



# Syllabus

## First Semester Courses in

### BSc (Biotechnology and Computational Biology)

### 2025-2026

#### Contents:

- Syllabus for Core Courses
  - USBTY4501CR1 From Cells to Systems: Biotechnology & Computational Biology
  - USBTY4501CR1PR Practical Insights: Cell, Biotech & Computational Biology
  
- Evaluation and Assessment guidelines

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*Shinde*

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MUMBAI - 400 001.

<b>FYBSc in Biotechnology and Computational Biology</b>		
<b>Course Title: From Cells to Systems: Biotechnology &amp; Comp Biology</b>		
<b>Course Code: USBTY4501CR1</b>		
Credits 4: Theory (3) = 45 hr		
<b>No.</b>	<b>Course Objectives</b>	
	<ol style="list-style-type: none"> <li>1. This course aims to provide a comprehensive understanding of cell biology, biotechnology, and computational biology.</li> <li>2. Students will explore the origin, evolution, and classification of cells, examining the ultrastructure of both prokaryotic and eukaryotic cells.</li> <li>3. The course will also cover the history, branches, and applications of biotechnology across various fields, along with global trends and relevant case studies and the interdisciplinary nature of computational biology, focusing on the analysis of biological data, including genomics, drug discovery, and ethical considerations, while exploring its practical applications in modern science.</li> </ol>	
<b>CO</b>	<b>Course Outcomes</b> <b>On completing the course, the learner will be able to</b>	<b>Bloom's Taxonomy Level (BT level)</b>
1	Explain the origin of life, evolution, classify cell types, and understand cell ultrastructure and biological organization.	Remembering
2	Describe and analyze the practical applications of biotechnology across various sectors, including diagnostics, therapeutics, food security, agriculture, industry, and the environment	Understanding
3	describe computational biology's interdisciplinary nature, historical milestones, and real-world applications like drug discovery, genomics, and other fields	Understanding
4	Students will gain an understanding of key concepts and applications in the field and explore career opportunities in the field.	Applying

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**Unit 1 Cell as a basic unit of living systems (15 lectures)**

- Origin of Life, Chemical and Biological Evolution, Discovery of cell and Cell Theory; broad classification of cell types, : archaeobacteria, PPLOs, Prokaryotic and Eukaryotic cell- plant cell, animal cell, bacterial cell and viruses
- Ultrastructure of Prokaryotic Cell
- Ultrastructure of Eukaryotic Cell and organelles

**Unit 2 Introduction to Biotechnology (15 lectures)**

- History and scope of Biotechnology, Branches of Biotechnology.
- Applications of Biotechnology in Diagnostics, Therapeutics, food security, Agriculture, industry and environment .
- Trends in Global Biotechnology Research.
- Relevant Case studies.

**Unit 3 Introduction to Computational Biology (15 lectures)**

- Concept of Computational Biology, Interdisciplinary nature
- Biological Data and Its Analysis - DNA as digital data
- Introduction to Algorithms in Biology - What are algorithms? How do they solve problems? examples of simple algorithms
- Applications of Computational Biology
- Future and Career in Computational Biology

List Of Recommended Reference Books

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). *Molecular biology of the cell* (6th ed.). Garland Science.
2. Hogeweg P. (2011). The roots of bioinformatics in theoretical biology. *PLoS computational biology*, 7(3), e1002021. <https://doi.org/10.1371/journal.pcbi.1002021>
3. Karp, G. (2020). *Cell and molecular biology: Concepts and experiments* (9th ed.). Wiley.
4. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (1993). *Microbiology: Concepts and applications* (5th ed.). McGraw-Hill.
5. Singh, B. D. (2021). *Biotechnology: Expanding horizons* (3rd ed.). Kalyani Publishers.
6. Thieman, W., & Palladino, M. (2019). *Introduction to biotechnology* (Global ed., 4th ed.). Pearson.

**Evaluation (Core Theory): Total marks per course - 100.**

- I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).  
CIA- 40 marks  
CIA 1: Written test -20 marks  
CIA 2: Assignment -20 marks

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- II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).  
 End Semester Examination – 60 marks  
 One question from each unit for 15 marks, with internal choice. Total marks per question with choice -20 to 22.

