



**R. E. Society's
R.P. Gogate College of Arts & Science and
R.V. Jogalekar College of Commerce
(Autonomous), Ratnagiri**

**Syllabus for
S. Y. B. Sc. Biotechnology Programme
Semester III and IV**

Under Choice Based Credit System (CBCS)

**To be implemented from the Academic Year
2024 - 2025**

**Bachelor of Science (B.Sc.) in Biotechnology Programme
Under Choice Based Credit System (CBCS)
Course Structure**

S. Y. Biotechnology

(To be implemented from Academic Year 2024-25)

Course Code	Semester III	Credits	Course Code	Semester IV	Credits
	Discipline Specific Course (DSC)			Discipline Specific Course (DSC)	
	Major			Major	
USBT301	Genetics	02	USBT401	Molecular Biology	02
USBT302	Immunology	02	USBT402	Bioprocess Technology	02
USBT303	Physiology	02	USBT403	Medical Microbiology	02
USBT304	Biotechnology Practical III	02	USBT404	Biotechnology Practical IV	02
	Minor			Minor	
USBT305	Applied Chemistry – I	02	USBT405	Applied Chemistry – III	02
USBT306	Applied Chemistry – II	02	USBT406	Applied Chemistry – IV	02
	Generic / Open Elective			Generic / Open Elective	
	Any one course from Open Elective Basket	02		Any one course from Open Elective Basket	02
	Any one course from Open Elective Basket	02			
	Skill Enhancement Course (SEC)			Vocational Skill Course (VSC)	
USBT307	Molecular Diagnostics	02	USBT407	Bioinformatics	02
			USBT408	Field Project (FP)/ Community Engagement Programme (CEP)	02

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Genetics
Class	S. Y. B. Sc.
Semester	III
Course Code	USBT301
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Major: Mandatory

Course Outcomes:

By the end of the course, the student will be able to:

CO1 - Develop an understanding of fundamental concepts of Mendelian genetics.

CO2 - Discuss the different processes in microbial genetics and their role in mapping genes.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Genetics Fundamentals	<p>Introduction to genetic and sub-disciplines of genetics: Transmission genetics, Molecular genetics, Population genetics and Quantitative genetics.</p> <p>Basic Terminologies in genetics Mendelian Genetics: Monohybrid Crosses and Mendel's Principle of Segregation. Representing crosses with a Branch Diagram. Confirming the principle of Segregation: The use of Test crosses. Dihybrid crosses and Mendel's Principle of Independent Assortment.</p> <p>Extensions of and Deviations from Mendelian Genetic Principles: Multiple Alleles - ABO Blood groups Modifications of Dominance Relationships: Incomplete Dominance and Codominance. Essential Genes and Lethal Alleles. Effects of the environment on Gene expression.</p> <p>Gene Interactions and Modified Mendelian Ratios: Epistatic and non-epistatic interactions.</p> <p>Mendelian Genetics in Humans: Pedigree Analysis. Examples of Human Genetic Traits</p>
II	Microbial Genetics	<p>Genetic analysis in Bacteria: Prototrophs, Auxotrophs.</p>

		<p>Genetic Mapping in Bacteria by Conjugation: Discovery of Conjugation in <i>E. coli</i>. The sex factor F, High-Frequency Recombination Strains of <i>E. coli</i>. F' Factors. Using conjugation to map bacterial genes- Interrupted-mating</p> <p>Genetic mapping in bacteria by Transformation Genetic mapping in Bacteria by Transduction: Bacteriophages - Lytic and Lysogenic pathway.</p> <p>Transduction Mapping of Bacterial Chromosomes - Generalized Transduction and Specialized Transduction.</p>
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Learning Resources recommended:

1. Russell, P. J., & Gordey, K. (2002). *iGenetics*, San Francisco: Benjamin Cummings.
2. Verma, P. S., & Agarwal, V. K. (2004). *Cell Biology, Genetics, Molecular Biology, Evolution and Ecology: Evolution and Ecology*. S. Chand Publishing.
3. Simmons, M. J., & Snustad, D. P. (2006). *Principles of genetics*. John Wiley & Sons.
4. Russell, P. J. (2000). *Fundamentals of genetics*. Longman Publishing Group.
5. Karp, G. (2009). *Cell and molecular biology: concepts and experiments*. John Wiley & Sons.
6. Strickberger M., *Genetics*. (1995). Australia: Deakin University.

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Genetics Fundamentals	Chalk and Talk, AV resources	15
II	Microbial Genetics	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Genetics Fundamentals	Long Answer	06
Q. 1 B)	I Genetics Fundamentals	Objective	04
Q. 2 A)	II Microbial Genetics	Long Answer	06
Q. 2 B)	II Microbial Genetics	Objective	04
Q. 3	I Genetics Fundamentals and II Microbial Genetics	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Immunology
Class	S. Y. B. Sc.
Semester	III
Course Code	USBT302
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Major: Mandatory

Course Outcomes:

By the end of the course, the student will be able to:

CO1 - To familiarize students with the immune effector mechanisms.

