

SAURASHTRA UNIVERSITY, RAJKOT



Accredited Grade “A” by NAAC (CGPA 3.05)

**COURSE STRUCTURE & SYLLABUS
FOR
UNDERGRADUATE PROGRAMME
IN
BIOTECHNOLOGY**

(Faculty of Science)

[As per Choice Based Credit System (CBCS) as recommended by UGC]

Effective from June - 2019

PREFACE

Updating and revision of the Curriculum at regular interval of time is a prime criterion of IQAC – NAAC and a prime need for the college and educational systems affiliated to University.

Biotechnology refers to the use of living organisms or the products of these organisms to improve human health and the human environment. It is revolutionizing the way we manufacture products and view the relationships of all living things. Although biotechnology is considered a growing science, the processes used today have their basis in the nature. These processes are used to transfer genetic materials from one cell into another by using a common bacterium. This transfer of DNA permits variance of one or several traits and confers a new property on an organism. For example, tomato plants have been made resistant to Tobacco Mosaic Virus, which can cause large crop loss.

Biotechnology has the potential to affect a number of fields and issues, including agriculture, food processing, health care, forensics, energy production, and the environment. Current applications include diagnostics, the production of vaccines and pharmaceuticals, and improved crop and livestock the life sciences such as biotechnology, medicine, biomedical research, bioinformatics, etc.

Composition of Curriculum for a particular subject requires following criteria to be considered:

1. Guidelines and Model curriculum given by the UGC and the University
2. Regional needs
3. Present national and International trends in the subject
4. Geographical parameters of the University and its demographic property
5. Relationship with other related subjects
6. Financial and statutory provisions of the state government
7. Resources of educational needs.

The content of a syllabus should be such that it maintains continuity with the course content of higher secondary class and post graduate course. The present curriculum is made keeping this in mind and is an effort to impart fundamental knowledge of the subject needed at this level.

Chairman, Board of Studies, Biotechnology
Saurashtra University, Rajkot (Gujarat)
Date: 22-06-2019

Annexure – “B”

SAURASHTRA UNIVERSITY
SCIENCE FACULTYSubject: **BIOTECHNOLOGY**

Sr. No.	Level	Semester	Course Group	Course (Paper) Title	Course (Paper) No.	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks	Course (Paper) Unique Code
01	UG	01	Core	Introduction to Biotechnology and Cell Biology	BT-101	7	30	70	50	150	16031800 0101 0100
02	UG	02	Core	Fundamentals of Biomolecules	BT-201	7	30	70	50	150	1603 1800 0102 0100
03	UG	03	Core	Basic Aspects of Cellular Metabolism	BT-301	7	30	70	50	150	1603 1800 0103 0100
04	UG	04	Core	Environmental Biotechnology	BT-401	7	30	70	50	150	1603 1800 0104 0100
05	UG	05	Core	Bioprocess and Biochemical Engineering	BT-501	7	30	70	50	150	1603 1800 0105 0100
06	UG	05	Core	Genetics and Molecular Biology	BT-502	7	30	70	50	150	1603 1800 0105 0200
07	UG	05	Core	Immunology	BT-503	7	30	70	50	150	1603 1800 0105 0300
08	UG	06	Core	Principles of Biotechnology Applied to Plants and Animals	BT-601	7	30	70	50	150	1603 1800 0106 0100
09	UG	06	Core	Analytical Techniques in Biotechnology	BT-602	7	30	70	50	150	1603 1800 0106 0200
10	UG	06	Core	Advanced Molecular Techniques and Bioinformatics	BT-603	7	30	70	50	150	1603 1800 0106 0300

