



**GLA**  
UNIVERSITY  
MATHURA  
Established vide U.P. Act 21 of 2010.

**B.Sc. (HONS.)  
(BIOTECHNOLOGY)  
COURSE CURRICULUM**

(w.e.f. Session 2021-22)

**INSTITUTE OF APPLIED  
SCIENCES & HUMANITIES**

**AMENDMENTS AS RECOMMENDED  
BY BOARD OF STUDIES**

**2021-22**

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# **COURSE STRUCTURE**

## **B.Sc. (HONS.)**

### **BIOTECHNOLOGY**

### First Semester

S. NO	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0001	Chemistry I	Core	4	0	0	4	4
2.	BSBC 0002	Cell Biology	Core	4	0	0	4	4
3.	BELH 0005	Remedial English	AECC1	2	2	0	3	4
4.	BMAS 0501 BSBO 0001	Biostatistics Remedial Biology	GE1	4	0	0	4	4
<b>PRACTICALS</b>								
5.	BSBC 0801	Chemistry I Lab	Core Lab	0	0	3	2	3
6.	BSBC 0802	Cell Biology Lab	Core Lab	0	0	3	2	3
7.	BSBO 0801	Environmental Biotechnology Lab	GE1 Lab	0	0	3	2	3
<b>TOTAL</b>				14	02	09	21	25

### Second Semester

S. NO	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0003	Biomolecules	Core	4	0	0	4	4
2.	BSBC 0018	Genetics	Core	4	0	0	4	4
3.	BSBC 0005	Environmental Science	AECC2	2	2	0	3	4
4.	BSBO 0002	Computer Fundamentals and Applications	GE2	4	0	0	4	4
<b>PRACTICALS</b>								
5.	BSBC 0803	Biomolecules Lab	Core Lab	0	0	3	2	3
6.	BSBC 0815	Genetics Lab	Core Lab	0	0	3	2	3
7.	BSBO 0802	Computer Application in Biotechnology Lab	GE2 Lab	0	0	3	2	3
<b>TOTAL</b>				14	02	09	21	25

### Third Semester

S. NO	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0006	Molecular Biology	Core	4	0	0	4	4
2.	BSBC 0007	Plant Science I	Core	4	0	0	4	4
3.	BSBC 0008	Biochemistry	Core	4	0	0	4	4
4.	BSBC 0009	Stem Cell Technology	SEC1	2	0	0	2	2
5.	BSBO 0003	Bioinformatics	GE3	4	0	0	4	4
<b>PRACTICALS</b>								
6.	BSBC 0805	Molecular Biology Lab	Core Lab	0	0	3	2	3
7.	BSBC 0806	Plant Science I Lab	Core Lab	0	0	3	2	3
8.	BSBC 0807	Biochemistry Lab	Core Lab	0	0	3	2	3
9.	BSBO 0803	Bioinformatics Lab	GE3 Lab	0	0	3	2	3
<b>TOTAL</b>				18	00	12	26	30

### Fourth Semester

S. NO	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0010	Instrumentation and Bio - Analytical Techniques	Core	4	0	0	4	4
2.	BSBC 0011	Microbiology	Core	4	0	0	4	4
3.	BSBC 0012	Immunology	Core	4	0	0	4	4
4.	BSBC 0013	Drug Discovery & Development	SEC2	2	0	0	2	2
5.	BSBO 0004	Clinical Microbiology	GE4	4	0	0	4	4
<b>PRACTICALS</b>								
6.	BSBC 0808	Instrumentation and Bio - Analytical Techniques Lab	Core Lab	0	0	3	2	3
7.	BSBC 0809	Microbiology Lab	Core Lab	0	0	3	2	3
8.	BSBC 0810	Immunology Lab	Core Lab	0	0	3	2	3
9.	BSBO 0804	Clinical Microbiology lab	GE4 Lab	0	0	3	2	3
<b>TOTAL</b>				18	00	12	26	30



### Fifth Semester

S. NO	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0014	Plant Biotechnology	Core	4	0	0	4	4
2.	BSBC 0015	Recombinant DNA Technology	Core	4	0	0	4	4
3.	DSE1	Discipline Specific Elective 1	Elective	4	0	0	4	4
4.	DSE2	Discipline Specific Elective 2	Elective	4	0	0	4	4
<b>PRACTICALS</b>								
5.	BSBC 0811	Plant Biotechnology Lab	Core Lab	0	0	3	2	3
6.	BSBC 0812	Recombinant DNA Technology Lab	Core Lab	0	0	3	2	3
7.	DSE1	Discipline Specific Elective 1 Lab	Elective Lab	0	0	3	2	3
8.	DSE2	Discipline Specific Elective 2 Lab	Elective Lab	0	0	3	2	3
<b>TOTAL</b>				16	00	12	24	28

### Six Semester

S. NO	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBC 0016	Animal Biotechnology	Core	4	0	0	4	4
2.	BSBC 0017	Genomics & Proteomics	Core	4	0	0	4	4
3.	DSE1	Discipline Specific Elective 1	Elective	4	0	0	4	4
4.	DSE2	Discipline Specific Elective 2	Elective	4	0	0	4	4
<b>PRACTICALS</b>								
5.	BSBC 0813	Animal Biotechnology Lab	Core Lab	0	0	3	2	3
6.	BSBC 0814	Genomics & Proteomics Lab	Core Lab	0	0	3	2	3
7.	DSE1	Discipline Specific Elective 1 Lab	Elective Lab	0	0	3	2	3
8.	DSE2	Discipline Specific Elective 2 Lab	Elective Lab	0	0	3	2	3
9.	BSBC 0815	Project Training		For two month			5	35
<b>TOTAL</b>				16	00	12	29	63

**DETAILS OF DISCIPLINE SPECIFIC ELECTIVE (DSE)**

**Fifth Semester**

S. NO	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBE 0017	IPR, Biosafety and Bioethics	Elective	4	0	0	4	4
2.	BSBE 0016	Chemistry-II	Elective	4	0	0	4	4
3.	BSBE 0006	Plant Science II	Elective	4	0	0	4	4
4.	BSBE 0007	Food and Industrial Biotechnology	Elective	4	0	0	4	4
5.	BSBE 0008	Enzymology	Elective	4	0	0	4	4
6.	BSBE 0009	Evolution and Ecology	Elective	4	0	0	4	4
<b>PRACTICALS</b>								
7.	BSBE 0816	Chemistry-II Lab	Elective Lab	0	0	3	2	3
8.	BSBE 0806	Plant Science II Lab	Elective Lab	0	0	3	2	3
9.	BSBE 0807	Food and Industrial Biotechnology Lab	Elective Lab	0	0	3	2	3
10.	BSBE 0808	Enzymology Lab	Elective Lab	0	0	3	2	3
11.	BSBE 0809	Evolution and Ecology Lab	Elective Lab	0	0	3	2	3

**DETAILS OF DISCIPLINE SPECIFIC ELECTIVE (DSE)**

**Six Semester**

S. NO	CODE	SUBJECT	CORE/ELECTIVES	TEACHING SCHEME			CREDITS	CONTACT HR/WK
				L	T	P		
1.	BSBE 0010	Fermentation Technology	Elective	4	0	0	4	4
2.	BSBE 0011	Role of Biotechnology in Forensic Science	Elective	4	0	0	4	4
3.	BSBE 0018	Chemistry-III	Elective	4	0	0	4	4
4.	BSBE 0013	Human Physiology	Elective	4	0	0	4	4
5.	BSBE 0014	Environmental Biotechnology	Elective	4	0	0	4	4
6.	BSBE 0015	Clinical Biochemistry	Elective	4	0	0	4	4
<b>PRACTICALS</b>								
5.	BSBE 0810	Fermentation Technology Lab	Elective Lab	0	0	3	2	3
6.	BSBE 0811	Role of Biotechnology in Forensic Science Lab	Elective Lab	0	0	3	2	3
7.	BSBE 0818	Chemistry- III Lab	Elective Lab	0	0	3	2	3
8.	BSBE 0813	Human Physiology Lab	Elective Lab	0	0	3	2	3
9.	BSBE 0814	Environmental Science Lab	Elective Lab	0	0	3	2	3
10.	BSBE 0815	Clinical Biochemistry Lab	Elective Lab	0	0	3	2	3

S. No.	Category	Subject	Credit	Total Credits
1	Core (Theory)	14	4	56
2	Core (Lab)	14	2	28
3	AECC	2	3	6
4	SEC	2	2	4
5	DSE (Theory)	4	4	16
6	DSE (Lab)	4	2	8
7	GE (Theory)	4	4	16
8	GE (Lab)	4	2	8
9	Project Training	1	5	5
	Total Credits			147

# SYLLABUS

## B.Sc. (HONS.)

# BIOTECHNOLOGY

**BSBC 0001: CHEMISTRY – I**

**OBJECTIVES:** Impart sufficient qualitative/quantitative analytical and synthetic chemical knowledge and skills to students. Impart a disciplined approach to conceptualizing chemical problems in numerical terms. Predict products of chemical reactions. Explain patterns of chemical reactions.

**Credits: 04**

**Semester I**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<p><b>Organic Chemistry as Chemistry of Carbon Compound :</b> Methods of purification, tests of purity, qualitative and quantitative elements analysis, determination of Molecular masses calculation of empirical and molecular formula, structural formula, functional groups and Nomenclature.</p> <p><b>Reaction intermediates, Organic reactions, and Mechanism of Nucleophilic Substitution reactions :</b> Types of Organic reactions, Free radicals, carbonium ion, carbanion, attacking reagents, Mechanism of Organic reactions, Nucleophilic substitution reactions, Electrophilic substitution reactions, Addition reactions, Elimination reactions.</p> <p><b>Periodic Table and Periodic Properties:</b> Atomic and Ionic Radii, ionization energy, Electron affinity and Electro negativity, definition, Methods of determination, trends in periodic table and application in predicting and explaining the Chemical Behaviour.</p>	18
II	<p><b>Chemical Bonding:</b> Ionic Bond, Covalency, Co-ordinate Valency Polar and non-polar covalent Bonds, Fajan's rule, Octet rule, Hybridization Rules for the calculation of Hybridization Valence shell electron pair repulsion theory, shapes of covalent molecules, Molecular Orbital theory, Hydrogen Bond, Vanderwaals forces, Bond strength and Bond energy.</p> <p><b>Chemical Kinetics and Catalysis – Introduction:</b> Chemical Kinetics and its scope, rate of a reaction, Factor influencing rate of reaction velocity or rate constant, order of reaction, Molecularity, Pseudomolecular reactions, Zero Order reactions, First Order reactions. Second order reactions, determination of order of reaction, Arrhenius equation concept of Activation energy, Activation energy and Chemical and Chemical reactions.</p> <p><b>Theory of Chemical Kinetics :</b> Smaller size effect of temperature on rate of reaction, simple collision theory of Bimolecular reactions, catalysis, characteristics of catalyzed reactions classification of catalysis, Enzyme Catalysis, Promoters and</p>	24

	poisons. <b>Phase Rule :</b> Gibb's phase rule, one component system, water and sulphur systems:- <b>Chemistry of S- and p-block elements: Comparative study, diagnol relationship, salient feature of hydrides and complexation tendencies including their function in Biosystem.</b>	
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### TEXT BOOK:

1. M.M.N. Tandon, "Unified Chemistry for B.Sc. First Year": Shivalal Agarwal & Co.,2016

### REFERENCE BOOKS:

1. S.Glasstone, "Textbook of Physical Chemistry": D. Van Nostrand Co., Princeton, NJ,1961
2. R.D.Madan, "Modern Inorganic Chemistry": S. Chand Publishing,2019
3. I.L. Finar, "Organic Chemistry Vol. 1":Pearson,2002

**FOCUS:** This course focuses on Employability aligned with CO1

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1: Determine the order of reaction, reaction rate etc. (*Evaluate*)

CO2: Apply rate constant, half-life and theories of reaction rate in chemical kinetics. (*Apply*)

CO3: Understand reaction intermediates such as carbocation, carbanion and free radical formed during a chemical reaction. (*Understand*)

CO4: Understanding variation of different parameters in periodic table and propose mechanism for chemical reactions. (*Remember*)

CO5: Calculate modular weight, conceptualize structure and bonding and deduce Gibb's phase rule. (*Analyze*)

CO6: Predict type of Hybridization and shape inorganic molecules and ions. (*Create*)

### Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO2, PSO3
CO2	PO1, PO2, PO4/PSO1, PSO3
CO3	PO6, PO7,PO8, PO9/PSO2
CO4	PO1, PO4, PO5, PO8/PSO1, PSO2
CO5	PO3, PO4, PO56 PO7/PSO2, PSO3
CO6	PO2, PO3, PO6, PO8, PO10/PSO2, PSO3



## BSBC0002: CELL BIOLOGY

**OBJECTIVES:** Cell biology is increasingly important in all life sciences. Many of the advancements in modern science are the result of a better understanding of cellular components and their functions.

**Credits: 04**

**Semester I**

**L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
I	<b>Cell- basic unit of life:</b> Discovery of cell, Cell theory, Cell shape & Morphology. <b>Cell types:</b> Classification of cell types (Prokaryotic and Eukaryotic cells) and their differences. <b>Plant and Animal cells:</b> Structure of Plant and Animal cells and their differences. <b>Cell Wall &amp; Plasma membrane:</b> Ultra structure and function of cell wall and plasma membrane.	14
	<b>Cellular Organelles:</b> Ultra structure and function of cellular organelles (Mitochondria, Endoplasmic reticulum, Ribosomes, Golgibodies, Lysosomes. Plastids , Peroxisomes & Glyoxysomes <b>Nucleus :</b> Ultra structure and function of nucleus. <b>Chromosomes:</b> Morphology and structural organization. Nucleosome model. Euchromatin and heterochromatin. Karyotyping and banding pattern.	18
II	<b>Special chromosome:</b> Salivary gland and Lamp brush chromosomes. <b>Cytoskeleton:</b> Microtubules, Intermediate filaments, Microfilaments. Centrioles & Basal bodies. <b>Cytosol:</b> Biochemical composition of cytosol. <b>Cell cycle:</b> Cell cycle and its regulation. <b>Cell division:</b> Mitosis & Meiosis their mechanisms and differences. <b>Different type of cells:</b> Totipotent cell, Pluripotent cells, Stem cells, Blood cells. <b>Cell locomotion</b> (Amoeboid, Ciliary, & Flagellar). <b>Cancerous cells:</b> Differences between normal cells and cancerous cells.	24

**TEXT BOOK:** Cytology, Genetics & Molecular Biology by Gupta, P.K

### REFERENCE BOOKS:

- Cell Biology - S.C. Rastogi
- Cell and Molecular Biology - De Robertis
- Cell and Molecular Biology - Lodish
- Cytology, Genetics and mol. Biology - P.K. Gupta
- Biotechnical cell biology - Veer Bala Rastogi
- Cell biology, Genetics, Mol. Biology, - P.S.Verma & V.K. Agrawal

- Mol. Biology of cell - Albert et al
- The Cell -Cooper

**FOCUS:** This course focuses on Employability aligned with CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to:

- CO-1: Understand basic structure of cell (*Understanding*).
- CO-2: Aware the students about basic difference between plant and animal Cell (*Knowledge*).
- CO-3: Know the basic cell organelles in cells (plant & animal) (*Understanding*).
- CO-4: Explain the basic and specialized function of cells (*Analyze*).
- CO-5: Understand the different level of organization in plants and animals (*Understanding*).
- CO-6: Discuss the basic difference between prokaryotes & eukaryotes (*Analyze*).
- CO-7: Differentiate Prokaryote and Eukaryote on the basis of structure and functions of cell components (*Knowledge*).
- CO-8: Explain the basic of cell division and cell cycle (*Analyze*).

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/ PSOs
CO1	PO1, PO3, PO7, PO8/PSO1, PSO3
CO2	PO1, PO2, PO4/PSO2, PSO3
CO3	PO1, PO3, PO7, PO8, PO10/PSO1, PSO3
CO4	PO1, PO4, PO7, PO8/PSO1, PSO2
CO5	PO1, PO2, PO5, PO8/PSO2, PSO3
CO6	PO1, PO4, PO6, PO8, PO9/PSO2, PSO3
CO7	PO1, PO5, PO6, PO8, PO10/PSO1, PSO2
CO8	PO1, PO2, PO6, PO8/PSO1, PSO3

**BELH 0005: REMEDIAL ENGLISH**

**COURSE OBJECTIVE**

The course will include intensive reading, writing, and listening practices. Special emphasis will be given on finding out the most frequent mistakes committed by students. The effort is to enable them to overcome these mistakes. In writing section, the focus will be on making correct sentences, guided writing, guessing word meaning in context. In reading and listening sections, the focus will be on understanding long sentences, studying the complex sentence structures and understanding main idea. The objective of the course is to help students attain a basic proficiency in reading and writing skills.

