENZYMOLOGY

[Credits: 2 (Marks: 50)] **(Total Periods: 30 Hours)**

Course Prerequisite:

- A foundational understanding of Biochemistry and Molecular Biology.
- Prior knowledge of General Chemistry and Organic Chemistry concepts, including reaction mechanisms and chemical kinetics.

Course Objective:

This course is designed to provide a comprehensive understanding of enzymes, their structure, function, and role in biological systems.

1. Explore the fundamentals of enzyme kinetics, thermodynamics, and catalysis.
2. Understand the structural and functional properties of enzymes.
3. Learn the techniques for enzyme purification and characterization.
4. Analyze the regulatory mechanisms and applications of enzymes in research, industry, and medicine.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Explain the fundamental principles of enzyme action, including catalytic mechanisms and specificity.
2. Perform and interpret enzyme kinetics experiments to determine parameters such as Vmax and Km.
3. Evaluate the role of cofactors, inhibitors, and activators in enzyme activity and regulation.
4. Apply methods for enzyme isolation, purification, and characterization.
5. Analyze the significance of enzymes in metabolic pathways and their regulation.
6. Discuss the applications of enzymes in industrial, medical, and biotechnological fields.

CURRICULUM DETAILS: SBCHCT1201: ENZYMOLOGY

Module No.	Unit No.	Topic	Hrs.
1.0		**Introduction of Enzymology**	**07**
	1.1	Definition and classification of enzymes. Historical perspective and significance. Enzyme nomenclature and IUBMB classification. Properties of enzymes.	
	1.2	Protein structure and its relevance to enzymatic function.	
	1.3	Catalytic mechanisms: General acid-base catalysis, covalent catalysis, and metal ion catalysis.	
	1.4	Active site and substrate binding. Role of cofactors and coenzymes.	
2.0		**Enzyme Kinetics**	**08**
	2.1	Principles of enzyme kinetics. Michaelis-Menten equation and its derivation.	
	2.2	Lineweaver-Burk plot and other graphical representations.	
	2.3	Inhibition kinetics: Competitive, non-competitive, and uncompetitive inhibition.	
	2.4	Allosteric enzymes and cooperative behavior.	
3.0		**Enzyme Regulation**	**07**
	3.1	Feedback inhibition and activation. Covalent modification (e.g., phosphorylation).	
	3.2	Zymogens and their activation. Isozymes and their physiological significance.	
	3.3	Methods of enzyme extraction and purification. Chromatographic techniques (e.g., affinity, ion-exchange, and gel filtration).	
	3.4	Electrophoretic techniques. Assay techniques for enzyme activity and specific activity	
4.0		**Solid State**	**08**
	4.1	Enzymes in food, textile, and pharmaceutical industries.	
	4.2	Enzyme immobilization techniques and applications.	
	4.3	Clinical enzymes as biomarkers and therapeutic agents.	
	4.4	Ribozymes and catalytic antibodies.	
		Total	**30**

Text Books and Reference Books:

1. "Enzymes: Biochemistry, Biotechnology, and Clinical Chemistry" by Trevor Palmer
2. "Understanding Enzymes" by Trevor Palmer and Philip Bonner
3. "Principles of Enzymology for Food Sciences" by John R. Whitaker
4. "Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry" by Irwin H. Segel
5. "Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis" by Robert A. Copeland
6. "Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins" by Nicholas C. Price and Lewis Stevens
7. "Enzymes: Catalysis, Kinetics, and Mechanisms" by N. P. Kulkarni
8. "The Physics of Enzymes" by Hans Frauenfelder, Guohui Cui, and Markus Meuwly
9. "Introduction to Protein Structure" by Carl Branden and John Tooze
10. "Biochemistry" by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer
11. "Textbook of Enzymology" by Trevor Palmer
12. "Lehninger Principles of Biochemistry" by David L. Nelson and Michael M. Cox
13. "Enzyme Kinetics and Mechanism" by Paul F. Cook and W.W. Cleland
14. "Protein Purification: Principles and Practice" by Robert K. Scopes
15. "Advances in Enzymology and Related Areas of Molecular Biology" edited by Alton Meister

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - III)

Major Practical Course

Course Code – SBCHCP1201

Title of the Course: Practical based on SBCHCT1201

[Credits: 2 (Marks: 50)] **(Total Periods: 60 Hours)**

CURRICULUM DETAILS: SBCHCP1201: Practical based on SBCHCT1201

Sr. No	Practical Exercises	Hrs.
1.	Preparation of Tris and Phosphate buffer for enzyme assay and determine pH	4
2.	Extraction of enzymes such as amylase from saliva.	4
3.	Extraction of enzymes such as amylase from plant material Potatoes.	4
4.	Extraction of enzymes such as urease from plant material from soybeans.	4
5.	Quantitative assay of enzyme activity using spectrophotometry (e.g., amylase activity by starch hydrolysis).	4
6.	Determining the optimum temperature and temperature stability of an enzyme.	4
7.	Determining the optimum pH and pH stability of an enzyme.	4
8.	Determine effect of substrate concentration on enzyme activity	4
9.	Purification of enzyme from ammonium sulphate precipitation.	4
10.	Purification of enzyme from dialysis.	4
11.	Qualitative and quantitative analysis of reaction products (e.g., glucose estimation in amylase assays using DNS method).	4
12.	Immobilization of enzymes (e.g., catalase or invertase) on matrices and assessing their activity.	4
13.	Separation of enzymes using SDS-PAGE and zymogram analysis to detect active enzymes.	4
14.	Investigating the effect of inhibitors (e.g., competitive, non-competitive, uncompetitive) on enzyme activity.	4
15.	Study of the role of metal ions or coenzymes in enzymatic reactions.	4
	Total	**60**

Text Books and Reference Books:

16. "Enzymes: Biochemistry, Biotechnology, and Clinical Chemistry" by Trevor Palmer
17. "Understanding Enzymes" by Trevor Palmer and Philip Bonner
18. "Principles of Enzymology for Food Sciences" by John R. Whitaker
19. "Biochemical Calculations: How to Solve Mathematical Problems in General Biochemistry" by Irwin H. Segel
20. "Enzymes: A Practical Introduction to Structure, Mechanism, and Data Analysis" by Robert A. Copeland
21. "Fundamentals of Enzymology: The Cell and Molecular Biology of Catalytic Proteins" by Nicholas C. Price and Lewis Stevens
22. "Enzymes: Catalysis, Kinetics, and Mechanisms" by N. P. Kulkarni
23. "The Physics of Enzymes" by Hans Frauenfelder, Guohui Cui, and Markus Meuwly
24. "Introduction to Protein Structure" by Carl Branden and John Tooze
25. "Biochemistry" by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer
26. "Textbook of Enzymology" by Trevor Palmer
27. "Lehninger Principles of Biochemistry" by David L. Nelson and Michael M. Cox
28. "Enzyme Kinetics and Mechanism" by Paul F. Cook and W.W. Cleland
29. "Protein Purification: Principles and Practice" by Robert K. Scopes
30. "Advances in Enzymology and Related Areas of Molecular Biology" edited by Alton Meister

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - III)

Major Core Theory Course

Course Code – SBCHCT1202

Title of the Course: Food Biochemistry

[Credits: 2 (Marks: 50)] **(Total Periods: 30 Hours)**

Course Prerequisite

- A foundational understanding of General Biochemistry and Organic Chemistry.
- Knowledge of Basic Food Science concepts, including food composition and nutritional science.