● **Distribution of Bloom's Taxonomy Levels for the Course Assessment**

Units	Remembering	Understanding	Analyzing And Application	Evaluation and Creation
*Percentage	20-30%	40%	30%	NA

<b>Course Title: Practical Insights into Cell Biology, Biotech, and Bioinformatics</b>		
<b>Course Code: USBTY4501CR1PR</b>		
Credits 1: Practical = 30 hr		
	<b>Course Objectives</b>	
	<ol style="list-style-type: none"> <li>To equip students with practical skills in observing and analyzing cell structures using staining techniques and light microscopy</li> <li>To provide students with a comprehensive understanding of key technological advancements, policies, and real-world applications through case studies, institutional mapping, and industry visits</li> <li>To introduce students to computational biology data and tools for exploring different fields.</li> </ol>	
<b>CO</b>	<b>Course Outcomes</b> <b>On completing the course, the learner will be able to</b>	<b>Bloom's Taxonomy Level (BT level)</b>
1	Perform cell staining and microscopy techniques, visualization and identify the cell types and organelles	Understanding and Apply
2	Gain the ability to create visual timelines of biotechnological breakthroughs, discuss case studies on biotechnology fields	Understanding

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3	Demonstrate the ability to navigate the biological data resources to extract valuable insights into gene functions, protein structures, and their applications in research.	Apply
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**Content**

***Cell Biology in Practice:***

- Use of Compound Microscope
- Temporary mounts of onion epidermal cells and cheek epithelial cells
- Monochrome staining of bacteria and yeast
- Study of prokaryotic cell and its components
- Study of ultrastructure of cells , Study of plant and animal tissues (permanent slides)

***Insights into Biotechnology:***

- Case studies
- Institution Mapping
- Local visit to a biotech lab, agricultural research center, or industry to observe real-world applications

***Insights into Computational Biology:***

- Exploration of data resources : Biodiversity data resources and Human Genome Project Database/s
- Genome, gene and protein data/database exploration
- Identifying Proteins Encoded by DNA
- AlphaFold Protein Structure Database

**Evaluation of (Practical) Total marks Practical course - 50.**

CIA: 20 marks: Viva on performed experiment and Journal.

End Semester Practical Examination – 30 marks.

- **Distribution of Bloom's Taxonomy Levels for the Course Assessment**

Units	Remembering	Understanding	Analyzing And Application	Evaluation and Creation
*Percentage	20-30%	40%	30%	NA

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## Syllabus

# First Semester Courses in - BSc (Biotechnology and Computational Biology) 2025-2026

### Contents:

- Syllabus for Vocational Skill course (VSC)
- USBTY4501VS1 Introduction to Programming: Concepts and Practice
  
- Evaluation and Assessment guidelines

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<b>FYBSc in Biotechnology and Computational Biology</b>		
<b>Course Title Introduction to Programming: Concepts and Practice</b>		
<b>Course Code: : USBTY4501VS1</b>		
Credits 2: Theory (1) = 15 hr and Practical (1) = 30 hr		
<b>No.</b>	<b>Course Objectives</b>	
	<p>This course aims to :</p> <ul style="list-style-type: none"> <li>• Introduce basic programming concepts, languages, syntax, and programming paradigms.</li> <li>• Equip students with skills in data types, operators, control structures, error handling, and file handling.</li> <li>• Enable students to set up development environments, write basic programs, and implement decision-making, loops, and data operations.</li> </ul>	
<b>CO</b>	<b>Course Outcomes</b> <b>On completing the course, the learner will be able to</b>	<b>Bloom's Taxonomy Level (BT level)</b>
1	Recall programming concepts, languages, syntax, semantics, logic, and various programming paradigms.	Remembering
2	gain a clear understanding of how to use data types, operators, control structures, error handling, debugging, and file handling in their code.	Understanding
3	write, run, and troubleshoot basic programs, including arithmetic operations and decision-making, and implement conditional statements, loops, and functions in interactive programs.	Applying
4	Manipulate lists, dictionaries, apply search/sort algorithms, and analyze how to manage and store data.  Read/write text files and debug programs to identify and fix errors effectively.	Analyse

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**Unit 1 Foundations of Programming**

**15 Lectures**

- Introduction to Programming -Programming concept; Types of programming languages (compiled vs. interpreted); Components of a program - Syntax, Semantics, and Logic.;
- Introduction to an IDE; Popular Programming Languages
- Variables, Data Types, and Operators
- Control Structures -Conditional statements ,Loops: for, while Break and continue statements.
- Functions and Modular Programming
- Data Structures
- File Handling
- Debugging and Error Handling

**Unit 2 Programming Practice**

**30 hrs**

- Setting up the development environment.
- Writing programs to perform basic arithmetic operations.
- Implementing conditional expressions with operators.
- Writing programs with decision-making constructs.
- Iterative programs
- Writing user-defined functions.
- Programs for searching and sorting in lists.
- Writing dictionary-based programs
- Programs to read and write text files.
- Debugging given code snippets.