**Credits: 03**

**Semester: I**

**L-T-P: 3-0-0**

Module No.	Content	Teaching Hours
I	<p><b>APPLIED GRAMMAR</b></p> <p><b>A.1. i. Tense and Voice:</b> Introducing the tenses; Use of tenses in different situations; Usage of forms of verbs in tenses; Introduction of Voice; Active and Passive Voice in tenses; Voice Change.</p> <p><b>ii. Parts of Speech:</b> <u>Noun</u>: countable and uncountable; <u>Pronoun</u>: Personal Pronoun; <u>Adjective</u>; <u>Adverb</u>; <u>Preposition</u></p> <p><b>A.2. Reading Comprehension</b></p> <p><b>i. Analyzing a Text:</b> Introducing the story 'Monkey's Paw' by W. W. Jacobs; Showing the video of the story 'Monkey's Paw'; Reading of the story 'Monkey's Paw' by W.W. Jacobs; Analysis of the form of the text: sentence structures &amp; vocabulary; Analysis of the content of the text: interactive session.</p> <p><b>ii. Analyzing Unseen Passages:</b> Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure</p>	20
II	<p><b>B.1. Reading Comprehension</b></p> <p><b>i. Analyzing a Text</b></p> <p>Introducing the story 'The Last Leaf' by O. Henry; Showing the video of the story 'The Last Leaf'; Reading of the story 'The Last Leaf' by O. Henry; Analysis of the form of the text: sentence structures &amp; vocab; Analysis of the content of the text: interactive session.</p> <p><b>ii. Reading an Essay:</b> Reading of the essay 'On Saying Please' by A. G. Gardiner; Textual Analysis of the essay; Discussion with the students: interactive session; Sample question and answers.</p> <p><b>iii. Analyzing Unseen Passages:</b> Reading a specimen text; Contextualizing the text; Vocabulary and sentence structure</p> <p><b>B.2. Narration:</b> Introducing direct and indirect speech; Transformation: direct and indirect, different types of sentences; Situation of 'No change' in speech.</p>	25

	<p><b>B.3.THEME BASED WRITING</b>  <u>Adjectives for People, Adverbs of Time, Animals, Bank, Baseball, Body, Buildings and Places, Car Parts, City, Classroom, Clothes, The Basic Colors (American Spellings) (gray), The Basic Colours (British Spellings) (grey), Cooking, Desserts, Dinner Table, Family Members, Fruit, Geography, House, Restaurant, Tools, Transportation, Vegetables, Weather</u></p>	
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**TEXT BOOKS:**

- Murphy, Raymond, *Intermediate English Grammar*. Cambridge University Press.
- Robert J. Dixon. *Complete Course in English*. A new revised edition

**REFERENCES:**

- Hornby, A.S., *Advanced Learners' Dictionary of Current English*, OUP
- Greenberg, Rondinone & Wiener. *The Advancing Writer Book I*, Harper Collins, College Publishers.
- Liz and Soars. *Headway Pre-Intermediate*. OUP
- Sharma, SD. A textbook of professional Communication Skills & ESP for Engineers and Professionals, Sarup & Sons, Delhi 2003

**COURSE OUTCOMES:** After completing the course students will be able to:

- CO1- Comprehend a text and answer the questions based on it clearly.
- CO2- Express their ideas in writing according to time and tense.
- CO3- Enrich their vocabulary in terms of contextual and situational conversation.
- CO4- Enhance their listening skills through the video of the text.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO8/PSO2, PSO3
CO2	PO1, PO2, PO4/PSO1, PSO3
CO3	PO6, PO7, PO8/PSO2, PSO3
CO4	PO3, PO6, PO7/PSO1

## BMAS 0501: BIOSTATISTICS

**OBJECTIVES:** To make the students understand the concept of biostatistics, probability, calculus and algebra.

**Credits: 04**

**Semester: I**

**L–T–P: 4–0–0**

Module	Contents	Hrs.
<b>I</b>	Logarithms, Introduction and simple problems on Differentiation, Integration (excluding trigonometric functions), Scalar and Vector quantities, Types of vectors, Addition and Subtraction of vectors, Scalar and Vector product of two vectors, Types of matrices, Operations on matrices (addition, subtraction and multiplication etc.). Introduction to Biostatistics, Data collection, Tabulation and Classification of data, Frequency distributions	18
<b>II</b>	Diagrammatical & Graphical representation of data, Measures of Central tendency and Dispersion, Introduction TEXT to Probability (simple problems). Correlation between two variables, Karl Pearson's formula for finding correlation coefficient, Rank correlation, Regression lines, Fitting of straight line & second degree parabola by the method of least squares, Population and sample, Testing of hypothesis, Level of significance, t-test, Chi-square test as a goodness of fit.	24

### TEXT BOOK:

- P. Banerjee, Introduction to Biostatistics, S. Chand & Co., Delhi, 2006.
- G. C. Beri, Business Statistics, TMH, New Delhi, 2015.
- H. Kishan, Differential Calculus, Atlantic Publishers and Distributors, Delhi, 2008.
- H. Kishan, Integral Calculus, Atlantic Publishers and Distributors, Delhi, 2005.

### REFERENCE BOOKS:

- S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi, 2014.
- B. K. Mahajan, Methods in Biostatistics, Jaypee Publications, New Delhi, 2010.

**FOCUS:** This course focuses on Skill development aligned with CO1

**COURSE OUTCOMES:** After completion of the course, student will be able to

C01 : Understand the concepts of basic calculus and logarithms. (*Understand, Remember, and Apply*)

C02: Able to apply, concepts of vector algebra and matrix theory in statistics. (*Understand, Remember, Evaluate, Create and Analyze, Apply*)

C03: Understand what is biostatistics and to be able to classify data. (*Understand, Remember, Evaluate and Apply*)

C04: Understand basic probability and its application in real life based problems. (*Understand, Remember, Evaluate, Create and Analyze, Apply*)

C05: Attain a basic proficiency in quantitative skills, understand and critically assess data collection & its representation. (*Understand, Remember, Evaluate, Create and Analyze, Apply*)

C06: Understand basic statistical interface (Testing). (*Understand, Remember and Analyze*)

**Mapping of Course Outcomes (Cos) with Program Outcomes (Pos) and Program Specific Outcomes (PSOs):**

<b>Cos</b>	<b>Pos/ PSOs</b>
C01	P01, P03, P07, P08/PS01, PS03
C02	P01, P02, P04/PS02, PS03
C03	P03, P07, P08/PS01, PS03
C04	P01,P02, P06, P08, P09/PS02
C05	P02, P04, P05, P07/PS01, PS02
C06	P02, P03, P06, P07, P09, P010/PS02, PS03

## BSBO 0001: REMEDIAL BIOLOGY

**OBJECTIVES:** This is an introductory course in biology which gives detail study on natural sources of plant and animal origin. Subject deals with the plant cell, animal cell classifications plant kingdom and study of animal issues.

**Credits: 04**

**Semester I**

**L–T–P: 4–0–0**

Module	Contents	Hrs.
I	<ul style="list-style-type: none"> <li>• Cell, Cell types, Cell Wall &amp; Plasma membrane</li> <li>• Cellular Organelles: Ultra structure and function of cellular organelles</li> <li>• Nucleus: Ultra structure and function of nucleus.</li> <li>• Chromosomes</li> <li>• Cytosol</li> <li>• Cell cycle, Cell divisio.</li> <li>• Methods of classification of plants</li> <li>• Morphology, anatomy and functions of different parts of Root, leaf, stem, flower, seed</li> <li>• Tissues in plants</li> </ul>	14
		18
II	<ul style="list-style-type: none"> <li>• Transportation, photosynthesis and respiration in plants</li> <li>• Plant growth and developments</li> <li>• Structure of plant cell</li> <li>• Classification of living organism</li> <li>• Concept of animal and plant classification</li> <li>• Systematic and binomial system of nomenclature</li> <li>• Viruses</li> <li>• Animal kingdom</li> <li>• Structure and life history of insects like mosquito, house fly , silk worm.</li> </ul>	24

### TEXT BOOK:

- Cell biology, S.C. Rastogi Rastogi publication

### REFERENCE BOOKS:

- Biotechnical cell biology, Veer Bala Rastogi, rastogi publication
- Cell biology, Genetics, Mol. Biology, P.S.Verma & V.K. Agrawal, S. Chand publication

**COURSE OUTCOMES:** After completion of the course, student will be able to

**CO1-** Understand the Classification System of both Plants & Animals. (*Understand and Remember*)

**CO2-** Understand some aspects of physiology of animals. (*Understand and Remember*)

**CO3-** Analyze various tissue system and organ system in plant and animals. (*Understand and Analyze*)

**CO4-** Understand Theory of evolution (*Understand and Remember*)

**CO5-** To learn and understand the components of living world, structure and functional system of plant and animal kingdom. (*Understand and Remember*)

**CO6-** Make aware the students to understand and learn about: various tissue systems and organ systems in plants and animals. (*Understand, Remember, Apply and Analyze*)

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/ PSOs
C01	PO3, PO4, PO7, PO8, PO9/PS01, PS03
C02	PO1, PO2, PO4, PO7, PO10/PS02, PS03
C03	PO1, PO2, PO6, PO8/PS01, PS03
C04	PO1, PO2, PO5, PO8, PO9/PS02, PS03
C05	PO1, PO4, PO6, PO8, PO10/PS01, PS02
C06	PO1, PO3, PO6, PO7/PS02, PS03



## BSBC 0801: CHEMISTRY- I LAB

**OBJECTIVES:** Predict products of chemical reactions. Explain patterns of chemical reactions. Demonstrate common chemical laboratory techniques, chemical instrumentation and other appropriate technology. Demonstrate ability to work in a cooperative environment, understanding of safe laboratory practice.

**Credits: 02**

**Semester I**

**L–T–P: 0–0–3**

Module	Contents	Hrs
I	<p><b>Physical:</b></p> <p>01. Determination of Surface Tension (using Stalagmo meter)</p> <p>02. Determination of Viscosity (using viscometer)</p> <p>03. Solubility Determination of</p> <p style="padding-left: 20px;">(i) KNO<sub>3</sub></p> <p style="padding-left: 20px;">(ii) Benzoic acid</p> <p style="padding-left: 20px;">(iii) Oxalic acid</p> <p style="padding-left: 20px;">(iv) Sodium sulphate</p> <p><b>Inorganic :</b></p> <p><b>Volumetric Analysis:</b></p> <p>01. Oxidation – Reduction titrations</p> <p style="padding-left: 20px;">(i) Strength of an oxalic acid solution.</p> <p style="padding-left: 20px;">(ii) Strength of ferrous ammonium sulphate (Mohr's salt) solution.</p> <p>02. Iodometry titrations</p> <p style="padding-left: 20px;">(i) Strength of an copper sulphate solution.</p> <p style="padding-left: 20px;">(ii) Strength of potassium dichromate solution.</p>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1 & CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1- Students will understand chemical reactions in terms of structure and analytical knowledge

CO2- Students will master in basic research skill.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/ PSOs</b>
C01	PO1, PO2, PO7, PO8/PS01, PS03
C02	PO3, PO5, PO4/PS02

## BSBC 0802: CELL BIOLOGY LAB

**OBJECTIVES:** Describe levels of organization and related functions in plants and animals cells, function and structure of cells, different staining technique etc.

**Credits: 02**

**Semester I**

**L–T–P: 0–0–3**

Module	Contents	Hrs.
I	Techniques involved in cell biology. Staining of different type of cells ( prokaryotes & Eukaryotes) Gram staining for gram positive and negative bacteria. Test for the presence of cellulose, cutin wax and phenolics. Study of plant tissues ( Dicot/ monocot stem & root) by staining . Differential staining of blood cells, (DLC) Use of micrometer and calibration. Measurement of onion epidermal cells. Isolation of chloroplast/ mitochondria from cell homogenate. Examination of various stages of mitosis and meiosis using appropriate plant material.	30

**FOCUS:** This course focuses on Skill development aligned with CO1& CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to

CO1- To understand basic staining techniques

CO2- To understand morphology and taxonomy of plant tissues

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

COs	POs/ PSOs
CO1	P01, P02, P07, P08/PS01, PS03
CO2	P03, P05, P06/PS02, PS03

## BSBO 0801: ENVIRONMENTAL BIOTECHNOLOGY LAB

**OBJECTIVES:** Course provides introduction to environmental biotechnology and focuses on the utilization of microbial processes in waste management, water and effluent treatment and bioremediation. Topics include microbial energy metabolism, microbial growth, approaches for studying microbial communities, basic principles of bioremediation, water and waste treatment.

**Credits: 02**

**Semester I**

**L–T–P: 0-0-3**

Module	Contents	Hrs.
I	<ul style="list-style-type: none"> <li>• Introduction to laboratory and Instruments.</li> <li>• Determination of soil and water health care.</li> <li>• Determination of total dissolved solids of the water samples.</li> <li>• Determination of hardness of water samples.</li> <li>• Determination of chlorine in the water samples.</li> <li>• Determination of dissolved oxygen of the water samples.</li> <li>• Determination of biological oxygen demand of the water samples.</li> <li>• Determination of chemical oxygen demand of the water samples.</li> <li>• Determination of total bacterial population from air, water and food samples.</li> </ul>	30

**FOCUS:** This course focuses on Skill development aligned with CO1 & CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to

CO1- To describe the most commonly applied disinfection methods and the steps typically involved in drinking water treatment process.

CO2- They also able to evaluate the potential for biodegradation of organic pollutants, microbial and physical/chemical environments.

### Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO5, PO7, PO8/PS01, PS03
CO2	PO1, PO3, PO6/PS02, PS03

## BSBC 0003: BIOMOLECULES

**OBJECTIVES:** To teach students about important biomolecules essential to life processes.

**Credits: 04**

**Semester II**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<p><b>Basic aspects of the chemistry of life:</b> bonding properties of carbon, asymmetry of carbon compounds, basic concept of pH, pKa, buffers, various bonds stabilizing biomolecules (peptide, glycosidic, ester, phosphodiester, disulfide, ionic, hydrogen, hydrophobic, vanderwall's force), water as a solvent of life</p> <p><b>Bioenergetics:</b> I and II laws of thermodynamics, high energy phosphate compounds (ATP, creatine phosphate, thioesters), oxidative phosphorylation (chemiosmotic hypothesis, ATP synthase, P/O ratio, uncoupling), photophosphorylation</p> <p><b>Carbohydrates:</b> chemical structures, classification, physiochemical properties and importance in biological cells</p> <p><b>Amino acids:</b> chemical structures, classification, physiochemical properties, zwitterions nature, glucogenic and ketogenic amino acids</p> <p><b>Proteins:</b> classification based on source, shape, composition and function, structural organization of proteins (primary, secondary, tertiary and quaternary structures), physiochemical properties</p>	18
II	<p><b>Enzymes:</b> nomenclature and classification, characteristics of Enzymes, mode of Enzyme action (lock and key hypothesis, induced fit hypothesis), Enzyme kinetics, derivation of Michaelis- Menten equation,</p> <p><b>Lipids:</b> chemical structures, classification, physiochemical properties and functions</p> <p><b>Nucleic acids:</b> structures of nitrogenous bases (adenine, guanine, thymine, cytosine and uracil), nucleotides and nucleosides, DNA secondary structure</p> <p><b>Vitamins:</b> classification and functions</p> <p><b>Phytochemistry:</b> Extraction methods, Qualitative &amp; Quantitative methods, structure, classification, properties &amp; therapeutic application of Secondary metabolites</p>	24

### TEXT BOOK:

- J.L. Jain, S. Jain and N. Jain, "Fundamental of Biochemistry": S. Chand & Company Pvt. Ltd, 2016

### REFERENCE BOOKS:

- J. M. Berg, L. Stryer, J. L Tymoczko and G.J. Gatto, "Biochemistry" : W.H. Freeman, 2015
- D.L. Nelson and M. Cox, "Lehninger Principles of Biochemistry" : W.H. Freeman,
- D.J. Voet, J.G. Voet and C.W. Pratt, " Principles of Biochemistry" : John Wiley & Sons, Inc, 2012

**FOCUS:** This course focuses on Skill development aligned with CO2 & CO3

**COURSE OUTCOMES:** The major outcomes of this course are:

**CO1:** The students will learn about the chemical structures of carbohydrate, and their structural and metabolic role in cellular system. (*Understand, Evaluate, Create and Analyze*)

**CO2:** The students will learn about structure and function of lipids, circulating lipids and inflammatory lipid mediators etc. They will also learn about classification and physio-chemical properties of amino acids along with primary, secondary, tertiary, quaternary structure of proteins. (*Understand, Evaluate, Create and Analyze*)

**CO3:** Understand about the structure and function of nucleosides and nucleotides. (*Remember, Understand and Analyze*)

**CO4:** The course will aid the students in understanding other accessory molecules like vitamins, and plant secondary metabolites. (*Understand*)

**CO5:** Understand about bioenergetics and oxidative phosphorylation to know about energy transformation in biological system. (*Understand, Analyze and Apply*)

**CO6:** Understand unique property of water as a universal solvent and its importance in biological system along with different bonds stabilizing biomolecules. (*Remember, Understand, Analyze*)

**CO7:** Understand phytochemistry, which enables students to explore traditional medicinal values of various plants. (*Understand*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P04, P05/PS02, PS03
CO2	P02, P04, P06, P08/PS01, PS03
CO3	P01, P03, P04/PS02, PS03
CO4	P02, P04, P05, P07, P010/PS01, PS03
CO5	P02, P06/PS01, PS03
CO6	P02, P04, P05, P07, P08, P010/PS01, PS03
CO7	P02, P04, P06/PS01

## BSBC 0018: GENETICS

**OBJECTIVES:** The objective of this course is to understand the Mendelian and non-mendelian modes of inheritance that govern passage of genetic traits across generation, to use this knowledge of inheritance to track alleles through generations and categorize and predict genotypes and phenotypes, to understand different mechanism of sex determination, basic principles of population genetics and classical and modern concept of genes.