Course Objective

This course aims to provide a deep understanding of the biochemical principles and processes that govern food composition, quality, and safety. Students will:

1. Learn the biochemical basis of food components, including carbohydrates, proteins, lipids, vitamins, and minerals.
2. Understand the role of enzymes and their applications in food processing.
3. Explore biochemical changes in food during processing, storage, and spoilage.
4. Analyze the biochemical basis of food preservation, safety, and nutritional enhancement.

Course Outcomes

Upon completion of the course, students will be able to:

1. Explain the structure, function, and biochemical properties of food components.
2. Analyze enzymatic and non-enzymatic reactions that occur during food processing and storage.
3. Evaluate the role of water activity, pH, and temperature in food stability.
4. Understand the principles of food preservation techniques from a biochemical perspective.
5. Assess the impact of biochemical changes on food quality and safety.
6. Apply biochemical principles to improve food texture, flavor, and nutritional value.

CURRICULUM DETAILS: SBCHCT1202: FOOD BIOCHEMISTRY

Module No.	Unit No.	Topic	Hrs.
1.0		**Introduction to Cell Biology**	**07**
	1.1	Definition and scope of food biochemistry. Overview of major food components: Carbohydrates, proteins, lipids, vitamins, and minerals.	
	1.2	Water: Structure, properties, and role in food systems. Structure and classification of carbohydrates.	
	1.3	Chemical and physical properties of sugars, starches, and dietary fibers.	
	1.4	Non-enzymatic browning reactions: Maillard reaction and caramelization.	
2.0		**Cell Wall and Cell Membrane**	**08**
	2.1	Structure, classification, and functional properties of food proteins.	
	2.2	Denaturation, coagulation, and gelation. Protein-lipid interactions and their effects on food quality.	
	2.3	Structure and classification of lipids.Oxidation of lipids: Mechanisms, effects on food quality, and prevention strategies.	
	2.4	Lipid modifications: Hydrogenation, interesterification, and enzymatic transformations.	
3.0		**Cell Organelle**	**07**
	3.1	Role of enzymes in food processing and quality control. Enzyme-catalyzed reactions in foods (e.g., pectinase, lipase, protease).	
	3.2	Enzyme inhibition and its applications in food preservation. Biochemical role of vitamins and minerals in food.	
	3.3	Stability of vitamins during processing and storage. Role of phytochemicals in health and their biochemical significance.	
	3.4	Effect of heat, pH, and light on food biochemistry. Changes in carbohydrates, proteins, and lipids during processing.	
4.0		**Microscopy**	**08**
	4.1	Biochemical basis of food spoilage and deterioration. Mechanisms of microbial growth inhibition: Freezing, drying, and chemical preservation.	
	4.2	Role of antioxidants in preventing oxidation.Fermentation biochemistry and its applications in food preservation.	
	4.3	Role of functional foods and nutraceuticals. Biochemical basis of dietary fibers, probiotics, and prebiotics.	
	4.4	Genetically modified organisms (GMOs) and their biochemical implications. Applications of nanotechnology in food biochemistry. Current trends in food biochemistry research.	
		Total	**30**

Text Books and Reference Books:

1. "Food Biochemistry and Food Processing" by Benjamin K. Simpson and others
2. "Principles of Food Chemistry" by John M. deMan
3. "Food Chemistry" by Owen R. Fennema (Edited by Srinivasan Damodaran and Kirk L. Parkin)
4. "Introduction to Food Chemistry" by Richard Owusu-Apenten.
5. "Biochemistry of Foods" by N.A.M. Eskin and Fereidoon Shahidi
6. "Food Biochemistry and Nutritional Value" by J.M. Jay, Martin J. Loessner, and David A. Golden
7. "Food Lipids: Chemistry, Nutrition, and Biotechnology" by Casimir C. Akoh and David B. Min
8. "Enzymes in Food Biotechnology" edited by Mohammed Kuddus
9. "Handbook of Food Biochemistry" edited by Zeynep Ustunol
10. "Postharvest: An Introduction to the Physiology and Handling of Fruit and Vegetables" by R. Wills et al.
11. "Advanced Dairy Chemistry" (Vol. 1-4) by Paul L.H. McSweeney and Patrick F. Fox
12. "Functional Food Ingredients and Nutraceuticals" by John Shi
13. "Food Analysis" by Suzanne Nielsen
14. "Food Proteins and Their Applications" by Srinivasan Damodaran and Alain Paraf
15. "Food Science" by Norman N. Potter and Joseph H. Hotchkiss

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - III)

Major Practical Course

Course Code – SBCHCP1202

Title of the Course: Food Biochemistry

[Credits: 2 (Marks: 50)] **(Total Periods: 60 Hours)**

CURRICULUM DETAILS: SBCHCP1201: Practical based on SBCHCT1201

Sr. No	Practical Exercises	Hrs.
1.	Quantification of reducing sugars in food samples using the DNS (Dinitrosalicylic acid) method.	4
2.	Estimation of total carbohydrate content in foods using the anthrone method.	4
3.	Determination of starch in cereals and tubers using spectrophotometric analysis.	4
4.	Quantitative analysis of proteins in food samples using the Biuret or Lowry method.	4
5.	Extraction and quantification of total lipids from food samples using Soxhlet extraction or Folch method.	4
6.	Measurement of FFA in edible oils to assess lipid quality and rancidity	4
7.	Determination of malondialdehyde (MDA) to assess lipid oxidation levels in food samples.	4
8.	Titrimetric or spectrophotometric determination of vitamin C in fruits and vegetables.	4
9.	Estimation of phenolic compounds in foods using the Folin-Ciocalteu reagent.	4
10.	Assessment of antioxidant potential in food samples using DPPH or FRAP assays.	4
11.	Determination of water activity in various food products and its impact on shelf life.	4
12.	Quantification of enzymatic activity in food processing or fermentation samples.	4
13.	Study of Maillard reaction kinetics and its effects on food color and flavor.	4
14.	Analysis of the stability of food-related enzymes under varying conditions.	4
15.	Determination of soluble and insoluble fiber in cereals, fruits, or vegetables using enzymatic methods.	4
	Total	**60**

Text Books and Reference Books:

