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
2023 - 2024

Name of Programme	**B. Sc. Biotechnology**
Level	UG
No. of Semesters	06
Year of Implementation	**2023 – 24**
Programme Specific Outcomes (PSO)	1. To impart hands on skills in preparation of buffers and solutions. 2. To impart skills in handling the cultures of micro – organisms. 3. To impart the knowledge of molecular biology techniques. 4. To impart the skills of Science communication. 5. To impart knowledge of society and make students aware about the Problems in society. 6. To understand basic principles of research methodology and identify a research problem. 7. To gain critical thinking and analytical skills to understand new diagnostic methods. 8. To write a business plan. 9. To design strategies for successful implementation of ideas.
Relevance of PSOs to the local, regional, national, and global developmental needs	Biotechnology is important at Global, Regional and local level. The significance of Biotechnology identified at all these levels and it is relevant to everyday life. The curriculum design of B. Sc. Biotechnology programme helps in understanding various concepts in detail. This programme includes hands on skills and knowledge of the different techniques related to molecular biology, tissue culture, basic chemistry and basic microbiology. This also involves the knowledge of problems in society. The application part is taken care of so that the learner shall be able to connect the phenomena around him with the curriculum. This programme also imparts the research values among the learners. The hard and softs skills acquired during the completion of this programme shall make him employable.

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 40 % marks in the first part and by conducting the Semester End Examinations of 60 % marks in the second part.

Standard of Passing

The learner to pass a course shall have to obtain a minimum of 40% marks in aggregate for each course where the course consists of Internal Assessment & Semester End Examination. The learner shall obtain minimum of 40% marks (i. e. 16 out of 40) in the Internal Assessment and 40% marks in Semester End Examination (i. e. 24 out of 60) separately, to pass the course and minimum of Letter Grade "P" in the project component, wherever applicable to pass a particular semester. A learner will be said to have passed the course if the learner passes the Internal Assessment and Semester End Examination together.

Performance Grading:

Letter Grades and Grade Points

Semester GPA/ Program CGPA Semester/Program	**% of Marks**	**Alpha-Sign / Letter Grade Result**
9.00-10.00	90.0 -100	0 (Outstanding)
8.00 ≤ 9.00	80.0 ≤ 90.0	A+ (Excellent)
7.00 ≤ 8.00	70.0 ≤ 80.0	A (Very Good)
6.00 ≤ 7.00	60.0 ≤ 70.0	B+ (Good)
5.50 ≤ 6.00	55.0 ≤ 60.0	B (Above Average)
5.00 ≤ 5.50	50.0 ≤ 55.0	C (Average)
4.00 ≤ 5.00	40.0 ≤ 50.0	P (Pass)
Below 4.00	Below 40	F (Fail)
Ab (Absent)	-	Absent

SMART Criteria for Course Outcomes:

Specific: Each course outcome is specific, outlining the knowledge and skills students are expected to acquire in relation to the specific topics covered.

Measurable: Each outcome can be measured through assessments, tests, or projects to determine the level of understanding and proficiency achieved by the students.

Achievable: The outcomes are achievable within the duration of the course, considering the number of lectures allocated to each topic.

Relevant: The outcomes are relevant to the subject of financial services and capital market, addressing important concepts, types, and mechanisms involved.

Time-bound: The outcomes are expected to be achieved by the end of the course, providing a clear timeline for assessment and evaluation.

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Biophysics
Course Code	USBT 301
Class	S. Y. B. Sc.
Semester	III
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To have a firm foundation in the fundamentals and applications of current biophysical theories related to optics and electromagnetic radiations.

CO2 - To have a firm foundation in the fundamentals and applications of current biophysical theories related to heat, sound, magnetism and fluid dynamics.

CO3 – To provide the skills in electrophoretic techniques.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Optics and Electromagnetic radiations	**Introduction to Optics and Lasers:** ***Optics* :** Properties of Light - Reflection, Refraction, Dispersion, Interference. ***Lasers* :** Properties of Lasers, Stimulated Emissions, Laser Action; Applications of Laser. **Electromagnetic Radiations:** Introduction to Electromagnetic Radiation. **Spectroscopy :** Types and Properties of Spectra; Basic Laws of Light Absorption. Spectrophotometer:-Principle, Instrumentation and Applications; UV-Vis Spectrophotometer, Single and Dual Beam Spectrophotometer.	15