**Credits: 04**

**Semester II**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<p><b>Introduction to Genetics</b>  <b>Mendelian Laws of Inheritance</b>  <b>Interaction of Genes:</b> Supplementary Genes (comb pattern in fowls), Complementary Genes (flowers pattern in sweet peas), Epistasis (fruit colour in Cucurbita pepo and pigmentation in onion bulb), Multiple factors (skin colour in human beings), Incomplete Dominance (flower colour in Mirabilis jalapa), Codominance (coat colour in short horned cattle), Multiple allelism (blood groups in human beings), Pleiotropy (sickle cell anaemia)  <b>Linkage:</b> Definition, coupling and repulsion hypothesis, linkage in Drosophila, linkage groups, factors affecting linkage  <b>Crossing over:</b> Definition, mechanism of crossing over, significance, crossing over in Drosophila, factors affecting crossing over  <b>Chromosome Map:</b> chromosome maps in Drosophila and maize, Interference, Coincidence  <b>Sex Determination:</b> chromosomal mechanism (XX-XY, XX-XO, ZO-ZZ and ZW-ZZ), male haploidy and haplodiploidy mechanism, genic balance theory, cytoplasmic sex determination, sex determination in melandrium, sphaerocarpus and higher plants (XX-XY, ZZ-ZW, XX-XO), Non disjunction as a proof of chromosomal theory of sex determination</p>	18
II	<p>Sex linkage, types of sex linked genes, inheritance of sex linked characters (colour blindness, haemophilia), inheritance of eye colour in Drosophila, criss cross inheritance, holandric genes  <b>Hereditary defects:</b> Klinefelter's syndrome, Turner's syndrome, Down's syndrome, Edward's syndrome, Patau's syndrome, cri du chat syndrome  <b>Concept of Genes:</b> classical and modern gene concept, pseudoallelism, position effect, concept of epigenetics  <b>Chromosomal aberrations:</b> structural changes (deletion, duplication, inversion and translocation), numerical changes (aneuploidy, euploidy, haploidy, polyploidy), Mutagens  <b>Cytoplasmic inheritance:</b> Definition, plasmagones, kappa particles in paramecium, shell coiling in snail, plastid inheritance in Mirabilis jalapa</p>	24

	<b>Population Genetics:</b> gene pool, gene frequency, Hardy-Weinberg law, significance, applications of Hardy-Weinberg law	
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### TEXT BOOK:

- Cell Biology, Genetics, Molecular Biology by Verma, P.K

### REFERENCE BOOKS:

- Principles of Genetics, Author: Gardner E.J & Snustad D.P, Pub: John Wiley
- Principles of Genetics, Author: Snustad D.P, Simmons M.J, Pub: John Wiley
- Genetics A molecular approach, Author: Brown T.A, Pub: BIOS Scientific
- Fundamentals of Genetics, Author: Singh B.D, Pub: Kalyani
- Genetics, Author: Rastogi V.B, Pub: Kedar Nath Ram Nath
- Genetics, Author: Verma P.S & Aggarwal V.K, Pub: S.Chand
- Principles of Gene Manipulations, Author: Old & Primose, Pub: Black Well Scientific
- Genes, Author: Lewine B, Pub: Oxford University Press, London

**FOCUS:** This course focuses on Employability aligned with CO4 & CO8

**COURSE OUTCOMES:** The main outcomes of this course are:

After completion of this course successfully, the students will be able to:

**CO1.** Describe fundamental molecular principles of genetics. (*Remembering & Understand*)

**CO2.** Understand relationship between phenotype and genotype in human genetic traits. (*Remembering & Understand*)

**CO3.** Describe the basics of genetic mapping. (*Remembering & Understand*)

**CO4.** Comprehensive and detailed understanding of genetic methodology AND quantification of heritable traits in families and populations provides insight into cellular and molecular mechanism. (*Remembering & Understand*)

**CO5.** Understand the pedigree formation and analysis. (*Understand, Analyze and Apply*)

**CO6.** Understand the cause of genetic disorders. (*Understand, Analyze and Apply*)

**CO7.** Understand the basic concept of population and genetics. (*Understand, Analyze and Apply*)

**CO8.** Implementation of basic statistics in solving research problems. (*Understand, Analyze and Apply*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P04, P05, P06, P07, P08/PS01, PS02
CO2	P02, P04, P05, P07, P08/PS02, PS03
CO3	P02, P03, P05, P06, P07, P08/PS01, PS03



C04	P01, P03, P05, P07, P08/PS02
C05	P01, P04, P05, P06, P07, P08/PS01, PS02
C06	P01, P04, P05, P06, P07, P08/PS01, PS02
C07	P02, P03, P05, P07, P08/PS01, PS03
C08	P01, P02, P03, P06, P07, P08/PS01, PS02

## BSBC 0005: ENVIRONMENTAL SCIENCE

**OBJECTIVES:** Recognize major concepts in environmental sciences and demonstrate in-depth understanding of the environment. The environmental science major prepares you for career success in natural resources and conservation, public health, environmental monitoring and remediation, industrial environmental management, or research or education of environmental science.

**Credits: 03**

**Semester II**

**L–T–P: 2–2–0**

Module No.	Content	Teaching Hours
<b>I</b>	Environment- Definition, scope, importance Natural Resources Forest resources- Use & over-exploitation, deforestation, timber extraction, mining, dams & their effects on forest & tribal people Water Resources, Mineral Resources, Food Resources, Energy, Land Resources	14
	Ecosystem- Concept, Structure & function, Producers, Consumers & decomposers. Energy flow in the ecosystem Ecological succession, Food chains, trophic levels, food webs & ecological pyramids. Evolution of ecosystem. Introduction, types, characteristics, features, structure & functions of – Forest ecosystem, Grassland ecosystem, Desert ecosystem & aquatic ecosystems- ponds, streams, lakes, rivers, oceans, estuaries	18
<b>II</b>	Definition, Causes, effects & control measures of – Air pollution, water pollution, land/ Soil pollution, Marine pollution, Noise pollution, thermal pollution, Nuclear Hazards, Bio indicators, Provision in the Indian Constitution and Environmental laws. Population Growth, Variation among nations Population explosion- Family Welfare programme, Environment & Human Health, Drug abuse, Human right. Value education, HIV/AIDS, Woman & Child Welfare Role of Information Technology in environment & human Health From unsustainable to sustainable development, Urban problems related to energy Climate Change- Global Warming, acid rain, Ozone layer depletion, nuclear accidents & holocaust Water Conservation, Rain Water harvesting, Watershed Management Environmental protection Act, Air ( prevention & control of pollution ) Act, Water ( prevention & control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act	24

### TEXT BOOK:

- Environmental Studies by Gupta, K.M

### REFERENCE BOOKS:

- Foundation of Environmental Studies, Prof. Devendra S. Bhargava, Galgotia Publications Pvt. Ltd.
- Environmental Ecology, S. Deshwal & A. Deshwal, Dhanpat Rai & co.
- Environmental Studies, K.M. Gupta, Umesh publication.

**FOCUS:** This course focuses on Skill development aligned with CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to:

**CO1-** Understand core concepts of environment and ecology and gain in-depth knowledge on nature and natural resources. (*Understand & Analyze*)

**CO2-** Predict the consequences of human actions on environment causing pollution & Global Problems. (*Understand & Apply*)

**CO3-** To identify, formulate and solve environmental problems by utilizing the concept of environmental studies. (*Evaluate, Apply & Create*)

**CO4-** Conservation of natural resources, ecological balance and biodiversity to achieve sustainable development. (*Understand & Analyze*)

**CO5-** Understanding of environmental policies and regulations. (*Understand & Evaluate*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO4, PO5, PO6/PSO2, PSO3
CO2	PO2, PO3, PO6, PO7, PO9/PSO1, PSO3
CO3	PO1, PO4, PO5, PO6, PO7, PO8, PO10/PSO1, PSO2
CO4	PO1, PO3, PO5, PO6, PO8/PSO1, PSO2
CO5	PO1, PO2, PO5, PO6, PO7, PO10/PSO1, PSO3

## BSBO 0002: COMPUTER FUNDAMENTALS AND APPLICATIONS

**OBJECTIVES:** The objective of this course is that student with life science background will be familiar with basic knowledge of computers

**Credits: 04**

**Semester II**

**L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
<b>I</b>	<p><b>Introduction:</b> Characteristics, evolution, and generations of computer systems, Basic Computer Organization: Input, Output, Storage, Arithmetic Logic Unit, Control Unit, and Central Processing Unit</p> <p><b>Number System:</b> Non-positional, Positional, Binary, Octal, and Hexadecimal, conversion from one number system to another</p> <p><b>Computer Code:</b> BCD, EBCDIC, and ASCII</p> <p><b>Computer Arithmetic:</b> Binary Addition, Subtraction, Multiplication, and Division</p> <p><b>Processor and Memory:</b> The Central Processing Unit (CPU): Control Unit, ALU, Instruction Set, and Registers, Processor Speed, Main Memory, RAM, ROM, PROM, and EPROM, Cache Memory</p> <p><b>Computer Software:</b> Relation between Hardware and Software, System, and Application Software, Logical System Architecture</p>	18
<b>II</b>	<p><b>Computer Languages:</b> Machine, Assembly, and High-level Language, assembler, Compiler, Linker, and Interpreter (<i>in brief</i>), General overview of C</p> <p><b>Operating System:</b> Functions, measuring system performance, Multiprogramming, Multitasking and Multiprocessing, time sharing</p> <p><b>Database Management System:</b> Introduction of Hierarchical, Network, Relational, and Object oriented</p> <p><b>Computer Networks:</b> Topologies: Star, Ring, Completely connected, Multi-access Bus, and Hybrid, Network Type: LAN, WAN, and MAN</p> <p><b>The Internet:</b> Email, FTP, and WWW, Uses of Internet</p> <p><b>Classification of Computers:</b> Notebook, PCs, Workstations, Mainframe, and Supercomputers</p>	24

### REFERENCE BOOKS, TEXT BOOKS, CASES:

- Sinha, P.K., Computer Fundamentals, BPB Publication, New Delhi Sixth Edition
- Jain Y.K. Elements of Computer Science, CBS Publishers and distributors, New Delhi
- Behrouz A. Forouzan and Richard F. Gilberg: "Computer Science- A structured Programming Approach using C", C Language learning, 2007

**FOCUS:** This course focuses on Skill development aligned with CO3

### COURSE OUTCOMES:

CO1- Bridge the fundamental concepts of computers with the present level of knowledge of the students. (*Understand and Remember*)

- CO2- Understand binary, hexadecimal and octal number systems and their arithmetic. (**Understand, Remember and Analyze**)
- CO3- Understand the fundamentals and classification of computer. (**Remember**)
- CO4- Understand the introduction to the fundamentals of hardware, software and programming. (**Understand, Remember and Apply**)
- CO5- Understand objectives & functions of Operating Systems. (**Understand, Remember and Analyze**)
- CO6- Perceive fundamental knowledge in system and application software. (**Understand and Apply**)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	PO1, PO4, PO5, PO6, PO10/PSO2, PSO3
C02	PO2, PO3, PO6, PO7, PO8/PSO1, PSO3
C03	PO3, PO4, PO8, PO9/PSO3
C04	PO1, PO3, PO5, PO6, PO7/PSO1, PSO3
C05	PO1, PO4, PO5, PO6, PO7, PO8, PO10/PSO1, PSO2
C06	PO2, PO3, PO5, PO6, PO8, PO9/PSO2, PSO3

**BSBC 0803: BIOMOLECULES LAB**

**OBJECTIVES:** The objectives of this paper is to well worse the students with basic fundamental practicals related to biomolecules

**Credits: 02**

**Semester II**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>To carry out preparation of Chromic acid</li> <li>To carry out preparation of Buffer: Acetate Buffer</li> <li>To carry out qualitative analysis of Carbohydrates</li> <li>To carry out qualitative analysis of Lipids</li> <li>To carry out qualitative analysis of amino acids</li> <li>To carry out qualitative analysis of Proteins</li> <li>Determination of Blood Group</li> <li>To estimate standard curve of <sup>32</sup>PNP so as to measure the activity of enzyme Acid Phosphatase</li> <li>To estimate the amount of enzyme Acid Phosphatase in unit/gram of potato tissue</li> <li>To determine the value of Km &amp; Vmax of an enzyme Acid Phosphatase</li> </ul>	30

**FOCUS:** This course focuses on Skill development aligned with CO1 & CO2

**COURSE OUTCOMES:** The major outcomes of this course are:

CO1- To understand qualitative analysis of Biomolecules (Carbohydrates, Lipids, amino acids, proteins)

CO2- To understand enzyme assay system in order to get useful product

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P02, P05, P06, P09/PS02, PS03
CO2	P04, P06, P07, P010/PS01, PS03

## BSBC 0815: GENETICS LAB

**OBJECTIVES:** The course helps to learn students the practical aspects of genetics

**Credits: 02**

**Semester II**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Observation of Drosophila- wild type and mutant type</li> <li>• Simple genetic problems (Problems and Interaction of genes)</li> <li>• Student’s ‘t’ test and Chi square test</li> <li>• Determination of blood group</li> <li>• Pedigree analysis: Symbols used in autosomal recessive disorder autosomal dominant disorder, Sex chromosomal (X &amp; Y linked).</li> <li>• Blood Cells (RBC &amp; WBC) counting using Haemocytometer</li> </ul>	30

**FOCUS:** This course focuses on Skill development aligned with CO1

**COURSE OUTCOME:** After completion of course, the student will be able to:

CO1- To resolve genetical problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7/PSO1, PSO3

## **BSBO 0802: COMPUTER APPLICATION IN BIOTECHNOLOGY LAB**

**OBJECTIVES:** To offer high-grade, value-based programmer in the field of Computer Applications. To bridge the gap between industry and academia by framing curricula and syllabi based on industrial and societal needs

**Credits: 2**

**Semester II**

**L–T–P: 0-0-3**

<b>Module No.</b>	<b>Content</b>	<b>Lab Hours</b>
<b>I</b>	<b>To study of various computer components</b> Hardware(Input Devices, Output devices), Software(System S/w, Application S/w),	<b>30</b>
	<b>To study about Booting and shut down process &amp; Windows XP</b> BIOS, POST and Booting Process	
	<b>To study Windows Desktop and Getting started with Windows XP</b> Getting Started with windows and Setting of Desktop	
	<b>To study MS Word</b> Formatting Editing, Grammar and Spelling checking and other important Tools of MS Office.	
	<b>To study MS PowerPoint</b> Preparing Slides, multimedia effects and slide animation.	
	<b>To study MS Excel</b> Using Formula, calculating field value, generating charts and other important tools of MS Excel	
	<b>To study C Programming concepts</b> C data type, conditional statements and concept of looping a Loopig	
	<b>To study about internet Browsing, Google Drive &amp; Email.</b> Web browser, E-mail account creation, sending E-mails with attachments, E-mail account setting etc.	



I	<p><b>To study about various Web Site &amp; Search Engine</b></p> <p>Surfing different important web sites and searching content using Search engine</p>	
	<p><b>To study about Social networking sites</b></p> <p>Study about Social networking Sites Account creating, setting Privacy and chatting using different web applications.</p>	

**FOCUS:** This course focuses on Skill development aligned with CO1 & CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1- Apply the knowledge of mathematics and computing fundamentals to various real life applications for any given requirement.

CO2- Design and develop applications to analyze and solve all computer science related problems.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO5, PO7, PO9/PS01, PS03
CO2	PO1, PO4, PO5, PO6, PO10/PS02

## BSBC 0006 : MOLECULAR BIOLOGY

**OBJECTIVES:** Course covers basic properties of cells, and gives insight into the controlling centre i.e., Nucleus. Course aims to equip students with knowledge of the regulatory element of the cell i.e., DNA its transcript i.e., RNA and protein biosynthesis as well as their interrelationship and regulation. From fundamental students are introduced to scientific literature on the molecular basis of the life and linking it to modern scientific research.

**Credits: 04**

**Semester III**

**L–T–P: 4–0–0**

Module	Contents	Hrs.
I	<p><b>Introduction to Molecular Biology:</b> Structure of DNA (ss/ ds/ triple helical/ Quadriplex), Chargaff's Rule, Melting temperature (T<sub>m</sub>), C-value &amp; C-value paradox, Genomic organization of prokaryotes &amp; eukaryotes, Nucleosome model of chromatin structural organization. Structure of gene (Introns; Exons). Central Dogma of Molecular biology.</p> <p><b>DNA replication:</b> Enzymes involved and mechanism of prokaryotic/ eukaryotic DNA replication.</p> <p><b>DNA repair system:</b> Mismatch repair; Nucleotide excision repair.</p> <p><b>DNA recombination:</b> Holliday model of recombination &amp; its mechanism. <b>Transposons:</b> Classification, basic mechanism of transposition (Copy &amp; Paste; Cut &amp; Paste mechanism).</p> <p><b>Transcription:</b> Prokaryotic and eukaryotic transcription. Regulation of Gene expression in Prokaryotes and Eukaryotes. Lac operon, Trp operon, RNA processing (Capping, Polyadenylation and Splicing). RNAi/ Si RNA.</p>	18
II	<p><b>Translation:</b> Genetic code, Prokaryotic and Eukaryotic translation, the translation machinery, mechanisms of initiation, elongation and termination, regulation of translation. Post translation modification of proteins. Chaperons assisted protein folding.</p> <p><b>Mutation:</b> Molecular mechanism of mutation, Mutagens, Site directed mutagenesis. Genome Sequencing (Sanger method, Maxam Gilbert Method and Automated DNA sequencing) application of sequence information for identification of defective genes. Molecular mapping of genome: physical maps, molecular mapping. Mini and Micro satellite DNA, molecular markers in genome analysis: RFLP, RAPD, VNTR and AFLP analysis. Molecular mapping in pedigree and disease analysis.</p>	24

### TEXT BOOK:

- Cell Biology, Genetics, Molecular Biology by Verma, P.K

### REFERENCE BOOKS:

- Molecular biology of cell, by Alberts B. D. Lewis J. Raff M. Roberts K. and Watson.

- Gene, Vol. V, VI, VII, VIII and IX, Lewin B., Oxford University Press, Oxford.
- Molecular biology of the Gene by Watson J. Hopkins, Roberts Steitz & Weiner, Benjamin Cummings.
- Text Book of Molecular Biology by K. Sivrama Sastry G. Padmanabhan and C. Subramanyam: MacMillan, India.
- Cell and Molecular biology by G. Karp, John Willey & Sons, U.S.A.
- Principles of Genetics by P.D. Snustad, M.L. Smmons, J.B. & Jenkins, John Willey & Sons, U.S.A.
- Cell and Molecular biology, De Robertis and De Robertis by Saunders Publications

**FOCUS:** This course focuses on Employability, Skill development aligned with CO2 & CO6

**OUTCOME:** After completing this course, student will able to

CO1. Understand characteristics of DNA and its primary, secondary and tertiary structure.