1. "Food Biochemistry and Food Processing" by Benjamin K. Simpson and others
2. "Principles of Food Chemistry" by John M. deMan
3. "Food Chemistry" by Owen R. Fennema (Edited by Srinivasan Damodaran and Kirk L. Parkin)
4. "Introduction to Food Chemistry" by Richard Owusu-Apenten.
5. "Biochemistry of Foods" by N.A.M. Eskin and Fereidoon Shahidi
6. "Food Biochemistry and Nutritional Value" by J.M. Jay, Martin J. Loessner, and David A. Golden
7. "Food Lipids: Chemistry, Nutrition, and Biotechnology" by Casimir C. Akoh and David B. Min
8. "Enzymes in Food Biotechnology" edited by Mohammed Kuddus
9. "Handbook of Food Biochemistry" edited by Zeynep Ustunol
10. "Postharvest: An Introduction to the Physiology and Handling of Fruit and Vegetables" by R. Wills et al.
11. "Advanced Dairy Chemistry" (Vol. 1-4) by Paul L.H. McSweeney and Patrick F. Fox
12. "Functional Food Ingredients and Nutraceuticals" by John Shi
13. "Food Analysis" by Suzanne Nielsen
14. "Food Proteins and Their Applications" by Srinivasan Damodaran and Alain Paraf
15. "Food Science" by Norman N. Potter and Joseph H. Hotchkiss

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - III)

Minor Core Theory Course

Course Code – SBCHMT1201

Title of the Course: Food Microbiology

[Credits: 2 (Marks: 50)] **(Total Periods: 30 Hours)**

Course Prerequisite

- Basic knowledge of General Microbiology and Biochemistry.
- Familiarity with concepts in Food Science and Organic Chemistry is recommended**.**

Course Objective

This course aims to provide a thorough understanding of the role of microorganisms in food, including their beneficial and detrimental effects. Students will:

1. Learn the fundamentals of food microbiology, including the classification and characteristics of food-associated microorganisms.
2. Understand the factors influencing microbial growth in food and their impact on food safety and quality.
3. Explore methods for controlling microorganisms in food to ensure safety and extend shelf life.
4. Analyze the use of beneficial microorganisms in food fermentation and biotechnology.

Course Outcomes

Upon completing this course, students will be able to:

1. Identify and classify microorganisms commonly associated with food.
2. Understand microbial growth dynamics and the factors influencing their activity in food systems.
3. Evaluate methods to detect and quantify microorganisms in food samples.
4. Apply principles of food preservation to inhibit microbial spoilage and ensure food safety.
5. Discuss the role of microorganisms in fermented food production and biotechnology.
6. Understand foodborne pathogens, their mechanisms, and methods for controlling outbreaks.

CURRICULUM DETAILS: SBCHMT1201: FOOD MICROBIOLOGY

Module No.	Unit No.	Topic	Hrs.
1.0		**Introduction of Food Microorganism**	**07**
	1.1	History and scope of food microbiology.Classification of microorganisms relevant to food (bacteria, fungi, yeasts, molds, and viruses).	
	1.2	Sources of microorganisms in foods. Factors affecting microbial growth: Intrinsic (pH, water activity, nutrients) and extrinsic (temperature, humidity, atmosphere).	
	1.3	Microbial metabolism and its impact on food quality and spoilage.	
	1.4	Spoilage of different food types: Dairy, meat, seafood, fruits, vegetables, and cereals.Biochemical changes associated with spoilage (lipid oxidation, protein degradation, fermentation).	
2.0		**Food Borne pathogen**	**08**
	2.1	Major foodborne pathogens: Bacteria (Salmonella, Listeria, E. coli, Clostridium botulinum), viruses, and parasites.	
	2.2	Mechanisms of pathogenesis and symptoms of foodborne illnesses.	
	2.3	Techniques for detection and enumeration of microorganisms: Plate count, microscopy, and molecular methods.	
	2.4	Rapid methods and biosensors for pathogen detection. Sampling procedures and microbiological quality standards.	
3.0		**Food Preservation**	**07**
	3.1	Principles of food preservation: Thermal (pasteurization, sterilization), chemical (preservatives), and biological methods.	
	3.2	Non-thermal techniques: High-pressure processing, irradiation, and modified atmosphere packaging.	
	3.3	Role of natural antimicrobials (essential oils, bacteriocins).	
	3.4	Emerging pathogens and antimicrobial resistance.	
4.0		**Fermentation and Beneficial Microorganism**	**08**
	4.1	Role of microorganisms in fermentation: Lactic acid bacteria, yeast, and molds.	
	4.2	Fermented foods and beverages: Yogurt, cheese, bread, beer, wine, and traditional foods.	
	4.3	Probiotics and their health benefits. Bio-preservation and biopackaging.	
	4.4	Applications of genetically modified microorganisms in food production. Use of enzymes and microbial metabolites in food processing.	
		Total	**30**

Text Books and Reference Books:

1. "Food Microbiology" by Martin R. Adams and Maurice O. Moss
2. "Modern Food Microbiology" by James M. Jay, Martin J. Loessner, and David A. Golden
3. "Fundamental Food Microbiology" by Bibek Ray and Arun Bhunia
4. "Foodborne Pathogens: Microbiology and Molecular Biology" edited by Pina M. Fratamico, Arun K. Bhunia, and James L. Smith
5. "Food Microbiology: An Introduction" by Thomas J. Montville, Karl R. Matthews, and Kalmia E. Kniel
6. "Microorganisms in Foods 8: Use of Data for Assessing Process Control and Product Acceptance" by ICMSF (International Commission on Microbiological Specifications for Foods)
7. "Food Microbiology: Fundamentals and Frontiers" by Michael P. Doyle, Francis Diez-Gonzalez, and Colin Hill
8. "Foodborne Microorganisms and Their Toxins: Developing Methodologies" edited by Clive de W. Blackburn and Peter J. McClure
9. "Lactic Acid Bacteria: Microbiological and Functional Aspects" edited by Seppo Salminen, Atte von Wright, and Arthur Ouwehand
10. "Principles of Food Sanitation" by Norman G. Marriott and Robert B. Gravani
11. "HACCP: A Practical Approach" by Sara Mortimore and Carol Wallace
12. "Pathogens and Toxins in Foods: Challenges and Interventions" edited by Vijay K. Juneja and John N. Sofos
13. "Microbiology of Safe Food" by Stephen J. Forsythe
14. "Food Spoilage Microorganisms" edited by Clive de W. Blackburn
15. "Prescott's Microbiology" by Joanne M. Willey, Linda M. Sherwood, and Christopher J. Woolverton

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - III)