		Microscopy: Types of Microscopy; Electron Optics; Electron Microscopy-Preparation of Specimen, SEM, TEM and Immuno-Electron Microscopy. Fluorescence Microscopy.	
II	Heat, Sound, Magnetism and Fluid dynamics	**Heat:** Concept of Temperature; Modes of Heat Transfer; Measuring Temperature; Platinum Resistance Thermometer; Thermocouple and Thermistors. **Sound:** Types of Sound Waves - Audible, Ultrasonic and Infrasonic Waves; Doppler Effect; Applications of Ultrasonic Waves. **Magnetism:** Magnetic Field; Magnetism of Earth; Paramagnetism, Diamagnetism, Ferromagnetism. Nuclear Magnetism and Biomagnetism. **Fluid Dynamics :** ***Viscosity*:** Definition Flow of Liquids through Capillaries; Stokes' Law; Terminal Velocity. Determination of 'η' by Falling Sphere Method; Viscosity Estimation by Oswald's Viscometer. ***Surface Tension*:** Definition - Surface Tension and Surface Energy; Capillary Action; Angle of Contact; Wettability; Temperature Dependence of Surface Tension. Applications in Biology.	15
III	Electrophoretic techniques	**Electrophoresis:** Migration of Ions in an applied electric field; Factors affecting Electrophoretic Mobility; Moving Boundary Electrophoresis;	15

		Principle of Electrophoresis; Supporting Matrix; Paper Electrophoresis; AGE; Native and SDS PAGE (reducing and non-reducing, continuous and discontinuous); IEF and 2D PAGE. Staining and Detection Methods; Gel-Documentation. Applications in Biology.	

Learning Resources recommended:

1. Brij Lal Subramanium, Chapter 3, 8, 14, 22

2. Concepts of modern Physics, Beiser, Topics 2.1 – 2.2

3. TY College analytical Chemistry, Himalaya Publications

4. Instrumentation: Devices and systems by C. S. Rangan, TMH Publication

5. Biophysical Chemistry – Principles and Techniques, Upadhyay and Nath

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Applied Chemistry – I
Course Code	USBT 302
Class	S. Y. B. Sc.
Semester	III
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To have a firm foundation in the fundamentals of organic chemistry.
CO2 - To impart the knowledge in the synthesis of organic compounds.
CO3 – To explore the fundamentals of green chemistry and synthesis.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
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 *wrt* Myoglobins, Haemoglobin. Biological Role of Carboxypeptidases, Catalases and Peroxidases. **Structure and Function :** Dioxygen Binding, Transfer and Utilization; Metal Complexes in Medicines.	15
II	Synthesis of organic compounds	**Synthesis of Organic Compounds :** Criteria for Ideal Synthesis; Selectivity and Yield. Linear and Convergent Synthesis and Multicomponent Reactions.	15

		Microwave Assisted Organic Synthesis, Ultrasound in Synthesis and Polymer supported Synthesis. Retrosynthesis.	
III	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.	15

Learning Resources recommended:

1. Advanced organic chemistry, Reinhard Bruckner
2. Biochemistry, Satyanarayan 4th edition
3. Textbook of Biochemistry, Lehninger 4th edition
4. College organic chemistry for T. Y. B. Sc. (Himalaya Publishing House)
5. Green Chemistry by Ahluwalia

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Immunology
Course Code	USBT 303
Class	S. Y. B. Sc.
Semester	III
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To familiarize students with the immune effector mechanisms.
CO2 - To provide the information about cell receptors.
CO3 – To impart the details of various immunotechniques.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
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	15
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).**	15

III	Immunotechniques	**Precipitation Reactions :** Immunoprecipitation, Immunoelectrophoresis, CIEP, Rocket Electrophoresis and 2-D Immunoelectrophoresis. **Agglutination Reactions :** Passive, Reverse Passive, Agglutination Inhibition. Coomb's Test; Complement Fixation Tests, RIA, ELISA, ELISPOT, Chemiluminescence, Western Blot, Immunofluorescence, Flow Cytometry. **Alternatives to Antigen-Antibody Reactions.**	15

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

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Cell Biology and Cytogenetics
Course Code	USBT 304
Class	S. Y. B. Sc.
Semester	III
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To have a firm foundation in the fundamentals of cytoskeleton.
CO2 – To acquire the knowledge about cell membrane.
CO3 – To impart the fundamentals of cytogenetics.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Cytoskeleton	**Cytoskeleton :** Overview of the Major Functions of Cytoskeleton. Microtubules: Structure and Composition. MAPs: Functions- Role in Mitosis, Structural Support and Cytoskeleton Intracellular Motility. Motor Proteins: Kinesins, Dynein; MTOCs. Dynamic Properties of Microtubules. Microtubules in Cilia and Flagella. Microfilaments: Structure, Composition, Assembly and Disassembly. Motor Protein: Myosin. Muscle Contractility: Sliding Filament Model. Actin Binding Proteins : Examples of Non-Muscle Motility. Intermediate Filaments :Structure and Composition; Assembly and Disassembly; Types and Functions.	15
II	Cell Membrane	**Cell Membrane :** Uptake of Nutrients by Prokaryotic Cells; Cell Permeability.	15

