



**Resolution No.:**

**Bharatiya Vidya Bhavan's  
M. M. College of Arts, N.M. Institute of Science,  
H.R.J. College of Commerce. (Bhavan's College)  
Autonomous  
(Affiliated to University of Mumbai)**



**Syllabus for: S.Y.B.Sc. Biotechnology**

**Program: B.Sc.**

**Program Code: BH.US**

**Course Code: (BH.USBT)**

**Choice Based Credit System (CBCS)  
with effect from academic year 2022-23**



## Program Outcomes – UG Programme in science

The B.Sc. programme is formulated based on the inputs received from the members of Board of Studies of Bhavan's College (Autonomous) and is geared to meet the standards prescribed by general science education. Our students are allowed to choose from any of the three subjects from the cluster of physics, chemistry, botany, zoology, statistics, mathematics and microbiology. Some learning outcomes include:

- PO1. Disciplinary Knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more other disciplines that form a part of an undergraduate programme of study. This programme helps students in building a solid foundation for further higher studies and research
- PO 2. Critical Thinking & Competency in Skills:** Take informed actions after identifying the assumptions that frame our thinking and actions. Critically evaluate practices, policies and theories by following scientific approach to knowledge development. Obtain proficiency in analytical reasoning, critical understanding, analysis and synthesis in order to solve theoretical and practical problems. This can orient students towards applications of their subject in other disciplines and, can also be utilized in modelling and solving real life problems.
- PO3: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; communicate with others using appropriate media; confidently share one's views and express herself/ himself; demonstrate the ability to listen carefully; and present complex information in a clear and concise manner to different groups.
- PO 4. Social Interaction:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group and act together as a group or a team in the interests of a common cause. Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- PO 5: Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.
- PO6: Interdisciplinary and Research Skills:** A sense of inquiry and capability for asking relevant/ appropriate questions, Ability to recognize cause- and- effect relationships, define problems, formulate hypotheses, interpret and draw conclusions from data, ability to plan, execute and report the results of an experiment or investigation which will enable them to apply one's learning to real life situations
- PO7: Proficiency in Employments:** This programme will help students to enhance their employability for Government jobs, related to science, data analysis jobs, and jobs in various other public and private enterprises.



## PROGRAM SPECIFIC OUTCOMES

	DESCRIPTION
	<b>A student completing Bachelor's Degree in B.Sc. program in the subject of Biotechnology will be able to:</b>
<b>PSO-1</b>	Understand the basic principles of Biochemistry, and Biophysics
<b>PSO-2</b>	Understand the basic concepts of Product chemistry and nanotechnology
<b>PSO-3</b>	Understand the basic concepts of Immunology and medical microbiology
<b>PSO-4</b>	Understand and to learn different fields of environmental biotechnology and cytogenetics
<b>PSO-5</b>	<i>To gain the knowledge of process of basic Molecular Biology and its application in biotechnology and genetic engineering.</i>
<b>PSO-6</b>	Understand the basics of bioprocess technology and molecular diagnostics

## PROGRAM OUTLINE

SEM	COURSE CODE	COURSE TITLE	Course Type	CREDITS
III	BH.USBT301	BIOPHYSICS-I	Core Subject	2
III	BH.USBT302	APPLIED CHEMISTRY I	Core Subject	2
III	BH.USBT303	IMMUNOLOGY	Core Subject	2
III	BH.USBT304	CELL BIOLOGY & CYTOGENETICS	Core Subject	2
III	BH.USBT305	MOLECULAR BIOLOGY & GENETIC ENGINEERING	Core Subject	2
III	BH.USBT306	BIOPROCESS TECHNOLOGY	Skill Enhancement Elective	2
III	BH.USBT307	RESEARCH METHODOLOGY AND SCIENTIFIC COMMUNICATION	General Elective	2
III	BH.USBT301	Practicals of USBT301, USBT302	Core Subject Practicals	2
III	BH.USBT302	Practicals of USBT303, USBT304	Core Subject Practicals	2
III	BH.USBT303	Practicals of USBT305, USBT306	Core Subject and Skill Enhancement Elective Practicals	2
IV	BH.USBT401	BIOCHEMISTRY	Core Subject	2
IV	BH.USBT402	APPLIED CHEMISTRY II	Core Subject	2
IV	BH.USBT403	MEDICAL MICROBIOLOGY	Core Subject	2
IV	BH.USBT404	ENVIRONMENTAL BIOTECHNOLOGY	Core Subject	2
IV	BH.USBT405	BIOSTATISTICS AND BIOINFORMATICS	Core Subject	2
IV	BH.USBT406	MOLECULAR DIAGNOSTICS	Skill Enhancement Elective	2
IV	BH.USBT407	ENTERPRENEURSHIP DEVELOPMENT	General Elective	2



IV	BH.USBTP401	Practicals of USBT401, USBT402	Core Subject Practicals	2
IV	BH.USBTP402	Practicals of USBT403, USBT404	Core Subject Practicals	2
IV	BH.USBTP403	Practicals of USBT405, USBT406	Core Subject and Skill Enhancement Elective Practical	2
		TOTAL		20 + 20



## **PREAMBLE**

Twenty First Century is known as the 'Century of Biotechnology'. Biotechnology is one of the youngest branches of Life Science, which has expanded and established as an advanced interdisciplinary applied science in last few years. Biotechnology at the core envisages the comprehensive study of Life and the Interdisciplinary potential of Biotechnology has led to a unique status for Biotechnology in Research and Industry.

The socio-economic potential of Biotechnology is well established which has almost become synonymous with modern development. Biotechnology has its applications in almost every field touching practically every human activity. The applied aspect of Biotechnology is now getting established with its applications in Industry, Agriculture, Health and Environment, Biotechnology is the lead science expanding exponentially.

Biotechnology demands a trained, skilled human resource to establish the Industry and Research sectors. The field is novel and still expanding which demands inputs in Infrastructure and Technology. The global and local focus is on developing new technological applications are fast growing. Biotechnology sector in Research and Industry is expanding which is set to augur the next major revolution in the world.

The demand for trained workforce in Biotechnology is ever growing in Fundamental Research and Industry Sector. Academic and Research Sectors also require interdisciplinary trained manpower to further the Biotechnology Revolution.

The need of the hour is to design appropriate syllabi which keeps pace with changing times and technology with emphasizes on applications while elucidating technology in depth. The present Syllabi is Restructured anticipating the future needs of Biotechnology Sector with more emphasis on imparting *hands-on* skills. The main thrust is laid on making syllabus compatible with developments in Education, Research and Industrial sectors. The Theory and Practical course in new restructured course will lead to impart *skill-set essentials* to further Biotechnology Sector.

The restructured syllabus combines basic principles of Physical, Chemical and Biological sciences in light of advancements in technology. The curriculum aims to impart basic knowledge with emphasis on its applications to make the students industry ready.



