

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 - 2016

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 is applied subject that 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: 16-02-2016

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	Metabolism of Biomolecules	BT-301	7	30	70	50	150	1603 1800 0103 0100
04	UG	04	Core	Environmental Biotechnology and Biostatistics	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)	Metabolism of Biomolecules	4
	BT -301 (Practical)	-do-	3
IV	BT -401 (Theory)	Environmental Biotechnology and Biostatistics	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.: Metabolism of Biomolecules (BT-301)

Course (Paper) Unique Code: 1603 18000103 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	03	Core	7	30	70	50	150

Course Objective:

- To understand the fundamentals and properties of enzymes and its kinetics
- Basics and fundamentals of metabolism and various pathways associated with various biochemical reaction and its association with health and diseases
- To understand the fundamentals of membrane structure and its role in molecular transportation
- To study concept of signal transduction, role of G protein in signal transduction
- To understand importance of plant and animal hormones

**COURSE STRUCTURE FOR UG PROGRAMME
BIOTECHNOLOGY- 301
SEMESTER- III**

Semester	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External marks	Total marks
III	BT-301 (Theory)	Metabolism of Biomolecules	6	4	2.5hrs	30	70	100
III	BT-301 (Practical)	Metabolism 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)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL

(SEMESTER – III)

SECTION – I		Marks –20	
<p>Ques. 1 Attempt the following Multiple Choice Questions in the given time period</p> <p>(The questions will be of Justification based MCQ, each carrying one mark. All the units will be covered in this section.)</p>			
SECTION – II		Marks – 50	
Ques.1	Answer specifically- (attempt any three out of six) Short Questions - (attempt any three out of six) Answer in detail – (attempt any two out of five)	Units 1 to 5 Units 1 to 5 Units 1 to 5	3x2= 6 Marks 3x3= 9 Marks 5x2= 10 Marks
Ques.2	Answer specifically- (attempt any three out of six) Short Questions - (attempt any three out of six) Answer in detail – (attempt any two out of five)	Units 1 to 5 Units 1 to 5 Units 1 to 5	3x2= 6 Marks 3x3= 9 Marks 5x2= 10 Marks

General Instructions

1. Time duration of each theory paper will be of two and halfhours.
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-301 –METABOLISM OF BIOMOLECULES
(THEORY)**

Unit-1:- ENZYME (credit-0.8)

- 1.1 Enzymes: - General properties, Nomenclature and Classification. Biocatalyst and Chemical Catalyst, Coenzymes, Cofactors, Isoenzyme and Allosteric Enzyme
- 1.2 Catalytic Mechanism (Proximity and Orientation effects, Acid base Catalysis, Covalent Catalysis and Metal ion catalysis and Transition state analog)
- 1.3 Enzyme Kinetics (derivation of Michaelis–Menten constant, linear transformation of the equation)
- 1.4 Enzyme Inhibition: Mechanism and Types (Irreversible and Reversible)
- 1.5 Mechanism of Enzyme Regulation: Covalent and Allosteric Regulation

UNIT-2:- METABOLISM - 1(credit-0.8)

- 2.1 Carbohydrate Metabolism: Glycolysis, fate of pyruvate
- 2.2 Carbohydrate Metabolism: TCA
- 2.3 Carbohydrate Metabolism: Gluconeogenesis and HMP
- 2.4 Lipid Metabolism: β -oxidation of fatty acids
- 2.5 ETC and Oxidative Phosphorylation

UNIT-3:- METABOLISM - 2(credit-0.8)

- 3.1 Protein Metabolism: Transamination, Decarboxylation and Deamination
- 3.2 Protein Metabolism: Urea Cycle
- 3.3 Biosynthesis of Nucleic Acid
- 3.4 Photosynthesis
- 3.5 Inborn Errors of Metabolism

UNIT-4:- HORMONES(credit-0.8)

- 4.1 Introduction to Hormones: Endocrine and Exocrine
- 4.2 Plant Hormones and its functions
- 4.3 Animal Hormones and its functions
- 4.4 Types of Animal Hormones
- 4.5 Disorders due to hormonal imbalance in humans