		Principles of Membrane Transport- Transporters and Channels; Active Transport Passive Transport; Types of Transporters; Types of ATP Driven Pumps - Na+ K+ Pump. Cell Junctions; Cell Adhesion and Extracellular Material Microvilli; Tight Junctions, Gap Junctions; Cell Coat and Cell Recognition. Cellular Interactions.	
III	Cytogenetics	**Cytogenetics :** Structure of Chromosome - Heterochromatin, Euchromatin, Polytene Chromosomes. **Variation in Chromosomal Structure and Number :** Deletion, Duplication, Inversion, Translocation, Aneuploidy, Euploidy and Polyploidy and Syndromes- Klinefelter, Turner, Cri-du-Chat, Trisomy -21, Trisomy 18 and Trisomy 13. **Sex Determination and Sex Linkage :** Mechanisms of Sex Determination (XX-XY, ZZ-ZW, XX-XO) Dosage Compensation and Barr Body. **Genetic Linkage, Crossing Over and Chromosomal Mapping :** Tetrad Analysis; Two-point Cross; Three point Cross; Pedigree Analysis.	15

Learning Resources recommended:

1. Microbiology, Prescott Harley, 7th edition
2. Molecular biology of the cell, Bruce Alberts, 4th edition
3. Cell and Molecular biology, De Robertis, 8th edition
4. iGenetics – A molecular approach, Russell, 3rd edition

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Molecular Biology
Course Code	USBT 305
Class	S. Y. B. Sc.
Semester	III
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To have an insight into mechanism of gene expression.
CO2 – To provide the knowledge about regulation of gene expression.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Gene Expression – Transcription	**Gene Expression- an Overview.** **Transcription Process in Prokaryotes :** RNA Synthesis; Promoters and Enhancers; Initiation of Transcription at Promoters; Elongation and Termination of an RNA Chain. **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.	15
II	Gene Expression – Translation	**Nature of Genetic Code.** **Wobble Hypothesis.** **Translation :** Process of Protein Synthesis (Initiation, Elongation, Translocation, Termination); **Post Translation Modifications.** **Protein sorting.**	15

III	Regulation of Gene Expression	**In Prokaryotes:** ***In Bacteria* :** *lac* Operon of *E. coli*; *trp* Operon of *E. coli*. ***In Viruses* :** Lytic / Lysogenic Regulation **In Eukaryotes :** Operons in Eukaryotes; Control of Transcriptional Initiation; Gene Silencing and Genomic Imprinting; Post-Transcriptional Control; RNA Interference.	15

Learning Resources recommended:

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

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Bioprocess Technology
Course Code	USBT 306
Class	S. Y. B. Sc.
Semester	III
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To understand the basic skills applied in fermentation technology.
CO2 - To build a foundation for more advanced studies in bioprocess technology.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Microorganisms in industrial processes	**Types of Microorganisms used in Industrial Processes :** Bacteria, Actinomycetes, Fungi and Algae. **Screening and Maintenance of Strains:** Primary Screening and Secondary Screening; Cultivation; Preservation of Industrially Important Microbial Strains.	15
II	Fermentor and Fermentation processes	**Design of a fermentor :** Stirred Tank Fermentor- Basic Design; Parts of a Typical Industrial Fermentor. **Fermentation Media :** Components; Design and Optimization. **Sterilization :** Sterilization of Fermentor and Fermentation Media. **Process Parameters :** *pH*, Temperature, Aeration, Agitation, Foam, etc.	15

		Types of Fermentation : Surface and Submerged; Batch and Continuous, Aerobic and Anaerobic. **Product Isolation and Purification.** **Study of Representative Fermentation Processes :** Outline of Penicillin and Ethanol Production by Fermentation along with a *flow-diagram*.	
III	In vivo and in vitro assay of industrial products	**Assay of Industrial Products:** Chemical and Biological; Types and Subtypes; Kinetics. Advantages and Disadvantages. Half-Life Determination of Pharmacological Products. Bioavailability and Bioequivalence Studies	15

Learning Resources recommended:

