SAURASHTRA UNIVERSITY, RAJKOT

(Faculty of Science)

COURSE STRUCTURE & SYLLABUS
FOR
UNDERGRADUATE PROGRAMME
IN
BIOTECHNOLOGY

(CORE COURSE FOR SEMESTER I & II)

As per Choice Based Credit System (CBCS)
Recommended by
University Grant Commission (UGC)
Government of India, New Delhi)

Effective from June - 2010
Preface

Updating and revision of the Curriculum at regular interval of time is a prime criterion of IQAC – NAAC and prime need for the college educational systems affiliated to Universities. University Grants Commission has advocated the implementation of **Choice Based Credit System** in undergraduate and post graduate levels for better teaching learning process and evaluation of the candidate.

Biotechnology refers to the use of living organisms or the products of these organisms to modify 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 rather new science, the processes used today have their basis in 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 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 etate 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: 21-04-2010**
## SKELETON OF COMPLETE COURSE CONTENT OF UNDER GRADUATE BIOTECHNOLOGY

### SEMESTER I - to VI

<table>
<thead>
<tr>
<th>SEMESTER</th>
<th>PAPER NO. &amp; CODE</th>
<th>TITLE OF THE PAPER</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>BT-101 (Theory)</td>
<td>Introduction to Biotechnology and Cell Biology</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>BT-101 (Practical)</td>
<td>-do-</td>
<td>3</td>
</tr>
<tr>
<td>II</td>
<td>BT-201 (Theory)</td>
<td>Fundamentals of Biochemistry, Biocomputing and Biostatistics</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>BT-201 (Practical)</td>
<td>-do-</td>
<td>3</td>
</tr>
<tr>
<td>III</td>
<td>BT-301 (Theory)</td>
<td>Basic aspects of cellular metabolism</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>BT-301 (Practical)</td>
<td>-do-</td>
<td>3</td>
</tr>
<tr>
<td>IV</td>
<td>BT-401 (Theory)</td>
<td>Environmental Biotechnology</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>BT-401 (Practical)</td>
<td>-do-</td>
<td>3</td>
</tr>
<tr>
<td>V</td>
<td>BT-501 (Theory)</td>
<td>Bioprocess and Biochemical Engineering</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>BT-501 (Practical)</td>
<td>-do-</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>BT-502 (Theory)</td>
<td>Genetics and Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>BT-502 (Practical)</td>
<td>-do-</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>BT-503 (Theory)</td>
<td>Immunology</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>BT-503 (Practical)</td>
<td>-do-</td>
<td>3</td>
</tr>
<tr>
<td>VI</td>
<td>BT-601 (Theory)</td>
<td>Principles of Biotechnology Applied to Plants and Animals</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>BT-601 (Practical)</td>
<td>-do-</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>BT-602 (Theory)</td>
<td>Analytical Techniques in Biotechnology</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>BT-602 (Practical)</td>
<td>-do-</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>BT-603 (Theory)</td>
<td>Advanced Molecular Techniques and Bioinformatics</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>BT-603 (Practical)</td>
<td>-do-</td>
<td>3</td>
</tr>
</tbody>
</table>
COURSE STRUCTURE FOR UG PROGRAMME

BIOTECHNOLOGY - 101

SEMESTER - I

<table>
<thead>
<tr>
<th>Semester</th>
<th>Course</th>
<th>Title</th>
<th>Hours/week</th>
<th>Credit</th>
<th>Exam hours</th>
<th>Internal marks</th>
<th>External marks</th>
<th>Total marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>BT-101</td>
<td>Introduction to Biotechnology and Cell Biology</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>25</td>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>I</td>
<td>BT-101 (Practical)</td>
<td>Introduction to Biotechnology and Cell Biology</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td>Nil</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

Total credits 7
Total marks 100

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 practicals/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 75 marks. There will be 25 marks for internal evaluation and 50 marks for external evaluation. Each practical paper/semester will be of 25 marks.
7. So, total marks of theory and practical for each paper will be 100 i.e. 75 + 25 = 100
Skeleton of Theory Examination Paper - External