*(Understand)*

CO2. Understand Complexity and organization of genome in different organism. *(Understand)*

CO3. Understand the DNA recombination and repair mechanism. *(Understand)*

CO4. Understand the semi-conservative mode of replication in prokaryotes and eukaryotes.

*(Understand)*

CO5. Describe process of transcription in prokaryotes & eukaryotes. *(Understand)*

CO6 Describe Operon concept, bacterial gene regulation & eukaryotic gene regulation.

*(Understand)*

CO7. Analyze the genetic code and describe the Translation and post translation modification process. *(Understand and Analyse)*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P02, P03, P05, P06/PS02, PS03
C02	P01, P04, P07, P08/PS01, PS02
C03	P01, P03, P06, P08/PS01, PS03
C04	P01, P02, P05, P07, P010/PS01, PS02
C05	P01, P03, P07, P08/PS02, PS03

C06	P01, P02, P05, P08/PS01, PS03
C07	P01, P03, P07, P08, P09/PS01, PS02

**BSBC 0007: PLANT SCIENCE-I**

**OBJECTIVES:** To study the morphology, taxonomy and physiology of Higher plants.

**Credits: 04**

**Semester III**

**L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
I	<p><b>Anatomy:</b> Techniques for study of plant anatomy, Meristems, Leaf anatomy, Epidermis, Stomata, Origin, Structure and function of vascular cambium, Structure of xylem and phloem, Cork cambium activity and products, Root stem transition,</p>	14
	<p><b>Taxonomy:</b> Systematic position, Distinguishing character and economic importance of the following families: Papaveraceae, Rutaceae, Apiaceae, Apocynaceae, Lamiaceae, Aselepiadaceae, Poaceae</p> <p><b>Plant Water Relations:</b></p> <p>Diffusion, Osmosis, Permeability, Imbibition, Plasmolysis, Osmotic potential, Water potential, DPD, Types of soil water, Mechanism of active and passive water absorption</p> <p><b>Ascent of sap:</b> Definition, Theories of ascent of sap</p>	18
II	<p><b>Transpiration:</b> Definition, Types, Stomatal apparatus, Stomatal periodicity, Mechanism of stomatal movements, Factors affecting stomatal movements, Factors affecting transpiration, Significance of transpiration, Wilting, Antitranspirants, Guttation</p> <p><b>Mineral Nutrition:</b> Essential macro and micro elements and their role in plants (deficiency, symptoms, disease and functions), Mechanism of passive and active mineral salt absorption, Hydroponics, Mechanism of translocation of solutes (Mass flow or munch hypothesis, protoplasmic streaming theory)</p> <p><b>Photosynthesis:</b> Introduction, Significance, Historical aspects, Photosynthetic pigments, Concept of two photosystems, Light phase: Cyclic and Non cyclic photophosphorylation (z scheme), Dark phase: Calvin cycle (C3), Hatch and slak cycle (C4) and CAM pathway, Photorespiration (C2 cycle), significance of Photosynthesis</p> <p><b>Respiration:</b> Introduction, Types, RQ, Glycolysis, Kreb's cycle, Factors affecting respiration, Fermentation</p>	24

**TEXT BOOK:**

- Unified Botany 3<sup>rd</sup> Year by Agrawal, S.B

- Text book of Botany Diversity and Systematics by Singh, V

### REFERENCE BOOKS:

- Botany, Author: A.C.Dutta, Pub: oxford university press
- Elementary Biology, Author: Bhatia & Tyagi, Pub: truman book company
- A Test Book of Plant Physiology, Biochemistry & Biotechnology, Author: Verma & Verma, Pub: S.chand
- Plant Physiology, Author: Salisbury & Ross, Pub: WADSWORTH Cengage learning
- Unified Botany, Author: Agrawal S.B, Pub: Shivalal Agrawal

**FOCUS:** This course focuses on Employability aligned with CO1 & CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to:

**CO1.** Understanding of plant classification systematics and the morphology, anatomy, and economic importance of various plants groups (*Understand and Remembering*)

**CO2.** Understand the fundamental physiological processes of plants especially nutrient and water dynamics of the plant systems (*Understand and Remembering*)

**CO3.** Learn about the introduction, significance, and historical aspects of photosynthesis and respiration and understand the role of primary production in energy transformations. (*Understand and Remembering*)

**CO4.** Apply the knowledge of plant science-specific techniques for studying the anatomy, structure, and function of plant vascular tissues (*Understand, Evaluate and Apply*)

**CO5.** Determine how the metabolic activity takes place in plants and how they are regulated and apply them for improving the plant growth and health. (*Apply*)

**CO6.** Know about the prospect, promises and application of hydroponic systems (an alternative farming system) (*Understand, Evaluate and Apply*)

**CO7.** Demonstrate the detailed knowledge of different macro and microelements and their role in maintaining the growth and physiology of plants (*Apply*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P03, P04, P06/PS02, PS03
CO2	P01, P02, P07, P08/PS01, PS03

C03	P01, P04, P07, P08/PS01, PS02
C04	P02, P05, P07, P08/PS02, PS03
C05	P03, P04, P06, P08, P09/PS01, PS02
C06	P02, P03, P05, P07, P010/PS01, PS03
C07	P01, P04, P07, P08/PS02, PS03

## BSBC 0008 : BIOCHEMISTRY

**OBJECTIVES:** To consolidate the student's training in Chemistry, Biology and other disciplines, as well as integrates the two to enhance a better understanding of biochemical principles.

**Credits: 04**

**Semester III**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<p><b>Carbohydrate metabolism:</b> Embden-Meyerhof pathway , regulation of glycolysis, fermentation, anaerobic fate of pyruvate, pentose phosphate pathway, citric acid cycle, regulation of citric acid cycle, gluconeogenic pathway, control of gluconeogenesis, glycogen metabolism (glycogenolysis and glycogenesis), regulation of glycogen metabolism, electron transport chain system</p> <p><b>Amino acids and protein metabolism:</b> essential aminoacids, nonessential aminoacids, glucogenic and ketogenic amino acids, amino acids biosynthesis (glutamate, glutamine, alanine, aspartate, asparagine serine, glycine, praline, cysteine, tyrosine), pathways of amino acids degradation (acetyl CoA family <math>\alpha</math>- ketoglutarate family, succinyl CoA family), urea cycle</p>	18
III	<p><b>Metabolism of Lipids and Nucleic acids:</b> fatty acid biosynthesis (fatty acid synthase complex, biosynthesis of long chain fatty acid, elongation of fatty acid chain, regulation), fatty acid oxidation (activation of fatty acids, role of carnitine in the transport of long chain fatty acid, <math>\beta</math> oxidation of saturated and unsaturated fatty acids, <math>\alpha</math> and <math>\omega</math> oxidation of fatty acids, regulation), biosynthesis of cholesterol, biosynthesis of purine and pyrimidine nucleotides, deoxyribonucleotides</p>	24

### TEXT BOOK:

- Instant notes Biochemistry by Hames, David

### REFERENCE BOOKS:

- Principles of Biochemistry, Author: AlbertL. Lehninger, Pub: CBS
- Biochemistry, Author: Lubert Stryer, Pub: Freeman International Edition
- Fundamentals of Biochemistry, Author: J.L. Jain, Pub: S. Chand and Company
- Biochemistry, Author: Keshav Trehan, Pub: Wiley Eastern
- Principles of Biochemistry, Author: Jeffery Zubey

**FOCUS:** This course focuses on Employability aligned with CO1 & CO2



**COURSE OUTCOMES:** After completion of course, the student will be able to:

- CO1:** Understand basic metabolic pathway of the cell. (*Understand, Analyze and Apply*)  
**CO2:** Understand various anabolic & catabolic pathways related to Carbohydrates. (*Understand, Analyze and Apply*)  
**CO3:** Understand various anabolic & catabolic pathways related to Proteins. (*Understand, Analyze and Apply*)  
**CO4:** Understand various anabolic & catabolic pathways related to Lipids. (*Understand, Analyze and Apply*)  
**CO5:** Understand various anabolic & catabolic pathways related to Nucleic acid. (*Understand, Analyze and Apply*)  
**CO6:** Understand essential aminoacids, nonessential aminoacids, glucogenic and ketogenic amino acids (*Understand*)  
**CO7:** Understand cholesterol biosynthesis. (*Understand*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01, P03, P05, P06/PS01, PS03
C02	P02, P03, P07, P010/PS01, PS02
C03	P01, P03, P05, P06, P07, P010/PS01, PS03
C04	P02, P03, P07, P08/PS01, PS02
C05	P01, P03, P05, P06, P09/PS01, PS03
C06	P02, P03, P07, P08/PS01, PS02
C07	P01, P03, P05, P06, P09/PS01, PS03

## BSBC: 0009 : STEM CELL TECHNOLOGY

**OBJECTIVES:** The programme offers excellent transferable skills for subsequent employment in biomedical and clinical research area. The students will also learn various ethical issues that concern the stem cell and tissue engineering research.

**Credits: 02**

**Semester III**

**L–T–P: 2–0–0**

Module No.	Content	Teaching Hours
I	<p><b>Introduction to Stem Cells</b> Definition, Classification, Stem-cell plasticity, Differences between adult and embryonic stem cells.</p> <p><b>Embryonic Stem Cells</b> Blastocyst and inner cell mass cells; Regulators of pluripotency and differentiation of stem cell; The isolation, expansion, genetic manipulation, genomic reprogramming, and cloning of stem cells. Stem cells cryopreservation.</p> <p><b>Cloning and nuclear transfer Technology:</b> Human Therapeutic and Reproductive Cloning. Mammalian Nuclear Transfer Technology. Risks of cloning? The Cloning of Dolly and other Mammals, Patient-Specific Embryonic Stem Cells Derived from Human SCNT Blastocyst. Human Cloning and Human Dignity: An Ethical Inquiry</p> <p><b>Ethics:</b> Controversy surrounding human embryonic stem cell research, societal implications: women, low-income, Different religious views, Current Ethical Guidelines in America, Ethical views of other countries and how this affects advancement of science Policy</p>	18
II	<p><b>Regenerative medicine:</b> Overview of embryonic and adult stem cells for therapy Neurodegenerative diseases; Parkinson’s, Alzheimer, Spinal Cord Injuries and other brain Syndromes; Tissue system Failures; Diabetes; Cardiomyopathy; Kidney failure; Liver failure; Cancer; Hemophilia etc</p>	24

### TEXT BOOK:

Robert Lanja, Essential of Stem Cell Biology, 2nd Edition, academic Press, 2006

### REFERENCE BOOKS:

- Ann A.Kiessling, Human Embryonic Stem Cells: An Introduction to the Science and Therapeutic Potential, Jones and Bartett, 2003.
- Peter J.Quesenberry, Stem Cell Biology and Gene Therapy, 1st Edition, Willy-Less, 1998

- A.D.Ho., R.Hoffiman, Stem cell Transplantation Biology Processes Therapy, Willy-VCH, 2006
- C.S.Potten, stem Cells, Elsevier,2006

**FOCUS:** This course focuses on Entrepreneurship, Skill development aligned with CO1 & CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1- Students will be able to explain how stem cells are derived for scientific research; compare and contrast tissue-specific stem cell types (e.g., blood, skin)

CO2- The basic mechanisms that regulate them; and extrapolate potential clinical use(s) of stem cells. The course content provides the necessary expertise to compete in an ever-changing world.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO5, PO7, PO10/PSO1, PSO3
CO2	PO1, PO3, PO7, PO8, PO9/PSO2, PSO3

### BSBO 0003: BIO-INFORMATICS

**OBJECTIVES:** Bioinformatics is an interdisciplinary program offering substantial training in both the biological sciences and the physical and mathematical sciences; our program emphasizes the integration of computer science with genetics and molecular biology.

**Credits: 04**

**Semester III**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<b>Introduction to Bioinformatics &amp; Biological Databases</b> Principles of DNA and Protein sequencing, File Formats for storage of Sequence and Structural Data, Primary Sequence Databases of Nucleic Acids and Proteins, Organism Specific Genome Databases, Structural Databases.	14
	Specialized Sequence Databases of Expressed Sequence Tags, Gene Expression, Single Nucleotide Polymorphism, OMIM, Unigene etc., Data Retrieval with ENTERZ, SRS and DBGET, Secondary Databases (Pfam, PROSITE, PRINT, Block, etc.) <b>Algorithms &amp; Tools</b> Sequence Alignment (Pair wise and Multiple), Alignment Algorithms, Database Similarity Searches (BLAST, FASTA AND psi-BLAST), Amino Acid Substitution Matrices (PAM, BLOSUM), Profiles and Motifs.	18
II	Protein Structure Prediction (Secondary and Tertiary), <i>ab initio</i> , Homology Modeling, Threading; ORF Prediction, Gene Prediction, Micro Array Data Analysis. <b>Applications of Bioinformatics in Biotechnology Research</b> PCR Primer designing, Structure Visualization Methods (SPD viewer, RasMol), Structure Classification (SCOP, CATH), Structural Alignment and Analysis (VAST), Bioinformatics Application in Drug target identifications, Computer aided Drug Designing and Computer aided Vaccine Designing	24

#### TEXT BOOK:

- Bioinformatics: Concepts, Skills and Application by Rastogi, S.C

#### REFERENCE BOOKS:

- B N Mishra, Bioinformatics: Concept and application, Pearson Education (in Press)
- O'Reilly: Developing Bioinformatics Computer Skill.
- Anthony JF Griffiths et al: An intro to Genetic analysis.
- Michael Starkey and Ramnath Elasarapu; Genomics Protocols, Humana Press
- Stephen Misner & Stephen Krawetz Bioinformatics Methods and Protocols

- Lawrence Hunter – Artificial Intelligence & Mol. Biology, free on web
- Westhead P: Instant notes on Bioinformatics; Viva Publication
- Hooman H Rasidi Bioinformatics Basic Application in Biological Science and medicine; CRC Press.

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1 & CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1: Describe the history, scope and importance of Bioinformatics and role of internet in Bioinformatics. (*Understand, Remember and Apply*)

CO2: To acquire an ability of knowledge and awareness of the basic principles and concepts of biology, computer science and mathematics. (*Understand, Remember and Analyze*)

CO3: Ability to understand existing software effectively to extract information from large databases and to use this information in computer modeling. (*Understand, Remember, Analyze and Apply*)

CO4: Ability to apply an understanding of the intersection of life and information sciences, the core of shared concepts, language and skills the ability to speak the language of structure-function relationships, information theory, gene expression, and database queries. (*Understand, Remember, Analyze and Apply*)

CO5: Ability to understand the overview about biological macromolecular structures and structure prediction methods. (*Understand, Remember and Apply*)

CO6: Ability to the basic concepts of Bioinformatics and its significance in Biological data analysis. (*Understand and Remember*)

CO7: Students will be able to engage professionally in problem-solving skills, including the ability to develop new algorithms and analysis methods. (*Understand, Remember Analyze and Apply*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO5, PO7/PSO2, PSO3
CO2	PO1, PO3, PO4, PO6/PSO1, PSO3
CO3	PO1, PO3, PO4, PO7, PO8, PO10/PSO2, PSO3
CO4	PO2, PO5, PO8, PO9, PO10/PSO1, PSO2
CO5	PO3, PO4, PO7, PO9, PO10/PSO1, PSO2

C06	P01, P02, P03, P05, P07, P09, P010/PS01, PS03
C07	P01, P02, P05, P07, P08, P09/PS02, PS03

## BSBC 0805: MOLECULAR BIOLOGY LAB

**OBJECTIVES:** Provide hands on experiments in performing basic molecular biology techniques such as DNA isolation, gel electrophoresis

**Credits: 02**

**Semester III**

**L-T-P : 0-0-3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Isolation of DNA from Bacterial cell</li> <li>• Isolation of DNA from Plant cell</li> <li>• Isolation of Plasmid DNA</li> <li>• Isolation of RNA</li> <li>• Estimate the concentration &amp; purity of DNA and RNA by Spectrophotometric method</li> <li>• Analysis of DNA by Agarose Gel Electrophoresis</li> <li>• To perform Restriction enzyme digestion</li> </ul>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1 & CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1- To understand safe laboratory practices and

CO2- To perform basic molecular biology technique

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7, PO10/PSO2, PSO3
CO2	PO1, PO2, PO3, PO4, PO6, PO9, PO10/PSO1, PSO3

**BSBC 0806 : PLANT SCIENCE-I LAB**

**OBJECTIVES:** Objective of this lab is to provide hands on training for plant physiology practical and taxonomy study by observation of plant external morphology and anatomy study by dissection of stem, root and leaf.

**Credits: 02**

**Semester III**

**L-T-P: 0-0-3**

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> <li>To demonstrate Osmosis with the help of Potato Osmometer</li> <li>To demonstrate the phenomenon of Plasmolysis</li> <li>To demonstrate root pressure</li> <li>To demonstrate that water moves up through the xylem of plant</li> <li>To demonstrate the phenomenon of Diffusion</li> <li>To demonstrate Transpiration phenomenon with belljar method</li> <li>To demonstrate the Stomatal transpiration by using four leaves</li> <li>To compare the Stomatal &amp; Cuticular transpiration of leaves of different plants by Cobalt chloride method</li> <li>To separate chlorophyll pigments by Paper &amp; Column Chromatography</li> <li>To show the effect of different wavelength of light the process of photosynthesis</li> <li>To study the anatomy of dicot and monocot stem</li> <li>To study the anatomy of dicot and monocot root</li> <li>To study the anatomy of dicot and monocot leaf</li> <li>To study the taxonomic character sticks of Vinca rosea</li> <li>To study the taxonomic character sticks of Hibiscus rosasinensis</li> <li>To study the taxonomic character sticks of Datura</li> </ul>	30

**FOCUS:** This course focuses on Employability aligned with CO1 & CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1- Student are able to identify the plants family, monocot and dicot anatomy



CO2- To understand the physiology of plants practically

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

<b>COs</b>	<b>POs/ PSOs</b>
C01	P01, P03, P04, P05, P07/PS03
C02	P02, P03, P04, P06/PS01, PS02

### BSBC 0807: BIOCHEMISTRY LAB

**OBJECTIVES:** To gain strong foundation and basic knowledge of biochemical methods and their application in biology. To have a greater understanding of the underlying theory of these methods and their practical applications in the laboratories.