CO2 - To provide the information about cell receptors.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Effectors of Immune Response	Haematopoiesis; Cells of the Immune System; Primary and Secondary Lymphoid Organs. Complement System- Classical, Alternate and Lectin; Regulation and Biological Effects of Complement System; Deficiencies of Complement System
II	Cell Receptors	T-cell Receptor Complex: Structure and Activation. MHC Classes - General Organization and Inheritance; Structures and Peptide Interactions; Class I and II Diversity and Polymorphism; Antigen Presentation - Endocytic and Exocytic Pathways; MHC Restriction. B-cell Receptor : Structure, Maturation and Activation B-T Cell Interaction (B-T cell Cooperation).

Learning Resources recommended:

1. Immunology by Janis Kuby, 5th edition
2. Textbook of Microbiology by Ananthnarayan and Paniker, 8th edition
3. Introduction to immunology by C. V. Rao

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Effectors of Immune Response	Chalk and Talk, AV resources	15
II	Cell Receptors	Chalk and Talk, AV resources	15

Evaluation Pattern:**A) Continuous Internal Evaluation: Maximum Marks: 20**

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Effectors of Immune Response	Long Answer	06
Q. 1 B)	I Effectors of Immune Response	Objective	04
Q. 2 A)	II Cell Receptors	Long Answer	06
Q. 2 B)	II Cell Receptors	Objective	04
Q. 3	I Effectors of Immune Response and II Cell Receptors	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Physiology
Class	S. Y. B. Sc.
Semester	III
Course Code	USBT303
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Major: Mandatory

Course Outcomes:

By the end of the course, the student will be able to:

CO1 - Gain insights into the Physiological Processes of Plants and functions of plant growth regulators.

CO2 - Develop a comprehensive and deep understanding of the vital physiological processes of animals.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Plant Physiology	<p>Photosynthesis: Hill's Reaction and its Significance, Light Reactions, Cyclic and Non-Cyclic Photoinduced Electron Flow, Energetics of Photosynthesis, Dark Phase of Photosynthesis, Calvin Cycle, C-3, C-4, CAM pathways, Rubisco oxygenase activity</p> <p>Plant hormones: Auxin, Gibberellins, Cytokinins, Ethylene, Abscisic acid</p> <p>Introduction to Secondary Metabolites</p>
II	Animal Physiology	<p>Introduction to physiology: Concept of homeostasis.</p> <p>Body fluids: Major types of Body fluid.</p> <p>Blood: Functions of blood, general properties of blood, Composition of blood. Thrombocytes or Platelets. Coagulation of blood. Theories of Coagulation. Haemolysis.</p> <p>Respiratory system: Phases of Respiration, Principle of gases exchange,</p>

		<p>Mechanism of breathing.</p> <p>Digestion and absorption: Mode of nutrition, Digestion: Digestion of foodstuffs, Digestion in humans. Absorption.</p> <p>Excretion: Organs of excretion. Types of excretory products. Excretion in vertebrates - Human</p> <p>Kidney: Structure of kidney, Structure of nephron. Function of kidney. Urine formation. Dialysis</p>
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Learning Resources recommended:

1. Verma, S. K., Verma, M. (2008). A Textbook of Plant Physiology, Biochemistry and Biotechnology. India: S. Chand Limited.
2. Gujral, S. K., Kochhar, S. L. (2020). Plant Physiology: Theory and Applications. United States: Cambridge University Press.
3. Rastogi, S. C. (2007). Essentials of Animal Physiology. India: New Age International (P) Limited, Publishers.
4. Reddy, B. (2014). Text Book of Animal Pyhysiology. Andra Paresh, IMRF Publication.
5. Sembulingam, K. (2008). Essentials of Medical Physiology. India: Juta, Limited.
6. Sherwood, L. (2012). Introduction to Human Physiology. United States: Brooks/Cole.

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Plant Physiology	Chalk and Talk, AV resources	15
II	Animal Physiology	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Plant Physiology	Long Answer	06
Q. 1 B)	I Plant Physiology	Objective	04
Q. 2 A)	II Animal Physiology	Long Answer	06
Q. 2 B)	II Animal Physiology	Objective	04
Q. 3	I Plant Physiology and II Animal Physiology	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Biotechnology Practical III
Class	S. Y. B. Sc.
Semester	III
Course Code	USBT304
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Major: Mandatory

Course Outcomes:

By the end of the course, the student will be able to:

CO1 – To impart knowledge and hands on experience of the various practicals related to Genetics, Immunology and Physiology.

Syllabus:

Unit Title	Sub titles (Learning Points)
Regular and Demonstration Practicals	<ol style="list-style-type: none"> 1. Problems based on Mendelian Genetics, its modifications and gene interactions. 2. Construction of pedigree charts and analysis of Human genetic traits using Pedigree analysis. 3. Preparation of competent cells and demonstration of Bacterial transformation and mapping. 4. Demonstration of Bacterial Conjugation and interrupted mating-based mapping. 5. Demonstration of transduction and mapping. 6. Induction of Polyploidy by PDB treatment using a suitable plant material. 7. To measure the rate of photosynthesis by Winkler's method. 8. Effect of PGRs on seed germination. 9. Solvent extraction of plant pigments and study the absorption spectra of pigments. 10. Effect of different concentrations of sodium chloride on RBC and determination of the concentration isotonic to blood. 11. Study of human blood count (RBC and WBC) using haemocytometer. 12. Estimation of Hemoglobin in human blood. 13. Analysis of Urine. 14. Demonstration of Phagocytosis. 15. Study of bacterial flora of skin (as a physical barrier in innate immunity) by swab method/ Hand imprint method.