(SEMESTER – I)

<table>
<thead>
<tr>
<th>SECTION - I</th>
<th>Marks – 1x30 = 30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ques. 1</td>
<td>Attempt the following Multiple Choice Questions in the given time period</td>
</tr>
<tr>
<td>(The questions will be of MCQ type each carrying one mark. All the units will be covered in this section.)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECTION - II</th>
<th>Marks – 40</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ques.1</td>
<td>Answer specifically- (attempt any three out of six)</td>
</tr>
<tr>
<td>Short Questions - (attempt any three out of six)</td>
<td>Units 1 to 5</td>
</tr>
<tr>
<td>Answer in detail – (attempt any one out of three)</td>
<td>Units 1 to 5</td>
</tr>
<tr>
<td></td>
<td>3x2= 6 Marks</td>
</tr>
<tr>
<td></td>
<td>3x3= 9 Marks</td>
</tr>
<tr>
<td></td>
<td>5x1= 5 Marks</td>
</tr>
<tr>
<td>Ques.2</td>
<td>Answer specifically- (attempt any three out of six)</td>
</tr>
<tr>
<td>Short Questions - (attempt any three out of six)</td>
<td>Units 1 to 5</td>
</tr>
<tr>
<td>Answer in detail – (attempt any one out of three)</td>
<td>Units 1 to 5</td>
</tr>
<tr>
<td></td>
<td>3x2= 6 Marks</td>
</tr>
<tr>
<td></td>
<td>3x3= 9 Marks</td>
</tr>
<tr>
<td></td>
<td>5x1= 5 Marks</td>
</tr>
</tbody>
</table>

General Instructions:

1) Time duration of each Theory Paper will be of Three (3) Hrs.
2) Total Marks of each Theory Paper will be 70 Marks.
3) There will be TWO Sections in Question Paper. **Section ONE** will be of Objective type Questions while **Section TWO** will be Descriptive. There will be TWO Questions in this section with internal option.
4) Section ONE will be of 30 Marks and Section TWO of 70 marks.
5) Both the Sections are compulsory and all questions in Section TWO are compulsory.
6) Both the sections are to be written in the separate answer sheet.
**Skeleton & Question Paper for Practical Examination**

(SEMESTER – I)

**SECTION- I: EXAMINER –I**

(EXTERNAL)

<table>
<thead>
<tr>
<th>Ex. No.</th>
<th>Detail of Exercise</th>
<th>Marks</th>
<th>Day of exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Perform Gram/Capsule/Spore/Cell wall staining of the given culture</td>
<td>07</td>
<td>1st Day</td>
</tr>
<tr>
<td>2</td>
<td>Certified Journal Submission</td>
<td>03</td>
<td>1st Day</td>
</tr>
<tr>
<td>3</td>
<td>Viva-voce</td>
<td>02</td>
<td>1st Day</td>
</tr>
</tbody>
</table>

**Total Marks** 12

**SECTION- II: EXAMINER –II**

(INTERNAL)

<table>
<thead>
<tr>
<th>Ex. No.</th>
<th>Detail of Exercise</th>
<th>Marks</th>
<th>Day to begin the exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>07 Division of Ocular Micrometer coincides with  division of stage micrometer. Let division of the Ocular Micrometer measures the object. Find the final size of the object OR Check the cell density of given sample by using Haemocytometer</td>
<td>07</td>
<td>1st Day</td>
</tr>
<tr>
<td>2</td>
<td>Spotting</td>
<td>04</td>
<td>1st Day</td>
</tr>
<tr>
<td>3</td>
<td>Viva-voce</td>
<td>02</td>
<td>1st Day</td>
</tr>
</tbody>
</table>