**Credits: 02**

**Semester III**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Estimation of carbohydrate by Anthrone method</li> <li>• Estimation of DNA by Diphenylamine method</li> <li>• Estimation of RNA by Orcinol method</li> <li>• Estimation of protein by Biuret method</li> <li>• Estimation of protein by Folin- Lowry's method</li> <li>• Estimation of cholesterol in blood serum</li> <li>• Separation of amino acid by Paper Chromatography &amp; determination of Rf values</li> <li>• Study the effect of temperature on the activity of enzyme Acid Phosphatase</li> <li>• Study the effect of pH on the activity of enzyme Acid Phosphatase</li> <li>• To perform agarose gel electrophoresis of given DNA sample</li> </ul>	30

**FOCUS:** This course focuses on Employability aligned with CO2 & CO3

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1- To understand basic fundamental concept of metabolism

CO2- Describe the qualitative analysis of carbohydrates, lipids, protein and nucleic acid

CO3- To understand the quantitative analysis of carbohydrates, lipids, protein, nucleic acid and cholesterol.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P03, P04, P05, P07, P08, P010/PS03
CO2	P02, P03, P04, P06, P08, P09/PS01, PS02
CO3	P01, P03, P04, P06, P08/PS02, PS03

## BSBO 0803 : BIO-INFORMATICS LAB

**OBJECTIVES:** To understand the use of bioinformatics tools freely available on internet. Focus on theory and practices of technique for analysis and manipulations of nucleic acids.

**Credits: 02**

**Semester III**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Sequence searching in NCBI using Enterz</li> <li>• BLAST Similarity searching for Orthologous sequences</li> <li>• ORF Finder</li> <li>• Multiple Alignments using ClustalX</li> <li>• Web browser based Homology Modeling</li> <li>• Structural Visualization Software: RasMol, SPDViewer</li> </ul>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1

**COURSE OUTCOME:** After completion of course, the student will be able to:

CO1- To understand and applied different bioinformatics tools for the better outcomes.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO4, PO5, PO7, PO9, PO10/PSO2, PSO3

## BSBC 0010: INSTRUMENTATION AND BIO-ANALYTICAL TECHNIQUES

**OBJECTIVES:** To develop skilled manpower in the field of Bioanalytical Sciences. The primary OBJECTIVES of this course are to develop the skills to understand the theory and practice of bio-analytical techniques.

**Credits: 04**

**Semester IV**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Concepts : Magnification and resolving power Simple light microscope Dark field microscope Phase contrast microscope Fluorescent microscope Electron microscope ( SEM & TEM) pH meter Concept of Chromatography Paper chromatography & Thin layer chromatography Column Chromatography : Gel filtration, Ion exchange & Affinity chromatography	18
II	Native & SDS Poly acryl amide gel electrophoresis Isoelectric focusing 2 D gel electrophoresis Immuno electrophoresis Principle and laws of spectroscopy Colorimetry Spectrophotometry ( Visible, UV infrared) Atomic absorption spectroscopy Nuclear Magnetic Resonance Fluorimetry Basic Principle of Centrifugation, Factors affecting Sedimentation velocity, Sedimentation Coefficient. Types of centrifugation: Analytical, Differential, Rate-Zonal and sedimentation equilibrium Centrifugation.	24

### TEXT BOOK:

- Life Science in Tools & Techniques by P.S.Bisen & Shruti Mathur

### REFERENCE BOOKS:

- An introduction to Practical Biochemistry by T. Plummer
- Experimental Biochemistry by V. Deshpande and B. Sasidhar Rao
- Principle and Techniques in Biochemistry and Mol. Biology, Keth, Wilson and Walker
- Biophysical Chemistry Upadhyay & Nath
- Practical Microbiology by Aneja.

- Elements of Spectroscopy by Gupta, Kumar, Sharma (Pragati Prakashan)
- Introduction to Atomic spectra by H.E. White (McGrawHill Publication)
- Biological Instrumentation & Methodology by Bajpai, P.K
- Introductory Practical Biochemistry by S.K. Sawhney, Randhir Singh,

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1 & CO5

**COURSE OUTCOME:** The major outcomes of this course are:

CO1- Students can understand the basic principles of different analytical techniques.

CO2-Students can aware of the different parts of the instruments.

CO3- They can analyze the errors, precision and accuracy of the instruments.

CO4-Students can able to interpret the results obtained by these techniques.

CO5- Apply these analytical tools in research and biotechnology industries for the development of biological product.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P02, P04, P05, P07, P08/PS01, PS03
CO2	P01, P03, P06, P07, P09, P010/PS02, PS03
CO3	P02, P03, P04, P05, P07, P08, P010/PS01, PS02
CO4	P01, P03, P06, P07, P08, P09/PS02, PS03
CO5	P01, P02, P04, P05, P07, P08, P010/PS01, PS02

## BSBC0011: MICROBIOLOGY

**OBJECTIVES:** The objective of the course is to familiarize students with aspects, scopes and applications of microbiology.

**Credits: 04**

**Semester IV**

**L–T–P : 4–0–0**

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> <li>• <b>History and Scope of Microbiology.</b></li> <li>• <b>Classification of Bacteria.</b></li> <li>• <b>Morphology and Anatomy of Bacteria-</b> Size, Shape and Arrangement of Bacterial Cell, Cell Wall, Cytoplasmic Membrane, Flagella, Spores, Fimbriae and Capsule, Mesosomes, Abnormal forms due to Defective Cell Wall.</li> <li>• <b>Sterilization-</b> Definition and Different Methods of Sterilization.               <ul style="list-style-type: none"> <li>• Physical Methods- Autoclave, Hot air oven, Laminar airflow, Seitz filters, Sintered glass filters and Membrane filters.</li> <li>• Chemical Methods: Alcohol, Aldehydes, Phenols, Halogens and Gaseous agents.</li> <li>• Radiation Methods: UV rays and Gamma rays.</li> </ul> </li> <li>• <b>Culture Media for Cultivation of Bacteria and Their Types-</b> Basal, Enriched, Selective Cum Differential and Enrichment medium.</li> <li>• <b>Principles of Staining Techniques and Their Types-</b> Negative, Simple and Differential and Special Staining.</li> <li>• <b>Bacterial Nutrition and Reproduction.</b></li> <li>• <b>Bacterial Growth</b> – Growth Curve, Factors Influencing Growth. Batch, Continuous, Synchronous Culture and Diauxic Growth.</li> <li>• <b>Bacterial Genetics-</b> Mutation, Gene Transfer Mechanism (Transformation, Conjugation, Transduction, Lytic and Lysogenic Cycle).</li> </ul>	18
II	<ul style="list-style-type: none"> <li>• <b>Economic Importance of Bacteria.</b></li> <li>• <b>Virus-</b> General Characteristics and Morphology of Viruses including Bacteriophages, Classification of Viruses. Virioids and Prions.</li> <li>• Multiplication of DNA and RNA Viruses including Bacterial Viruses (Bacteriophages).</li> <li>• <b>Bacterial diseases and their control-</b> Tuberculosis, Tetanus, Typhoid and Food poisoning Bacteria (<i>Salmonella</i>).</li> <li>• <b>Viral diseases and their control-</b> Rabies, Hepatitis and HIV infection.</li> <li>• <b>Fungal diseases and their control-</b> Candidiosis and Sporotrichosis.</li> <li>• <b>Protozoan diseases and their control-</b> Malaria and Sleeping Sickness.</li> <li>• Antibacterial and Antifungal Agents.</li> </ul>	24

### TEXT BOOK:

- A Text Book of Microbiology by Dubey, R.C

### REFERENCE BOOKS:

- Microbiology, Authors- Pelczar, Chan and Kreig.
- Microbiology- an Introduction- (8th Edn), Authors- Tortora, G.J., Funke, B.R., Case, C.L.
- General Microbiology, Authors- Stainer, Ingharam, Wheelis and Painter.
- Microbial Physiology, Authors- Moat and Foster.
- A Text book of Microbiology, Authors- P. Chakraborty.
- Textbook of Microbiology, Authors- Dubey and Maheshwari.
- Microbiology, A Practical Approach. Authors- Patel and Phanse
- General Microbiology, Authors- Powar and Dagainawala.
- Microbiology, Author- S.S. Purohit.
- Microbiology, Authors- Prescott, Herley and Klein.
- Bacteriology, Authors- Topley and Wilson.

**FOCUS:** This course focuses on Employability, Skill development aligned with All COs

**COURSE OUTCOMES:** The major outcomes of this course are:

- CO1:** Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes. (*Remembering, Understand*)
- CO2:** Understand the structural similarities and differences among various physiological groups of bacteria/archaea. (*Remembering, Understand*)
- CO3:** Know various Culture media and their applications and also understand various physical and chemical means of sterilization. (*Remembering, Analyze*)
- CO4:** Know general bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae. (*Remembering, Analyze*)
- CO5:** Comprehend the various methods for identification of unknown microorganisms. (*Apply, Remembering, Analyze*)
- CO6:** Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism – Autotrophy and heterotrophy. (*Remembering, Understand*)
- CO7:** Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement. (*Understand, Remembering and Analyze*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO7/PSO2, PSO3
CO2	PO2, PO3, PO4, PO6/PSO1, PSO2
CO3	PO1, PO3, PO4, PO6, PO8/PSO2, PSO3
CO4	PO1, PO2, PO4, PO5, PO7, PO8, PO10/PSO1, PSO2
CO5	PO2, PO4, PO7, PO8, PO9/PSO1, PSO3
CO6	PO1, PO3, PO4, PO7, PO9, PO10/PSO2, PSO3
CO7	PO2, PO3, PO5, PO5, PO7, PO8, PO9/PSO1, PSO3

## BSBC 0012: IMMUNOLOGY

**OBJECTIVES:** The students will be introduced to the basic concepts of immunology as it relates to human and animal health. The course is designed for students with knowledge of immunology and defense mechanism against invading agents and non-self agents.

**Credits: 04**

**Semester IV**

**L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> <li>• <b>History and Overview of Immunology</b></li> <li>• <b>Immunity:</b> Introduction, Innate Immunity –Definition, Anatomical, Physiological and Cellular barriers, Mechanisms (Phagocytosis, Inflammation, Complement Activation, Fever and Interferon), Ubiquity of Innate Immunity, Adaptive Immunity – Definition, Types, Differences between Innate and Adaptive Immunity, Cooperation between Innate and Adaptive Immunity, Characteristic Attributes, Types of Immune Responses in Adaptive Immunity.</li> <li>• <b>Antigens :</b> Definition of Antigen/Immunogen and Hapten, Factors influencing Antigenicity, Types of Antigens, Epitopes/ Antigenic Determinants, Cell Surface Receptors for antigens, Antigen Recognition Molecules</li> <li>• <b>Cells and Organs of the Immune system:</b> Hematopoietic stem cell, Haematopoesis, Cells of immune system (B Lymphocytes, T Lymphocytes, Macrophages, Null Cell, Mast Cells, Dendritic cell), Organs of the immune system Central Lymphoid Organs and Peripheral Lymphoid Organs</li> <li>• <b>Immunoglobulins (Antibodies )</b> – Definition, Basic structure, General Functions, Immunoglobulin Classes , Physicochemical and Biological Characteristics, Antigenic Determinants on Immunoglobulin ( Isotype ,Allotype and Idiotype ), Monoclonal Antibodies and their Applications, Theories of Antibodies Formation.</li> </ul>	18
II	<ul style="list-style-type: none"> <li>• <b>Antigen-Antibody Interactions and Serological Tests</b> – Characteristics of Antigen- Antibody Interactions, Physico-chemical Forces Involved in Ag-Ab interactions, Sensitivity and Specificity , Factors Influencing Antigen – Antibody Interactions, Cross Reactivity, Adjuvant , Examples , Importance and Mode of Actions, Serological Tests and their Applications:-, Agglutination test , Precipitation tests, Immuno Diffusion and Immunoelectrophoresis, RadioImmuno Assay (RIA ), Enzyme Linked Immunosorbent Assay ( ELISA ) , Chemiluminescence, Immunofluorescence and Complement Fixation Tests</li> <li>• <b>Immune Responses and Role in Infectious Diseases –Types of Immune responses:</b> Humoral Immune Response , Primary and secondary Response, Cell Mediated Immune Response, Scope of CMI, Mechanism of Humoral and Cell Mediated immune Responses, Major Histocompatibility Complex(MHC) and Role of MHC</li> </ul>	24



	<p>molecules in CMI, Immune Responses against Bacterial, Viral , Fungal and Parasitic Infections, Auto Immunity and Immunotolerance.</p> <ul style="list-style-type: none"> <li>• <b>Immunoregulatory Molecules and Immunomodulation</b></li> <li>• <b>Hypersensitivity and Allergy</b> – Definition, Classification, Distinguishing Features of Immediate and Delayed Hypersensitivity IgE Mediated Hypersensitivity (Type I), Method used for Detection, Anaphylactic Reaction. Antibody Mediated Cytotoxicity (Type II) Hyper Sensitivity, Mechanism and Examples Immune Complex (Type III) Hypersensitivity: Localized and Generalized Type III Reactions, Mechanism Anybody Mediated Cell Stimulation (Type V) Hypersensitivity . Mechanism Delayed (Type IV) Hypersensitivity Me chanism and Important Aspect in Diagnosis of Diseases</li> <li>• <b>Vaccines and Toxoids</b> <ul style="list-style-type: none"> <li>○ Inactivated and Live Attenuated Vaccines</li> <li>○ Sub unit Vaccines</li> <li>○ Conjugate Vaccines</li> <li>○ Recombinant Vector Vaccines</li> <li>○ DNA Vaccines</li> <li>○ Toxoids</li> </ul> </li> </ul>	
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### TEXT BOOK:

- Immunology by Shetty, N

### REFERENCE BOOKS:

- Immunology and immunotechnology by Ashim k. Chakravarty (Oxford university Press)
- Immunology by C. Fatima
- Immunology by Kubly (Free man publication)
- Essentials of immunology by Roitt ( Blackwell scientific publication)
- Immunology by Benacera
- Infection & Immunity by John Playfair & Gregory Bancroft (Oxford university Press)

**FOCUS:** This course focuses on Employability aligned with All COs

**COURSE OUTCOME:** The major outcome of this course is:

After completion of this course successfully, the students will be able to:

CO1: Learn the key concepts of immunological mechanisms and our body respond towards pathogen attack. (**Remembering and Understand**)

CO2: How this could be extrapolated towards development of novel therapeutic interventions against various diseases. (**Understand, Analyze and Apply**)

CO3: This course will explain the role of immune response in infectious diseases and help in understanding the biology behind the allergic reactions among people. (**Understand, and Remembering**)

CO4: To apply immune associated mechanism in medical biotechnology research. (*Understand and Remembering*)

CO5: Course will be able to explain the procedure for the antigen-antibody interaction-based test and their specificity and sensitivity. (*Understand, Analyze and Apply*)

CO6: Able to understand the procedure for vaccines development and their applications. (*Remembering and Understand*)

CO7: Able to understand different immunological techniques and their applications in disease diagnosis. (*Understand, Analyze and Apply*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO5, PO7, PO8/PSO1, PSO3
CO2	PO2, PO3, PO5, PO6, PO8, PO10/PSO1, PSO2
CO3	PO1, PO2, PO3, PO5, PO7, PO8, PO9/PSO2, PSO3
CO4	PO2, PO4, PO5, PO8, PO9, PO10/PSO2, PSO3
CO5	PO1, PO3, PO4, PO5, PO7, PO9/PSO1, PSO3
CO6	PO2, PO5, PO8, PO9, PO10/PSO2, PSO3
CO7	PO1, PO2, PO3, PO5, PO7, PO8, PO9/PSO1, PSO3

## BSBC 0013: DRUG DISCOVERY & DEVELOPMENT

**OBJECTIVES:** The objective of this course is to introduce students the basic process of drug discovery and various considerations to bring drug in market place

**Credits: 02**

**Semester IV**

**L–T–P: 2-0-0**

Module No.	Content	Teaching Hours
I	Process of Drug Discovery: reductionist target-based approach, Target identification and validation, lead identification: High through-put screening, lead optimization and prioritization: ADME-TOX properties  New strategies in drug discovery: Structure based drug designing, Molecular docking,	10
II	Computer aided drug designing, chemi-informatics etc Process of Drug Development: considerations and strategies, cost estimates, factors for choosing candidates for drug development, preclinical studies (cell-based and animal studies), clinical studies (Phase 1, 2, 3)	14

### TEXT BOOK:

- Drug Discovery & Development: Traditional Medicine and Ethnopharmacology by Bhushan Patwardhan

### REFERENCE BOOK:

- Drug Discovery and Development: Technology in Transition By Raymond G Hill

**FOCUS:** This course focuses on Entrepreneurship, Skill development aligned with All COs

**COURSE OUTCOME:** The major outcome of this course is:

CO1- Students will have an **understanding** of drug discovery pipeline and its connection with life science

CO2- Utilise in silico **approaches** to critically evaluate the pharmacophore for ligand-protein binding

CO3 Compare and **understand** common natural sources of drugs and contemporary approaches to drug design and development

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

<b>COs</b>	<b>POs/ PSOs</b>
C01	PO2, PO3, PO4, PO5, PO7, PO8/PSO2, PSO3
C02	PO1, PO2, PO4, PO5, PO7, PO8, PO10/PSO2, PSO3
C03	PO2, PO3, PO5, PO6, PO7, PO8, PO9/PSO1, PSO3

## BSBO 0004 : CLINICAL MICROBIOLOGY

**OBJECTIVES:** To familiarize students with various techniques and their applications in diagnosis of diseases through clinical microbiology.