Learning Resources recommended:

1. Russell, P. J., & Gordey, K. (2002). IGenetics, San Francisco: Benjamin Cummings.
2. Verma, P. S., & Agarwal, V. K. (2004). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology: Evolution and Ecology. S. Chand Publishing.
3. Simmons, M. J., & Snustad, D. P. (2006). Principles of genetics. John Wiley & Sons.
4. Russell, P. J. (2000). Fundamentals of genetics. Longman Publishing Group.
5. Karp, G. (2009). Cell and molecular biology: concepts and experiments. John Wiley & Sons.
6. Immunology by Janis Kuby, 5th edition
7. Textbook of Microbiology by Ananthnarayan and Paniker, 8th edition
8. Introduction to immunology by C. V. Rao
9. Verma, S. K., Verma, M. (2008). A Textbook of Plant Physiology, Biochemistry and Biotechnology. India: S. Chand Limited.
10. Gujral, S. K., Kochhar, S. L. (2020). Plant Physiology: Theory and Applications. United States: Cambridge University Press.
11. Rastogi, S. C. (2007). Essentials of Animal Physiology. India: New Age International (P) Limited, Publishers.
12. Reddy, B. (2014). Text Book of Animal Pyhysiology. Andra Paresh, IMRF Publication.
13. Sembulingam, K. (2008). Essentials of Medical Physiology. India: Juta, Limited.
14. Sherwood, L. (2012). Introduction to Human Physiology. United States: Brooks/Cole.

Teaching Plan:

Unit Title	Teaching Methods	No. of Lectures
Regular and Demonstration Practicals	Hands on performance, videos, demonstration	60

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Journal	05
Viva	05
Identification/ Genetics Problem	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No.	Type of Experiment	Marks
Q. 1	Major	20
Q. 2	Minor	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Applied Chemistry – I
Class	S. Y. B. Sc.
Semester	III
Course Code	USBT305
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Minor

Course Outcomes:

By the end of the course, the student will be able to:

CO1 – Develop an understanding of the different aspects of Organic Chemistry.

CO2 - Discuss role of Organic Compounds in Biology and Synthesis of Organic Compounds.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Organic Chemistry	Introduction to Types of Organic Reactions: Addition, Elimination and Substitution Reactions. Essential and Non-essential Elements in Biological Systems. Role of Metal Ions in Biological Systems. Metal Coordination in Biological Systems: Enzymes, Apoenzymes and Coenzymes. Biological Role of Metalloenzymes with respect to myoglobins, Haemoglobin. Biological Role of Carboxypeptidases, Catalases and Peroxidases. Structure and Function: Dioxygen Binding, Transfer and Utilization; Metal Complexes in Medicines.
II	Synthesis of Organic Compounds	Synthesis of Organic Compounds: Criteria for Ideal Synthesis; Selectivity and Yield. Linear and Convergent Synthesis and Multicomponent Reactions. Microwave Assisted Organic Synthesis, Ultrasound in Synthesis and Polymer supported Synthesis. Retrosynthesis.

Learning Resources recommended:

1. Bahl, B. S., & Bahl, A. (2017). A textbook of organic chemistry. S. Chand Publishing.
2. Lee, J. D. (2008). Concise inorganic chemistry. John Wiley & Sons.

- Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2013). Fundamentals of analytical chemistry. Cengage learning.
- Vogel, A. I., & Jeffery, G. H. (1989). Vogel's textbook of quantitative chemical analysis. Wiley.
- Mosher, M. (1992). Organic Chemistry. (Morrison, Robert Thornton; Boyd, Robert Neilson).

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Organic Chemistry	Chalk and Talk, AV resources	15
II	Synthesis of Organic Compounds	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Organic Chemistry	Long Answer	06
Q. 1 B)	I Organic Chemistry	Objective	04
Q. 2 A)	II Synthesis of Organic Compounds	Long Answer	06
Q. 2 B)	II Synthesis of Organic Compounds	Objective	04
Q. 3	I Organic Chemistry and II Synthesis of Organic Compounds	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Applied Chemistry – II
Class	S. Y. B. Sc.
Semester	III
Course Code	USBT306
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Minor

Course Outcomes:

By the end of the course, the student will be able to:

CO1 – Develop skills towards preparation of standard solutions in the laboratory and understand the role of buffers.

CO2 – Explore the fundamentals of green chemistry and synthesis.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Water, standard solutions and Buffers	Structure, Properties and functions: Water Preparation of standard solutions: Concept and significance of chemical and biological solutions. Normality, Molarity, Molality, Mole fraction, Mole concept, Solubility, Weight ratio, Volume ratio, Weight to Volume ratio, ppb, ppm, millimoles, milliequivalents (Numericals expected). Primary and secondary standards: Preparation of standard solutions, Principle of volumetric analysis. Concept of pH: Buffer solutions – Concept of Buffers, Derivation of Henderson – Hasselbalch equation for acidic and basic buffers. Buffering capacity. Biological buffers: Significance of biological buffers. pH of body fluids like blood and saliva. Blood buffer systems: For example, Carbonate, Acetate and Phosphate buffers. Protein buffers (Introduction). Significance of TRIS buffers (Introduction).