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

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Research Methodology
Course Code	USBT 307
Class	S. Y. B. Sc.
Semester	III
No. of Credits	02
Nature	Theory/ ~~Practical~~/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To develop research aptitude, logical thinking and reasoning.
CO2 – To provide skills in interpretation and report writing.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
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	15
II	Research design and Data collection	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	15

		through Schedules; Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method	
III	Interpretation and Report Writing	Meaning of Interpretation, Why Interpretation? Technique of Interpretation, Precautions in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.	15

Learning Resources recommended:

1. Research Methodology by C. R. Kothari, 3rd edition

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals of USBT301 and USBT302
Course Code	USBTP301
Class	S. Y. B. Sc.
Semester	III
No of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 – To impart knowledge and hands on experience of the various practicals related to biophysics and applied chemistry.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practicals	1. Study of Absorption Spectra of Coloured Compounds ($CuSO_4$, $CoCl_2$, $KMnO_4$). 2. Verification of Beer-Lambert's Law. 3. Extraction of Plasmid DNA and Separation by Agarose Gel Electrophoresis. 4. Determination of Purity of Plasmid DNA using UV Spectrophotometry. 5. Electrophoresis of Proteins by PAGE and SDS-PAGE. 6. Purification of any TWO Organic Compounds by Recrystallization Selecting Suitable Solvent. 9. Organic Estimations: Acetone, Amide, Benzoic Acid. 10. Organic Preparations : a) Acetylation of Primary Amine (Preparation of Acetanilide). b) Base Catalyzed Aldol Condensation (Synthesis of Dibenzalpropanone).	120
Demonstration Practicals	1. Study of the Structure and Function of an Electron Microscope (Visit / Video Demonstration - including Sample Preparation and Staining). 2. Demonstration of Structure and Working of a Fluorescence Microscope (Stained Preparation).	

Learning Resources recommended:

1. Advanced organic chemistry, Reinhard Bruckner
2. Biochemistry, Satyanarayan 4th edition
3. Textbook of Biochemistry, Lehninger 4th edition
4. College organic chemistry for T. Y. B. Sc. (Himalaya Publishing House)
5. Green Chemistry by Ahluwalia
6. TY College analytical Chemistry, Himalaya Publications
7. Instrumentation: Devices and systems by C. S. Rangan, TMH Publication
8. Biophysical Chemistry – Principles and Techniques, Upadhyay and Nath

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
Practicals of USBTP301	4 experiments of 1.5 hrs duration (02 Papers)	06 hrs	60 M (02 Papers) (02 Major and 02 Minor Experiments OR 02 Major Experiments)	40 M (20 M for Journal, 10 M for viva, 10 M for overall performance)	100

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals of USBT303 and USBT304
Course Code	USBTP302
Class	S. Y. B. Sc.
Semester	III
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To impart knowledge and hands on experience of the various practicals related to immunology.
CO2 - To impart knowledge and hands on experience of the various practicals related to cell biology and cytogenetics.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practicals	1. Complement Fixation Test (CFT). 2. Passive Agglutination- RA Factor Test. 3. Immunoelectrophoresis. 4. ELISA (Kit-based) - HEPALISA. 5. DOT-ELISA. 6. Study of Chromosomal Aberrations- Deletion, Duplication, Inversion, Translocation and Syndromes- Trisomy 21 Trisomy 13 Trisomy 18, Klinefelter, Turner and Cri-du-Chat. 7. Induction of Polyploidy by PDB Treatment using Suitable Plant Material. 8. Study of Polytene Chromosomes. 9. Mapping based on Tetrad Analysis and Three Point Cross. 10. Pedigree Analysis- Autosomal and Sex-Linked.	120
Demonstration Practicals	Western Blotting - Demonstration.	
Visit	Flow Cytometry - Lab Visit.	

Learning Resources recommended:

1. Microbiology, Prescott Harley, 7th edition
2. Molecular biology of the cell, Bruce Alberts, 4th edition

3. Cell and Molecular biology, De Robertis, 8th edition
4. iGenetics – A molecular approach, Russell, 3rd edition
5. Immunology by Janis Kuby, 5th edition
6. Textbook of Microbiology by Ananthnarayan and Paniker, 8th edition
7. Introduction to immunology by C. V. Rao

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
Practicals of USBTP302	4 experiments of 1.5 hrs duration (02 Papers)	06 hrs	60 M (02 Papers) (02 Major and 02 Minor Experiments OR 02 Major Experiments)	40 M (20 M for Journal, 10 M for viva, 10 M for overall performance)	100