**Credits: 04**

**Semester IV**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> <li>• Overview and application of clinical microbiology.</li> <li>• Types, collection methods and transport of clinical specimens.</li> <li>• Direct examination of specimens.</li> <li>• The Bacteriology Section</li> <li>• The Mycology Section</li> <li>• The Parasitology Section</li> </ul>	18
II	<ul style="list-style-type: none"> <li>• The Virology/Sexually Transmitted Diseases (STD) Section</li> <li>• <b>The Mycobacteriology Section</b> Antimicrobial Assays – Bioassays, Liquid chromatographic Assays.</li> <li>• Bactericidal Tests – Minimal Bactericidal Concentration (MBC), Serum Antibacterial Titer (STT) and Serum Bactericidal Titer (SBT)</li> </ul>	24

### TEXT BOOK:

- Henry's Clinical Diagnosis and Management by Laboratory Methods. 23 Edition.

### REFERENCE BOOKS:

- Laboratory procedures in clinical microbiology. 2nd Edition. By John A. Washington.
- Clinical Microbiology Made Ridiculously Simple. 5th Edition. Mark Gladwin, Bill Trattler. Publisher Medmaster.

**FOCUS:** This course focuses on Employability, Skill development aligned with All COs

**COURSE OUTCOMES:** The major outcomes of this course are:

- CO1: Understand basic concepts and contribution of microbes in infectious diseases. (*Understand*)
- CO2: Understand importance and handling clinical specimens. (*Understand, Remember and Apply*)
- CO3: Understand bacterial associated infectious diseases and their prevention. (*Understand, Remember and Analyze*)
- CO4: Understand mycology and associated infections in humans. (*Understand and Analyze*)
- CO5: Understand viral infections and their prevention. (*Understand and Analyze*)

CO6: Understand the concept of antimicrobial assays. (*Understand and Remember*)

CO7 - To develop novel antimicrobial assays and agents. (*Create*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P02, P03, P04, P05, P07, P08/PS02, PS03
C02	P01, P03, P05, P06, P07, P08/PS01, PS03
C03	P01, P02, P04, P05, P07, P08/PS02, PS03
C04	P01, P03, P04, P06, P07, P08, P09, P010/PS01, PS03
C05	P02, P03, P04, P05, P07, P08, P010/PS01, PS02
C06	P02, P03, P04, P05, P07, P08/PS01, PS03
C07	P01, P03, P04, P05, P07, P08, P010/PS02, PS03

**BSBC 0808: INSTRUMENTATION AND BIO- ANALYTICAL  
TECHNIQUES LAB**

**OBJECTIVES:** To provide the students with a comprehensive overview of current developments in bioanalytical techniques.

**Credits: 02**

**Semester IV**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Microscopy – Light microscopy : principles, parts &amp; function, Operation</li> <li>• Calibration of Micropipette, pH Meter and Electronic Balance</li> <li>• Buffer preparation with the help of pH meter</li> <li>• Separation of chlorophyll pigment by Paper Chromatography</li> <li>• Separation of mixture of Sugars/ Amino acids/ Plants pigments by Thin Layer Chromatography</li> <li>• Demonstration of Immuno electrophoresis</li> <li>• Demonstration of SDS-PAGE.</li> <li>• Separation of Nucleic acid by Agarose gel electrophoresis.</li> <li>• Estimation of protein in given sample by colorimeter/ spectrophotometer</li> <li>• Principle &amp; operation of Centrifuge</li> <li>• To carry out qualitative test for Amylase, Invertase, Pepsin enzymes.</li> <li>• RBC &amp; WBC count by Haemocytometer in blood</li> <li>• To carry out qualitative test for sugars, protein, lipids</li> <li>• Prepares Slides: Historical slides of mammals of following organs- Stomach, Intestine, Liver, Pancreas, Kidney, Testis, Ovary and Spinal cord</li> <li>• Embryological Slides: Whole mount of chick embryo showing primitive streak, Whole mount of 5, 10, 20, and 48 somites stage of embryo</li> <li>• Microscopic study of different tissues.</li> <li>• Estimation of haemoglobin in blood, Determination of bleeding time, clotting time.</li> <li>• Recording of body temperature, pulse rate and blood pressure, basic understanding of Electrocardiogram – PQRST waves and their significance.</li> </ul>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1

**COURSE OUTCOME:** The major outcome of this course is:

CO1- The student will be able to use and apply various techniques like microscopy,

electrophoresis and chromatography in related experiments.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

<b>COs</b>	<b>POs/ PSOs</b>
C01	PO2, PO3, PO4, PO5, PO7, PO8, PO10/PS01, PS02



### BSBC0809: MICROBIOLOGY LAB

**OBJECTIVES:** The main objective of this course is to well verse the students with practical knowledge of Microbiology that they have taught in the theory and provide hands on training on practical techniques of Microbiology related practical.

**Credits: 02**

**Semester IV**

**L–T–P: 0–0–3**

Module No.	Contents	Lab Hours
I	<ul style="list-style-type: none"> <li>• To study basic rules and safety measures in microbiology laboratory.</li> <li>• To study different methods of cleaning of glass wares used in microbiology laboratory.</li> <li>• To study the working of different types of Instruments used in microbiology laboratory.</li> <li>• To prepare cotton plugs for conducting microbiological experiments.</li> <li>• Demonstration of bacteria in water, soil, air, skin and working table tops.</li> <li>• To perform Negative staining of given bacterial culture.</li> <li>• To perform Simple staining for the study of bacterial morphology.</li> <li>• To perform Gram’s staining to differentiate Gram positive and Gram negative bacteria.</li> <li>• To perform Acid- Fast staining to differentiate Acid-Fast and Non Acid- Fast bacteria.</li> <li>• To perform Capsule staining of given bacterial culture.</li> <li>• To prepare Nutrient Agar, Nutrient Broth, Blood Agar and Mac-Conkey Agar Medium for the routine cultivation of bacteria.</li> <li>• To prepare Potato Dextrose Agar, Sabouraud Agar and Martin’s Rose Bengal Agar Medium for the routine cultivation of fungi.</li> <li>• To Study different methods of obtaining pure culture of microorganisms.</li> <li>• To isolate and enumerate bacterial colonies from soil samples.</li> <li>• Isolation and enumeration of fungi from soil.</li> <li>• To perform in-vitro antibiotic sensitivity test against specific bacterial cultures.</li> </ul>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with All COs

**COURSE OUTCOMES:** The major outcomes of this course are:

CO1: After completing the practical course, student will able to culture, isolate and purify microbes form various sites and

CO2: They can observe the morphology of microbes by using different staining techniques.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

<b>COs</b>	<b>POs/ PSOs</b>
C01	PO1, PO3, PO5, PO6, PO7, PO8, PO10/PS01, PS02
C02	PO2, PO3, PO4, PO5, PO7, PO8, PO9/PS01, PS03

## BSBC 0810: IMMUNOLOGY LAB

**OBJECTIVES:** To well verse the students with practical knowledge of Immunology and its application that they have taught in the theory and to provide hands on training.

**Credits: 02**

**Semester IV**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Various routes of inculcation in Laboratory animal</li> <li>• Preparation of Somatic antigen</li> <li>• Raising of Antiserum in Laboratory animal</li> <li>• Quantization of total serum Immunoglobulin by ZnSO<sub>4</sub> turbidity test</li> <li>• Bacterial slide agglutination test</li> <li>• Determination of Blood Groups in Human</li> <li>• Tube Agglutination Test</li> <li>• Ochterlony Immuno diffusion test</li> <li>• Erythrocyte rosette formation by T lymphocyte</li> <li>• Rocket Electrophoresis</li> <li>• ELISA Test</li> </ul>	30

**FOCUS:** This course focuses on Employability aligned with All COs

**COURSE OUTCOMES:** The major outcomes of this course are:

CO1: Student will be able to handle the laboratory animals

CO2: They can perform various serological tests which finally enhance the ability to understand related theory.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO4, PO6, PO7, PO8, PO10/PSO1, PSO2
CO2	PO1, PO2, PO3, PO4, PO6, PO7, PO8/PSO2, PSO3

## BSBO 0804 : CLINICAL MICROBIOLOGY LAB

**OBJECTIVES:** This course aims to impart in students an understanding of clinical microbiology and contribution of microbes in infectious diseases.

**Credits: 02**

**Semester IV**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Safety measures in clinical microbiology lab</li> <li>• Collection of various clinical specimens.</li> <li>• Isolation of bacterial strains from clinical specimens.</li> <li>• Isolation of fungal strains from clinical specimens.</li> <li>• Bactericidal Tests – Minimal Bactericidal Concentration (MBC).</li> <li>• Antimicrobial susceptibility assays.</li> </ul>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1

**COURSE OUTCOME:** The major outcome of this course is:

CO1: Students will be able to collect and handle various clinical specimens with knowledge of antimicrobial assay.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P02, P05, P06, P07, P08, P010/PS02, PS03

## BSBC 0014: PLANT BIOTECHNOLOGY

**OBJECTIVES:** To provide knowledge of different techniques for the utilization of Plant material for the production of valuable products as well as provide the idea how plant can be useful for the human welfare.

**Credits: 04**

**Semester V**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	Introduction to cell tissue culture, tissue culture as a technique to produce novel plants and hybrids: Tissue culture media (composition and preparation). Initiation and maintenance of callus and suspension culture; single cell clones. Organogenesis: Anther, pollen and ovary culture for production of haploid plants and homozygous lines. somatic embryogenesis, artificial seeds, Shoot-tip culture: rapid clonal propagation and production of virus –free plants. Embryo culture and embryo rescue Protoplast isolation, culture and fusion; selection of hybrid cells and regeneration of hybrid plants, cybrids. Basic Techniques in r-DNA Technology for Plant transformation : Ti and Ri plasmids, mechanisms of DNA transfer role of virulence genes, use of Ti and Ri as Vectors,	18
II	Binary vectors , use of 35S and other promoters, genetic markers, Reporter genes, reporter gene with introns, viral vectors and their applications, Vector less or direct DNA transfer (particle bombardment, electroporation, microinjection). Single cell suspension culture, Plant secondary metabolites, therapeutic proteins, and edible vaccines. Application of plant transformation for productivity and performance : Transgenic Plants resistance to herbicides (phosphinotricin , glyphosphate , sulphonylurea , atrazine ); insect (Bt genes) , non Bt like protease inhibitors, alpha amylase inhibitors , virus resistance , coat protein mediated, nucleocapsid gene, disease resistance , chitinases, 1-3 beta glucanase, abiotic stress (salinity , drought ) , post harvest losses, long shelf life of fruits and flowers, use of ACC synthase (1-aminocyclopropane-1-carboxylate synthase) polygalactouranase, ACC oxidase, male sterile lines , bar and barnase systems, carbohydrate composition and storage , ADP glucose pyrophosphatase.	24

### TEXT BOOK:

Biotechnology by B.D.Singh (Kalyani Publishers)

### REFERENCE BOOKS:

- Plant Tissue Culture: Application and Limitations. Bhowjwani, S.S. 1990.
- Plant Cell Culture: A practical approach. Dixon. 1994.
- Plant Cell Culture, Advances in Biochemical Engineering and Biotechnology. Anderson, L.A.,
- Biochemistry & Molecular Biology of Plants. Kosuge. 1983

- Biochemistry & Molecular Biology of Plants, Buchnan, Gruissen Jones, I.K. International Pvt. Ltd., 2004.
- Plant Biotechnology, Ashwani Kumar, Shikha Rohy, I.K. International Pvt. Ltd, 2006.
- Plant Taxonomy, O.P. Sharma, TMH Publication, 2006.
- Biotechnology by B.D.Singh (Kalyani Publishers)
- Text book of Biotechnology by R.C.Dubey ( S.Chand and company

**FOCUS:** This course focuses on employability aligned with All COs

**COURSE OUTCOMES:** At the end of the course, a student will be able to:

CO1: Understand the fundamental concept of plant biotechnology plant tissue culture, tissue culture media, and techniques for the development of plants with desired traits. (*Understand and Remembering*)

CO2: Find out the processes of plant biotechnology and their application for improving the crop quality, production of secondary metabolites, and other value-added products. (*Understand, Evaluate and Apply*)

CO3: Understand the outcome of biotechnological solutions developed through plant biotechnological interventions, particularly in the perspectives of plant, human, and environmental health. (*Understand, Remembering and Implementation*).

CO4: Demonstrate the knowledge of plant tissue culture, genetically improved plants, and thoughtful application of post-harvest techniques to meet the need for sustainable development (*Understand, Evaluate and Apply*)

CO5: Understand the essence of genetically modified/transgenic plant and their application for the development of therapeutic proteins, edible vaccines, insect, virus, herbicide, and abiotic stress resistance plants. (*Understand, Evaluate and Apply*)

CO6: Apply the knowledge of plant biotechnological approaches to grow the plants under in vitro conditions and utilize them further for small-scale and commercial applications. (*Apply*)

CO7: Determine the factors of executing research-oriented experiments by accessing the stepwise instructions of DNA transfer, genetic markers, and recombinant DNA technology (*Evaluate and Apply*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01, P02, P05, P06, P07, P08/PS01, PS03
C02	P02, P03, P05, P06, P08/PS02, PS03
C03	P01, P03, P05, P07, P08, P09/PS01, PS02
C04	P02, P04, P06, P08, P010/PS02, PS03
C05	P01, P03, P04, P05, P07,P09/PS01, PS03
C06	P01, P03, P04, P06, P09/PS02, PS03
C07	P01, P02, P05, P06, P08, P010/PS01, PS02

## BSBC 0015 : RECOMBINANT DNA TECHNOLOGY

**OBJECTIVES:** To expose students with recent advances in the field of Recombinant DNA Technology and their implication in life sciences research.

**Credits: 04**

**Semester V**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<p><b>Vectors</b> Gene Cloning -Concept and Basic Steps; Cloning Vectors: Plasmid Cloning Vector pBR322,pUC19, Vectors for Cloning large piece of DNA; –Bacteriophage-<math>\lambda</math> and other phage vectors; Cosmids, Phagemids; YAC and BAC vectors</p> <p><b>Tools &amp; Techniques</b> Enzymes used in Recombinant DNA Technology Endonucleases, Ligases and other Enzymes useful in Gene Cloning, PCR technology for Gene/DNA Detection, Cloning of Foreign Genes: Transferring DNA into <i>E. coli</i> –Chemical induction and Electroporation,</p>	18
II	<p>Gene library: Construction of cDNA library and Genomic Library, Screening of Gene Libraries – screening by DNA Hybridization, Immunological Assay and Protein Activity, Marker Genes: Selectable Markers and Screenable Markers Gene Expression in Prokaryotes: Strong and Regulatable Promoters; Increasing Protein Production; Fusion Proteins; Translation Expression Vectors; DNA Integration into Bacterial Genome; Increasing Secretions; Metabolic Load, Recombinant Protein Production in Yeast: <i>Saccharomyces cerevisiae</i> Expression Systems; Mammalian Cell Expression Vectors</p> <p>Gene Therapy for diseases (AIDS, Cystic Fibrosis and Parkinson), Applications of Recombinant DNA Technology</p>	24

### TEXT BOOK:

- Biotechnology by B.D.Singh (Kalyani Publishers)

### REFERENCE BOOKS:

- DNA cloning 1 and 2. Glover, D.M. and Hames, B.D. IRL Press (Oxford University Press, USA).
- Molecular Cloning, A laboratory Manual. Sambrook, J., Fritsch, E.F., Mariatis. Cold b Spring Harbor Laboratory, USA.
- Recombinant DNA. Watson.
- Molecular Biology of the Cell. Alberts, Johnson, Lewis, Raff, Roberts and Walter.
- Advanced Genetics, G.S. Miglani, Narosa Publishing House.
- DNA Science, David A. Micklos, Grog. A Freyer, I.K. International Pvt. Ltd.
- Frontiers in Plant Science, K.G. Mukerji et al, I.K. International Pvt. Ltd.

- Schaum's - Molecular & Cell Biology, Gregory B. Ralston, William D. Stan's field, TMH Publication.
- Schaum's – Genetics, Susan Elrod, William Stan's field, TMH Publication.
- Principle of Genetics, Robert H. Tamarin, TMH Publication.
- Genetics, C. Sarin, TMH Publication.

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1

**COURSE OUTCOMES:** The major outcomes of this course are:

CO1- Students will acquaint theoretical understanding of genetic engineering tools and techniques, i.e. restriction digestion, blotting, map-based cloning, PCR etc

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P02, P05, P06, P07, P08, P010/PS01, PS03



## BSBE 0017: IPR, BIOSAFETY AND BIOETHICS

**COURSE OBJECTIVES:** An intellectual property right enlightens the student knowledge towards the field of environment protection. Bioethics will enable the students to develop an attitude towards environmental protection, general guidelines for patenting and the ethical issues involved.

**Credits: 04**

**Semester V**

**L-T-P: 4-0-0**

Module No.	Content	Teaching Hours
I	Introduction of IPR, Establishment and functions of GATT, WTO, WIPO and TRIPS. Different types of intellectual property rights (IPR) - Patents, Trade mark, Trade secret, Copy right and Geographical indications. Application draft for getting patents. Requirements of governing patents. Licensing - Flav'r Savr™ tomato as a model case. Biopiracy and case studies on patents (Basmati rice, Turmeric, and Neem). Indian Patent Act, 1970 and recent amendments.	20
II	Biosafety-Introduction. Different levels of biosafety– BL1, BL2, BL3 and BL4. Biosafety guidelines in India. Guidelines for rDNA research activities, Good Laboratory Practices (GLP). Containment- Physical containment, Biological containment. Biological weapons. Bioethics-Introduction. Animal Rights. General issues related to environmental release of transgenic plants, animals and microorganisms. Ethical issues related to research in embryonic stem cell cloning.	20

### Text Book:

- Bioethics and Biosafety, M.K.Sateesh, I.K.International Pvt. Ltd, New Delhi, India.