Minor Practical Course

Course Code – SBCHMP1201

Title of the Course: Food Microbiology

[Credits: 2 (Marks: 50)] **(Total Periods: 60 Hours)**

CURRICULUM DETAILS: SBCHMP1201: Practical based on SBCHMT1201

Sr. No	Practical Exercises	H
1.	Isolation and identification of microorganisms from raw and processed food using standard plate count methods.	4
2.	Estimation of total bacterial count in food samples using the pour plate or spread plate method.	4
3.	Determination of coliforms and Escherichia coli in food using the Most Probable Number (MPN) method.	4
4.	Isolation and quantification of yeasts and molds in food samples using Sabouraud Dextrose Agar.	4
5.	Identification of spoilage-causing microorganisms in perishable foods like milk, meat, and vegetables.	4
6.	Detection and identification of pathogens such as Salmonella, Listeria monocytogenes, and Staphylococcus aureus in food samples.	4
7.	Determining the sensitivity of foodborne pathogens to antibiotics using the disk diffusion method.	4
8.	Isolation and identification of beneficial microorganisms (e.g., lactic acid bacteria) from fermented products like yogurt and sauerkraut.	4
9.	Examination of fungal species in stored grains using microscopic and cultural methods.	4
10.	Detection and staining of spore-forming bacteria (e.g., Bacillus species) in food samples.	4
11.	Microbiological analysis of water used in food processing for total coliform count and fecal contamination.	4
12.	Study of microbial growth under various temperature conditions (e.g., refrigeration and room temperature).	4
13.	Identification of viral contaminants in food using molecular techniques such as PCR (polymerase chain reaction).	4
14.	Testing the effect of chemical preservatives (e.g., sodium benzoate, sorbic acid) on microbial growth in food.	4
15.	Application of rapid methods like ELISA	4
	Total	**60**

Text Books and Reference Books:

1. "Food Microbiology" by Martin R. Adams and Maurice O. Moss
2. "Modern Food Microbiology" by James M. Jay, Martin J. Loessner, and David A. Golden
3. "Fundamental Food Microbiology" by Bibek Ray and Arun Bhunia
4. "Foodborne Pathogens: Microbiology and Molecular Biology" edited by Pina M. Fratamico, Arun K. Bhunia, and James L. Smith
5. "Food Microbiology: An Introduction" by Thomas J. Montville, Karl R. Matthews, and Kalmia E. Kniel
6. "Microorganisms in Foods 8: Use of Data for Assessing Process Control and Product Acceptance" by ICMSF (International Commission on Microbiological Specifications for Foods)
7. "Food Microbiology: Fundamentals and Frontiers" by Michael P. Doyle, Francis Diez-Gonzalez, and Colin Hill
8. "Foodborne Microorganisms and Their Toxins: Developing Methodologies" edited by Clive de W. Blackburn and Peter J. McClure
9. "Lactic Acid Bacteria: Microbiological and Functional Aspects" edited by Seppo Salminen, Atte von Wright, and Arthur Ouwehand
10. "Principles of Food Sanitation" by Norman G. Marriott and Robert B. Gravani
11. "HACCP: A Practical Approach" by Sara Mortimore and Carol Wallace
12. "Pathogens and Toxins in Foods: Challenges and Interventions" edited by Vijay K. Juneja and John N. Sofos
13. "Microbiology of Safe Food" by Stephen J. Forsythe
14. "Food Spoilage Microorganisms" edited by Clive de W. Blackburn
15. "Prescott's Microbiology" by Joanne M. Willey, Linda M. Sherwood, and Christopher J. Woolverton

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - III)

Generic Elective Course

Course Code – SBCHGE 1201

Title of the Course: Basic Concept of Nutrition

[No. of Credits: 2 Credit] **[Total: 30 Hours]**

CURRICULUM DETAILS: SBCHGE 1201: Basic Concept of Nutrition

Module No.	Unit No.	Topic	Hrs.
1.0		**Introduction to Nutrition**	**08**
	1.1	Definition and scope of nutrition. Relationship between food, nutrition, and health. Overview of essential nutrients and their classification	
	1.2	Carbohydrates: Types, functions, sources, and dietary requirements.	
	1.3	Proteins: Amino acids, protein quality, functions, and sources.	
	1.4	Fats: Types (saturated, unsaturated, trans fats), functions, sources, and dietary recommendations.	
2.0		**Vitamin and Minerals**	**07**
	2.1	Vitamins: Classification (water-soluble and fat-soluble), functions, sources, and deficiencies.	
	2.2	Minerals: Major and trace minerals, functions, sources, and imbalances.	
	2.3	Importance of water in nutrition. Electrolyte balance and its role in health.	
	2.4	Hydration needs and effects of dehydration.	
3.0		**Energy Balance and weight Management**	**07**
	3.1	Concepts of energy intake and expenditure.Basal Metabolic Rate (BMR) and factors affecting it.	
	3.2	Weight management: Overweight, obesity, and underweight.	
	3.3	Nutrition during infancy, childhood, adolescence, adulthood, and old age.	
	3.4	Special considerations for pregnancy and lactation. Nutritional needs for athletes and individuals with specific conditions.	
4.0		**Malnutrition and Dietary Deficiencies**	
	4.1	Importance of balanced diets and food pyramids.Nutritional	

		guidelines and recommendations (e.g., RDA). Principles of meal planning and food portioning.	**08**
	4.2	Types of malnutrition: Undernutrition and overnutrition. Common dietary deficiencies: Iron, iodine, vitamin A, and protein-energy malnutrition.Public health measures to combat malnutrition.	
	4.3	Functional foods and nutraceuticals. Role of diet in disease prevention (e.g., diabetes, cardiovascular diseases).	
	4.4	Introduction to personalized nutrition and nutrigenomics.	

Text Books and Reference Books:

1. "Introduction to Human Nutrition" by Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy, and Hester H. Vorster
2. "Modern Nutrition in Health and Disease" by A. Catharine Ross, Benjamin Caballero, Robert J. Cousins, Katherine L. Tucker, and Thomas R. Ziegler
3. "Understanding Nutrition" by Ellie Whitney and Sharon Rady Rolfes
4. "Nutrition and Metabolism" by Susan A. Lanham-New, Ian A. Macdonald, and Helen M. Roche
5. "Human Nutrition and Dietetics" by Michael J. Lean and E. M. Elia
6. "Krause's Food & the Nutrition Care Process" by L. Kathleen Mahan, Janice L. Raymond
7. "Advanced Nutrition and Human Metabolism" by Sareen S. Gropper, Jack L. Smith, and Timothy P. Carr
8. "Williams' Essentials of Nutrition and Diet Therapy" by Eleanor Schlenker and Joyce Ann Gilbert
9. "The Science of Nutrition" by Janice Thompson, Melinda Manore, and Linda Vaughan
10. "Nutrition for Health, Fitness, and Sport" by Melvin H. Williams, Eric S. Rawson, and Timothy P. Gordon
11. "Public Health Nutrition" by M. J. Gibney, Barrie M. Margetts, John M. Kearney, and Lenore Arab
12. "The Biochemical Basis of Human Nutrition" by Martha H. Stipanuk and Marie A. Caudill
13. "Community Nutrition in Action: An Entrepreneurial Approach" by Marie A. Boyle and David H. Holben
14. "Nutrition: Concepts and Controversies" by Frances Sizer and Ellie Whitney
15. "Nutrition Through the Life Cycle" by Judith E. Brown, Janet Isaacs, Beate Krinke, and Maureen A. Murtaugh

National Education Policy 2020

B.Sc. Biochemistry II Year (Semester - III)