UNIT-5:- MOLECULAR TRANSPORTATION AND SIGNALING(credit-0.8)

- 5.1 Composition and architecture of membrane
- 5.2 Solute transport across membrane
- 5.3 Signal transduction cascade
- 5.4 Regulation of cell cycle by protein kinase
- 5.5 Role of signal transduction by hormones

LIST OF PRACTICALS

- Exp.1. To demonstrate working operations of spectrophotometer.
- Exp.2. Estimation of Protein by Biuret method.
- Exp.3. Estimation of Reducing Sugar by Nelson- Somogyi method
- Exp.4. Estimation of Nucleic Acid (DNA and RNA)
- Exp. 5, 6, 7 Assaying of various enzymes (any three):

- a) Amylases by KI-I2 method.
- b) Phenol oxidase (Potato).
- c) Phosphatases
- d) Urease.
- e) Invertase by GOD/POD and DNSA method.
- f) Proteolytic enzymes (Trypsin or Pepsin).
- g) Lipases (Germinating castor seeds).

Exp.8, 9, 10 Enzyme Kinetics:

- a) Effect of Substrate concentration (Determination of K_m and V_{max}).
- b) Effect of pH and temperature on enzyme activity
- c) Effect of Enzyme inhibitors on enzyme activity

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. Spectrophotometer and/or Colorimeter
8. Incubator
9. Stirrer
10. Centrifuge
11. Vortex

LIST OF REFERENCES

1. Lehninger. Principles of Biochemistry, Nelson & Cox, 4th Edition.
2. Voet & Voet Donald. 3rd Edition. Fundamentals of Biochemistry, J/W.
3. Mathews, Van Holde, Biochemistry, 3rd Edition Pearson Education.
4. Garret and Grisham, Biochemistry, Thomsan Edition, 3rd Edn.
5. U Satyanarayan, Biochemistry, 3rd Edn, Books and Allied Pvt. Ltd.
6. Salisbury and Rose, Plant Physiology, 4th Edn, Wadsworth Pub.
7. Arthur M. Lask, Introduction to Protein Science, Oxford publication.
8. Stryer – Biochemistry. W.H. Freeman & Co.

9. Price & Steven, Fundamentals of Enzymology, 3rd Edition
10. Cohn and Stumph. Outline of Biochemistry. Wiley eastern.
11. Creighton, proteins: Structure & Molecular Properties, Freeman Pub.
12. Zube's Biochemistry. 4th Edition Macmillan.
13. Switzer and Garrity. Experimental Biochemistry WH Freeman. 2nd Edition
14. Hames and Hooper. 2000. Instant notes in Biochemistry. BIOS Sci. Publ.
15. Smith G. Biotechnology. Cambridge Univ. Press.
16. Geoffrey Cooper. The cell with CD- Rom. Sinauer Assn. Incorp.
17. Elliott & Elliot. 3rd Edition Biochemistry and molecular biology.
18. Seidman and Moore. 2000. Basic laboratory methods for biotechnology. Longman
19. Boyer, Concepts in biochemistry. Thomson
20. A.V.S.S. Rama Rao, A Text book of Biochemistry, UBS Publisher
21. S.R. Thimmaiah, Standard methods in Biochemical Analysis, Kalayani Pub.
22. Sawhney and Randhir Singh, Introductory Practical Biochemistry, Narosa Pub.
23. Beedu Sashidar Rao & Vijay Deshpande, Experimental Biochemistry, I K Int. Pvt. Ltd.
24. Plumner. An introduction to practical Biochemistry, 3rd Edition
25. J. Jayaraman. Lab Manual in Biochemistry.
26. Biotechnology, U. Satyanarayan, Books and Allied
27. Practical manuals of Biotechnology, S. Chand

P.S. The above reference book list are common for all the unit

Annexure – “C”

FACULTY OF SCIENCE**Syllabus**

Subject: **BIOTECHNOLOGY**

Course (Paper) Name & No.: Environmental Biotechnology and Biostatistics (BT-401)