### Reference Books:

- Molecular Biotechnology, Second Edition, Glick, B.R., and Pasternack, J.J., ASM Press, Washington, DC.
- Introduction to Plant Biotechnology, H.S.Chawla, Oxford & IBH Publishing Co. Pvt. Ltd.

**FOCUS:** This course focuses on Entrepreneurship, Skill development aligned with all COs

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO.1- Uptake challenging problems associated with patenting, intellectual property rights.

CO.2- Handle basic research skills.

CO.3- Understand the importance of the intellectual property rights in practical life.

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):**

<b>COs</b>	<b>POs/ PSOs</b>
CO1	PO2, PO3, PO5, PO8, PO10/PSO2, PSO3
CO2	PO1, PO2, PO4, PO5, PO9,PO10/PSO1, PSO3
CO3	PO1, PO2, PO5, PO6, PO7,PO8/PSO2

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**DEPARTMENT OF BIOTECHNOLOGY, INSTITUTE OF APPLIED SCIENCE & HUMANITIES (IAH)**

**BSBE 0016: CHEMISTRY- II**

**OBJECTIVES:** Impart sufficient qualitative/quantitative analytical and synthetic chemical knowledge and skills to students. Impart a disciplined approach to conceptualizing chemical problems in numerical terms. Predict products of chemical reactions. Explain patterns of chemical reactions.

**Credits: 04**

**Semester V**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<p><b>Stereo Chemistry of Organic Compounds :</b></p> <p>Structural Isomerism, Stereo Isomerism, Optical Isomerism, Optically active compound without chiral center, Resolution of Racemic Mixtures, Geometrical Isomerism, R.S. System of Configuration of optical isomers, E/Z system of configuration of geometrical isomers, conformational Isomerism.</p> <p><b>General Methods of preparation and properties</b> of alkanes, alkenes, alkynes, halogen substituted alkanes (<math>\text{CH}_2\text{Cl}_2, \text{CHCl}_3, \text{CCl}_4</math>).</p> <p><b>Aldehydes &amp; Ketones:</b> Nomenclature and structure of the carbonyl group, synthesis of aldehydes and Ketones. Chemical reactions of the carbonyl group. Unsaturated aldehydes and ketones.</p>	18
II	<p><b>Alcohols &amp; Phenols:</b> Classification and nomenclature, Monohydric Alcohols, nomenclature, methods of preparation by reduction of aldehydes and Ketones, carboxylic acid and esters, Hydrogen Bonding, Acidic nature, reaction of alcohol</p> <p>Nomenclature, Structure and Bonding, Preparation of phenols, Physical properties and acidic character comparative acidic strength of alcohols and phenols, resonance stabilization of Phenoxide ion, Reactions of Phenols.</p> <p><b>Chemistry of S- and p-block elements:</b> Comparative study, diagonal relationship, salient features of hydrides and complexation tendencies including their function in Biosystem.</p> <p><b>Polymers:</b> Preparation, Properties, Classification and uses of the following polymers, Polystyrene, Polyacrylonitrile, Polymethacrylate, Polymethylmethacrylate, Polyethylene,</p>	24

	Polybutadiene, Polyvinylidene, Polycarbonates, Polyesters, Polyurethanes, Nylon, Phenolic polyesters, Polyamides, Polysulphones,	
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**TEXT BOOK:**

1. M.M.N. Tandon, "Unified Chemistry for B.Sc. Second Year": Shivalal Agarwal & Co., 2016

**REFERENCE BOOKS:**

2. J. D. Lee, "Concise Inorganic Chemistry": Wiley, 2008

3. R.D. Madan, "Modern Inorganic Chemistry": S. Chand Publishing, 2019

4. I.L. Finar, "Organic Chemistry Vol. 1": Pearson, 2002

**FOCUS:** This course focuses on Employability aligned with All COs

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1: Understanding different isomerism in organic compounds. (*Understand*)

CO2: Propose the mechanism for organic compounds synthesis. (*Create*)

CO3: Apply different reactions for polymer preparations. (*Apply*)

CO4: Understanding variation of different parameters in periodic table. (*Remember*)

CO5: Design the mechanistic route for synthesis and reactions of various hydrocarbons. (*Analyze*)

CO6: Identify the name of a reaction and its mechanistic routes. (*Evaluate*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P02, P03, P04, P05, P06, P09/PS02, PS03
CO2	P01, P02, P03, P06, P08, P010/PS01, PS03
CO3	P01, P02, P04, P07, P08, P010/PS02, PS03
CO4	P01, P02, P04, P05, P06/PS01, PS02
CO5	P01, P02, P04, P05, P06, P08, P010/PS01, PS02
CO6	P01, P03, P04, P05, P06, P09, P010/PS02, PS03

## BSBE 0006: PLANT SCIENCE- II

**OBJECTIVES:** The objective of the course is to help students attain a basic proficiency in the area of plant research, which includes plant breeding and impact of various etiological agents.

**Credits: 04**

**Semester V**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<p>Microsporophyll, Structure of anther; microsporogenesis and structure of microspore and development of the male gametophyte.</p> <p>Megasporophyll, Structure of ovule (megasporengium), types of Ovules, megasporogenesis and development of the female gametophyte with particular reference to polygonum type.</p> <p>Megagametogenesis, Fertilization, double fertilization, embryogeny and endosperm</p> <p>Apomixis and polyembryony.</p> <p>Characteristics of fungal, bacterial &amp; viral disease &amp; their control measures</p> <p>Systematic position, morphology of etiological agent, Host- parasite relationship, disease cycle in the following diseases - White Rust of crucifers, Late blight of potato, Loose smut of wheat, Rust of wheat, Citrus canker and Yellow vein disease of Bhindi.</p>	14
II	<p>Nature and OBJECTIVES of plant breeding. General methods of plant breeding., Role of hybrid vigour in plant breeding.</p> <p>Economic importance with special reference to plant yielding:</p> <p>a) Food: Cereals (Rice, Wheat, Maize) Potato, sugarcane, legumes (Pigeon pea, gram and pea): Oil yielding plants (Sarson, Til, Ground Nut, Cotton). Fruits (Apple, Peach and Citrus).</p> <p>b) Common fiber yielding plants cotton, Sunhemp, Jute and Coir.</p> <p>c) Medicinal plants (Paper somniferum, Rauwolfia serpentina and Atropa beladonna).</p> <p>Common timber yielding plants- Pinus, Cedrus Deodara, Shorea robusta, Dalbergia</p>	14

**TEXT BOOK:** A Text Book of Botany Structure Development & Reproduction in Angiosperm by Singh, V

### REFERENCE BOOKS:

- Singh, Pande-Jain, A Text Book of Botany, Rastogi Publication
- R.S. Mehrotra, Plant Pathology, Tata McGraw-Hill Publishing Company Ltd.
- Dutta A.C. A Class of Botany, Oxford University Press.

**FOCUS:** This course focuses on Employability aligned with CO3, CO5 & CO6

**COURSE OUTCOMES:** The main outcomes of this course are:

**CO1-**Student will develop the understanding of anatomy, growth, development and reproduction in plants as well as understand the process of asexual reproduction for formation of fruit, ovule and seed without fertilization. (*Remember and Understan*)

**CO2-** Introduce students to the basic principles and concepts of plant pathology and plant disease management to understand the world of plant pathogens, identify common plant diseases and device control measures. (*Understand and Apply*)

**CO3-**The students will gain insight to the interplay of plant-microbe interactions under biotic and abiotic stresses and learn how to harness these interactions for disease resistance and abiotic stress tolerance. (*Evaluate and Apply*)

**CO4-**The students will learn the steps involved plant breeding, testing, release and commercialization of new cultivars. (*Understand, Analyze and Create*)

**CO5-** The students will learn how purposeful manipulation of qualities in plants is done to create new varieties with a set of desired characteristics. (*Evaluate and Create*)

**CO6-**The students will able to demonstrate broad understanding about plant breeding/genetics. (*Remember and Understan*)

**CO7-**Understand the various uses of plants and the services provided by the plants of economic importance to mankind. (*Understand, Analyze and Apply*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P03, P04, P05, P06, P07, P08, P09/PS01, PS02
CO2	P01, P02, P03, P05, P06, P07, P08/PS02, PS03
CO3	P01, P03, P04, P05, P06, P07, P08,P010/PS01, PS02
CO4	P01, P03, P05, P06, P07, P08,P09/PS01, PS02
CO5	P01, P02, P03, P05, P06, P07, P08,P010/PS02, PS03
CO6	P01, P02, P04, P05, P06, P07, P08, P010/PS01, PS02
CO7	P01, P03, P05, P06, P07, P09/PS01, PS03

## BSBE 0007: FOOD AND INDUSTRIAL BIOTECHNOLOGY

**OBJECTIVES:** The objective of the course is to help students attain a basic proficiency, role and application of biotechnology in the area of food and industrial processes.

**Credits: 04**

**Semester V**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> <li>• History and Overview of Food and Industrial Microbiology.</li> <li>• <b>Contribution of Microorganisms in Food Microbiology-</b> Bacteria, Yeast and Moulds.</li> <li>• Principles of Microbial Growth, Factors Influencing Microbial Growth in Food.</li> <li>• <b>The Bioreactor/Fermenter-</b> Types and Parts, Scale-up, Media Design for Fermentation Processes.</li> <li>• Production of Microbial Enzymes and Their Applications in Industries, Immobilized Enzymes.</li> <li>• <b>Principles underlying Food Spoilage and Contamination-</b> Canned Food, Sugar Products, Fruits, V vegetables, Meat and Poultry.</li> <li>• <b>Bacterial Food Borne Infections and Intoxications-</b> <i>Bacillus</i>, <i>Clostridium</i>, <i>Escherichia</i>, <i>Salmonella</i>, <i>Shigella</i>, <i>Staphylococcus</i> and <i>Vibrio</i></li> <li>• Microbial Metabolism and Its Impacts on the Production of Various Metabolites of Industrial Importance.</li> <li>• <b>Alcoholic Beverages</b> – Beer and Wine.</li> </ul>	18
II	<ul style="list-style-type: none"> <li>• <b>Organic acids</b> – Citric Acid and Lactic Acid.</li> <li>• <b>Antibiotics</b> – Penicillin and Streptomycin.</li> <li>• <b>Amino acids</b> – Glutamic acid.</li> <li>• <b>Vitamins</b> – B12</li> <li>• <b>Principles of Food Preservation</b> – Asepsis, Removal of Microorganisms, Anaerobic Conditions, High and Low Temperature, Drying.</li> <li>• Chemical Preservatives and Food Additives.</li> <li>• <b>Food Fermentation and Food Produced by Microbes-</b> Bread, Cheese, Vinegar, Youghart, Coffee and Pickles.</li> <li>• Oriental Fermented Foods.</li> <li>• Microbial Cells as Food- Single Cell Protein, Mushroom Cultivation.</li> </ul>	24

### TEXT BOOK:

- Biotechnology by Dubey, R.C

## REFERENCE BOOKS:

- Frazier, W.S. and Weshoff, D.C., Food Microbiology by McGraw Hill Book Co., New York.
- Mann & Trusswell, Essentials of human nutrition by oxford university press.
- Jay, J.M., Modern Food Microbiology, CBS Publications, New Delhi.
- Lindsay, Applied Science Biotechnology. Challenges for the flavour and Food Industry, Willis Elsevier.
- Roger, A., Gordon, B. and John, T., Food Biotechnology.

**FOCUS:** This course focuses on Employability, Skill development aligned with CO3, CO5 & CO6

**COURSE OUTCOMES:** The main outcomes of this course are :

- CO1: Understand basic concepts and contribution of microbes in food industry. (*Understand*)  
 CO2: Understand positive and negative impact of various microbes on food items. (*Understand and Apply*)  
 CO3: Understand bacterial food borne infection and intoxications and their prevention. (*Understand and Analyze*)  
 CO4: Understand design, working and applications of Bioreactor/Fermenter. (*Understand and Analyze*)  
 CO5: Understand principles of food preservation. (*Understand and Analyze*)  
 CO6: Understand the concept of Microbial Metabolism and Its Impacts on the Production of Various Metabolites of Industrial Importance. (*Understand*)  
 CO7: Understand the concept of microbial cells as Food, their production, cultivation and significance. (*Understand and Apply*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01, P03, P04, P05, P06, P07, P08/PS01, PS02
C02	P01, P03, P04, P06, P07, P08/PS01, PS02
C03	P01, P02, P03, P04, P05, P07, P08/PS03
C04	P02, P03, P04, P05, P06, P07, P08, P09, P010/PS01, PS03
C05	P01, P03, P04, P06, P07, P08, P09, P010/PS01, PS02
C06	P02, P03, P05, P06, P08, P09, P010/PS01, PS02, PS03
C07	P01,P03, P04, P05, P06, P07, P08,P010/PS01, PS02



## BSBE 0008: ENZYMOLOGY

**OBJECTIVES:** The objective of this course is to well versed students with basic concepts of Enzyme technology

**Credits: 04**

**Semester V**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> <li>• Classification and Nomenclature of enzymes</li> <li>• Isoenzymes and Multienzyme complexes</li> <li>• Enzyme Inhibition: Reversible (competitive, non-competitive &amp; uncompetitive) and Irreversible</li> <li>• Isolation and Purification of enzymes</li> </ul>	18
II	<ul style="list-style-type: none"> <li>• Enzyme Kinetics-Michaelis-Menton equation</li> <li>• Effect of temperature, pH, substrate concentration, product concentration, coenzyme concentration</li> <li>• Regulation of enzyme activity</li> <li>• Medicinal applications of enzymes</li> <li>• Industrial application of enzymes</li> <li>• Enzymes as an analytes</li> </ul>	24

### TEXT BOOK:

- Enzyme Technology by S. Shanmugam & T. Satishkumar, Pub: I.K.International

### REFERENCE BOOK:

- Understanding Enzymes by T.Palmer, Pub: Ellis Horwood Limited
- Fundamentals of Enzymology by Nicholas C. Price & Lewis Stevens, Pub: Oxford University Press

**FOCUS:** This course focuses on Employability aligned with CO2, CO3 & CO5

**COURSE OUTCOMES:** The main outcomes of this course are:

CO1- Acquire the knowledge of enzymes, their properties and classification, Mechanism of action, Michaelis-Menten initial rate equation, methods for the determination of Km and Vmax. *(Understand, Analyze and Apply)*

CO2- Learn about enzyme kinetics, effect of enzymes concentration, pH and temperature on kinetics of enzyme reactions, enzyme inhibition and activation, and Multisubstrate enzyme kinetics. *(Understand, Analyze and Apply)*

CO3- Acquire fundamental knowledge on enzymes and their importance in biological reactions. *(Understand)*

CO4- Understand various mechanism of regulation of enzyme activity. *(Understand and Analyze)*

CO5- Exposure to the concept of activation energy and its importance in biological reactions. *(Understand, Analyze and Apply)*

CO6- Understanding the role of enzymes in clinical diagnosis and industries. (*Understand, Analyze and Apply*)

CO7- Learn and Understand various techniques of enzyme purification. (*Understand, Analyze and Apply*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P01, P03, P04, P05, P06, P07, P08/PS01, PS02
C02	P02, P04, P05, P06, P08, P09, P010/PS01, PS03
C03	P01, P03, P04, P06, P07, P08, P09, P010/PS01, PS02
C04	P02, P03, P04, P05, P06, P07, P010/PS02, PS03
C05	P01, P03, P04, P05, P06, P07, P08, P09, P010/PS01, PS02
C06	P02, P04, P05, P06, P07, P08, P09, P010/PS01, PS03
C07	P01, P03, P05, P06, P07, P08, P09/PS01, PS02

## BSBE 0009: EVOLUTION AND ECOLOGY

**OBJECTIVES:** Evolution & Ecology course helps students to understand the concept of evolution of life of Earth from simple P.K. to complex E.K. Cells, direct and indirect evidences of evolution. It would provide an insight into the different forms of ecological interactions, concept of pollution ecology and comprehend the catastrophic effect of human activities which could destroy ecological harmony.