# **SEMESTER III**



<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: III</b>	
<b>Course: S.Y.B.Sc. : Biophysics</b>				<b>Course Code: BH.USBT301</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial(Pe riods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2+1=03</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>
<b>Course Objectives:</b> The objective of this course is to have a firm foundation of the fundamentals and applications of current biophysical theories.					
<b>Course Outcomes:</b> By the end of the course the student will be able to:					
<ul style="list-style-type: none"> <li>Relate principles of Physics to applications and techniques in the field of Biology such as Microscopy, Spectroscopy and Electrophoresis.</li> </ul>					
<b>INDEX</b>					
<b>Module</b>	<b>Description</b>				<b>No of Lect.</b>
<b>1</b>	<b>Optics and Electromagnetic Radiations</b>				<b>15</b>
<b>2</b>	<b>Sound, Magnetism and Fluid Dynamics</b>				<b>15</b>
<b>3</b>	<b>Electrophoretic Techniques</b>				<b>15</b>
	<b>TOTAL</b>				<b>45</b>
<b>Detailed syllabus</b>					
<b>Units</b>	<b>Detailed descriptions</b>				<b>Lecture period /unit</b>
<b>UNIT I Spectroscopy and Microscopy</b>	<b>Spectroscopy :</b> Types and Properties of Spectra; Basic Laws of Light Absorption. Spectrophotometer:-Principle, Instrumentation and Applications; UV-Vis Spectrophotometer, Single and Dual Beam Spectrophotometer. <b>Microscopy:</b> Types of Microscopy; Electron Optics; Electron Microscopy-Preparation of Specimen, SEM, TEM and Immuno-Electron Microscopy. Fluorescence Microscopy.				<b>15</b>
<b>UNIT II Sound, Magnetism and Fluid Dynamics</b>	<b>Sound:</b> Types of Sound Waves - Audible, Ultrasonic and Infrasonic Waves; Doppler Effect; Applications of Ultrasonic Waves. <b>Magnetism:</b> Magnetic Field; Nuclear Magnetism and Biomagnetism. <b>Fluid Dynamics : Viscosity:</b> Definition Flow of Liquids through Capillaries; Stokes' Law; Terminal Velocity. Determination of 'η' by Falling Sphere Method; Viscosity Estimation by Oswald's Viscometer. <b>Surface Tension:</b> Definition - Surface Tension and Surface Energy; Capillary Action; Angle of Contact; Wettability; Temperature Dependence of Surface Tension. Applications in Biology.				<b>15</b>



<b>Unit III</b>	<b>Electrophoresis:</b>	<b>15</b>
<b>Electrophoretic Techniques</b>	Migration of Ions in an applied electric field; Factors affecting Electrophoretic Mobility; Moving Boundary Electrophoresis; 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.	
	<b>TOTAL</b>	<b>45</b>

### Reference books

1. Essential Biophysics, Narayanan, New Age Publ
2. Handbook of Molecular Biophysics (Methods & Application), 2009, HG Bohr, Wiley
3. Principles & techniques of Biochemistry & Molecular Biology, Wilson & Walker.

### Details of Continuous Assessment (CIA)

Continuous Assessment	Details	Marks
Component 1 (CIA-1)	Written Test	20 marks
Component 2 (CIA-2)	Poster / Powerpoint presentation	20 marks





<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: III</b>	
<b>Course: S.Y.B.Sc. : APPLIED CHEMISTRY-I</b>				<b>Course Code: BH.USBT302</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial(Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2+1=03</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>

**Course Objectives:** The objective of this course is to have a firm foundation of the fundamentals and applications of Organic and Green Chemistry.

**Course Outcomes:** By the end of the course the student will be able to:

- Develop an understanding of the different aspects of Organic and Green Chemistry.
- Discuss role of Organic Compounds in Biology and Synthesis of Organic Compounds.
- Discuss role of Green Chemistry and its application in Industry.

### INDEX

Module	Description	No of Lect.
<b>1</b>	<b>ORGANIC CHEMISTRY</b>	<b>15</b>
<b>2</b>	<b>SYNTHESIS OF ORGANIC COMPOUNDS</b>	<b>15</b>
<b>3</b>	<b>GREEN CHEMISTRY AND SYNTHESIS</b>	<b>15</b>
	<b>TOTAL</b>	<b>45</b>

### Detailed syllabus

Units	Detailed descriptions	Lecture period /unit
<b>UNIT I Organic Chemistry</b>	<p><b>Introduction to Types of Organic Reactions :</b> Types of addition, elimination and substitution reaction Essential and Non-essential Elements in Biological Systems. Role of Metal Ions in Biological Systems.</p> <p><b>Metal Coordination in Biological Systems :</b> Enzymes, Apoenzymes and Coenzymes. Biological Role of Metalloenzymes <i>wrt</i> Myoglobins, Haemoglobin. Biological Role of Carboxypeptidases, Catalases and Peroxidases. Application of enzymes</p> <p><b>Structure and Function :</b> Di-oxygen Binding, Transfer and Utilization; Metal Complexes in Medicines.</p>	<b>15</b>
UNIT II Synthesis of Organic Compounds	<p><b>Synthesis of Organic Compounds :</b> Criteria for Ideal Synthesis; Selectivity and Yield. Linear and Convergent Synthesis and Multicomponent Reactions. Microwave Assisted Organic Synthesis(microwave assisted synthesis of nanomaterials), Ultrasound in Synthesis( sonochemical synthesis of nanomaterials) and Polymer supported Synthesis. <b>Retro synthesis.</b></p>	<b>15</b>
UNIT III	<p><b>Green Chemistry and Synthesis:</b> Introduction to Green Chemistry Principles of Green Chemistry.</p>	<b>15</b>



Green Chemistry and Synthesis	Green Synthesis in Industry: Green Materials, Green Reagents, Green Solvents and Green Catalysts. <b>(Commercial applications of all green reagents, solvents, materials and catalyst)</b>	
	<b>TOTAL</b>	<b>45</b>

### Reference books

Organic Chemistry, R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, 7th Edition, Pearson Education (2011).  
 Organic Chemistry, T.W.G. Solomon and C.B. Fryhle, 9th Edition, John Wiley & Sons, (2008)  
 V.K. Alhuwalia, New trends in green chemistry, 2nd edition (2006)  
 U. Satyanarayan Principles of biochemistry, 4<sup>th</sup> edition (2013)  
 Nanotechnology principles and practices, 3<sup>rd</sup> edition Dr. Sulbha kulkarni, 3<sup>rd</sup> edition (2014)  
 Himalaya publication, College organic chemistry textbook T.Y.B.Sc 13<sup>th</sup> edition (2019)  
 Kenji Okitsu Francesca Cavaleri Sonochemical Production of Nanomaterials (2017)

### Details of Continuous Assessment (CIA)

Continuous Assessment	Details	Marks
Component 1 (CIA-1)	Written Test	20 marks
Component 2 (CIA-2)	Poster / Powerpoint presentation	20 marks



<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: III</b>	
<b>Course: S.Y.B.Sc. : IMMUNOLOGY</b>				<b>Course Code: BH.USBT303</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial(Pe riods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2+1=03</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>

**Course Objectives:**

The objective of this course is to familiarize students with the Immune Effector Mechanisms and various Immuno Techniques

**Course Outcomes:**

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

1. Understand the role of different types of Cells, Effector Molecules and Effector Mechanisms in Immunology.
2. Understand the principles underlying various Immunotechniques.
3. Differentiate the precipitation and agglutination reactions using suitable examples and effectively determine various tests used for detection of antigens.