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals of USBT305 and USBT306
Course Code	USBTP303
Class	S. Y. B. Sc.
Semester	III
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To impart knowledge and hands on experience of the various practicals related to molecular biology.
CO2 - To provide knowledge and hands on experience of the various practicals related to bioprocess technology.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practicals	1. Study of *E. coli* Diauxic Growth Curve- (Lactose and Glucose). 2. Study of lac 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 Penicillium spp. by Solvent Extraction. 8. Lab Scale Production of Ethanol. 9. Purification of Ethanol from Broth Culture of Saccharomyces 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.	120

Learning Resources recommended:

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

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
Practicals of USBTP303	4 experiments of 1.5 hrs duration (02 Papers)	06 hrs	60 M (02 Papers) (02 Major and 02 Minor Experiments OR 02 Major Experiments)	40 M (20 M for Journal, 10 M for viva, 10 M for overall performance)	100

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Biochemistry
Course Code	USBT401
Class	S. Y. B. Sc.
Semester	IV
No. of Credits	02
Nature	Theory/ ~~Practical/ Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To gain an insight into the metabolic processes associated with catabolism of carbohydrates.
CO2 - To gain an insight into the metabolic processes associated with catabolism of amino acids.
CO3 - To gain an insight into the metabolic processes associated with catabolism of lipids and nucleotides.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Carbohydrate metabolism, ETS and Energy rich compounds	**Carbohydrate Metabolism :** Glycolytic Pathway and its Regulation, Homolactic Fermentation; Alcoholic Fermentation; Energetics of Fermentation; Citric Acid Cycle and its Regulation; Gluconeogenesis; Pentose Phosphate Pathway; Glyoxalate Pathway; Reductive TCA. (Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above Pathways) **Electron Transport System :** Electron Transport and Oxidative Phosphorylation. Inhibitors of ETS. **Energy Rich Compounds :** ATP as Energy Currency, Structure of ATP, Hydrolysis, Other Energy Rich Compounds other than ATP like PEP, Creatine Phosphate, etc.	15

II	Amino acid metabolism	**Amino Acid Breakdown :** Deamination, Transamination, Urea Cycle, Breakdown of Glucogenic and Ketogenic Amino Acids. **Amino Acids as Biosynthetic Precursors :** Biosynthesis of Epinephrine, Dopamine, Serotonin, GABA, Histamine, Glutathione. (Sequence of Reactions, Regulation and Metabolic Disorders of the above Pathways)	15
III	Lipid and nucleotide metabolism	**Lipid Metabolism :** Mobilization, Transport of Fatty Acids. Beta, Alpha and Omega Oxidation of Saturated Fatty Acids; Oxidation of Unsaturated Fatty Acids; Oxidation of Odd Chain Fatty Acids. Energy Yield, Ketone Body Breakdown to Yield Energy. (Sequence of Reactions, Regulation, Energy Yield and Metabolic Disorders of the above Pathways) **Nucleotide Metabolism :** Degradation of Purines and Pyrimidines.	15

Learning Resources recommended:

1. Biochemistry by Satyanarayan and Chakrapani
2. Lehninger Principles of Biochemistry, 4th edition, Nelson and Cox
3. Biochemistry, Voet and Voet, 3rd edition
4. General Microbiology by Stanier

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Applied Chemistry – II
Course Code	USBT402
Class	S. Y. B. Sc.
Semester	IV
No. of Credits	02
Nature	Theory/ ~~Practical/ Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To have a firm foundation in the fundamentals and applications of current chemical theories for the physical world.
CO2 – To provide the knowledge of sampling and separation techniques.
CO3 – To explore polymers and nanomaterials.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
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.	15
II	Natural product chemistry	**Natural Product Chemistry :** Primary and Secondary Metabolites. Classification of Natural Products based on Bio-Synthesis.	15

		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.	
III	Polymers and nanomaterials	**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. **Nanomaterials :** Introduction to Nanomaterials. Forms of Nanomaterials: Nanoparticles, Nanofilms and Nanotubes Synthesis and Characterization of Nanomaterials. Applications of Nanomaterials.	15

Learning Resources recommended:

1. Vogel's Textbook of Quantitative chemical analysis, 6th edition
2. Textbook of organic chemistry for T. Y. B. Sc., Himalaya Publishing House
3. Nanomaterials by B. Viswanathan
4. Polymer Science, V. R. Gowariker, Viswanathan