Course (Paper) Unique Code: 1603 1800 0104 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	04	Core	7	30	70	50	150

Course Objective:

- To bring the awareness about environment and use of biotechnology to solve problems related to biodiversity and pollution
- To understand the fundamentals of terrestrial and marine ecosystem
- To understand the concept of biodegradation and role of bacteria in metabolism of xenobiotics
- To study the properties of waste water and techniques to treat waste water
- To study concepts of statistics and its applications in the biotechnology

**COURSE STRUCTURE FOR UG PROGRAMME
BIOTECHNOLOGY- 401
SEMESTER-IV**

Sem	Course	Title	Hours /week	Credit	Exam duration	Internal marks	External Marks	Total Marks
IV	BT-401 (Theory)	Environmental Biotechnology and Biostatistics	6	4	2.5hrs	30	70	100
IV	BT-401 (Practical)	Environmental Biotechnology and Biostatistics	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)

SKELETON OF THEORY EXAMINATION PAPER -EXTERNAL

(SEMESTER –IV)

SECTION – I		Marks – 20	
<p>Ques. 1 Attempt the following Multiple Choice Questions in the given time period</p> <p>(The questions will be of Justification based MCQ, each carrying one mark. All the units will be covered in this section.)</p>			
SECTION – II		Marks – 50	
Que.1	Answer specifically- (attempt any three out of six)	Units 1 to 5	3x2= 6 Marks
	Short Questions - (attempt any three out of six)	Units 1 to 5	3x3= 9 Marks
	Answer in detail – (attempt any two out of five)	Units 1 to 5	5x2= 10 Marks
Que.2	Answer specifically- (attempt any three out of six)	Units 1 to 5	3x2= 6 Marks
	Short Questions - (attempt any three out of six)	Units 1 to 5	3x3= 9 Marks
	Answer in detail – (attempt any two out of five)	Units 1 to 5	5x2= 10 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-401–ENVIRONMENTAL BIOTECHNOLOGY AND BIostatISTICS

(THEORY)

Unit 1:- Ecosystem and its component (credit-0.8)

- 1.1 Terrestrial Biomes: - Deserts, Grasslands, Tundra & Forests and Aquatic Biomes: Freshwater & Saline Ecosystem
- 1.2 Biogeochemical Cycles: Nitrogen, Carbon & Sulfur cycle
- 1.3 Biodiversity: - Factors affecting biodiversity, Biodiversity conservation
- 1.4 Interaction within, between & among populations
- 1.5 Population Ecology, Population characteristics, Models of population growth and Interactions

Unit 2:- Environmental pollutions and its remedies (credit-0.8)

- 2.1 Diversity of metabolic processes among bacteria
- 2.2 Overview: Biodegradation of Hydrocarbon & Xenobiotics
- 2.3 Biodegradation of DDT, Nitrobenzene
- 2.4 An overview of process of Bioremediation & Biomagnification
- 2.5 Conventional Air Pollutants & Acid rain & Acid mine drainage

Unit 3:- Microbial Application in Environment (credit-0.8)

- 3.1 Physical, Chemical & Biological properties of water and waste-water
- 3.2 Primary, Secondary and Tertiary treatment processes
- 3.3 Treatment of solid wastes (Anaerobic digestion and composting)
- 3.4 Biofertilizers and Biocontrol
- 3.5 Bioleaching and Bioplastics

Unit 4:- Biostatistics - 1 (credit-0.8)

- 4.1 Scope and applications of Biostatistics
- 4.2 Samples and population concept, Collection, Processing and Presentation of data
- 4.3 Frequency distribution
- 4.4 Measures of Central tendency- Arithmetic, Harmonic and Geometric Mean, Mode and Median, their applications, merits and demerits
- 4.5 Measures of dispersion- Range, Variance, Standard Deviation, Coefficient of Variance, their applications, merits and demerits

UNIT:-5 Biostatistics - 2 (credit-0.8)