Skill Enhancement Course

Course Code – SBCHVC1201

Title of the Course: Biochemistry Laboratory Skill-III

[No. of Credits: 2 Credit] **[Total: 60 Hours]**

CURRICULUM DETAILS: SBCHSC 1201: Biochemistry Laboratory Skill-III

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1	Thin layer Chromatography	4
2	Gel electrophoresis	4
3	Spectrophotometer	4
4	PCR	4
5	Southern Blotting	4
6	Northern Blotting	4
7	Western Blotting	4
8	Extraction of Biomolecule by Soxhlet apparatus.	4
9	ELISA	4
10	HPLC	4
11	Paper Chromatography	4
12	Detection of blood group in human	4
13	Streaking, Spreading, Pouring techniques for microbial culture	4
14	Antigen antibodies interaction	4
15	Dialysis	4
	Total	**60**

Text Books and Reference Books:

1. Biochemistry Laboratory: Modern Theory and Techniques" by Rodney F. Boyer
2. Experiments in Biochemistry: A Hands-on Approach" by Shawn O. Farrell and Lynn E. Taylor
3. Biochemical Techniques: Theory and Practice" by John F. Robyt and Bernard J. White
4. Practical Biochemistry: Principles and Techniques" by Keith Wilson and John Walker
5. Laboratory Manual for Principles of Biochemistry" by David K. Jemiolo and William M. Scovell
6. Biochemistry Laboratory Manual for Undergraduates: An Inquiry-Based Approach" by Timea Gerczei Fernandez and Scott Pattison
7. A Biochemistry Laboratory Manual" by John Tansey
8. Biochemistry Laboratory: A Student-Centered Approach" by Benjamin F. Lasseter and Scott A. Ensign
9. Experimental Biochemistry" by Robert L. Switzer and Liam F. Garrit
10. Laboratory Experiments in Biochemistry" by Swapan Kumar Nat

Syllabus for B. Sc. Biochemistry,

Fourth Year

Semester – IV

As Per National Education Policy- 2020

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - IV)

Major Core Theory Course

Course Code – SBCHCT 1251

Title of the Course: GENETICS

[Credits: 2 (Marks: 50)] **(Total Periods: 30 Hours)**

Course Prerequisite

- Basic knowledge of Biology.
- Familiarity with basic concepts in Molecular Biology and Cell Biology is recommended.

Course Objective

The course is designed to provide students with a comprehensive understanding of the fundamental principles of genetics and their applications. Students will:

1. Understand the principles of heredity and variation.
2. Learn the molecular basis of genetic inheritance and gene regulation.
3. Explore genetic mapping, population genetics, and the role of genetics in evolution.
4. Examine the applications of genetic principles in biotechnology and medicine.

Course Outcomes

By the end of the course, students will:

1. Comprehend the principles of Mendelian and non-Mendelian inheritance.
2. Explain the structure and function of genetic material.
3. Analyze genetic variation and its implications in populations.
4. Understand modern genetic technologies and their applications

CURRICULUM DETAILS: SBCHCT 1251: GENETICS

Module No.	Unit No.	Topic	Hrs. Required
1.0		**Principles of Mendelian and Non-Mendelian Genetics**	**07**
	1.1	Mendelian Genetics: Laws of inheritance: Law of Segregation and Law of Independent Assortment.	
	1.2	Monohybrid and dihybrid crosses. Test cross and back cross.	
	1.3	Incomplete dominance, codominance, multiple alleles, and lethal alleles. Epistasis and gene interactions.	
	1.4	Polygenic inheritance and quantitative traits. Mitochondrial inheritance and cytoplasmic inheritance. Epigenetics and genomic imprinting.	
2.0		**Molecular Basis of Genetics**	**08**
	2.1	DNA and RNA: Types, structure, and properties. Organization of the genome in prokaryotes and eukaryotes.	
	2.2	Mechanism of replication in prokaryotes and eukaryotes.	
	2.3	Transcription: Mechanism, RNA polymerases, and post-transcriptional modifications. Translation: Genetic code, tRNA, and ribosomes.	
	2.4	Operon model in prokaryotes (lac operon, trp operon). Epigenetic regulation in eukaryotes.	
3.0		**Genetic Mapping and Mutations**	**08**
	3.1	Concept of linkage, recombination frequency, and genetic mapping. Construction of genetic maps using three-point crosses.	
	3.2	Types of mutations: Point mutations, frameshift mutations, and chromosomal mutations. Causes of mutations: Spontaneous and induced	
	3.3	DNA repair mechanisms: Excision repair, mismatch repair, and SOS response. Chromosomal abnormalities (e.g., Down syndrome, Turner syn	
	3.4	Monogenic disorders (e.g., sickle cell anemia, cystic fibrosis). Polygenic disorders and multifactorial inheritance.	
4.0		**Population Genetics and Applications of Genetics**	**07**
	4.1	Gene pool, allele frequency, and Hardy-Weinberg equilibrium. Factors affecting allele frequency: Mutation, selection, migration, genetic drift.	
	4.2	Molecular evolution and speciation. Phylogenetic analysis and genetic diversity.	
	4.3	Genetic engineering and recombinant DNA technology. CRISPR-Cas9 and gene editing techniques.	
	4.4	Applications in medicine, agriculture, and forensic science.Ethical, legal, and social issues in genetics.	
		Total	**30**

Text Books and Reference Books:

1."Principles of Genetics" by D. Peter Snustad and Michael J. Simmons

2. "Genetics: A Conceptual Approach" by Benjamin A. Pierce

3. "Molecular Biology of the Gene" by James D. Watson, Tania A. Baker, Stephen P. Bell, et al.

4. "Genetics: Analysis and Principles" by Robert J. Brooker

5. "Human Molecular Genetics" by Tom Strachan and Andrew Read

6."Introduction to Genetic Analysis" by Anthony J. F. Griffiths, Susan R. Wessler, Richard C. Lewontin,

7. "Concepts of Genetics" by William S. Klug, Michael R. Cummings, Charlotte A. Spencer, and others

8. "Genes IX" by Benjamin Lewin

9. "The Selfish Gene" by Richard Dawkins

10. "Essentials of Genetics" by William S. Klug, Michael R. Cummings, and others

11. "Genomes" by T.A. Brown

12."Cell and Molecular Biology: Concepts and Experiments" by Gerald Karp

13."Molecular Genetics of Bacteria" by Larry Snyder and Wendy Champness

14. "Population Genetics" by Matthew B. Hamilton

15."Fundamentals of Genetics" by B.D. Singh

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester -IV)

Major Practical Course

Course Code – SBCHCP 1251

Title of the Course: Practical based on SBCHCT 1251

[No. of Credits: 2 Credit] **[Total: 60 Hours]**

CURRICULUM DETAILS: SBCHCP 1251: Practical based on SBCHCT 1251

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1	Study different stages of mitosis under a microscope.	4
2	Identify and differentiate stages of meiosis.	4
3	Demonstrate Mendelian inheritance patterns.	4
4	Visualize the structure and banding pattern of polytene chromosomes.	4
5	Analyze human chromosomes and detect conditions like Down syndrome.	4
6	Extract and observe DNA using simple laboratory techniques.	4
7	Separate DNA fragments by size using agarose gel electrophoresis.	4
8	Analyze inheritance patterns using family pedigrees.	4
9	Perform a transformation experiment and understand horizontal gene transfer.	4
10	Amplify specific DNA sequences for analysis.	4
11	Map genes based on linkage and recombination frequency.	4
12	Study recombination rates using maize kernels.	4
13	Study dominant and recessive traits as per Mendel's laws.	4
14	Identify Barr bodies as markers of sex chromatin in females.	4
15	Study the effects of UV radiation on bacterial survival and mutation rates.	4
	Total	**60**

Text Books and Reference Books:

1."Principles of Genetics" by D. Peter Snustad and Michael J. Simmons

2. "Genetics: A Conceptual Approach" by Benjamin A. Pierce

3. "Molecular Biology of the Gene" by James D. Watson, Tania A. Baker, Stephen P. Bell, et al.