**INDEX**

Module	Description	No of Lect.
<b>1</b>	<b>The Immune System</b>	<b>15</b>
<b>2</b>	<b>Cell Receptors</b>	<b>15</b>
<b>3</b>	<b>Immuno Techniques</b>	<b>15</b>
<b>TOTAL</b>		<b>45</b>

**Detailed syllabus**

Units	Detailed descriptions	Lecture period /unit
<b>UNIT I The Immune System</b>	Primary and Secondary Lymphoid Organs. Complement System- Classical, Alternate and Lectin; Regulation and Biological Effects of Complement System; Deficiencies of Complement System	<b>15</b>
<b>UNIT II Cell Receptors:</b>	T-cell Receptor Complex : Structure and Activation. MHC Classes - Structures and Peptide Interactions; Class I and II  Antigen Presentation - Endocytic and Exocytic Pathways; B-cell Receptor : Structure, Maturation and Activation B-T Cell Interaction (B-T cell Cooperation).	<b>15</b>
<b>UNIT III Immuno-Techniques</b>	Precipitation Reactions : Immunoprecipitation, Immunoelectrophoresis, CIEP, Rocket Electrophoresis and 2-D Immunoelectrophoresis. Agglutination Reactions : Passive, Reverse Passive, Agglutination Inhibition.	<b>15</b>



	Coomb's Test; Complement Fixation Tests, RIA, ELISA, ELISPOT, Chemiluminescence, Western Blot, Immunofluorescence, Flow Cytometry. Alternatives to Antigen-Antibody Reactions.	
	<b>TOTAL</b>	<b>45</b>

### Reference books

1. Judy Owen, Jenni Punt, Sharon Stranford, Kuby immunology, 7th edition (2012), Freeman and Co., NY
2. Sudha Gangal and Shubhangi Sontakke, Textbook of basic and clinical immunology, 1st edition (2013), University Press, India
3. Male, Jonathan Brostoff, David Roth, Ivan Roitt, Immunology, 7th edition (2006), David Mosby, USA.
4. C V Rao, 5<sup>th</sup> edition, Introduction to Immunology - - Narosa Publishing Hous

### Details of Continuous Assessment (CIA)

Continuous Assessment	Details	Marks
Component 1 (CIA-1)	Written Test	20 marks
Component 2 (CIA-2)	Poster / Powerpoint presentation	20 marks



<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: III</b>	
<b>Course: S.Y.B.Sc. : CELL BIOLOGY AND CYTOGENETICS</b>				<b>Course Code: BH.USBT304</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2+1=03</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>
<b>Course Objectives:</b>					
The objective of this course is to have a firm foundation in the fundamentals of cell biology and cytogenetics.					
<b>Course Outcomes:</b>					
By the end of the course the student will be able to:					
1. develop an understanding of the cytoskeleton and cell membrane.					
2. discuss the structure of nucleus and various aspects of Cell cycle and Cell division:					
3. discuss the Structure and Significance of Special type of Chromosomes, sex linkage and Extra Chromosomal Inheritance					
<b>INDEX</b>					
<b>Module</b>	<b>Description</b>				<b>No of Lect.</b>
<b>1</b>	<b>Cytoskeleton</b>				<b>15</b>
<b>2</b>	<b>Cell Cycle and Cell Division</b>				<b>15</b>
<b>3</b>	<b>Cytogenetics</b>				<b>15</b>
	<b>TOTAL</b>				<b>45</b>
<b>Detailed syllabus</b>					
<b>Units</b>	<b>Detailed descriptions</b>				<b>Lecture period /unit</b>
<b>UNIT I Cytoskeleton</b>	<b>Overview of the Major Functions of Cytoskeleton.</b> 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.				<b>15</b>
<b>UNIT II Cell cycle and Cell division:</b>	<b>Cell cycle and Cell division:</b> Nucleus: Morphology, nuclear envelope, nucleoplasm, nucleolus and chromatin. Cell Cycle: G1, S, G2 and M phases, Check points. Mitosis: Stages, Mitotic apparatus, cytokinesis, Mitogens and Inhibitors, Significance. Meiosis: Stages, Synaptonemal complex, crossing over and chiasma formation, Significance. Cell senescence and Cell death (Apoptosis): Programmed cell death, Mechanism of cell death and significance.				<b>15</b>



<b>UNIT III</b> <b>Cytogenetics</b>	<b>Cytogenetics:</b> Structure and Significance of Special type of Chromosomes: Polytene Chromosome - Salivary gland chromosome in Drosophila, Lampbrush chromosome in amphibian Oocyte. Supernumerary B Chromosome. Sex Linkage: Definition of sex linkage, Meiotic behavior of chromosome and non - disjunction. Sex linkage in Drosophila. Sex linked genes in poultry, moths and man, Sex linked inheritance in man (Colour-blindness, Haemophilia), Attached X-chromosome. Extra Chromosomal Inheritance / Cytoplasmic Inheritance: Characteristic features of Cytoplasmic Inheritance. Inheritance of: Mitochondrial DNA, Chloroplast DNA, Kappa articles in Paramecium, Sigma factor in Drosophila, Shell coiling in snail.	<b>15</b>
	<b>TOTAL</b>	<b>45</b>

**Reference books**

1. Cytogenetics, Plant Breeding and evolution by U.Sinha and Sunita Sinha , Vikas Publishing House Private, Limited, 1998.
2. Cytology, Genetics and Molecular Biology by P.K.Gupta (2002), Rastogi publications.
3. Elements of Genetics by Phundan Singh, Kalyani Publishers. 2009.
4. Principles of Genetics by E.J.Gardener, M.J.Simmons and D.P.Snustad.J.Wiley and Sons pubs (1998).