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Medical Microbiology
Course Code	USBT403
Class	S. Y. B. Sc.
Semester	IV
No. of Credits	02
Nature	Theory/ ~~Practical/ Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To gain insight into disease factors and processes.
CO2 – To provide the knowledge about diseases caused by microorganisms.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Infectious diseases	**Host Parasite Relationship:** Normal Flora; Factors Affecting the Course of Infection and Disease; Mechanisms of Infection and Virulence Factors. **Infection:** Patterns of Infection; Types of Infections; Signs and Symptoms; Epidemiology and Epidemiological Markers. **Diseases:** Origin of Pathogens; Vectors; Acquisition of Infection; Koch's Postulates.	15
II	Medical Microbiology – Causative organisms – I	**Skin :** *S. aureus*, *S. pyogenes.* **Respiratory Tract Infections :** *M. tuberculosis*, *S. pneumoniae* (Characteristics Transmission, Course of Infection, Lab Diagnosis, Management of TB, Prevention and Control, Immuno and Chemoprophylaxis, DOTS and MDR).	15

		Urinary Tract Infections : *E. coli*: Characteristics, Virulence, Clinical disease, and *E. coli* Infections. *Proteus.*	
III	Medical Microbiology – Causative organisms – II	**GI Tract Infections :** *Salmonella and Shigella spps. (*Characteristics, Virulence-Pathogenesis and Immunity, Clinical Disease, Carriers Lab Diagnosis, Phage Typing Prophylaxis and Treatment). **Sexually Transmitted Diseases :** Syphilis and Gonorrhoea. **Nosocomial Infections :** *Ps. Aeruginosa*	15

Learning Resources recommended:

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

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Environmental Biotechnology
Course Code	USBT404
Class	S. Y. B. Sc.
Semester	IV
No. of Credits	02
Nature	Theory/ ~~Practical/ Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To gain awareness about different types of environmental pollution.
CO2 – To impart the knowledge of global environmental problems and related issues.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Environmental pollution	**Sources of Pollution.** **Air Pollution :** Types; Sources; Classification of Air Pollutants; Air Pollution Monitoring and Control. **Water Pollution :** Causes, Types and Classification; Eutrophication; Assessment of Water Quality- Pollutant Monitoring and Control; **Soil and Solid Waste Pollution :** Characteristics of Wastes, Impacts of Solid Waste on Health, Occupational Hazards and Control. **Soil Erosion :** Concept, Causes and Effects.	15
II	Global environmental problems and issues	**Green House Effect :** Factors Responsible for Green House Effect; Green House Gases. Global Warming; Ozone Depletion; Kyoto Protocol; UV Radiation; Acid Rain.	15
III	Bioremediation	Concept of Bioremediation. Microorganisms in Bioremediation,	15

		Mycoremediation and Phytoremediation. Bioremediation Technologies. Measuring Bioremediation in the Field. Bioaugmentation and Biostimulation. Monitoring the Efficacy of Bioremediation.	

Learning Resources recommended:

1. Environmental Biotechnology by Indu Shekhar Thakur, IK International
2. Environmental Biotechnology by Allan Scragg Oxford University press

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Biostatistics and Bioinformatics
Course Code	USBT405
Class	S. Y. B. Sc.
Semester	IV
No. of Credits	02
Nature	Theory/ ~~Practical/ Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To learn and understand the basic concepts of bioinformatics.
CO2 – To learn and understand the basic concepts and problem solving skills in biostatistics.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Introduction to computers and biological databases	**Computer Basics :** Organization of a Computer; I/O Units; Computer Memory; Processor; Binary Arithmetic; Logic Circuit; Architecture; Operating System. **Internet Basics :** Connecting to the Internet, E-mail, FTP, www, Difference between www and Internet. **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). **Genome Information Resources:** DNA Sequence Databases Specialized Genomic Resources.	15

		Protein Databases based on Composition, Motifs and Patterns. **Protein Structure Visualization Software.**	
II	BLAST and sequence alignment	**BLAST and Sequence Alignment:** BLAST and its Types; Retrieving Sequence using BLAST. **Pairwise Alignment:** Identity and Similarity; Global and Local Alignment; Pairwise Database Searching. **Multiple Sequence Alignment:** 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.	15
III	Biostatistics	Theory and Problems based on- Coefficient of Correlation and Regression Analysis; Steps in Testing Statistical Hypothesis; Parametric Tests:- Z Test – Single Mean and Two Means, t-Test – Single Mean, Paired and Unpaired; Chi-Square Test.	15

Learning Resources recommended:

1. Bioinformatics by S. C. Rastogi
2. Bioinformatics by Attawood
3. Methods in Biostatistics by B. K. Mahajan

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	Unit	Marks
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Molecular Diagnostics
Course Code	USBT406
Class	S. Y. B. Sc.
Semester	IV
No. of Credits	02
Nature	Theory/ ~~Practical/ Project/ other (please specify)~~
Type	~~Core~~/ Elective

Course Outcomes:

CO1 - To learn and understand the molecular techniques and utilizing these techniques in diagnosis.