II	Green Chemistry and Synthesis	Green Chemistry and Synthesis: Introduction to Green Chemistry; Need and Relevance of Green Chemistry; Principles of Green Chemistry. Green Synthesis in Industry: Green Materials, Green Reagents, Green Solvents and Green Catalysts.
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Learning Resources recommended:

1. Cox M. M. & Nelson D. L. (2008). Lehninger Principles of Biochemistry (Vol. 5), New York: Wh Freeman.
2. Conn E. & Stumpf P. (2009) Outlines of Biochemistry, John Wiley & Sons.
3. Satyanarayana U. and Chakrapani U. (2007), Biochemistry, 3rd Edition, Books and Allied (P) Ltd.
4. Mu, P. & Plummer D. T. (2001). Introduction to practical biochemistry, Tata McGraw-Hill Education.
5. Green Chemistry by Ahluwalia.

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Water, standard solutions and Buffers	Chalk and Talk, AV resources	15
II	Green Chemistry and Synthesis	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Water, standard solutions and Buffers	Long Answer	06
Q. 1 B)	I Water, standard solutions and Buffers	Objective	04
Q. 2 A)	II Green Chemistry and Synthesis	Long Answer	06
Q. 2 B)	II Green Chemistry and Synthesis	Objective	04
Q. 3	I Water, standard solutions and Buffers and II Green Chemistry and Synthesis	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Entrepreneurship Development
Class	S. Y. B. Sc.
Semester	III
Course Code	USOEBT308
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Open Elective

Course Outcomes:

By the end of the course, the student will be able to:

CO1 – To develop and systematically apply an entrepreneurial way of thinking.

CO2 – To identify and create the business opportunities.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Introduction to Entrepreneurship Development and Setting-up of an Enterprise and Planning	Concept of Entrepreneur; Entrepreneurship; Need and Importance; Factors Influencing Entrepreneurship; Essentials of a Successful Entrepreneur Location of Enterprise; Real Estate and Human Resource Planning, Financial Planning; Role of Government and Financial Institutions in Entrepreneurship Development; Raising Money from Venture Capitalists, Government Grants, Product Selection and Ideas; Project Planning and Formulation; Project Feasibility Assessment; Regulatory Affairs, Corporate Laws, Innovation, IPR generation and Protection, Preparation of a Business Plan, Characteristics and Importance of Planning
II	Marketing, sales, advertising and International market research	Marketing Plan for an Entrepreneur; Strategic Alliances, Advertising and Sales Promotion; Market Assessment, Need for International Market Research, Domestic vs. International Market Research, Cost and Methodology of Market Research, Desk and Field Research

Learning Resources recommended:

1. Towards Entrepreneurship by Dr. M. R. Kurup
2. Handbook of Entrepreneurship Development by Basotia and Sharma

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Introduction to Entrepreneurship Development and Setting-up of an Enterprise and Planning	Chalk and Talk, AV resources	15
II	Marketing, sales, advertising and International market research	Chalk and Talk, AV resources	15

Evaluation Pattern:**A) Continuous Internal Evaluation: Maximum Marks: 20**

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Introduction to Entrepreneurship Development and Setting-up of an Enterprise and Planning	Long Answer	06
Q. 1 B)	I Introduction to Entrepreneurship Development and Setting-up of an Enterprise and Planning	Objective	04
Q. 2 A)	II Marketing, sales, advertising and International market research	Long Answer	06
Q. 2 B)	II Marketing, sales, advertising and	Objective	04

	International market research		
Q. 3	I Introduction to Entrepreneurship Development and Setting-up of an Enterprise and Planning and II Marketing, sales, advertising and International market research	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Research Methodology
Class	S. Y. B. Sc.
Semester	III
Course Code	USOEBT309
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Open Elective

Course Outcomes:

By the end of the course, the student will be able to:

CO1 - To develop research aptitude, logical thinking and reasoning.

CO2 – To provide skills in interpretation and report writing.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Introduction to Research Methodology and Research Problem	Meaning of Research; Objectives of Research; Motivation in Research; Types of Research; Research Approaches; Significance of Research; Research Methods versus Methodology; Research Process; Criteria of Good Research; Problems Encountered by Researchers in India; What is a Research Problem? Selecting the Problem; Necessity of Defining the Problem; Technique Involved in Defining a Problem
II	Research design, Data collection and Interpretation	Meaning of Research Design; Need for Research Design; Features of a Good Design; Important Concepts Relating to Research Design; Different Research Designs; Basic Principles of Experimental Designs; Developing a Research Plan- Collection of Primary Data; Observation Method; Interview Method; Collection of Data through Questionnaires; Collection of Data through Schedules; Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method. Meaning of Interpretation, Why Interpretation? Technique of Interpretation, Precautions in Interpretation.