**Details of Continuous Assessment (CIA)**

Continuous Assessment	Details	Marks
Component 1 (CIA-1)	Written Test	20 marks
Component 2 (CIA-2)	Poster / Powerpoint presentation	20 marks



<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: III</b>	
<b>Course: S.Y.B.Sc. : Molecular Biology &amp; Genetic Engineering</b>				<b>Course Code: BH.USBT305</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2+1=03</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>
<b>Course Objectives:</b>					
The objective of this course is to acquaint students with concept of Molecular Biology and genetic Engineering.					
<b>Course Outcomes:</b>					
By the end of the course the student will be able to:					
1. gain an understanding of the basic concepts of Molecular Biology					
2. Understand the tools used in Genetic Engineering.					
<b>INDEX</b>					
<b>Module</b>	<b>Description</b>				<b>No of Lect.</b>
<b>1</b>	<b>Regulation of Gene Expression in Prokaryotes and Viruses</b>				<b>15</b>
<b>2</b>	<b>Regulation of Gene Expression in Eukaryotes</b>				<b>15</b>
<b>3</b>	<b>Basics of Genetic Engineering</b>				<b>15</b>
	<b>TOTAL</b>				<b>45</b>
<b>Detailed syllabus</b>					
<b>Units</b>	<b>Detailed descriptions</b>				<b>Lecture period /unit</b>
<b>UNIT I</b>  <b>Regulation of Gene Expression in Prokaryotes and Viruses</b>	<b>In Prokaryotes: In Bacteria :</b> lac Operon of E.coli; trp Operon of E.coli.  <b>In Viruses :</b> Lytic / Lysogenic Regulation				<b>15</b>
<b>UNIT II</b>  <b>Regulation of Gene Expression in Eukaryotes</b>	<b>In Eukaryotes :</b> Control of Transcriptional Initiation; Gene Silencing and Genomic Imprinting; Post-Transcriptional Control; Protein Translocation RNA Interference.				<b>15</b>
<b>UNIT III</b> <b>Basics of Genetic Engineering</b>	<b>Gene cloning-</b> Isolation and purification of Nucleic Acids; <b>Isolation of gene of interest:</b> Restriction digestion, electrophoresis, blotting, cutting, and joining DNA, <b>methods of gene transfer</b> in prokaryotes and eukaryotes				<b>15</b>



	<b>Recombinant selection and screening methods:</b> genetic, immunochemical, Southern and Western analysis, nucleic acid hybridization, <b>Cloning strategies</b> -genomic DNA libraries, cDNA libraries,	
	<b>TOTAL</b>	<b>45</b>

### Reference books

1. iGenetics- Peter Russell -Pearson Education
2. Genes XI, 11th edition (2012), Benjamin Lewin, Publisher - Jones and Barlett Inc. USA

### Details of Continuous Assessment (CIA)

Continuous Assessment	Details	Marks
<b>Component 1 (CIA-1)</b>	<b>Written Test</b>	<b>20 marks</b>
<b>Component 2 (CIA-2)</b>	<b>Poster / Powerpoint presentation</b>	<b>20 marks</b>





<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: III</b>	
<b>Course: S.Y.B.Sc. : BIOPROCESS TECHNOLOGY: UPSTREAM AND DOWNSTREAM PROCESSING(Skill enhancement)</b>				<b>Course Code: BH.USBT306</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial( Periods per week per batch)</b>	<b>Credits (Theory +Practical )</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2+1=03</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>

**Course Objectives:**

The objective of this course is to understand the basic skills applied in Fermentation Technology and build a foundation for more advanced studies in Bioprocess Technology.

**Course Outcomes:** By the end of the course the student will be able to

- Develop an understanding of the various aspects of Bioprocess Technology.
- Develop skills associated with screening of Industrially Important Strains
- Understand principles underlying design of Fermenter and Fermentation Process
- To understand isolation and purification of product after fermentation and assaying product to know the productivity

**INDEX**

<b>Module</b>	<b>Description</b>	<b>No of Lect.</b>
<b>1</b>	<b>Microorganisms in Industrial Processes</b>	<b>15</b>
<b>2</b>	<b>Fermenter and Fermentation media</b>	<b>15</b>
<b>3</b>	<b>Assay and recovery of product</b>	<b>15</b>
	<b>TOTAL</b>	<b>45</b>

**Detailed syllabus**

<b>Units</b>	<b>Detailed descriptions</b>	<b>Lecture period /unit</b>
<b>1</b>	<b>Microorganisms in Industrial Processes</b>	<b>15L</b>
<b>i.</b>	Types of Microorganisms used in Industrial Processes: Bacteria, Actinomycetes, Fungi and Algae.	
<b>ii.</b>	Screening and Maintenance of Strains: Primary Screening and Secondary Screening	
<b>iii.</b>	Strain improvement and development	
<b>iv.</b>	Preservation of Industrially Important Microbial Strains	
<b>2.</b>	<b>Fermenter and Fermentation media</b>	<b>15L</b>
<b>i.</b>	Design of a fermenter : - Basic Design; Parts of a Typical Industrial Fermentor, Process Parameters: pH, Temperature, Aeration, Agitation, Foam, pressure, dissolved oxygen, flow and load etc.	
<b>ii.</b>	Different types of fermenters Stirred Tank Fermenter Airlift, bubble column, Deep shaft	



iii.	Fermentation Media: Components; Design and Optimization. Sterilization :		
iv.	Sterilization of Fermenter and Fermentation Media.		
<b>Deletion from unit:2</b>	<b>Product Isolation and Purification. Study of Representative Fermentation Processes : Outline of Penicillin and Ethanol Production by Fermentation along with a flow-diagram</b> <b>Types of Fermentation: Surface and Submerged; Batch and Continuous, Aerobic and Anaerobic.</b>	<b>Types of fermentation with examples will be included in TY as applications</b>	<b>of</b>
3	<b>Assay and recovery of product</b>	<b>15L</b>	
i.	Introduction of DSP 1. Solid liquid separation Foam separation Precipitation – Centrifugation (Basket, Tubular bowl, Multichamber), Chromatography (Application of adsorption, Ions exchange, Seize exclusion and affinity chromatography) Filtration (Batch filtration (Plate and frame) and Continuous filtration (Drum filter) 2. Cell disruption- physical and chemical methods 3. Solvent extraction (single stage, Co-current and counter current extraction) 4. Drying		
ii.	Assay of fermentation product 1. Physicochemical 2. Biological		
	<b>TOTAL</b>	<b>45</b>	

#### REFERENCES:

- Text book
- 1 L. E. Casida. (1991) .Industrial Microbiology. (1st ed) Wiley Publisher.John Wiley & Sons Canada, Limited,
  - 2 P. F. Stanbury and A. Whitaker, (2003) Principles of Fermentation Technology (2nd Edition).Elsevier Science Ltd
  - 3 A. H. Patel (1996), Industrial Microbiology. (1st ed) Macmillan India Ltd.  
+Reference book
  - 4.E. M. T. El-Mansi, C. F. A. Bryce, (1999) Fermentation Microbiology and Biotechnology. CRC press
  5. W. Crueger and A. Crueger. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