**Total Marks** 13

**Instructions to the candidates**

1. All the students have to remain present at the examination centre 15 minutes before the scheduled time for examination.
2. Students have to carry with them certified journal, I-card or examination receipt, and other necessary requirements for examination.
3. Candidate should not leave the laboratory without the permission of examiner.
4. Use of calculator is allowed but the use of mobile phones is strictly prohibited.
5. The candidate has to leave the laboratory only after the submission of all the answer sheets of the exercises performed.
BT-101- Introduction to Biotechnology and Cell Biology
(THEORY)

Unit-1: INTRODUCTION AND SCOPE OF BIOTECHNOLOGY
(Teaching Hrs. –12, Total Credit– 0.8)
1.1 Historical Perspective
1.2 Definitions of Biotechnology
1.3 Applications of Biotechnology- Agriculture, Medicine & Environment
1.4 Ethical and Social Impacts
1.5 Current Status of Biotechnology and Future of Biotechnology in Developing World.

NIT-2: BASIC CONCEPT AND UNDERSTANDING OF CELL
(Teaching Hrs. –12, Total Credit– 0.8)
2.1 Concept Of Life, Cell As A Basic Unit Of Living System and Cell Theory
2.2 Origin and Evolution of Cell
2.3 Diversity of Cell Size and Shape
2.4 Classification, Structure and Function of Prokaryotic cell
2.5 Microscopic Techniques for Study of Cell

UNIT-3: STRUCTURE AND FUNCTION OF CELL ORGANELLES
(Teaching Hrs. –12, Total Credit– 0.8)
3.1 Cell Wall and Plasma Membrane
3.2 Cytoskeleton
3.3 Mitochondria, Chloroplast, Endoplasmic Reticulum, Golgi Bodies
3.4 Lysosomes, Glyoxisomes, Peroxisomes, Ribosomes
3.5 Nucleus

UNIT-4: CELL CYCLE AND CELL DIVISION
(Teaching Hrs. –12, Total Credit– 0.8)
4.1 Overview of Cell Cycle
4.2 Mitosis and Meiosis
4.3 DNA Packaging (Prokaryotic and Eukaryotic)
4.4 Structure and Ultrastructure of Chromosome
4.5 Polytene and Lampbrush Chromosomes
UNIT-5:- ADVANCE STUDIES IN CELL BIOLOGY

(Teaching Hrs. –12, Total Credit— 0.8)

5.1 Cell Locomotion – Amoeboid, Flagella, Cilia, Cytoplasmic Streaming
5.2 Cell – Cell Interaction
5.3 Cellular Basis of Development – Gametogenesis, Fertilization, Events during Fertilization, Early Embryonic Development.
5.4 Overview of Stem cells
5.5 Cancer Biology
BT-101- Introduction to Biotechnology and Cell Biology
(PRACTICAL)

- **Practical hrs.-3hrs/day for 2 days/Week.**
- **Total credit- 3**
- **Total 6 hrs./week**

LIST OF PRACTICALS

Exp.1. Introduction to LAB and lab environment
Exp.2. Pipetteman use and calibration
Exp.3. Use of top-loading balances, analytical balances and double pan balances
Exp.4. Using and writing standard experimental protocols; Flow chart
Exp.5. Preparation of solution
Exp.6. Preparation of buffer solution
Exp.7. Operation of pH meter and measurement of pH
Exp.8. Staining techniques (Simple, Differential and Special)
Exp.9. Calibration of stage and ocular micrometer and measurement of given biological samples
Exp.10. Use of Haemocytometer and determination of cell densities (Blood cells/Yeast)
Exp.11. Cytology and histology of various organs (Permanent slides or fresh preparation)
Exp.12 Cell types of plants – maceration of various tissues and identification of Xylem, vessels, trachieds, stomata, root hair
Exp.13. Preparation of permanent slides showing different stages of cell division – Mitosis and meiosis
Exp.14. Human Karyotyping
LIST OF REFERENCES