**SKELETON OF COMPLETE COURSE CONTENT OF
UNDER GRADUATE BIOTECHNOLOGY
SEMESTER I to VI**

SEMESTER	PAPER NO. & CODE	TITLE OF THE PAPER	CREDIT
I	BT-101 (Theory)	Introduction to Biotechnology and Cell Biology	4
	BT -101 (Practical)	-do-	3
II	BT -201 (Theory)	Fundamentals of Biomolecules	4
	BT -201 (Practical)	-do-	3
III	BT -301 (Theory)	Basic Aspects of Cellular Metabolism	4
	BT -301 (Practical)	-do-	3
IV	BT -401 (Theory)	Environmental Biotechnology	4
	BT -401 (Practical)	-do-	3
V	BT -501 (Theory)	Bioprocess and Biochemical Engineering	4
	BT -501 (Practical)	-do-	3
	BT -502 (Theory)	Genetics and Molecular Biology	4
	BT -502 (Practical)	-do-	3
	BT -503 (Theory)	Immunology	4
	BT -503 (Practical)	-do-	3
VI	BT -601 (Theory)	Principles of Biotechnology Applied to Plants and Animals	4
	BT -601 (Practical)	-do-	3
	BT -602 (Theory)	Analytical Techniques in Biotechnology	4
	BT -602 (Practical)	-do-	3
	BT -603 (Theory)	Advanced Molecular Techniques and Bioinformatics	4
	BT -603 (Practical)	-do-	3

Annexure – “C”

FACULTY OF SCIENCE

Syllabus

Subject: **BIOTECHNOLOGY**

Course (Paper) Name & No.: Introduction to Biotechnology and Cell Biology (BT-101)

Course (Paper) Unique Code: 1603 18000101 0100

External Exam Time Duration: 2.5 Hours

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	01	Core	7	30	70	50	150

Course Objective:

- To uncover the fundamental principles, developments and potential applications of Biotechnology
- To understand the structure and functions of prokaryotic and eukaryotic cells and its organelles
- To provide overview of stem cell and cancer biology

**COURSE STRUCTURE FOR UG PROGRAMME
BIOTECHNOLOGY- 101
SEMESTER- I**

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
I	BT-101 (Theory)	Introduction to Biotechnology and Cell Biology	6	4	2.5hrs	30	70	100
I	BT-101 (Practical)	Introduction to Biotechnology and Cell Biology	6	3	One day per batch	15	35	50
Total credits				7	Total marks			150

General instructions

1. The medium of instruction will be English for theory and practical courses
2. There will be 6 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 2 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of “five” units. There will be 60 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

Annexure – “C”

**SKELETON OF THEORY EXAMINATION
(SEMESTER – I)**

Question-1 Unit 1(Total Marks=14)		
Q.1 A	One word questions	4 Marks
Q.1 B	Short question(any 1 out of 2)	2Marks
Q.1 C	Answer in brief (any 1 out of 2)	3 Marks
Q.1 D	Write a note on (any 1 out of 2)	5 Marks
Question-1 Unit 2(Total Marks=14)		
Q.1 A	One word questions	4 Marks
Q.1 B	Short question(any 1 out of 2)	2Marks
Q.1 C	Answer in brief (any 1 out of 2)	3 Marks
Q.1 D	Write a note on (any 1 out of 2)	5 Marks
Question-1 Unit 3(Total Marks=14)		
Q.1 A	One word questions	4 Marks
Q.1 B	Short question(any 1 out of 2)	2Marks
Q.1 C	Answer in brief (any 1 out of 2)	3 Marks
Q.1 D	Write a note on (any 1 out of 2)	5 Marks
Question-1 Unit 4(Total Marks=14)		
Q.1 A	One word questions	4 Marks
Q.1 B	Short question(any 1 out of 2)	2Marks
Q.1 C	Answer in brief (any 1 out of 2)	3 Marks
Q.1 D	Write a note on (any 1 out of 2)	5 Marks
Question-1 Unit 5(Total Marks=14)		
Q.1 A	One word questions	4 Marks
Q.1 B	Short question(any 1 out of 2)	2Marks
Q.1 C	Answer in brief (any 1 out of 2)	3 Marks
Q.1 D	Write a note on (any 1 out of 2)	5 Marks

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

**BT-101- INTRODUCTION TO BIOTECHNOLOGY AND CELL BIOLOGY
(THEORY)**

Unit-1:- INTRODUCTION AND SCOPE OF BIOTECHNOLOGY (credit-0.8)