#### Details of Continuous Assessment (CIA)

Continuous Assessment	Details	Marks
Component 1 (CIA-1)	Written Test	20 marks
Component 2 (CIA-2)	Poster / Powerpoint presentation	20 marks



<b>Course: S.Y.B.Sc. : RESEARCH METHODOLOGY AND SCIENTIFIC COMMUNICATION</b>				<b>Course Code: BH.USBT307</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>
<b>Course Objectives:</b>					
The objective of this course is to develop Research Aptitude, Logical Thinking and Reasoning.					
<b>Course Outcomes:</b>					
By the end of the course the student will be able to:					
<ul style="list-style-type: none"> <li>• Understand basic principles of Research Methodology and identify a Research Problem.</li> <li>• Understand a general definition of Research Design.</li> <li>• Identify the overall Process of Designing a Research Study from its inception to its Report.</li> </ul>					
<b>INDEX</b>					
<b>Module</b>	<b>Description</b>				<b>No of Lect.</b>
<b>1</b>	<b>Introduction to Research Methodology and Research Design</b>				<b>15</b>
<b>2</b>	<b>Interpretation and Report Writing</b>				<b>15</b>
<b>3</b>	<b>Scientific Writing and Communication Skills</b>				<b>15</b>
	<b>TOTAL</b>				<b>45</b>
<b>Detailed syllabus</b>					
<b>Units</b>	<b>Detailed descriptions</b>				<b>Lecture period /unit</b>
<b>UNIT I Introduction to Research Methodology and Research Design</b>	Meaning of Research; Objectives of Research; Types of Research; Research Approaches; Significance of Research; Research Methods versus Methodology; Research Process; Criteria of Good Research; Meaning of Research Design; Need for Research Design; Features of a Good Design; Important Concepts Relating to Research Design; Basic Principles of Experimental Designs; Collection of Primary Data; Observation Method; Interview Method; Collection of Data through Questionnaires; Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method				<b>15</b>
<b>UNIT II Interpretation and Report Writing</b>	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.				<b>15</b>
<b>Unit III Scientific Writing and</b>	Communication Skills				<b>15</b>



<p><b>Communication Skills</b></p>	<p>Introduction to Communication – Communication Elements -- Verbal and Non-Verbal Communications.</p> <p>Principles of Effective Communication,</p> <p>Oral Presentations Scientific Reading, Writing &amp; Presentation Scientific Writing Process of Scientific Writing: Thinking, Planning, Rough Drafts and Revising Contents.</p> <p>Introduction to Scientific Reports and Writings Compilation of Experimental Data, Communication Methods in Science,. Writing Papers, Reviews, Bibliography Plagiarism--Introduction to Plagiarism , Examples of Plagiarism</p>	
	<p><b>TOTAL</b></p>	<p><b>45</b></p>
<p><b>References :</b></p> <p style="text-align: center;">1. Research methodology- C.R. Kothari</p>		
<p><b>Details of Continuous Assessment (CIA)</b></p>		
<p><b>Continuous Assessment</b></p>	<p><b>Details</b></p>	<p><b>Marks</b></p>
<p><b>Component 1 (CIA-1)</b></p>	<p><b>Written Test</b></p>	<p><b>20 marks</b></p>
<p><b>Component 2 (CIA-2)</b></p>	<p><b>Poster / Powerpoint presentation</b></p>	<p><b>20 marks</b></p>



### **SEM 3 PRACTICALS**

#### **PRACTICALS OF BIOPHYSICS AND APPLIED CHEMISTRY**

1. Absorption spectra of coloured compounds
2. Verification of Beer Lambert's law
3. Isolation of plasmid DNA culture
4. Extraction and isolation of plasmid DNA
5. Quantification of plasmid DNA
6. Agarose gel electrophoresis
7. Electron microscopy
8. Fluorescence microscopy
9. SDS page
10. Purification by recrystallisation
11. Estimation of : acetone, amide, benzoic acid
12. Synthesis of : acetanilide, dibenzal propanol

#### **PRACTICALS OF IMMUNOLOGY, CELL BIOLOGY AND CYTOGENETICS**

1. Complement fixation test
2. RA factor test
3. Immunoelectrophoresis
4. Hepelisa
5. Dot ELISA
6. Western blotting
7. Flow cytometry
8. Study of chromosomal aberrations
9. Induction of polyploidy in plants
10. Study of polytene chromosome
11. Gene mapping
12. Pedegree analysis

#### **PRACTICALS OF MOLECULAR BIOLOGY AND BIOPROCESS TECHNOLOGY**

1. Study of E.coli Diauxic Growth Curve- (Lactose and Glucose).
2. Study of lac Gene Expression using Blue-White Selection
3. Expression of  $\beta$ -galactosidase and Measurement of Activity.
4. Screening for an Alcohol Producing Strain of Microorganisms
5. Determination of Ethanol tolerance of alcohol producing strain
6. Determination of Sugar tolerance of alcohol producing strain
7. Lab Scale Production of Ethanol.
  - a. Inoculum preparation
  - b. Fermentation proper
8. Purification of Ethanol from Broth Culture of Saccharomyces spp. by Distillation.
9. Estimation of ethanol from Recovered Broth by dichromate method



# **SEMESTER IV**



<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: IV</b>	
<b>Course: S.Y.B.Sc. :Biochemistry</b>				<b>Course Code: BH.USBT401</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial(Pe riods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2+1=03</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>
<b>Course Objectives:</b>					
The objective of this course is to gain an insight into the Metabolic Processes associated with Catabolism of Carbohydrates, Amino Acids, Lipids and Nucleotides.					
<b>Course Outcomes:</b> By the end of the course the student will be able to					
<ul style="list-style-type: none"> <li>• Discuss the Metabolic Pathways of Carbohydrates, Amino Acids, Lipids and Nucleotides.</li> <li>• Explain the Role of Energy Rich Molecules in Metabolism</li> </ul>					
<b>INDEX</b>					
<b>Module</b>	<b>Description</b>				<b>No of Lect.</b>
<b>1</b>	<b>Carbohydrate Metabolism</b>				<b>15</b>
<b>2</b>	<b>Amino Acid Metabolism</b>				<b>15</b>
<b>3</b>	<b>Lipid and Nucleotide Metabolism</b>				<b>15</b>
	<b>TOTAL</b>				<b>45</b>
<b>Detailed syllabus</b>					
<b>Units</b>	<b>Detailed descriptions</b>				<b>Lecture period /unit</b>
<b>UNIT I Carbohydrate Metabolism, ETS and Energy Rich Compounds</b>	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 . Energy Rich Compounds : ATP as Energy Currency, Structure of ATP, Hydrolysis, Other Energy Rich Compounds other than ATP like PEP, Creatine Phosphate, etc.				<b>15</b>
<b>UNIT II Amino Acid Metabolism</b>	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)				<b>15</b>
<b>UNIT III Lipid and Nucleotide</b>	Lipid Metabolism : Mobilization, Transport of Fatty Acids. Beta, Alpha and Omega Oxidation of Saturated Fatty Acids;				<b>15</b>