Learning Resources recommended:

1. Kothari C.R., “Research Methodology, Methods and Techniques” (Second revised edition, New Age International Publication, 2004).
2. Saravanel P., “Research Methodology” (Kitab Mahal, Sixteenth edition, 2007).
3. Ranjit Kumar, “Research Methodology, a step-by-step guide for beginners” (Pearson education Australia, Second edition 2005).
4. Mark Saunders, Philip Lewis, Adrain Thornhiu, “Research Methods for Business Students” (Pearson Education ltd, Seventh edition, 2016)

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Introduction to Research Methodology and Research Problem	Chalk and Talk, AV resources	15
II	Research design, Data collection and Interpretation	Chalk and Talk, AV resources	15

Evaluation Pattern:**A) Continuous Internal Evaluation: Maximum Marks: 20**

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Introduction to Research Methodology and Research Problem	Long Answer	06
Q. 1 B)	I Introduction to Research Methodology and Research Problem	Objective	04

Q. 2 A)	II Research design, Data collection and Interpretation	Long Answer	06
Q. 2 B)	II Research design, Data collection and Interpretation	Objective	04
Q. 3	I Introduction to Research Methodology and Research Problem and II Research design, Data collection and Interpretation	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Molecular Diagnostics
Class	S. Y. B. Sc.
Semester	III
Course Code	USBTS307
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Skill Enhancement Course

Course Outcomes:

By the end of the course, the learner will be able to:

CO1 - To learn and understand the molecular techniques.

CO2 – To provide the importance of techniques in diagnosis.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Basics of molecular diagnostics	<p>Introduction to Molecular Diagnostics: Overview of Molecular Diagnostics; History of Molecular Diagnostics; Molecular Diagnostics in Post Genomic Era; Areas used in Molecular Diagnostics; Future Prospects - Commercialising Molecular Diagnostics, Personalized Medicine, Theranostics.</p> <p>Characterisation and analysis of Nucleic – Acids and Proteins: Extraction, Isolation and Detection of DNA, RNA and Proteins; Restriction Endonucleases and Restriction Enzyme Mapping.</p> <p>Hybridisation Techniques: Southern, Northern, Western and FISH; Markers, Probes and its Clinical Applications.</p>
II	Molecular Biology based diagnostics	<p>DNA Polymorphism and Identification: RFLP and Parentage Testing; RFLP and Sickle-Cell Anaemia.</p> <p>Molecular Diagnostics for Infectious Diseases Molecular Testing for <i>Neisseria</i>, Molecular Diagnosis for HIV-1;</p> <p>Genetic Counselling and Molecular Diagnosis Genetic Testing- Need and Uses; genetic Counselling. Case Studies- Diagnostic Testing for Cystic Fibrosis; Fragile X Diagnostic and Carrier Testing.</p> <p>Ethical, Social and Legal Issues to Molecular - Genetic Testing</p>

Learning Resources recommended:

1. Molecular Diagnostics by George Patrinos
2. Molecular Diagnostics: Fundamentals, methods and clinical applications, Lela Buckingham and Maribeth Flaws
3. Molecular Diagnostics: For the clinical laboratories, edited by William B. Coleman, Gregory J. Tsongalis

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Basics of molecular diagnostics	Chalk and Talk, AV resources	15
II	Molecular Biology based diagnostics	Chalk and Talk, AV resources	15

Evaluation Pattern:**A) Continuous Internal Evaluation: Maximum Marks: 20**

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Basics of molecular diagnostics	Long Answer	06
Q. 1 B)	I Basics of molecular diagnostics	Objective	04
Q. 2 A)	II Molecular Biology based diagnostics	Long Answer	06
Q. 2 B)	II	Objective	04

	Molecular Biology based diagnostics		
Q. 3	I Basics of molecular diagnostics and II Molecular Biology based diagnostics	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Molecular Biology
Class	S. Y. B. Sc.
Semester	IV
Course Code	USBT401
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Major: Mandatory

Course Outcomes:

By the end of the course, the student will be able to:

CO1 - To have an insight into mechanism of gene expression.

CO2 – To provide the knowledge about regulation of gene expression.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Gene Expression – Transcription and Translation	<p>Gene Expression- an Overview.</p> <p>Transcription Process in Prokaryotes: RNA Synthesis; Promoters and Enhancers; Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain.</p> <p>Transcription in Eukaryotes: Eukaryotic RNA Polymerases; Eukaryotic Promoters; Transcription of Protein Coding Genes by RNA Polymerase; Eukaryotic mRNA's; Transcription of other genes; Spliceosomes; RNA editing.</p> <p>Nature of Genetic Code.</p> <p>Wobble Hypothesis.</p> <p>Translation: Process of Protein Synthesis (Initiation, Elongation, Translocation, Termination);</p> <p>Post Translation Modifications.</p>
II	Regulation of Gene Expression	<p>In Prokaryotes:</p> <p>In Bacteria: <i>lac</i> Operon of <i>E. coli</i>; <i>trp</i> Operon of <i>E. coli</i>.</p> <p>In Viruses: Lytic / Lysogenic Regulation</p> <p>In Eukaryotes: Operons in Eukaryotes; Control of Transcriptional Initiation; Gene Silencing and Genomic Imprinting; Post-Transcriptional Control; RNA Interference.</p>

Learning Resources recommended:

1. iGenetics – A molecular approach, Russell, 3rd edition
2. Molecular biology of the cell, Bruce Alberts, 4th edition.