- 1.1 Historical perspective and Definitions of Biotechnology
- 1.2 Current Status of Biotechnology and Future of Biotechnology in Developing World.
- 1.3 Overview of Recombinant DNA Technology
- 1.4 Applications of Biotechnology - Agriculture, Medicine & Environment
- 1.5 Ethical and Social Impacts of Biotechnology

UNIT-2:- BASIC CONCEPT AND UNDERSTANDING OF CELL (credit-0.8)

- 2.1 Concept of Life and Cell Theory, Origin and evolution of cell
- 2.2 Diversity of Cell Size and Shape
- 2.3 Ultrastructure and Function of Prokaryotic cell and Virus
- 2.4 Ultrastructure and Function of Eukaryotic cell
- 2.5 Microscopic Techniques for the Study of cell

UNIT-3:- STRUCTURE AND FUNCTION OF CELL ORGANELLES (credit-0.8)

- 3.1 Cell Wall and Plasma Membrane
- 3.2 Mitochondria and Chloroplast
- 3.3 Endoplasmic Reticulum and Golgi Bodies
- 3.4 Lysosomes, Glyoxisomes and Peroxisomes
- 3.5 Ribosomes

UNIT-4:- NUCLEUS, CELL CYCLE AND CELL DIVISION (credit-0.8)

- 4.1 Structure and function of Nucleus
- 4.2 Ultrastructure of chromosomes
- 4.3 Overview of cell cycle
- 4.4 Mitosis and Meiosis
- 4.5 Regulation of cell cycle

UNIT-5:- ADVANCE STUDIES IN CELL BIOLOGY (credit-0.8)

- 5.1 Cytoskeleton
- 5.2 Cell Locomotion – Amoeboid, Flagella, Cilia, Cytoplasmic Streaming
- 5.3 Cell – Cell Interaction
- 5.4 Overview of Stem cells
- 5.5 Overview of Cancer biology

LIST OF PRACTICALS

- Exp.1. Introduction to LAB and lab environment
- Exp.2. Preparation of solution
- Exp.3. Staining techniques (Simple and Differential)
- Exp.4. Staining techniques (Special Staining)
- Exp.5. Calibration of stage and ocular micrometer and measurement of given biological samples
- Exp.6. Preparation of slides showing different stages of cell division – Mitosis and meiosis
- Exp.7. Human Karyotyping
- Exp.8. Isolation of microbes by streaking, spreading and pouring method
- Exp.9. Isolation and microscopic observation of chloroplast
- Exp.10. Observation of bacterial motility by performing hanging drop method
- Exp.11. One day Field visit

LIST OF INSTRUMENTS

- 1. pH Meter
- 2. Hot Air Oven
- 3. Weigh Balance
- 4. Water Bath
- 5. Refrigerator
- 6. Autoclave
- 7. Spectrophotometerand/or Colorimeter
- 8. Microscope
- 9. Shaker
- 10. Incubator
- 11. Stirrer
- 12. Centrifuge
- 13. Hemocytometer
- 14. Vortex
- 15. Laminar air flow
- 16. Micrometer
- 17. Microtome

LIST OF REFERENCES

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2. Biotechnology Fundamental & application, S.S.Purohit, Agrobios
3. Biotechnology, B.D.Singh
4. Biotechnology, U. Satyanarayan, Books and Alllied
5. C. B. Powar, Cell Biology, Himalaya Press.
6. Cell & Molecular Biology, P.K.Gupta, Rastogi Pub.
7. Cytogenetics, P.K. Gupta, Rastogi Pub.
8. Practical manuals of Biotechnology, S. Chand
9. Verma, Cell biology ,Genetics ,Molecular Biology, Evolution & Ecology.2006
10. Albert, Essential Cell Biology,Garland Science.
11. De Robertis, Cell Biology
12. Geoffrey Cooper, The Cell, Sinauer Asso. Incorp
13. Karp, Cell & Molecular Biology: concepts & Experiments.4th Edition.
14. Lodish, Cell & Molecular Biology, W.H.Freeman.5th Edn.