CO2 – To provide the importance of various nucleic acid amplification methods.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Basics of molecular diagnostics	**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. **Characterisation and analysis of Nucleic – Acids and Proteins:** Extraction, Isolation and Detection of DNA, RNA and Proteins; Restriction Endonucleases and Restriction Enzyme Mapping. **Hybridisation Techniques:** Southern, Northern, Western and FISH; Markers, Probes and its Clinical Applications.	15
II	Nucleic acid amplification methods	**Target amplification :** PCR - General Principle; Components of a Typical PCR	15

		Reaction; Experimental Design; Primer Designing; Control of PCR Contamination and Mispriming; PCR Product Clean-up and Detection. **PCR Types :** Reverse Transcriptase and Real Time PCR. **Probe amplification :** Ligase Chain Reaction	
III	Molecular Biology based diagnostics	**DNA Polymorphism and Identification:** RFLP and Parentage Testing; RFLP and Sickle-Cell Anaemia. **Molecular Diagnostics for Infectious Diseases** Molecular Testing for *Neisseria,* Molecular Diagnosis for HIV-1; **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. **Ethical, Social and Legal Issues to Molecular - Genetic Testing**	15

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 laboratorian, edited by William B. Coleman, Gregory J. Tsongalis

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Entrepreneurship Development
Course Code	USBT407
Class	S. Y. B. Sc.
Semester	IV
No. of Credits	02
Nature	Theory/ ~~Practical/ Project/ other (please specify)~~
Type	~~Core~~/ Elective

Course Outcomes:

CO1 - To develop and systematically apply an entrepreneurial way of thinking.
CO2 – To identify and create the business opportunities.

Curriculum:

Unit	Title	Learning Points	No. of Lectures
I	Introduction to Entrepreneurship Development	Concept of Entrepreneur; Entrepreneurship; Need and Importance; Factors Influencing Entrepreneurship; Essentials of a Successful Entrepreneur	15
II	Setting-up of an Enterprise and Planning	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;	15
III	Marketing, sales, advertising and International market research	Marketing Plan for an Entrepreneur; Strategic Alliances, Advertising and Sales Promotion; Market Assessment, Need for International	15

		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

Evaluation Pattern

A. Internal Evaluation

Method	**Marks**
Class Test/ Online Examination	20
Assignment	10
Overall performance	10

B. Semester End Evaluation (Paper Pattern)

Question No.	**Unit**	**Marks**
1	I	Long Answer Questions 15 M
2	II	Long Answer Questions 15 M
3	III	Long Answer Questions 15 M
4	All Units	Short notes (03 out of 06) 15 M

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals based on USBT401 and USBT402
Course Code	USBTP401
Class	S. Y. B. Sc.
Semester	IV
No of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To impart knowledge and hands on experience of the various practicals related to biochemistry.
CO2 - To provide the knowledge and hands on experience of the various practicals related to applied chemistry.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practicals	1. Determination of Lactate Dehydrogenase (LDH) Activity in Blood Serum. 2. Determination of Total, LDL and HDL Cholesterol in Serum. 3. Organ Function Tests: Liver (SGPT, SGOT); Kidney (Urea from Serum). 4. Estimation of Uric Acid and Creatinine in Urine. 5. Qualitative Detection of Ketone Body in Urine. 6. Isolation of Mitochondria and Demonstration of ETC using a Marker Enzyme. 7. Separation of Binary (Solid-Solid) Mixture (Min 4 Compounds). 8. Identification of Organic Compound of Known Chemical Type (Min 4 Compounds). 9. HPLC analysis and Interpretation of any one Secondary Metabolite from Plants 10. Analysis of Essential Oils from any Plant Source using GC. 11. HPTLC fingerprint analysis of any one Medicinally Important Plant. 12. Chemical and Biological Synthesis of Silver Nanoparticles and its Characterisation by UV- VIS Spectrophotometer.	120

Learning Resources recommended:

1. Vogel's Textbook of Quantitative chemical analysis, 6th edition
2. Textbook of organic chemistry for T. Y. B. Sc., Himalaya Publishing House
3. Nanomaterials by B. Viswanathan
4. Polymer Science, V. R. Gowariker, Viswanathan
5. Biochemistry by Satyanarayan and Chakrapani
6. Lehninger Principles of Biochemistry, 4th edition, Nelson and Cox
7. Biochemistry, Voet and Voet, 3rd edition
8. General Microbiology by Stanier