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Gene Expression – Transcription and Translation	Chalk and Talk, AV resources	15
II	Regulation of Gene Expression	Chalk and Talk, AV resources	15

Evaluation Pattern:**A) Continuous Internal Evaluation: Maximum Marks: 20**

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Gene Expression – Transcription and Translation	Long Answer	06
Q. 1 B)	I Gene Expression – Transcription and Translation	Objective	04
Q. 2 A)	II Regulation of Gene Expression	Long Answer	06
Q. 2 B)	II	Objective	04

	Regulation of Gene Expression		
Q. 3	I Gene Expression – Transcription and Translation and II Regulation of Gene Expression	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Bioprocess Technology
Class	S. Y. B. Sc.
Semester	IV
Course Code	USBT402
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Major: Mandatory

Course Outcomes:

By the end of the course, the student will be able to:

CO1 - To understand the basic skills applied in fermentation technology.

CO2 - To build a foundation for more advanced studies in bioprocess technology.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Microorganisms in industrial processes	<p>Types of Microorganisms used in Industrial Processes: Bacteria, Actinomycetes, Fungi and Algae.</p> <p>Screening and Maintenance of Strains: Primary Screening and Secondary Screening; Cultivation; Preservation of Industrially Important Microbial Strains.</p>
II	Fermenter and Fermentation processes	<p>Design of a fermenter: Stirred Tank Fermenter- Basic Design; Parts of a Typical Industrial Fermenter.</p> <p>Fermentation Media: Components; Design and Optimization.</p> <p>Sterilization: Sterilization of Fermenter and Fermentation Media.</p> <p>Process Parameters: <i>pH</i>, Temperature, Aeration, Agitation, Foam, etc.</p> <p>Types of Fermentation: Surface and Submerged; Batch and Continuous, Aerobic and Anaerobic.</p> <p>Product Isolation and Purification.</p> <p>Study of Representative Fermentation Processes: Outline of Penicillin and Ethanol Production by Fermentation along with a <i>flow-diagram</i>.</p>

Learning Resources recommended:

1. Fermentation by Casida
2. Fermentation by A. H. Patel

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Microorganisms in industrial processes	Chalk and Talk, AV resources	15
II	Fermenter and Fermentation processes	Chalk and Talk, AV resources	15

Evaluation Pattern:**A) Continuous Internal Evaluation: Maximum Marks: 20**

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Microorganisms in industrial processes	Long Answer	06
Q. 1 B)	I Microorganisms in industrial processes	Objective	04
Q. 2 A)	II Fermenter and Fermentation processes	Long Answer	06
Q. 2 B)	II Fermenter and Fermentation processes	Objective	04
Q. 3	I Microorganisms in industrial processes and II Fermenter and Fermentation processes	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Medical Microbiology
Class	S. Y. B. Sc.
Semester	IV
Course Code	USBT403
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Major: Mandatory

Course Outcomes:

By the end of the course, the student will be able to:

CO1 - Gain insight into disease factors and processes.

CO2 – Provide the knowledge about diseases caused by microorganisms.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Infectious diseases	<p>Host Parasite Relationship: Normal Flora; Factors Affecting the Course of Infection and Disease; Mechanisms of Infection and Virulence Factors.</p> <p>Infection: Patterns of Infection; Types of Infections; Signs and Symptoms; Epidemiology and Epidemiological Markers.</p> <p>Diseases: Origin of Pathogens; Vectors; Acquisition of Infection; Koch's Postulates.</p>
II	Causative organisms	<p>Skin : <i>S. aureus</i>, <i>S. pyogenes</i>.</p> <p>Respiratory Tract Infections : <i>M. tuberculosis</i>, <i>S. pneumoniae</i> (Characteristics Transmission, Course of Infection, Lab Diagnosis, Management of TB, Prevention and Control, Immuno and Chemoprophylaxis, DOTS and MDR).</p> <p>Urinary Tract Infections : <i>E. coli</i>: Characteristics, Virulence, Clinical disease, and <i>E. coli</i> Infections. <i>Proteus</i>.</p> <p>Nosocomial Infections: <i>Ps. Aeruginosa</i></p> <p>GI Tract Infections : <i>Salmonella</i> and <i>Shigella</i> spp. (Characteristics, Virulence – Pathogenesis and Immunity, Clinical disease, carriers, Lab. diagnosis, Phage typing, Prophylaxis and Treatment).</p>

Learning Resources recommended:

1. Microbiology: An introduction, Tortora, 9th edition
2. Microbiology by Pelczar and Chan, 5th edition

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Infectious diseases	Chalk and Talk, AV resources	15
II	Causative organisms	Chalk and Talk, AV resources	15

Evaluation Pattern:**A) Continuous Internal Evaluation: Maximum Marks: 20**

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Infectious diseases	Long Answer	06
Q. 1 B)	I Infectious diseases	Objective	04
Q. 2 A)	II Causative organisms	Long Answer	06
Q. 2 B)	II Causative organisms	Objective	04
Q. 3	I Infectious diseases and II Causative organisms	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Biotechnology Practical IV
Class	S. Y. B. Sc.
Semester	IV
Course Code	USBT404
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Major: Mandatory

Course Outcomes:

By the end of the course, the student will be able to:

CO1 – To impart knowledge and hands on experience of the various practicals related to Molecular Biology, Bioprocess technology and Medical Microbiology.