6. Glick, Molecular Biotechnology, ASM Publication.
8. C.B. Powa, Cell Biology, Himalaya Press.
16. Essential Biology (3rd Edition), Campbell, Reece & Simon,
17. De Robertis, Cell Biology
18. Biotechnology Fundamental & application, S.S. Purohit, Agrobios
19. Analyzing Chromosome, B. Czepulkowski, BIOS Scientific Publishers Ltd
24. Biotechnology, U. Satyanarayan, Books and Allied
### 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 75 marks. There will be 25 marks for internal evaluation and 50 marks for external evaluation. Each practical paper / semester will be of 25.
7. Marks. So, total marks of theory and practical for each paper will be 100 i.e. 75 + 25 = 100)
### General Instructions:

1) Time duration of each Theory Paper will be of Three (3) Hrs.

2) Total Marks of each Theory Paper will be 70 Marks.

3) There will be TWO Sections in Question Paper. **Section ONE** will be of Objective type Questions while **Section TWO** will be Descriptive. There will be TWO Questions in this section with internal option.

4) Section ONE will be of 30 Marks and Section TWO of 70 marks.

5) Both the Sections are compulsory and all questions in Section TWO are compulsory.

6) Both the sections are to be written in the separate answer sheet.
Skeleton & Question Paper for Practical Examination

SEMESTER – II

SECTION- I: EXAMINER –I
(EXTERNAL)

<table>
<thead>
<tr>
<th>Ex. No.</th>
<th>Detail of Exercise</th>
<th>Marks</th>
<th>Day of exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Estimation of reducing sugar/ non reducing sugar OR Qualitative tests for carbohydrate</td>
<td>07</td>
<td>1st Day</td>
</tr>
<tr>
<td>2</td>
<td>Certified Journal Submission</td>
<td>03</td>
<td>1st Day</td>
</tr>
<tr>
<td>3</td>
<td>Viva-voce</td>
<td>02</td>
<td>1st Day</td>
</tr>
<tr>
<td></td>
<td><strong>Total Marks</strong></td>
<td><strong>12</strong></td>
<td></td>
</tr>
</tbody>
</table>

SECTION- II: EXAMINER –II
(INTERNAL)

<table>
<thead>
<tr>
<th>Ex. No.</th>
<th>Detail of Exercise</th>
<th>Marks</th>
<th>Day to begin the exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Solve biostatistics questions (mean/standard deviation/ regression coefficient/ correlation coefficient)</td>
<td>07</td>
<td>1st Day</td>
</tr>
<tr>
<td>2</td>
<td>Spotting</td>
<td>04</td>
<td>1st Day</td>
</tr>
<tr>
<td>3</td>
<td>Viva-voce</td>
<td>02</td>
<td>1st Day</td>
</tr>
<tr>
<td></td>
<td><strong>Total Marks</strong></td>
<td><strong>13</strong></td>
<td></td>
</tr>
</tbody>
</table>

Instructions to the Candidates

1. All the students have to remain present at the examination centre 15 minutes before the scheduled time for examination.
2. Students have to carry with them Certified journal, I-card or examination receipt, and other necessary requirements for examination.
3. Candidate should not leave the laboratory without the permission of examiner.
4. Use of calculator is allowed but the use of Mobile phones is strictly prohibited.
5. The candidate has to leave the laboratory only after the submission of all the answer sheets of the exercises performed.
BT-201- Fundamentals of Biochemistry, Biocomputing and Biostatistics

(THEORY)

UNIT 1:- CHEMISTRY OF LIFE: AN INTRODUCTION

(Teaching Hrs. –12, Total 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

UNIT 2:- THE MOLECULES OF LIFE – I

(Teaching Hrs. –12, Total Credit– 0.8)

2.1 Chemistry of Carbohydrates: Functions And Classifications, Monosaccharides: Configuration and Conformation, Reactions of Monosaccharides, Sugar Derivatives
2.2 Disaccharides and Polysaccharides: Classifications and Functions
2.3 Glycoconjugates: Proteoglycans, Glycoproteins and Glycolipids
2.4 Amino Acids: Structures, General Properties, Classifications, Nomenclature, Nonstandard Amino Acid (Amino Acid Derivatives)
2.5 Proteins: An Overview of Four Levels of Structures in Proteins, Classifications of Proteins, Properties of Proteins, Biologically Important Peptides