Annexure – “C”

FACULTY OF SCIENCE

Syllabus

Subject: **BIOTECHNOLOGY**

Course (Paper) Name & No.: Fundamentals of Biomolecules (BT-201)

Course (Paper) Unique Code: 1603 18000102 0100

External Exam Time Duration: 2.5 Hours

Name of Program	Semester	Course Group	Credit	Internal Marks	External Marks	Practical /Viva Marks	Total Marks
Bachelor of Science	02	Core	7	30	70	50	150

Course Objective:

- To understand the structure, function and inter-relationships of biomolecules with the perspective of life

**COURSE STRUCTURE FOR UG PROGRAMME
BIOTECHNOLOGY- 201
SEMESTER-II**

Sem	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External Marks	Total Marks
II	BT-201 (Theory)	Fundamentals of Biomolecules	6	4	2.5hrs	30	70	100
II	BT-201 (Practical)	Fundamentals of Biomolecules	6	3	One day per batch	15	35	50
Total credits				7	Total marks			150

GENERAL INSTRUCTIONS

1. The medium of instruction will be English for theory and practical courses
2. There will be 6 lectures / week / theory paper / semester.
3. Each lecture will be of 55 mins.
4. There will be 2 practical / week / paper / batch. Each practical will be of 3 periods
5. Each semester theory paper will be of “five” units. There will be 60 hrs. of theory teaching / paper / semester.
6. Each Theory Paper / Semester will be of 100 Marks. There will be 30 marks for internal evaluation and 70 marks for external evaluation. Each Practical Paper / Semester will be of 50 Marks with 15 marks for internal and 35 marks for external evaluation. So, Total Marks of Theory and Practical for each Paper will be 150. (100 + 50 = 150)

Annexure – “C”

**SKELETON OF THEORY EXAMINATION
(SEMESTER – II)**

Question-1 Unit 1(Total Marks=14)		
Q.1 A	One word questions	4 Marks
Q.1 B	Short question(any 1 out of 2)	2Marks
Q.1 C	Answer in brief (any 1 out of 2)	3 Marks
Q.1 D	Write a note on (any 1 out of 2)	5 Marks
Question-1 Unit 2(Total Marks=14)		
Q.1 A	One word questions	4 Marks
Q.1 B	Short question(any 1 out of 2)	2Marks
Q.1 C	Answer in brief (any 1 out of 2)	3 Marks
Q.1 D	Write a note on (any 1 out of 2)	5 Marks
Question-1 Unit 3(Total Marks=14)		
Q.1 A	One word questions	4 Marks
Q.1 B	Short question(any 1 out of 2)	2Marks
Q.1 C	Answer in brief (any 1 out of 2)	3 Marks
Q.1 D	Write a note on (any 1 out of 2)	5 Marks
Question-1 Unit 4(Total Marks=14)		
Q.1 A	One word questions	4 Marks
Q.1 B	Short question(any 1 out of 2)	2Marks
Q.1 C	Answer in brief (any 1 out of 2)	3 Marks
Q.1 D	Write a note on (any 1 out of 2)	5 Marks
Question-1 Unit 5(Total Marks=14)		
Q.1 A	One word questions	4 Marks
Q.1 B	Short question(any 1 out of 2)	2Marks
Q.1 C	Answer in brief (any 1 out of 2)	3 Marks
Q.1 D	Write a note on (any 1 out of 2)	5 Marks

General Instructions

1. Time duration of each theory paper will be of two and half hours.
2. Total marks of each theory paper will be 70 marks.
3. There will be internal option for all the questions (as shown in table above)
4. All questions are compulsory

**BT-201- FUNDAMENTALS OF BIOMOLECULES
(THEORY)**

Unit 1:- Chemistry of Life: An Introduction (credit-0.8)

- 1.1 The Properties of Water
- 1.2 The Properties of Biomolecules
- 1.3 Chemical Bonds/Interactions : Ionic, Covalent, Nonpolar, Polar, Hydrogen Bonds, Hydrophobic Interactions, Vander Wall's Attractive Force
- 1.4 pH, pKa, Acids, Bases and Buffers
- 1.5 Thermodynamics of Biological System : The First Law, The Second Law, The Third Law, Free Energy, ATP and other High Energy Compounds