<b>Metabolism</b>	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.		
	<b>TOTAL</b>	<b>45</b>	

**Reference books**

1. Jeffery Zubey , Principles of Biochemistry, 4th edition (1997), McGraw-Hill College, USA
2. David Nelson & Michael Cox, Lehninger , Principles of Biochemistry. 5th Edition (2008), W.H. Freeman and company, NY.
3. Donald Voet & Judith Voet , Fundamentals of Biochemistry. 3rd Edition (2008), Joh Wiley and Sons, I. USA
4. U. Satyanarayana & U. Chkrapani, Biochemistry 5th Edition 2019

**Details of Continuous Assessment (CIA)**

<b>Continuous Assessment</b>	<b>Details</b>	<b>Marks</b>
<b>Component 1 (CIA-1)</b>	<b>Written Test</b>	<b>20 marks</b>
<b>Component 2 (CIA-2)</b>	<b>Poster Presentation</b>	<b>20 marks</b>





<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: IV</b>	
<b>Course: S.Y.B.Sc. : Applied Chemistry-II</b>				<b>Course Code: BH.USBT402</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial(Pe riods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2+1=03</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>

**Course Objectives:** The objective of this course is to have a firm foundation of the fundamentals and applications of current Chemical Theories for the Physical World.

**Course Outcomes:** - By the end of the course the student will:

- Develop an understanding of the different aspects of Analytical Chemistry.
- Gain knowledge of Natural Product Chemistry and related acquired skills.
- Gain an understanding of basic concepts in Polymer Chemistry and Nanotechnology.

### INDEX

Module	Description	No of Lect.
<b>1</b>	<b>Sampling and Separation Techniques</b>	<b>15</b>
<b>2</b>	<b>Natural Product Chemistry And Chromatography</b>	<b>15</b>
<b>3</b>	<b>Polymers and Nanotechnology</b>	<b>15</b>
	<b>TOTAL</b>	<b>45</b>

### Detailed syllabus

Units	Detailed descriptions	Lecture period /unit
<b>UNIT I Sampling and Separation Techniques</b>	<p><b>Sampling :</b> Importance of Sampling and Sampling Techniques Types of Sampling - Random and Non-Random Sampling of Solids, Liquids and Gases. Hazards in sampling</p> <p><b>Separation Techniques :</b> 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, factors affecting sedimentation Chromatography: affinity chromatography and its applications , Ion exchange chromatography and its applications</p>	<b>15</b>
<b>UNIT II Natural Product Chemistry And Chromatography</b>	<p><b>Natural Product Chemistry :</b> 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. Concept of: Ultraviolet and visible spectroscopy</p>	<b>15</b>



	IR Spectroscopy X-ray Analysis <b>Chromatographic Separation of Natural Products :</b> Gas Chromatography and its Applications. Liquid Chromatography: HPLC and its Applications. HPTLC for Separation and Analysis of Natural Products.	
<b>UNIT III Polymers and Nanotechnology</b>	<b>Polymers :</b> Introduction to Polymers. Stereochemistry of Polymers. Biodegradable Polymers. <b>Nanotechnology :</b> Introduction to Nanomaterials. Forms of Nanomaterials : Nanoparticles, Nanofilms and Nanotubes Synthesis: Chemical method : Sol-gel method, colloidal route method Physical methods: high energy ball mill, melt mix , laser pyrolysis Biological synthesis using microbes, plant extracts protein , DNA Characterization of Nanomaterials. Applications of Nanomaterials in cosmetics, medical field, agriculture and food Effect of Nanotechnology on human health	<b>15</b>
	<b>TOTAL</b>	<b>45</b>

### Reference books

Dr. Sulbha kulkarni Nanotechnology principles and practices, 3 rd edition 2015  
 Himalaya Publication College Analytical Chemistry textbook .T.Y.B.Sc 26<sup>th</sup> edition 2020  
 Jeremy Ramsden , Nanotechnology : An introduction 1<sup>st</sup> edition 2011  
 Vogel's Textbook of quantitative chemical analysis , 5<sup>th</sup> edition 1989  
 Lehninger , Principles of Biochemistry. 5th Edition (2008), David Nelson & Michael Cox, W.H. Freeman and  
 company, NY.

### Details of Continuous Assessment (CIA)

Continuous Assessment	Details	Marks
Component 1 (CIA-1)	Written Test	20 marks
Component 2 (CIA-2)	Poster / Power-point presentation	20 marks



<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: IV</b>	
<b>Course: S.Y.B.Sc. : MEDICAL MICROBIOLOGY</b>				<b>Course Code: BH.USBT403</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial( Periods per week per batch)</b>	<b>Credits (Theory +Practical )</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2+1=03</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>
<b>Course Objectives:</b> The objective of this course is to gain insight into Disease Factors and Processes and Diseases Caused by Microorganisms					
<b>Course Outcomes:</b> By the end of the course the student will be able to: <ul style="list-style-type: none"> <li>• List the factors playing a role in causing a disease</li> <li>• Discuss the various aspects of Systemic Infections including Causative Agents, Symptoms and Prophylaxis and treatment.</li> <li>• Gain the technical capability of handling, isolating and identifying various Bacteria</li> </ul>					
<b>INDEX</b>					
<b>Detailed syllabus</b>					
<b>Units</b>	<b>Detailed descriptions</b>				<b>Lecture period /unit</b>
<b>I</b>	Infectious Diseases				<b>15L</b>
	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. Zoonosis Nosocomial infections Koch's Postulates..				
<b>II</b>	Causative organisms-I				<b>15L</b>
	Morphological and cultural characteristics, Pathogenesis, Lab diagnosis, prophylaxis and treatment of diseases caused by pathogen: <i>Staphylococcus.aureus</i> , <i>Streptococcus.pyogenes</i> , <i>Streptococcus pneumoniae</i> , <i>Corynebacterium.diphtheriae</i> , <i>Mycobacterium tuberculosis</i> , <i>Clostridium tetanii</i> Case study				
<b>III</b>	Causative Organisms- II				<b>15L</b>



	Morphological and cultural characteristics, Pathogenesis, Lab diagnosis, prophylaxis and treatment of diseases caused by pathogen: <i>Escherichia.coli</i> , <i>Salmonella typhi</i> <i>Shigella sp</i> , <i>Proteus sp</i> , <i>Pseudomonas aeruginosa</i> , <i>Klebsiella pneumoniae</i> , Case study		
	<b>TOTAL</b>	<b>45</b>	

**Note: Earlier organisms were there in syllabus in context to only one type of infection for example S. aureus for skin infections only, S. typhi for Gastrointestinal tract infections only, other complications were not included, now in revised syllabus it will be covered with case study. Case study would be a self-study topic.**

**References :**

**Text book**

1. Ananthanarayan, R. and Paniker, C., (1980). Textbook of microbiology. (1st ed). Orient Longman
2. Talaro, K. P., & Talaro, A. (2002). Foundations in microbiology (4th ed.). Boston: McGraw-Hill.
3. Willey, J. M., Sherwood, L., Woolverton, C. J., & Prescott, L. M. (2008). Prescott, Harley, and Klein's microbiology.(7th ed) New York: McGraw-Hill Higher Education

**Reference Book**

1. Cruickshank R. (1969) Medical microbiology, (11 th ed) , E & S Livingstone Limited
2. Tortora, Gerard J., et al. Microbiology, (2004).An Introduction. (8th ed.), Benjamin / Pearson.