Syllabus:

Unit Title	Sub titles (Learning Points)
Regular Practicals	<ol style="list-style-type: none"> 1. Study of <i>E. coli</i> Diauxic growth curve – Lactose and Glucose. 2. Study of <i>lac</i> gene expression using Blue-White selection. 3. Expression of β-galactosidase and measurement of activity. 4. Screening for an antibiotic producing strain of microorganism. 5. Screening for an alcohol producing strain of microorganism. 6. Lab scale production of Penicillin (Static and shaker). 7. Purification of Penicillin from Broth culture of <i>Penicillium</i> spp. By solvent extraction. 8. Lab scale production of ethanol. 9. Purification of ethanol from Broth culture of <i>Saccharomyces</i> spp. by Distillation. 10. Estimation of Penicillin from recovered broth by Chemical (Iodometric) method. 11. Estimation of Penicillin from recovered broth by Biological (Bioassay) method. 12. Estimation of alcohol from recovered broth by dichromate method. 13. Identification of <i>S. aureus</i> – Isolation, Catalase, Coagulase test. 14. Identification of <i>E. coli</i> – Isolation, Sugar fermentations, IMViC. 15. Identification of <i>Proteus</i> – Isolation, Sugar fermentations, IMViC. 16. Identification of <i>Pseudomonas</i> – Isolation, Urease test, Oxidase test, TSI slant. 17. Identification of <i>Salmonella</i> – Isolation, Sugar fermentations, TSI slant.

Learning Resources recommended:

1. iGenetics – A molecular approach, Russell, 3rd edition
2. Molecular biology of the cell, Bruce Alberts, 4th edition.
3. Fermentation by Casida
4. Fermentation by A. H. Patel
5. Microbiology: An introduction, Tortora, 9th edition
6. Microbiology by Pelczar and Chan, 5th edition

Teaching Plan:

Unit Title	Teaching Methods	No. of Lectures
Regular Practicals	Hands on performance, videos, demonstration	60

Evaluation Pattern:**A) Continuous Internal Evaluation: Maximum Marks: 20**

Method	Marks
Journal	05
Viva	05
Identification	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No.	Type of Experiment	Marks
Q. 1	Major	20
Q. 2	Minor	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Applied Chemistry – III
Class	S. Y. B. Sc.
Semester	IV
Course Code	USBT405
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Minor

Course Outcomes:

By the end of the course, the student will be able to:

CO1 – Develop an understanding of the different aspects of Analytical Chemistry.

CO2 – Gain an understanding of basic concepts in Polymer Chemistry.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Sampling and Separation Techniques	Sampling : Importance of Sampling and Sampling Techniques Types of Sampling - Random and Non-Random Sampling of Solids, Liquids and Gases. Separation Techniques : Types of Separation Techniques - Filtration, Zone Refining, Distillation, Vacuum Distillation. Solvent Extraction – Partition Coefficient and Distribution Ratio, Extraction Efficiency, Separation Factor, Role of Complexing Agents, Chelation, Ion Pair Formation, Solvation, and Soxhlation. Centrifugation - Basic Principles of Sedimentation.
II	Polymers	Polymers : Introduction to Polymers. Types of Polymers - Monomer, Polymer, Homopolymer, Copolymer, Thermoplastics and Thermosets, Addition and Condensation Polymers (Examples and Uses) Stereochemistry of Polymers. Biodegradable Polymers.

Learning Resources recommended:

1. Bahl, B. S., & Bahl, A. (2017). A textbook of organic chemistry. S. Chand Publishing.
2. Lee, J. D. (2008). Concise inorganic chemistry. John Wiley & Sons.
3. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2013). Fundamentals of analytical chemistry. Cengage learning.
4. Vogel, A. I., & Jeffery, G. H. (1989). Vogel's textbook of quantitative chemical analysis. Wiley.
5. Mosher, M. (1992). Organic Chemistry. (Morrison, Robert Thornton; Boyd, Robert Neilson).
6. Polymer Science, V. R. Gowariker, Viswanathan.

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Sampling and Separation Techniques	Chalk and Talk, AV resources	15
II	Polymers	Chalk and Talk, AV resources	15

Evaluation Pattern:**A) Continuous Internal Evaluation: Maximum Marks: 20**

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Sampling and Separation Techniques	Long Answer	06
Q. 1 B)	I Sampling and Separation Techniques	Objective	04
Q. 2 A)	II Polymers	Long Answer	06
Q. 2 B)	II Polymers	Objective	04
Q. 3	I Sampling and Separation Techniques and II Polymers	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Applied Chemistry – IV
Class	S. Y. B. Sc.
Semester	IV
Course Code	USBT406
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Minor

Course Outcomes:

By the end of the course, the student will be able to:

CO1 – Gain knowledge of natural product chemistry and related acquired skills.