Unit 2:- The Molecules of Life – I: Carbohydrates (credit-0.8)

- 2.1 Chemistry of Carbohydrates: Functions And Classifications, Monosaccharides: Configuration and Conformation,
- 2.2 Reactions of Monosaccharides and Sugar Derivatives
- 2.3 Disaccharides: Functions And Classifications
- 2.4 Polysaccharides: Functions And Classifications
- 2.5 Glycoconjugates: Proteoglycans, Glycoproteins and Glycolipids

Unit 3:- The Molecules of Life – II: Proteins (credit-0.8)

- 3.1 Amino Acids: Structures, General Properties, Classifications, Nomenclature, Nonstandard Amino Acid (Amino Acid Derivatives)
- 3.2 Proteins: An Overview of Four Levels of Structures in Proteins, Classifications of Proteins, Properties of Proteins, Biologically Important Peptides
- 3.3 Protein folding mechanism and significance
- 3.4 DNA-Protein and Protein-Protein Interactions
- 3.5 Protein sequencing: Edman and Sanger Method

Unit 4:-The Molecules of Life – III: Nucleic acids (credit-0.8)

- 4.1 Basic Understanding of Nucleotides, Structure and Properties of Nitrogen Basis, Functions of Nucleotides. Nucleotide Analogs
- 4.2 Nucleic Acids: Historical aspects of DNA as Genetic Material, Semi-Conservative Nature of DNA, Chargaff's Rule
- 4.3 Watson and Crick DNA Double Helix Structure, other Types of DNA Structure, Denaturation and Renaturation of DNA
- 4.4 Types of RNA and their Functions, Catalytic RNAs (Ribozymes)
- 4.5 Nucleic acid sequencing: Sanger and Maxam Gilbert Method

UNIT:-5 The Molecules of Life – IV:Lipids and vitamins (credit-0.8)

- 5.1 Lipids: Classifications of Lipids and Functions of Lipids
- 5.2 Structure of Fatty Acids, Triacylglycerol's, Phospholipids and Steroids
- 5.3 Functions of Fatty Acids, Triacylglycerol's, Phospholipids and Steroids
- 5.4 Vitamins: Classification, Functions and Sources
- 5.5 Vitamins: Deficiency Disorders

LIST OF PRACTICALS

- Exp.1 Operation of pH meter.
- Exp.2 Preparation of buffer
- Exp.3 Qualitative tests for carbohydrates
- Exp.4 Qualitative tests for Amino acids
- Exp.5 Titration curve of amino acids and determination of pI, pK1 and pK2.
- Exp.6 Qualitative test for Lipids
- Exp.7 Qualitative test for Nucleic acids
- Exp.8 Estimation of reducing and non-reducing sugars by Cole's method
- Exp.9 Titrimetric analysis of Ascorbic acid
- Exp.10 Estimation of Vitamin B12
- Exp.11 One day Field visit

LIST OF INSTRUMENTS

- 1. pH Meter
- 2. Hot Air Oven
- 3. Weigh Balance
- 4. Water Bath
- 5. Refrigerator
- 6. Incubator
- 7. Spectrophotometer

LIST OF REFERENCES

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- 3. Elements Of Biochemistry by Dulsy Fatima,R PMeyyan,L M Narayanan, Saras Publication
- 4. Fundamentals of Biochemistry, A. C. Deb

5. Fundamentals of Biochemistry, J. L. Jain, Sunjay Jain and Nitin Jain, S. Chand Pub.
6. Introductory practical Biochemistry, S. K. Sawhney and Randhir Singh
7. J. Jayaraman. Lab Manual in Biochemistry.
8. Zube's Biochemistry. 4th Edition Macmillan.
9. Cohn and Stumph. Outline of Biochemistry. Wiley eastern.
10. Lehninger. Principles of Biochemistry, Nelson & Cox, 4th Edition.
11. Plummer. An introduction to practical Biochemistry, 3rd Edition
12. Stryer – Biochemistry. W.H. Freeman & Co.
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