Programme: B.Sc. Biotechnology				Semester: IV	
Course: S.Y.B.Sc. : ENVIRONMENTAL BIOTECHNOLOGY				Course Code: BH.USBT404	
Teaching Scheme				Evaluation Scheme (Theory)	
Lecture (Periods per week)	Practical (Periods per week per batch)	Tutorial(Pe riods per week per batch)	Credits (Theory +Practical)	Continuous Internal Assessment (CIA) (CIA-I & II)	End Semester Examination (ESE)
03	03	NIL	2+1=03	20+20=40	(Marks: 60)
<b>Course Outcomes:</b>					
By the end of the course the student will be able to:					
1. Understand the significance of renewable energy resources.					
2. Application of different life forms in Environmental Remediation..					
<b>INDEX</b>					
Module	Description			No of Lect.	
1	<b>Environmental Pollution</b>			15	
2	<b>Global Environmental Problems and Issues</b>			15	
3	<b>Bioremediation</b>			15	
	<b>TOTAL</b>			<b>45</b>	
<b>Detailed syllabus</b>					
Units	Detailed descriptions			Lecture period /unit	
<b>UNIT I Environment Pollution</b>	Water Pollution : Causes, Types and Classification; Eutrophication; Assessment of Water Quality- Pollutant Monitoring and Control; <b>Aerobic and Anaerobic treatment of wastewater</b> 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	
<b>UNIT II Global Environmental Problems and Issues</b>	Air Pollution : Types; Sources; Classification of Air Pollutants; Air Pollution Monitoring and Control. Green House Effect : Factors Responsible for Green House Effect; Green House Gases. Global Warming; Ozone Depletion; Kyoto Protocol; UV Radiation; Acid Rain.			15	
<b>UNIT III Bioremediatin</b>	Concept of Bioremediation. Microorganisms in Bioremediation, Mycoremediation and Phytoremediation. Bioremediation Technologies. Measuring Bioremediation in the Field. Bioaugmentation and Biostimulation. Monitoring the Efficacy of Bioremediation			15	
	<b>TOTAL</b>			<b>45</b>	

**Reference books**

1. P.S. Verma and Agarwal- S, Ecology –7<sup>th</sup> edition. Chand Publications
2. Rehm and Reed- Wiley, Biotechnology: Environmental Processes-
3. Indu Shekhar Thakur, Environmental Biotechnology

**Details of Continuous Assessment (CIA)**

<b>Continuous Assessment</b>	<b>Details</b>	<b>Marks</b>
<b>Component 1 (CIA-1)</b>	<b>Written Test</b>	<b>20 marks</b>
<b>Component 2 (CIA-2)</b>	<b>Poster / Powerpoint presentation</b>	<b>20 marks</b>



<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: IV</b>	
<b>Course: S.Y.B.Sc. : BIOINFORMATICS and BIOSTATISTICS</b>				<b>Course Code: BH.USBT405</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2+1=03</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>
<b>Course Objectives:</b>					
The objective of this course is learning and understanding basic concepts of Bioinformatics and Biostatistics.					
<b>Course Outcomes:</b>					
By the end of the course the student will be able to:					
1. gain an understanding of the basic concepts of Bioinformatics and Biostatistics.					
2. Understand the tools used in bioinformatics.					
3. apply the various statistical tools for analysis of biological data					
<b>INDEX</b>					
<b>Module</b>	<b>Description</b>				<b>No of Lect.</b>
<b>1</b>	<b>Introduction to Computers and Biological Databases</b>				<b>15</b>
<b>2</b>	<b>BLAST and Sequence Alignment</b>				<b>15</b>
<b>3</b>	<b>Biostatistics</b>				<b>15</b>
	<b>TOTAL</b>				<b>45</b>
<b>Detailed syllabus</b>					
<b>Units</b>	<b>Detailed descriptions</b>				<b>Lecture period /unit</b>
<b>UNIT I</b> <b>Introduction to Computers and Biological Databases</b>	What is bioinformatics and its relation with molecular biology. 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 Protein Databases based on Composition, Applications of Bioinformatics.				<b>15</b>
<b>UNIT II</b> <b>BLAST and Sequence Alignment</b>	BLAST and Sequence Alignment: <i>BLAST and its Types; Retrieving Sequence using BLAST.</i> Pairwise Alignment: <i>Identity and Similarity; Global and Local Alignment; Pairwise Database Searching.</i> 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.				<b>15</b>



<b>UNIT III Biostatistics</b>	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.	<b>15</b>
	<b>TOTAL</b>	<b>45</b>

### Reference books

1. Bioinformatics- methods and S.C.Rastogi, N. Mendiratta, PHL learning Pvt. Ltd. applications Genomics, Proteomics P.Rastogi 3rd edition.
2. Introductory Biostatistics. 1st edition. (2003), Chap T. Le. John Wiley, USA
3. Methods in Biostatistics- B. K. Mahajan –Jaypee Brothers

### Details of Continuous Assessment (CIA)

Continuous Assessment	Details	Marks
<b>Component 1 (CIA-1)</b>	<b>Written Test</b>	<b>20 marks</b>
<b>Component 2 (CIA-2)</b>	<b>Poster / Powerpoint presentation</b>	<b>20 marks</b>





<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: IV</b>	
<b>Course: S.Y.B.Sc. : Molecular Dignostics</b>				<b>Course Code: BH.USBT406</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2+1=03</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>
<b>Course Objectives:</b>					
The objective of this course is learning and understanding Molecular Techniques and utilizing these techniques in Diagnosis.					
<b>Course Outcomes:</b>					
By the end of the course the student will be able to:					
1. Gain an understanding of the basic Principles used in Molecular Diagnosis.					
2. Gain critical thinking and analytical skills to understand new Diagnostic Methods.					
<b>INDEX</b>					
<b>Module</b>	<b>Description</b>				<b>No of Lect.</b>
<b>1</b>	<b>Basics of Molecular Dignostics</b>				<b>15</b>
<b>2</b>	<b>Nucleic Acid Amplification Methods</b>				<b>15</b>
<b>3</b>	<b>Molecular Biology Based Dignostics</b>				<b>15</b>
	<b>TOTAL</b>				<b>45</b>
<b>Detailed syllabus</b>					
<b>Units</b>	<b>Detailed descriptions</b>				<b>Lecture period /unit</b>
<b>UNIT I Basics of Molecular Dignostics</b>	Introduction to Molecular Diagnostics : Overview of Molecular Diagnostics; Areas used in Molecular Diagnostics; Future Prospects - 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.				<b>15</b>
<b>UNIT II</b>	<b>Target amplification :</b> PCR - General Principle; Components of a Typical PCR Reaction; Experimental Design; Primer Designing; Control of PCR Contamination and Mispriming; PCR Product Clean-up and Detection. <b>Types of PCR used in dignostics:</b>				<b>15</b>