CO2 – Gain an understanding of basic concepts in nanotechnology.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Natural Product Chemistry	Natural Product Chemistry : Primary and Secondary Metabolites. Classification of Natural Products based on Bio-Synthesis. Classification of Natural Products based on Structure- Alkaloids, Phenolics, Essential Oils and Steroids. Structure Determination of Natural Products. Commercial Synthesis of Natural Products. Chromatographic Separation of Natural Products: Gas Chromatography and its Applications. Liquid Chromatography: HPLC and its Applications. HPTLC for Separation and Analysis of Natural Products.
II	Nanotechnology	Nanomaterials: Introduction to Nanomaterials. Forms of Nanomaterials: Nanoparticles, Nanofilms and Nanotubes. Synthesis and characterization of nanomaterials. Applications of Nanomaterials.

Learning Resources recommended:

1. Bahl, B. S., & Bahl, A. (2017). A textbook of organic chemistry. S. Chand Publishing.
2. Vogel, A. I., & Jeffery, G. H. (1989). Vogel's textbook of quantitative chemical analysis. Wiley.
3. Patel H. N., Turakhia S. P., Puniyani S. R. (2018). F. Y. B. Sc. College Practical Chemistry for Biotechnology, Himalaya Publishing House
4. Nanomaterials by B. Viswanathan

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Natural Product Chemistry	Chalk and Talk, AV resources	15
II	Nanotechnology	Chalk and Talk, AV resources	15

Evaluation Pattern:**A) Continuous Internal Evaluation: Maximum Marks: 20**

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Natural Product Chemistry	Long Answer	06
Q. 1 B)	I Natural Product Chemistry	Objective	04
Q. 2 A)	II Nanotechnology	Long Answer	06
Q. 2 B)	II Nanotechnology	Objective	04
Q. 3	I Natural Product Chemistry and II Nanotechnology	Short Note	10

Syllabus for Bachelor of Science in Biotechnology for the year 2024-25

Nomenclature of the Course	Bioinformatics
Class	S. Y. B. Sc.
Semester	IV
Course Code	USBTV407
No. of Credits	02
Nature	Theory/ Practical/ Project/ other
Type	Vocational Skill Course (VSC)

Course Outcomes:

By the end of the course, the student will be able to:

CO1 – To develop an understanding of introduction to computers and biological databases.

CO2 – To develop an understanding of BLAST and sequence alignment.

Syllabus:

Unit No.	Unit Title	Sub titles (Learning Points)
I	Introduction to computers and biological databases	<p>Computer Basics : Organization of a Computer; I/O Units; Computer Memory; Processor; Binary Arithmetic; Logic Circuit; Architecture; Operating System.</p> <p>Internet Basics : Connecting to the Internet, E-mail, FTP, www, Difference between www and Internet.</p> <p>Biological Databases : Classification of Databases - Raw and Processed Databases; Primary (NCBI), Secondary (PIR) and Tertiary or Composite (KEGG) Databases; Structure and Sequence Databases. Specialized Databases - Protein Pattern Databases; Protein Structure and Classification Databases (CATH/SCOP).</p> <p>Genome Information Resources: DNA Sequence Databases Specialized Genomic Resources. Protein Databases based on Composition, Motifs and Patterns.</p> <p>Protein Structure Visualization Software.</p>
II	BLAST and sequence alignment	<p>BLAST and Sequence Alignment: BLAST and its Types; Retrieving Sequence using BLAST.</p> <p>Pairwise Alignment: Identity and Similarity; Global and Local Alignment; Pairwise Database Searching.</p> <p>Multiple Sequence Alignment:</p>

		Goal of Multiple Sequence Alignment; Computational Complexity; Manual Methods; Simultaneous Methods; Progressive Methods; Databases of Multiple Alignment; Secondary Database Searching; Analysis Packages; MSA and Phylogenetic Trees.
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Learning Resources recommended:

1. Sinha, P. K., Sinha, P. (2004). Computer Fundamentals. India: BPB Publications.
2. Goel, A. (2010). Computer Fundamentals. India: Pearson Education.
3. Wempen, F. (2014). Computing Fundamentals: Introduction to Computers. Germany: Wiley.
4. Bioinformatics by S. C. Rastogi
5. Bioinformatics by Attawood

Teaching Plan:

Unit No.	Unit Title	Teaching Methods	No. of Lectures
I	Introduction to computers and biological databases	Chalk and Talk, AV resources	15
II	BLAST and sequence alignment	Chalk and Talk, AV resources	15

Evaluation Pattern:

A) Continuous Internal Evaluation: Maximum Marks: 20

Method	Marks
Class Test	10
Home Assignment	05
Active class participation and Attendance	05

B) Semester End Examination: Maximum Marks: 30

Question No. and Sub questions	Unit (with number and title)	Type of Question	Marks
Q. 1 A)	I Introduction to computers and biological databases	Long Answer	06
Q. 1 B)	I Introduction to computers and biological databases	Objective	04
Q. 2 A)	II BLAST and sequence alignment	Long Answer	06
Q. 2 B)	II BLAST and sequence alignment	Objective	04
Q. 3	I Introduction to computers and biological databases and II BLAST and sequence alignment	Short Note	10



(Rashmi A. Bhawe)
Chairperson and HoD