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
Practicals of USBTP401	4 experiments of 1.5 hrs duration (02 Papers)	06 hrs	60 M (02 Papers) (02 Major and 02 Minor Experiments OR 02 Major Experiments)	40 M (20 M for Journal, 10 M for viva, 10 M for overall performance)	100

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals based on USBT403 and USBT404
Course Code	USBTP402
Class	S. Y. B. Sc.
Semester	IV
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To impart knowledge and hands on experience of the various practicals related to medical microbiology.
CO2 - To impart knowledge and hands on experience of the various practicals related to environmental biotechnology.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practicals	1. Identification of *S. aureus* - Isolation, Catalase, Coagulase Test. 2. Identification of *E. coli*- Isolation, Sugar Fermentations, IMViC. 3. Identification of Salmonella- Isolation, Sugar Fermentations, TSI Slant. 4. Identification of Shigella- Isolation, Sugar Fermentations, TSI Slant. 5. Identification of Proteus- Isolation, Sugar Fermentations, IMViC. 6. Identification of Pseudomonas - Isolation, Urease test, Oxidase Test, TSI Slant. 7. RPR Test (Kit Based). 8. Permanent Slide- Mycobacterium. 9. Biological Oxygen Demand (BOD). 10. Chemical Oxygen Demand (COD). 11. Isolation of Bacteria from Air by Gravity Sedimentation Method. 12. Most Probable Number (MPN) – Presumptive, Confirmed and Completed Tests. 13. Bioremediation of Metal.	120
Visit	Visit to STP / CETP	

Learning Resources recommended:

1. Microbiology: An introduction, Tortora, 9th edition
2. Microbiology by Pelczar and Chan, 5th edition
3. Environmental Biotechnology by Indu Shekhar Thakur, IK International
4. Environmental Biotechnology by Allan Scragg Oxford University press

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
Practicals of USBTP402	4 experiments of 1.5 hrs duration (02 Papers)	06 hrs	60 M (02 Papers) (02 Major and 02 Minor Experiments OR 02 Major Experiments)	40 M (20 M for Journal, 10 M for viva, 10 M for overall performance)	100

Syllabus for S. Y. B. Sc. Biotechnology Autonomous from the year 2023-24

Name of the Course	Practicals based on USBT405 and USBT406
Course Code	USBTP403
Class	S. Y. B. Sc.
Semester	IV
No. of Credits	02
Nature	~~Theory~~/ Practical/ ~~Project/ other (please specify)~~
Type	Core/ ~~Elective~~

Course Outcomes:

CO1 - To impart knowledge and hands on experience of the various practicals related to biostatistics and bioinformatics.
CO2 - To impart knowledge and hands on experience of the various practicals related to molecular diagnostics.

Curriculum:

Title	Learning Points	No. of Lectures
Regular Practicals	1. Familiarization with NCBI, EMBL, DDBJ, PIR, KEGG Databases. 2. Use of NCBI BLAST Tool. 3. Pairwise and Multiple Sequence Alignment and Phylogeny. 4. Classification of Proteins using CATH/SCOP. 5. Visualization PDB Molecules using Rasmol/Raswin. 6. Handling and Calibration of Micropipette. 7. Isolation, Quantitative Analysis and AGE of Genomic DNA from Bacteria and Yeast. 8. Isolation and Detection of RNA from Bacteria and Yeast. 9. Restriction Enzyme Digestion. 10. RFLP- Kit Based. 11. Primer Designing through Open Online Source NCBI-BLAST. 12. DNA Amplification – PCR.	120

Learning Resources recommended:

1. Bioinformatics by S. C. Rastogi
2. Bioinformatics by Attawood
3. Methods in Biostatistics by B. K. Mahajan
4. Molecular Diagnostics by George Patrinos
5. Molecular Diagnostics: Fundamentals, methods and clinical applications, Lela Buckingham and Maribeth Flaws
6. Molecular Diagnostics: For the clinical laboratorian, edited by William B. Coleman, Gregory J. Tsongalis

Evaluation Pattern

	No. of Experiments	Duration	Total Marks	CIE	Total
Practicals of USBTP403	4 experiments of 1.5 hrs duration (02 Papers)	06 hrs	60 M (02 Papers) (02 Major and 02 Minor Experiments OR 02 Major Experiments)	40 M (20 M for Journal, 10 M for viva, 10 M for overall performance)	100

Sd/-

(Rashmi A. Bhave)
The Chairperson, BoS