4. "Genetics: Analysis and Principles" by Robert J. Brooker

5. "Human Molecular Genetics" by Tom Strachan and Andrew Read

6."Introduction to Genetic Analysis" by Anthony J. F. Griffiths, Susan R. Wessler, Richard C. Lewontin,

7. "Concepts of Genetics" by William S. Klug, Michael R. Cummings, Charlotte A. Spencer, and others

8. "Genes IX" by Benjamin Lewin

9. "The Selfish Gene" by Richard Dawkins

10. "Essentials of Genetics" by William S. Klug, Michael R. Cummings, and others

11. "Genomes" by T.A. Brown

12."Cell and Molecular Biology: Concepts and Experiments" by Gerald Karp

13."Molecular Genetics of Bacteria" by Larry Snyder and Wendy Champness

14. "Population Genetics" by Matthew B. Hamilton

15."Fundamentals of Genetics" by B.D. Singh

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - IV)

Minor Core Theory Course

Course Code – SBCHCT 1252

Title of the Course: MOLECULAR BIOLOGY

[Credits: 2 (Marks: 50)] **(Total Periods: 30 Hours)**

Course Prerequisite

- A foundational understanding of Cell Biology and Biochemistry.
- Basic knowledge of Genetics and Biological Chemistry is recommended

Course Objective

The course aims to provide an in-depth understanding of the molecular mechanisms that govern cellular processes. Students will:

1. Learn the structure and function of nucleic acids and proteins.
2. Explore the mechanisms of replication, transcription, translation, and gene regulation.
3. Understand molecular techniques used in research and biotechnology.
4. Analyze molecular biology's applications in medicine, agriculture, and industry.

Course Outcomes

Upon successful completion of this course, students will be able to:

1. Describe the molecular structure and functions of DNA, RNA, and proteins.
2. Understand the mechanisms of DNA replication, repair, and recombination.
3. Explain transcription, translation, and regulation of gene expression.
4. Apply molecular biology techniques in genetic engineering and diagnostics.
5. Interpret recent advancements in molecular biology and their societal implications.

CURRICULUM DETAILS: SBCHCT 1252: MOLECULAR BIOLOGY

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Structure and Function of Nucleic Acids**	**07**
	1.1	DNA and RNA: Chemical composition and molecular structure. DNA topology: Supercoiling and chromatin organization.	
	1.2	DNA packaging in prokaryotes and eukaryotes.	
	1.3	Types of RNA and their roles (mRNA, tRNA, rRNA, snRNA,	
	1.4	Structure of the genome: Prokaryotic, eukaryotic, mitochondrial, and chloroplast genomes.	
2.0		**DNA Replication, Repair, and Recombination**	**08**
	2.1	Mechanisms of DNA replication: Prokaryotic vs. eukaryotic replication.	
	2.2	Enzymes involved in replication (e.g., DNA polymerase, helicase, primase). Origin of replication and replication fork dynamics.	
	2.3	Mismatch repair, base excision repair, nucleotide excision repair, and double-strand break repair.	
	2.4	Homologous recombination and site-specific recombination. Role of recombination in genetic diversity.	
3.0		**Transcription and RNA Processing**	**08**
	3.1	Mechanism of transcription: Prokaryotic vs. eukaryotic transcription.	
	3.2	Role of RNA polymerase and transcription factors. Promoters, enhancers, and silencers.	
	3.3	Post-transcriptional modifications:5' capping, splicing, and polyadenylation. RNA editing and transport.	
	3.4	Non-coding RNAs and their functions (e.g., miRNA, siRNA, lncRNA).	
4.0		**Translation and Regulation of Gene Expression**	**07**
	4.1	Mechanism of translation:Structure of ribosomes and the genetic code. Steps of translation: Initiation, elongation, and termination.	
	4.2	Post-translational modifications of proteins.	
	4.3	Operon models in prokaryotes (e.g., lac operon, trp operon). Epigenetic regulation in eukaryotes: DNA methylation, histone modification, and chromatin remodeling.	
	4.4	RNA interference and its role in gene silencing.	
		Total	**30**

Text Books and Reference Books:

1. "Molecular Biology of the Cell" by Bruce Alberts, Alexander D. Johnson, Julian Lewis, et al.
2. "Molecular Biology of the Gene" by James D. Watson, Tania A. Baker, Stephen P. Bell, et al.
3. "Molecular Cell Biology" by Harvey Lodish, Arnold Berk, Chris A. Kaiser, et al.
4. "Genes XI" by Benjamin Lewin
5. "Principles of Molecular Biology" by Burton E. Tropp
6. "Molecular Biology: Principles and Practice" by Michael M. Cox, Jennifer Doudna, and Michael O'Donnell
7. "Molecular Cloning: A Laboratory Manual" by Michael R. Green and Joseph Sambrook
8. "Biochemistry and Molecular Biology of Plants" by Bob B. Buchanan, Wilhelm Gruissem, and Russell L. Jones
9. "Molecular Genetics of Bacteria" by Larry Snyder and Wendy Champness
10. "Advanced Molecular Biology" by Richard M. Twyman
11. "Essential Molecular Biology: A Practical Approach" by Terry Brown
12. "From Genes to Genomes: Concepts and Applications of DNA Technology" by Jeremy W. Dale and Malcolm von Schantz
13. "Introduction to Molecular Biology" by Peter Paolella
14. "Molecular Biology and Biotechnology" by John M. Walker and Ralph Rapley
15. "DNA Science: A First Course in Recombinant DNA Technology" by David A. Micklos and Greg A. Freyer

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester -IV)