UNIT 3:- THE MOLECULES OF LIFE – II

(Teaching Hrs. –12, Total Credit– 0.8)

3.1 Lipids: Classifications of Lipids, Functions of Lipids, Fatty Acids, Triacylglycerols, Phospholipids, Steroids
3.2 Basic Understanding of Nucleotides, Structure and Properties of Nitrogen Basis, Functions of Nucleotides, Nucleotide Analogs
3.3 Nucleic Acids: Historical aspects of DNA as Genetic Material, Semi Conservative Nature of DNA, Chargaff’s Rule
3.4 Watson and Crick DNA Double Helix Structure, other Types of DNA Structure, Denaruration and Renaturation of DNA, Types of RNA and their Functions, Catalytic RNAs (Ribozymes)

3.5 Vitamins: Classification, Functions, Sources and Deficiency Disorder

UNIT 4 BIOCOMPUTING

(Teaching Hrs. –12, Total Credit– 0.8)

4.1 Computer Applications: Structure of computer (components, peripherals, use, types); the window screen and parts of window, the control panel

4.2 Creation of a drawing, use of window explorer, word processor use, spreadsheet use, Database use, presentation use

4.3 Internet, email and web authoring: setup of email address, Concept of domain, understanding the terms, http, www, URL, book marking web sites, forwarding and saving web pages.

4.4 Basics of HTML, page creation and design using HTML

4.5 Inserting tables and images into WebPages, understanding PDF files, Multimedia usage

UNIT:-5 BIOSTATISTICS

(Teaching Hrs. –12, Total Credit– 0.8)

5.1 Scope of Biostatistics, Samples and population concept, Collection of data- sampling techniques, Processing of data, Presentation of data

5.2 Measures of Central tendency- Arithmetic, Harmonic and Geometric mean, Mode and Median, their applications, merits and demerits; Measures of dispersion- Range, Variance, Standard Deviation, Coefficient of Variance, their applications, merits and demerits

5.3 Correlation analysis and Regression analysis: Linear, Bivariate regression analysis

5.4 Probability and Conditional probability, Theoretical distributions-Binomial and Poisson Distribution and their Properties; Normal distribution and its properties, Skewness and kurtosis

5.5 Significance tests: The meaning of significance, Hypothesis testing, Student’s t-test, Chi square test (nonparametric test), Analysis of variance- introduction and application in biology, one-way and two-way ANOVA, Calculation of F-Ratio, least significant difference.
BT-201- Fundamentals of Biochemistry, Biocomputing and Biostatistics  
(PRACTICAL)

- Practical hrs.-3hrs/day for 2 days/Week.
- Total credit- 3
- Total 6 hrs./week

LIST OF PRACTICALS

Exp.1 Qualitative tests for carbohydrates
Exp.2 Qualitative tests for Amino acids
Exp.3 Titration curve of amino acids and determination of pI, pK1 and pK2.
Exp.4 Estimation of reducing and non reducing sugars
Exp.5 Estimation of amino acids
Exp.6 Introduction to Window operating system
Exp.7 Overview of window accessories
Exp.8 Use and application of Word-2000
Exp.9 Excel and Power Point-2000
Exp.10 Basics of Internet working
Exp.11 Concept of multimedia and web-paging
Exp.12 Arrangement of data in tabulate format
Exp.13 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
LIST OF REFERENCES

4. Jiang, Xu & Zhang, Current topics in Computational Molecular Biology, Ane Books
5. Gary B. Fogel & David Corne, Evolutionary Computation in Bioinformatics, Morgan, Kaufmann Publishers
7. Rajaraman, Computer oriented Numerical Methods, Pentice Hall India.
8. Stallings, Computer Organization & Architecture, Pentice Hall India.