- 5.1 Correlation analysis and Regression analysis: Linear, Bivariate regression analysis
- 5.2 Probability and Conditional probability, Theoretical distributions- Binomial and Poisson distribution and their Properties; Normal distribution and its properties, Skewness and kurtosis
- 5.3 Student's t-test- introduction and application in biology
- 5.4 Chi square test- introduction and application in biology
- 5.5 Analysis of variance- introduction and application in biology

LIST OF PRACTICALS

- Exp. 1. Physical parameters of waste water (Color, Turbidity, Odor, pH,TS, TDS and TSS Estimation)
- Exp. 2. $\text{NH}_4\text{-N}$ Estimation
- Exp. 3. $\text{NO}_2\text{-N}$ Estimation and $\text{NO}_3\text{-N}$ Estimation
- Exp. 4. Chloride Estimation
- Exp. 5. Ca-Mg Hardness
- Exp. 6. Phosphorus Phosphate Estimation
- Exp. 7. Dissolved oxygen (DO)
- Exp. 8. Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD)
- Exp. 9. Bacteriological analysis by MPN technique
- Exp. 10. Biostatistics examples:
- a. Calculation of Mean, Standard Deviation and Coefficient of Variance
 - b. Frequency distribution graphs and curves
 - c. Value of confidence limit for the population mean
 - d. Significant test: Student's t-test for paired and unpaired data
 - e. Chi-square test
 - f. Analysis of variance (ANOVA) - Randomized Block Design (RBD)
 - g. Regression coefficient and Correlation coefficient
- 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. BOD Incubator
8. Autoclave
9. UV Spectrophotometer and Colorimeter
10. COD Apparatus

11. Incubator
12. Stirrer
13. Vortex

LIST OF REFERENCES

1. Jerrold H Zar, Biostatistical analysis, 4th Edition, Pearson Education
2. P.S.S.Sundar Rao, An Introduction to Biostatistics, Eastern Economy Edition.
3. N.Gurumani, An Introduction to Biostatistics, 2nd Edition, MJP Publisher.
4. Saras Publication, Biostatistics applications
5. Wayne W. Daniel, Biostatistics: a foundation for analysis in the health sciences. Wiley & Sons
6. Manoj Tiwari & Kapil Khulbe, Environmental studies, IK International
7. Bimal Bhattacharya & Rintu Banerjee, Environmental Biotechnology, Oxford Pub.
8. H.R. Singh, Environmental Biology, S. Chand Pub.
9. P.D. Sharma, Environmental Microbiology, Narosa Pub.
10. Nuzhat Ahmed, Industrial And Environmental Biotechnology, Horizon press
11. S.K. Agrawal, Advanced Environmental Biotechnology, APH pub.
12. Gareth M. Evans & Judith C. Furlong, Environmental Biotechnology, Wiley pub.
13. K. Omasa, Pollution & Plant Biotechnology, Springer IntEdn
14. Indu Shekhar Thakur, Environmental Biotechnology, IK International
15. William P. Cunningham, Environmental Science, McGraw Hill
16. Pradipta Kumar Mohapatra, Textbook of Environmental Biotechnology, IK Int.
17. A. Mackenzie, Instant notes in Ecology, Viva books Pvt Ltd
18. Rajvaidhya, Environmental Biochemistry, APH Pub
19. Ahmed, Industrial & Envi. Biotech, Horizon
20. Bitton, Wastewater Microbiology - 2 ed, Wiley
21. Purohit Shammi, Environmental Sciences, Student Edi
22. Eugene Odum, Ecology, Oxford
23. Gerba & Pepler, Environment microbiology
24. Hammer. Water and Wastewater technology. Prentice-Hall.
25. APHA. Water and Wastewater analysis.
26. Scragg, A. H. 1999. Environ. Biotechnology. Longman.
27. Rittman & Mc Carthy. Environ. Biotechnology. Principles & application. McGraw-Hill.

28. N.P.Cheremisinoff. 1999. Biotechnology for waste and wastewater treatment. Noyes Pub.
29. Michael Heal. (Ed). Environ monitoring &biodiagnostics of hazardous Contaminants.
30. Milton, Wainwright. 1999. An Introduction to Environ. Biotechnology. Kluwer Academy.

P.S. The above reference book list are common for all the unit