Major Practical Course

Course Code – SBCHCP 1252

Title of the Course: Practical based on SBCHCT 1252

[No. of Credits: 2 Credit] **[Total: 60 Hours]**

CURRICULUM DETAILS: SBCHCP 1252: Practical based on SBCHCT 1252

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1	Extract and quantify genomic DNA using spectrophotometry.	4
2	Extract plasmid DNA and analyze it using agarose gel electrophoresis.	4
3	Separate DNA fragments based on size and visualize them using ethidium bromide or other stains.	4
4	Amplify a specific DNA fragment using PCR and analyze the results on an agarose gel.	4
5	Digest DNA with restriction enzymes and analyze fragment patterns using gel electrophoresis.	4
6	Perform ligation reactions using T4 DNA ligase and verify the results.	4
7	Introduce foreign plasmid DNA into E. coli and analyze transformation efficiency.	4
8	Transfer DNA from an agarose gel to a membrane and hybridize it with a labeled probe.	4
9	Isolate RNA, separate it using gel electrophoresis, and detect specific transcripts.	4
10	Detect specific proteins in a sample using antibodies and chemiluminescence or chromogenic detection.	4
11	Analyze RNA integrity and purity.	4
12	Perform quantitative PCR to measure gene expression levels.	4
13	Insert a gene of interest into a vector and verify by restriction digestion and sequencing.	4
14	Induce protein expression in bacterial cells and purify it using affinity chromatography.	4
15	Analyze the binding of proteins to DNA sequences.	4
	Total	**60**

Text Books and Reference Books:

1. "Molecular Biology of the Cell" by Bruce Alberts, Alexander D. Johnson, Julian Lewis, et al.
2. "Molecular Biology of the Gene" by James D. Watson, Tania A. Baker, Stephen P. Bell, et al.
3. "Molecular Cell Biology" by Harvey Lodish, Arnold Berk, Chris A. Kaiser, et al.
4. "Genes XI" by Benjamin Lewin
5. "Principles of Molecular Biology" by Burton E. Tropp
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13. "Introduction to Molecular Biology" by Peter Paolella
14. "Molecular Biology and Biotechnology" by John M. Walker and Ralph Rapley
15. "DNA Science: A First Course in Recombinant DNA Technology" by David A. Micklos and Greg A. Freyer

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - IV)

Minor Core Theory Course

Course Code – SBCHMT 1251

Title of the Course: IMMUNOLOGY

[Credits: 2 (Marks: 50)] **(Total Periods: 30 Hours)**

Course Prerequisite

- Fundamental knowledge of **Cell Biology** and **Biochemistry**.
- Basic understanding of **Microbiology** and **Genetics** is recommended.

Course Objective

This course aims to provide a detailed understanding of the immune system, its components, and its role in health and disease. Students will:

1. Understand the basic concepts and mechanisms of the immune system.
2. Learn about the cellular and molecular aspects of immunity.
3. Explore the clinical applications of immunology, including vaccine development and immunotherapy.
4. Analyze immunological disorders and the mechanisms of immune regulation.

Course Outcomes

Upon successful completion of the course, students will be able to:

1. Describe the components and functions of the immune system.
2. Explain the processes of innate and adaptive immunity.
3. Understand antigen-antibody interactions and their applications.
4. Analyze immunological techniques and their uses in diagnostics and research.
5. Discuss immune-related disorders and therapeutic approaches.

CURRICULUM DETAILS: SBCHCT 1251: IMMUNOLOGY

Module No.	Unit No.	Topic	Hrs. Required to cover the contents
1.0		**Introduction to Immunology**	**07**
	1.1	Overview of the immune system: Innate and adaptive immunity.	
	1.2	Cells of the immune system: T cells, B cells, macrophages, dendritic cells, and NK cells.	
	1.3	Organs of the immune system: Bone marrow, thymus, spleen, lymph nodes, and MALT.	
	1.4	Overview of immunological memory and tolerance.	
2.0		**Antigens, Antibodies, and Major Histocompatibility Complex (MHC)**	**08**
	2.1	Antigens: Types, properties, and antigenicity determinants.	
	2.2	Antibodies: Structure, classes, and functions of immunoglobulins.	
	2.3	Antigen-antibody interactions: Agglutination, precipitation, ELISA, and immunofluorescence.	
	2.4	Major Histocompatibility Complex (MHC): Structure, types (MHC-I and MHC-II), and role in antigen presentation.	
3.0		**Immune Response and Regulation**	**08**
	3.1	Innate immunity: Mechanisms, pattern recognition receptors, and inflammation.	
	3.2	Adaptive immunity:Humoral immunity: B cell activation and antibody production.	
	3.3	Cell-mediated immunity: T cell activation, differentiation, and effector functions	
	3.4	Cytokines and their role in immune regulation.Immune tolerance: Central and peripheral tolerance mechanisms.	
4.0		**Immunological Disorders and Applications**	**07**
	4.1	Hypersensitivity reactions: Types I-IV with examples.Autoimmune diseases: Mechanisms and examples (e.g., rheumatoid arthritis, lupus).	
	4.2	Immunodeficiency diseases: Primary and secondary immunodeficiencies (e.g., SCID, AIDS)	
	4.3	Vaccines: Types (live, inactivated, subunit, DNA vaccines), development, and immunization programs.	
	4.4	Applications of immunology:Monoclonal antibodies and hybridoma technology.Immunotherapy for cancer and autoimmune diseases. Transplant immunology and graft rejection.	

		Total	**30**

Text Books and Reference Books:

1. "Kuby Immunology" by Judith A. Owen, Jenni Punt, Sharon A. Stranford
2. "Janeway's Immunobiology" by Kenneth Murphy and Casey Weaver
3. "Essential Immunology" by Peter J. Delves and Ivan M. Roitt
4. "Cellular and Molecular Immunology" by Abul K. Abbas, Andrew H. Lichtman, and Shiv Pillai
5. "Fundamentals of Immunology" by William E. Paul
6. "Immunology: A Short Course" by Richard Coico and Geoffrey Sunshine
7. "Basic Immunology: Functions and Disorders of the Immune System" by Abul K. Abbas, Andrew H. Lichtman, and Shiv Pillai
8. "The Immune System" by Peter Parham
9. "Introduction to Immunology" by John W. Kimball
10. "Case Studies in Immunology: A Clinical Companion" by Raif Geha and Luigi Notarangelo
11. "Veterinary Immunology: An Introduction" by Ian R. Tizard
12. "Immunology: Understanding the Immune System" by Klaus D. Elgert
13. "Clinical Immunology: Principles and Practice" by Robert R. Rich, Thomas A. Fleisher, et al.
14. "Immunology and Evolution of Infectious Disease" by Steven A. Frank
15. "How the Immune System Works" by Lauren M. Sompayrac.