**List of references:**

1. Curran, D., Ferracchiati, F. C., Gilani, S. F., Gillespie, M., Gopikrishna, S., Hart, J., Mathew, B. K., Olsen, A., Pinnock, J., & Titus, T. (2005). Pro .NET 1.1 Remoting, Reflection, and Threading. Apress eBooks.
2. Frenz, C. M. (2002). Visual Basic and Visual Basic .NET for Scientists and Engineers.
3. Goodrich, M. T., Tamassia, R., & Goldwasser, M. H. (2013). Data Structures and Algorithms in Python. In Wiley Publishing eBooks.
4. Graba, J. (1998). Up and running with C++. In Springer eBooks.
5. Sebesta, R. W. (2018). Concepts of Programming Languages.
6. Wilson, K. (2022). The Absolute Beginner's Guide to Python Programming: A Step-by-Step Guide with Examples and Lab Exercises. Apress.

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**Distribution of Bloom's Taxonomy Levels for the Course Assessment**

Units	Remembering	Understanding	Analyzing And Application	Evaluation and Creation
*Percentage	10 %	20 %	55 %	15 %

**Evaluation (VSC): Total marks per course – 50**

- I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).  
CIA- 20 marks
- II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).  
End Semester Examination – 30 marks

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# Syllabus

## First Semester Courses in

### BSc (Biotechnology and Computational Biology)

### 2025-2026

#### Contents:

- Syllabus for Skill Enhancement Course (SEC)
- USBTY4501SE1 Foundations of Computing and Web Technologies
  
- Evaluation and Assessment guidelines

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<b>FYBSc in Biotechnology and Computational Biology</b>		
<b>Course Title: Foundations of Computing and Web Technologies</b>		
<b>Course Code: USBTY4501SE1</b>		
Credits 2: Theory (1) = 15 hr and Practical (1) = 30 hr		
<b>No.</b>	<b>Course Objectives</b>	
	This course provides foundational knowledge of computers and the internet, covering their history, evolution, functionalities, and key components. Learners will develop basic web design skills by creating HTML webpages with interactive elements using JavaScript.	
<b>CO</b>	<b>Course Outcomes</b> <b>On completing the course, the learner will be able to</b>	<b>Bloom's Taxonomy Level (BT level)</b>
1	Identify and-describe the evolution, functionalities, and components of computers, including hardware, memory hierarchy, and internet infrastructure.	Remembering
2	Explain the roles of system and utility software, internet protocols, and services such as web browsing, email, and cloud-based file sharing.	Understanding
3	Identify basic computer components and its assembly, navigate internet tools, and create webpages using HTML and JavaScript to implement interactivity.	Applying
4	Compare and evaluate different types of computers, memory devices, and internet services to determine their suitability for specific tasks and environments.	Analyse

Content

**Unit 1: Introduction to Computers and the Internet**

**15 Lectures**

Computer History and Types of Computers ; Evolution of computers from early machines to modern computing; Functionalities: Input, Processing, Storage, Output; Computer Memory, Motherboard, and Memory Hierarchy ; Role of Buses and Ports: Data transmission and connectivity; Computer Hardware



and Software Basics - system softwares , utility softwares

Web designing and internet : Introduction to the Internet ( Basic concepts and workflow); Internet Infrastructure (Servers: Types and roles; Internet Service Providers; Understanding HTTP, HTTPS); Internet Services (Web browsing, File sharing- FTP and cloud services;, search engines; Internet Addressing - IP addresses, Domain names and URL's

**Unit 2: Practical Basics of Computers and Web Development**

**(30hours)**

- Computer History and Generations
- Demonstration of different types of computers
- Exploring Computer Components
- Demonstrate the types of memory devices
- Identify different ports and their uses in a computer system.
- Explore and navigate popular web browsers
- Install and set up a web development environment
- Create a simple HTML document with essential tags
- Create a webpage with links, images, and lists using basic HTML tags
- Create a simple webpage with a table and form elements
- Introduction to JavaScript: Add interactivity to a webpage by implementing simple scripts

**List of recommended Books:**

- Comer, D. E. (2018). The Internet book: everything you need to know about computer networking and how the Internet works. Chapman and Hall/CRC.
- Hennessy, J. L. (2013). Computer Organization and Design MIPS Edition: The Hardware/Software Interface (The Morgan Kaufmann Series in Computer Architecture and Design) PDF.
- Rajaraman, V., & Adabala, N. (2014). Fundamentals of computers. PHI Learning Pvt. Ltd.
- Rawal, B. S., Manogaran, G., & Peter, A. (2022). Networking All-In-One for Dummies. In Cybersecurity and Identity Access Management (pp. 63-86). Singapore: Springer Nature Singapore.

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• **Distribution of Bloom's Taxonomy Levels for the Course Assessment**

Units	Remembering	Understanding	Analyzing And Application	Evaluation and Creation
*Percentage	15 %	25 %	40 %	10 %

**Evaluation (SEC): Total marks per course – 50**

- I. Formative Assessment 'for' Learning (continuous internal assessment - CIA to improve learning).  
CIA- 20 marks
- II. Summative Assessment 'of' Learning (focus on outcomes, quantitative data for outcomes of instruction).  
End Semester Examination – 30 marks

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