<b>Nucleic Acid Amplification Methods</b>	Reverse Transcriptase and Real Time PCR. Nested PCR <b>Probe amplification :</b> Ligase Chain Reaction	
<b>UNIT III Molecular Biology based Diagnostics</b>	<b>DNA Polymorphism and Identification:</b> 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	<b>15</b>
	<b>TOTAL</b>	<b>45</b>

#### Reference books

1. Molecular diagnostics- Fundamentals , methods and clinical applications – Buckingham and Flaws F.A. Davis Company Philadelphia.
2. Molecular diagnostics for the clinical laboratorian by coleman and Tsongalis , Humana press

#### Details of Continuous Assessment (CIA)

Continuous Assessment	Details	Marks
<b>Component 1 (CIA-1)</b>	<b>Written Test</b>	<b>20 marks</b>
<b>Component 2 (CIA-2)</b>	<b>Poster / Powerpoint presentation</b>	<b>20 marks</b>



<b>Programme: B.Sc. Biotechnology</b>				<b>Semester: IV</b>	
<b>Course: S.Y.B.Sc. : Entrepreneurship Development</b>				<b>Course Code: BH.USBT407</b>	
<b>Teaching Scheme</b>				<b>Evaluation Scheme (Theory)</b>	
<b>Lecture (Periods per week)</b>	<b>Practical (Periods per week per batch)</b>	<b>Tutorial (Periods per week per batch)</b>	<b>Credits (Theory +Practical)</b>	<b>Continuous Internal Assessment (CIA) (CIA-I &amp; II)</b>	<b>End Semester Examination (ESE)</b>
<b>03</b>	<b>03</b>	<b>NIL</b>	<b>2</b>	<b>20+20=40</b>	<b>(Marks: 60)</b>
<b>Objective:</b>					
To develop and systematically apply an Entrepreneurial way of thinking that will allow identification and creation of Business Opportunities.					
Course Outcomes:					
<ul style="list-style-type: none"> <li>By the end of the course the student will be able to: Develop an understanding of the systematic process and to select and screen a Business Idea.</li> <li>Design strategies for successful implementation of ideas.</li> </ul>					
<b>INDEX</b>					
<b>Module</b>	<b>Description</b>				<b>No of Lect.</b>
<b>1</b>	<b>Introduction to Entrepreneurship Development</b>				<b>15</b>
<b>2</b>	<b>Setting-up of an Enterprise and Planning</b>				<b>15</b>
<b>3</b>	<b>Marketing, Sales, Advertising and International Market research</b>				<b>15</b>
	<b>TOTAL</b>				<b>45</b>
<b>Detailed syllabus</b>					
<b>Units</b>	<b>Detailed descriptions</b>				<b>Lecture period /unit</b>
<b>UNIT I Introduction to Entrepreneurship Development</b>	Concept of Entrepreneur; Entrepreneurship; Need and Importance; Factors Influencing Entrepreneurship;  Essentials of a Successful Entrepreneur				<b>15</b>
<b>UNIT II Setting-up of an Enterprise and Planning</b>	Location of Enterprise; 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, IPR generation and Protection, Preparation of a Business Plan				<b>15</b>
<b>UNIT III Marketing, Sales,</b>	Marketing Plan for an Entrepreneur; Strategic Alliances, Advertising and Sales Promotion;				<b>15</b>



<b>Advertising and International Market research</b>	Market Assessment, Need for International Market Research, Domestic vs. International Market Research, Cost and Methodology of Market Research, Desk and Field Research	
	<b>TOTAL</b>	<b>45</b>
<b>References :</b> 1. Entrepreneurship – Kurup 2. Handbook of Entrepreneurship development		
<b>Details of Continuous Assessment (CIA)</b>		
<b>Continuous Assessment</b>	<b>Details</b>	<b>Marks</b>
<b>Component 1 (CIA-1)</b>	<b>Written Test</b>	<b>20 marks</b>
<b>Component 2 (CIA-2)</b>	<b>Poster / Powerpoint presentation</b>	<b>20 marks</b>



## **SEM IV PRACTICAL**

### **Biochemistry & Applied chemistry Practicals**

1. Determination of LDH activity in blood serum
2. Determination of cholesterol in serum
3. Organ function test: SGOT/SGPT, serum urea
4. Estimation of uric acid and creatinine
5. Detection of ketone bodies
6. Isolation and detection of mitochondria
7. Separation of binary mixtures ( 3 mixtures)
8. Identification of organic compound ( 3 compounds)
9. HPLC of plant secondary metabolite
10. GC of plant essential oils
11. HPTLC of medically important plants
12. Synthesis of nanoparticles

### **Medical microbiology and environmental biotechnology Practicals**

1. Study of *Staphylococcus aureus*
2. Study of *E.coli*
3. Study of *Salmonella spp*
4. Study of *Shigella spp*
5. Study of *Proteus spp*
6. Study of *Pseudomonas spp*
7. Rapid plasma reagin
8. Study of permanent slide- mycobacteria
9. Biochemical oxygen demand
10. Chemical oxygen demand
11. Isolation of bacteria from air by gravity sedimentation method
12. MPN analysis of water
13. Bioremediation of metals
14. Report of industrial visit

### **Biostatistics, bioinformatics and molecular diagnostics**

1. Study of bioinformatics databases
2. Use of NCBI BLAST tool
3. Sequence alignment and phylogeny
4. Classification of proteins
5. Visualization of proteins using software
6. Handling and calibration of micropipette
7. Study of genomic DNA
8. Study of RNA
9. Restriction digestion of DNA
10. RFLP analysis
11. Primer designing using NCBI BLAST
12. DNA amplification using PCR

**External Examination scheme:**

Sr.no	Questions on	Question	Option	Marks	Total marks
1	Unit-I	A or A and B	Any two out of three	8 or 8 marks and 7marks	15
2	Unit-II	A or A and B	Any two out of three	8 or 8 marks and 7marks	15
3	Unit-III	A or A and B	Any two out of three	8 or 8 marks and 7marks	15
4	All Units	A,B,C,D and E	Any three out of Five	5 marks each	15
				Total	60