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester -IV)

Minor Practical Course

Course Code – SBCHMP 1251

Title of the Course: Practical based on SBCHMT 1251

[No. of Credits: 2 Credit] **[Total: 60 Hours]**

CURRICULUM DETAILS: SBCHMP 1251: Practical based on SBCHMT 1251

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1	Immunize an animal to prepare antiserum for specific antigen detection.	4
2	Determine ABO and Rh blood groups using agglutination reactions.	4
3	Perform a microscopic count and identification of different types of WBCs.	4
4	Detect and quantify specific antigens or antibodies in a sample.	4
5	Demonstrate antigen-antibody interactions in a gel matrix.	4
6	Quantify antigens using antigen-antibody precipitation in an electric field.	4
7	Detect specific proteins using antibodies after gel electrophoresis.	4
8	Quantify specific proteins in a sample based on antigen-antibody precipitation in agar.	4
9	Detect the presence of specific antibodies or antigens by complement fixation.	4
10	Analyze immune cell populations based on surface markers and fluorescence.	4
11	Separate mononuclear cells from whole blood using density gradient centrifugation.	4
12	Assess the proliferative response of lymphocytes to mitogens or antigens.	4
13	Detect antibodies or viruses using agglutination of red blood cells.	4
14	Assess hypersensitivity reactions to specific allergens.	4
15	Visualize and quantify phagocytic activity of macrophages using a suitable substrate (e.g., latex beads or bacteria).	4
	Total	**60**

Text Books and Reference Books:

1. "Kuby Immunology" by Judith A. Owen, Jenni Punt, Sharon A. Stranford
2. "Janeway's Immunobiology" by Kenneth Murphy and Casey Weaver
3. "Essential Immunology" by Peter J. Delves and Ivan M. Roitt
4. "Cellular and Molecular Immunology" by Abul K. Abbas, Andrew H. Lichtman, and Shiv Pillai
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12. "Immunology: Understanding the Immune System" by Klaus D. Elgert
13. "Clinical Immunology: Principles and Practice" by Robert R. Rich, Thomas A. Fleisher, et al.
14. "Immunology and Evolution of Infectious Disease" by Steven A. Frank
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National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - IV)

Generic Elective Course

Course Code – SBCHGE 1251

Title of the Course: Diet Therapy

[No. of Credits: 2 Credit] **[Total: 30 Hours]**

CURRICULUM DETAILS: SBCHGE 1251: Diet Therapy

Module No.	Unit No.	Topic	Hrs.
1.0		**Introduction to Diet Therapy**	**08**
	1.1	Principles of diet therapy: Preventive, curative, and supportive roles	
	1.2	Modifications of the normal diet: Texture, consistency, and nutrient cont	
	1.3	Nutritional assessment in therapeutic diet planning: Dietary, anthropometric, biochemical, and clinical assessments. Role of the dietitian in healthcare settings.	
2.0		**Dietary Management of Deficiency and Metabolic Disorders**	**07**
	2.1	Energy imbalances: Obesity and undernutrition.	
	2.2	Protein-energy malnutrition (PEM): Kwashiorkor and marasmus.	
	2.3	Micronutrient deficiencies: Iron, vitamin A, iodine, and calcium.	
	2.4	Metabolic disorders: Diabetes mellitus, hyperlipidemia, and metabolic syndrome.	
3.0		**Diet Therapy for Gastrointestinal, Liver, and Renal Disorders**	**08**
	3.1	Gastrointestinal disorders: Peptic ulcers, inflammatory bowel disease (IBD), and celiac disease.	
	3.2	Liver disorders: Hepatitis, cirrhosis, and fatty liver disease.	
	3.3	Renal disorders: chronic kidney disease (CKD), nephrotic syndrome, and kidney stones.	
4.0		**Specialized Diet Therapy for Other Health Conditions**	**07**
	4.1	Cardiovascular diseases: Hypertension, atherosclerosis, and heart failure	
	4.2	Cancer: Nutritional management during chemotherapy, radiation, and re	
	4.3	Food allergies and intolerances: Lactose intolerance, gluten sensitivity.	
		Total	**30**

Text Books and Reference Books:

1. "Krause's Food & The Nutrition Care Process" by L. Kathleen Mahan, Janice L. Raymond
2. "Modern Nutrition in Health and Disease" by A. Catharine Ross, Benjamin Caballero, et al.
3. "Nutrition and Diagnosis-Related Care" by Sylvia Escott-Stump
4. "Williams' Essentials of Nutrition and Diet Therapy" by Eleanor Schlenker and Joyce Gilbert
5. "Medical Nutrition Therapy: A Case Study Approach" by Marcia Nahikian-Nelms, Sara Long Anderson
6. "Clinical Dietetics and Nutrition" by F.P. Antia and Philip Abraham
7. "Manual of Clinical Nutrition Management" by Morrison Healthcare
8. "The Science and Practice of Nutrition Support: A Case-Based Core Curriculum" by M. Patricia Fuhrman, Pamela Charney
9. "ADA Pocket Guide to Nutrition Assessment" by Pamela Charney and Ainsley Malone
10. "Diet and Nutrition in Critical Care" by Rajkumar Rajendram, Victor R. Preedy, Colin R. Martin
11. "Food, Nutrition and Diet Therapy" by Sue Rodwell Williams
12. "Human Nutrition and Dietetics" by Michael J. Gibney, Susan A. Lanham-New, Aedin Cassidy
13. "Nutrition Therapy and Pathophysiology" by Marcia Nahikian-Nelms, Kathryn P. Sucher
14. "Textbook of Clinical Nutrition and Functional Medicine" by Alex Vasquez
15. "Handbook of Clinical Nutrition and Dietetics" by Rowan Stewart

National Education Policy 2020

B.Sc. Biochemistry, II Year (Semester - IV)

Skill Enhancement Course

Course Code – SBCHVC 1251

Title of the Course: Biochemical Techniques

[No. of Credits: 2 Credit] **[Total: 60 Hours]**

CURRICULUM DETAILS: SBCHVC 1251: Biochemical Techniques

Sr. No	Practical Exercises	Hrs. Required to cover the contents
1.	Isolation Plasmid.	4
2.	Blotting.	4
3.	Demonstration of HPTLC.	4
4.	Demonstration of HPLC.	4
5.	Demonstration of GCMS.	4
6.	Demonstration of X-ray Crystallography.	4
7.	Demonstration of X-ray MRI	4
8.	Demonstration of FTIR	4
9.	Demonstration of AAS	4
10.	Demonstration of Bomb Calorimeter	4
11.	Demonstration of Kjeldahl Analyzer	4
12.	Demonstration of Soxhlet Extractor	4
13.	Demonstration of Moisture Analyzer	4
14.	Demonstration of Texture Analyzer	4
15.	Demonstration of Refractometer	4
	Total	**60**

Text Books and Reference Books:

1) Instrumental Methods in Biochemical Analysis" by H. Holzer and H. Scherz
2) Biochemical Techniques" by Keith Wilson and John Walker
3) Practical Skills in Biomolecular Sciences" by Rob Reed and David Holmes
4) Bioanalytical Chemistry" by Andreas Manz and Nicolaas A. M. E. Schultes
5) Principles and Techniques of Biochemistry and Molecular Biology" by Keith Wilson and John Walker
6) Biochemical Methods" by Sadasivam and Manickam
7) Biochemical Instrumentation" by David Holme and Hazel Peck
8) Basic Laboratory Methods in Medical Parasitology" by World Health Organization
9) Laboratory Techniques in Biochemistry and Molecular Biology" by Raphael L. Levine and Miles D. Houslay
10) Experimental Biochemistry: A Student Companion" by Nikolaus Pfanner and Wilhelm G. Höhne