**Credits: 04**

**Semester V**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> <li>• Origin of life-Theory of chemical evolution, Oparin’s hypothesis, Miller Experiment, Protenoid microsphere, RNA first model, Origin of RNA, DNA</li> <li>• Theory of organic evolution-Lamarkism, Neo-Lamarkism, Darwinism, Neo-Darwinism, Germ plasm theory, Mutation theory</li> <li>• Direct evidences of evolution: Palaentological evidences, Fossils</li> <li>• Indirect evidences of evolution: taxonomy, Comarative anatomy, Connecting links, Homology, Analogy, Vestigial Organs etc.</li> <li>• Molecular Phylogeny: Gene and Species tree; Paralougous and homologous genes, Cladogaram and Dendrogram. Ecology: Definition, Branches of ecology, Relationship of ecology with other desciplines, Ecological tools and techniques, Significance of ecology for man</li> <li>• Population: Definition, Population characterstics, Population growth and forms</li> </ul>	18
II	<ul style="list-style-type: none"> <li>• Biotic Community: Definition, Organization, Interaction in biotic community: Predation, Parasitism, Amensalism, Commensalism, Protocooperation, Mutualism, Competition</li> <li>• Ecological Succession: Definition, Types of Succession: Lithosere, Hydrosere</li> <li>• Sustainable development, Energy need of population, Non renewable (Coal; Oil; Natural Gas); Renewable energy (Wind; Water, Solar, Biomass) resources and Indian Energy Policy, laws and initiatives. Use of modern Biotech approach in energy management.</li> <li>• Understanding nature characteristics and types of disasters, causes and effects, Geographical (Earthquake; Volcanic; Landslide), Wind and Water related disasters (Droughts, Cyclones, Tsumani), Manmade disaster (Nuclear, biological and Chemical disasters). Bioweapons. Disaster mitigation: Strategy and prevention.</li> </ul>	24

### TEXT BOOK:

- Cell Biology, Genetics, Mol. Biology Evolution and Ecology P.S. Verma

### REFERENCE BOOKS:

- Fundamental of ecology M C Dash
- Elementary Biology Bhatia & Tyagi

**FOCUS:** This course focuses on Employability aligned with CO5, CO6 & CO7

**COURSE OUTCOMES:** The main outcomes of this course are:

**CO1-** Understanding the key concepts in evolutionary biology, the history of life on Earth, and theories of evolution. (*Remember and Understand*)

**CO2-** Gain in-depth knowledge on origin of life, principles of evolution and phylogenetic relationships between organisms. (*Remember, Understand and Apply*)

**CO3-** Demonstrate an understanding of ecological relationships between organisms and their environment and develop understanding of structure/function relationships in organisms. (*Understand and Apply*)

**CO4-** Examine the genetic and environmental bases of variation in organisms; and describe how populations are regulated. (*Apply and Evaluate*)

**CO5-** Understand the core concepts of ecology through critical thinking and gain insight on community ecology, population and demography and ecological succession. (*Remember, Understand and Analyze*)

**CO6-** Define sustainability and identify major sustainability challenges, apply concepts of sustainable development to address sustainability challenges in a global context. (*Understand and Analyze*)

**CO7-** Develop understanding about natural calamity and disasters, disaster mitigation through risk reduction and other strategies for prevention. (*Evaluate and Create*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P03, P04, P05, P06, P07, P08/PS01, PS02
CO2	P02, P04, P05, P06, P08/PS01, PS03
CO3	P01, P02, P04, P05, P06, P08, P09/PS01, PS03
CO4	P01, P02, P03, P05, P06, P08, P09/PS01, PS03
CO5	P01, P02, P03, P05, P08, P09/PS01, PS02
CO6	P01, P02, P04, P05, P07, P08, P09/PS01, PS03
CO7	P01, P02, P03, P05, P06, P08, P010/PS01, PS02

## BSBC 0811: PLANT BIOTECHNOLOGY LAB

**OBJECTIVES:** To well verse the students with practical knowledge of plant biotechnology that they have taught in the theory and provide hands on training on practical techniques of plant tissue culture and food microbiology , food biochemistry and food biotechnology related practice.

**Credits: 02**

**Semester V**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Introduction to plant tissue culture laboratory and overview of Plant Tissue culture techniques.</li> <li>• Preparation of explants by aseptic technique.</li> <li>• Preparation of Murashige-Skoog (MS) and other media for plant tissue culture.</li> <li>• Inoculation of explants on MS media for callus formation.</li> <li>• Anther culture for production of Haploid embryo.</li> <li>• Shoot tip culture for production of virus free plants.</li> <li>• Development of plantlet by embryo culture.</li> <li>• Extraction of genomic DNA from leaf.</li> </ul>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1

**COURSE OUTCOMES:** The main outcomes of this course are:

CO1- Students will be able to culture plant tissue, plant extraction, and essential oil extraction and qualitative testing of food product biochemically and microbiologically.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO5, PO6, PO7, PO8/PSO1, PSO2

## BSBC 0812 : RECOMBINANT DNA TECHNOLOGY LAB

**OBJECTIVES:** To make the students well verse with practical knowledge of molecular biology on the basis of the tools and techniques of recombinant DNA technology and its application on the basis of subject taught in theory.

**Credits: 02**

**Semester V**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Plasmid isolation</li> <li>• Genomic DNA isolation</li> <li>• Competent Cell preparation</li> <li>• Transformation</li> <li>• Gene Expression using IPTG+X-Gal system</li> <li>• Polymerase Chain Reaction</li> </ul>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1

**COURSE OUTCOMES:** The main outcomes of this course are:

CO1- Students will be able to plan and perform simple experiments on DNA isolation, PCR based amplification which could lay foundations in choosing careers towards forensic sciences, criminal investigations.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1,PO2, PO3, PO4, PO5, PO6, PO7, PO8/PSO1, PSO3

## BSBE 0816: CHEMISTRY- II LAB

**OBJECTIVES:** Predict products of chemical reactions. Explain patterns of chemical reactions. Demonstrate common chemical laboratory techniques, chemical instrumentation and other appropriate technology. Demonstrate ability to work in a cooperative environment, understanding of safe laboratory practice.

**Credits: 02**

**Semester V**

**L–T–P: 0–0–3**

Module No.	Content	Teaching Hours
I	<p><b><u>Inorganic :-</u></b></p> <p>(1) Qualitative analysis of inorganic mixtures, containing not more than 4 (four) ionic species (excluding insoluble substances) Out of the following :-  <math>Pb^{2+}</math>, <math>Hg^{2+}</math>, <math>Hg_2^{2+}</math>, <math>Ag^+</math>, <math>Bi^{2+}</math>, <math>Cu^{2+}</math>, <math>Cd^{2+}</math>, <math>As^{3+}</math>, <math>Sn^{4+}</math>, <math>Sn^{2+}</math>, <math>Fe^{2+}</math>, <math>Fe^{3+}</math>, <math>Al^{3+}</math>, <math>Co^{2+}</math>, <math>Ni^{2+}</math>, <math>Mn^{2+}</math>, <math>Zn^{2+}</math>, <math>Ba^{2+}</math>, <math>Sr^{2+}</math>, <math>Ca^{2+}</math>, <math>Mg^{2+}</math>, <math>NH_4^+</math>, <math>K^+</math>, <math>Co_3^{2-}</math>, <math>S^{2-}</math>, <math>SO_3^{2-}</math>, <math>S_2O_3^{2-}</math>, <math>NO_2^-</math>, <math>CH_3</math> to <math>O^-</math>, <math>F^-</math>, <math>Cl^-</math>, <math>Br^-</math>, <math>I^-</math>, <math>NO_3^-</math>, <math>SO_4^{2-}</math>, <math>GO_4^{2-}</math>, <math>PO_4^{3-}</math>, <math>BO_3^{3-}</math>.</p> <p>(2) Gravimetric estimation of Barium and <math>SO_4^{2-}</math> as <math>Baso_4</math> ions.</p> <p><b><u>Organic :-</u></b></p> <p>(1) Purification of Organic Compounds by crystallization (from water and alcohol) and distillation.</p> <p>(2) Detection of functional groups in mono functional Organic compounds</p>	30

**FOCUS:** This course focuses on Employability aligned with CO1 & CO2

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1- Understand chemical function in terms of structure and analytical knowledge.

CO2- Students will be master in basic research skills.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P04, P05, P06, P08, P010/PS02, PS03
CO2	P02, P03, P05, P07, P09/PS01, PS03

**BSBE 0806: PLANT SCIENCE-II LAB**

**OBJECTIVES:** The main objective of this course is to well verse the students with practical knowledge of plant science that they have taught in the theory and provide hands on training.

**Credits: 02**

**Semester V**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Demonstration of reproductive parts of flowering plants</li> <li>• Study of structures in T.S of microsporangium (anther)</li> <li>• Study of structures of megasporophyll</li> <li>• Study of structures in T.S of megasporangium(ovule)</li> <li>• Collection and preservation of diseased plants</li> <li>• Identification of plant diseases based on symptoms</li> <li>• Preparation of media for isolation of different plant pathogens</li> <li>• Methods for isolation of different plant pathogens</li> <li>• Methods of staining of different plant pathogens (bacteria &amp; fungi)</li> <li>• Study of characteristics of various plant pathogens through slides</li> <li>• Live specimens and their comparative account/study</li> <li>• Study of communities by quadrant method to work out frequency and density</li> <li>• Physico-chemical nature of soil (soil texture, pH measurement, carbonate, nitrate and base deficiency)</li> <li>• Determination of soil moisture percentage</li> </ul>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with CO2 & CO3

**COURSE OUTCOMES:** After completing the practical course, student will able to:

CO1- Culture, isolate and purify epiphytic and endophytic microbes form infected plant parts

CO2- They can observe the morphology by using different staining techniques.

CO3- Students can perform various experiments regarding to detection of Physico-chemical nature of soil.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO4, PO5, PO6, PO7, PO8, PO10/PS01, PS03
CO2	PO1, PO3, PO4, PO7, PO8/PS02, PS03
CO3	PO1, PO4, PO5, PO6, PO7, PO8, PO9/PS01, PS02



## BSBE 0807: FOOD AND INDUSTRIAL BIOTECHNOLOGY LAB

**OBJECTIVES:** Students learn the practical applications of food science. It explores Food science application in food products development. Main aim of these experiments to make safe, high quality food products that is profitable to all segments of agriculture.

**Credits: 02**

**Semester V**

**L–T–P: 0–0–3**

S.No.	Name of Experiments
1.	Demonstrates the principles of butter making.
2.	Precipitation of Casein and making of casein glue.
3.	Demonstrates the importance of salt in meat processing.
4.	Demonstrates how appearance influences our perception of how foods taste.
5.	Demonstrates the chemistry of candy making
6.	Microbial testing of Milk and milk products.
7.	Isolation Gluten from different flour and its use in Bread making.
8.	Different food sample analysis for quality.
9.	Isolation of amylase from different flours.
10.	Culturing of different microbes used in fermented food products..
11	Determination of moisture, fat, ash and fiber content of food.

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1

**COURSE OUTCOMES:** After completing the practical course, student will able to:

CO1: Understand laboratory experiments which demonstrate some simple scientific principles that apply to food and explain why and how it is possible to make certain food products.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P02, P04, P05, P06, P07, P08/PS01, PS03

## BSBE 0808: ENZYMOLOGY LAB

**OBJECTIVES:** The objectives of this paper are to make students well verse with the fundamentals of enzymology

**Credits: 02**

**Semester V**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• To estimate standard curve of pNP so as to measure the activity of enzyme acid phosphatase</li> <li>• To find out the activity or amount of enzyme acid phosphatase in unit per gram of potato tissue</li> <li>• To determine the specific activity of enzyme acid phosphatase in Unit/mg of potato tissue</li> <li>• To study the effect of substrate con. on the activity of enzyme acid phosphatase</li> <li>• To determine value of <math>K_m</math> and <math>V_{max}</math> of enzyme acid phosphatase by using following graph (i) Michaelis- Menton graph (ii) Lineweaver Burk plot (iii) Hofstee's plot</li> <li>• To study the effect of temperature over the activity of enzyme acid phosphatase and to determine its optimum temperature</li> <li>• To study the effect of pH over the activity of enzyme acid phosphatase and to determine its pH</li> </ul>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1

**OUTCOME:** After completion of this paper students will be able:

CO1- To understand enzyme assay system, which will help them to cope up with research and industry related to enzymology

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P03, P05, P07, P08/PS01, PS03

## BSBE 0809: EVOLUTION AND ECOLOGY LAB

**OBJECTIVES:** The main objective of this course is to well verse the students with practical knowledge of plant science that they have taught in the theory and provide hands on training.

**Credits: 02**

**Semester V**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Determination of the presence of carbonates and nitrates in different soil sample</li> <li>• Determination of physico-chemical properties of given soil samples</li> <li>• Determination of water holding capacity of given soil samples</li> <li>• Determination of presence of inorganic salts in the given soil samples</li> <li>• Determination of presence of phosphorous in the soil</li> <li>• Determination of presence of nitrates in the soil</li> <li>• Determination of presence of potassium in the soil</li> <li>• Determination of physico-chemical properties of water samples</li> <li>• Determination of dissolved oxygen of the given water samples</li> <li>• Determination of physico-chemical properties of plant</li> </ul>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with CO1 & CO2

**COURSE OUTCOMES:** After completing the practical course, student will able:

CO1: To culture, isolate and purify epiphytic and endophytic microbes form infected plant parts and can observe the morphology by using different staining techniques.

CO2: In addition, students can perform various experiments regarding to detection of Physico-chemical nature of soil.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO5, PO7, PO8, PO10/PSO1, PSO2
CO2	PO1, PO2, PO3, PO5, PO7, PO8, PO9/PSO2, PSO3

## BSBC 0016: ANIMAL BIOTECHNOLOGY

**OBJECTIVES:** To understand the principles of animal cell culture and its application, *in-vitro* reproductive techniques for ovum and embryo manipulation and the concept of gene cloning and expression.

**Credits: 04**

**Semester VI**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> <li>• Scope of animal tissue culture</li> <li>• Natural media and artificially defined media</li> <li>• Primary cell culture: Disaggregation of tissues, enzymatic disaggregation &amp; mechanical disaggregation</li> <li>• Cell lines : Sub culture and maintenance of cell lines</li> <li>• Cryopreservation of cell lines</li> <li>• Large scale culture of animal cell</li> </ul>	18
II	<ul style="list-style-type: none"> <li>• Growth factors promoting proliferation of animal cells: EGF, FGF, PDGF, IL-1, IL-2, NGF and Erythropoietin</li> <li>• Production and application of monoclonal antibodies</li> <li>• Transfection of animal cell lines Expression of cloned proteins in <i>E.coli</i>, <i>S. cerevisiae</i>, insect cells, animal cells and animals</li> <li>• Over production and down stream processing of the expressed proteins</li> <li>• Transgenic animals: Technique and application, Knock out animal production</li> </ul>	24

### TEXT BOOK:

- Animal Tissue Culture by A. Wilson Aruni & P. Ramadass

### REFERENCE BOOKS:

- |                                    |                   |
|------------------------------------|-------------------|
| • Biotechnology-expanding horizons | B.D. Singh        |
| • Animal Biotechnology             | M.M.Ranga         |
| • Culture of animal cells          | R.Ian Freshney    |
| • Animal cell culture              | John R.W. Masters |

**FOCUS:** This course focuses on Employability aligned with CO3, CO6 & CO7

**COURSE OUTCOMES:** After completing this course, student will able:

CO1: Understand concept of animal biotechnology. (*Understanding*)

CO2: Know instrumentation and scope of animal cell culture. (*Knowledge*)

CO3: Explain the concept of monoclonal antibody technology and its application in different fields. (*Analyze*)

CO4: Understand *in-vitro* reproductive techniques for ovum and embryo manipulation. (*Understanding*)

CO5: Explain the production and applications of monoclonal antibodies. (*Analyze*)

CO6: Understand the principles of cloning and expression of foreign proteins in animal cells. (*Understanding*)

CO7: Explain the general principles of generating transgenic and knockout animals. (*Analyze*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

<b>Cos</b>	<b>POs/ PSOs</b>
C01	PO1, PO2, PO3, PO5, PO7, PO8/PSO2, PSO3
C02	PO1, PO3, PO5, PO7, PO8/PSO1, PSO3
C03	PO1, PO2, PO3, PO5, PO7, PO8/PSO1, PSO2
C04	PO1, PO3, PO7, PO8, PO9/PSO1, PSO3
C05	PO2, PO3, PO5, PO5, PO8, PO10/PSO1, PSO2
C06	PO1, PO2, PO3, PO5, PO7, PO8, PO10/PSO2, PSO3
C07	PO2, PO3, PO5, PO7, PO8, PO9/PSO1, PSO3

## BSBC 0017 : GENOMICS AND PROTEOMICS

**OBJECTIVES:** To expose students with recent advances in the field of Genomics & Proteomics and their implication in life sciences research.

**Credits: 04**

**Semester VI**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<p><b>Genomics</b> Genome sequencing: Shot Gun, Clone Contig, Contig assembly by chromosomal walking, sequence tagged site; Genetic and Physical Mapping, Importance of map in sequence assembly</p> <p>Genome Annotation: identifying genes in a genome sequence, determining the function of an unknown gene</p>	14
II	<p><b>Proteomics</b> Chemical classification of amino acids, Principles of protein structure (Primary, Secondary, Tertiary and Quaternary), dihedral angles (<math>\psi</math> and <math>\phi</math>), Ramachandran Plot</p> <p>Studying the Proteome: separation of proteins using 2D Gel, identification of individual protein using MALDI-TOF, ADME-Tox properties of drug candidates.</p> <p><b>Applications of Proteomics &amp; Genomics</b> Drug Discovery and Development, Microarray Technology, Pharmacogenomics, Metagenomics, epigenomics, Chromatin immunoprecipitation sequencing (ChIP), Protein-protein interaction, Yeast-Two- Hybrid system for protein-protein interaction</p>	14

### TEXT BOOK:

- Biotechnology by Dubey, R.C

### REFERENCE BOOKS:

- Introduction to Genomics. Arthur Lesk. Oxford University Press
- Brown TA, Genomes by Garland Science.
- Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and
- Bioinformatics by Benjamin Cummings.
- Primrose S & Twyman R, Principles of Gene Manipulation and Genomics by Blackwell.
- Glick BR & Pasternak JJ, Molecular Biotechnology by ASM Press.

**FOCUS:** This course focuses on Employability aligned with CO3, CO4 & CO5

**COURSE OUTCOMES:** After completing this course, student will able:

CO1-Inferred the basic concepts of genomics and proteomics. (*Remember & Understand*)

CO2-Understanding the use of genomics and proteomics tools and techniques. (*Understand & Remember*)

CO3-Suggesting and outlining solution to theoretical and experimental problems in Genomics and Proteomics fields. (*Analyze, Apply & Create*)

CO4-Be able to classify the complexity of genome/ proteome structural and functional organization. (*Evaluate & Apply*)

CO5-Formulate and assess experimental design for solving theoretical and experimental problems in Genomics and Proteomics fields. (*Create*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/ PSOs
C01	PO1, PO2, PO3, PO4, PO7, PO8/PS01, PS03
C02	PO1, PO3, PO5, PO7, PO8/PS01, PS03
C03	PO1, PO2, PO3, PO5, PO6, PO8/PS01, PS03
C04	PO1, PO2, PO3, PO4, PO7, PO8, PO9/PS01, PS02
C05	PO1, PO2, PO3, PO5, PO7, PO8, PO10/PS01, PS02

## BSBE 0010: FERMENTATION TECHNOLOGY

**OBJECTIVES:** Fermentation technology course helps students to apply the concepts learned in the area of microbiology, biochemistry for obtaining commercially important byproducts. Students are introduced to the concept of fermentation technology, scaling up techniques, wet & dry milling and the concepts, components of a bioreactor enabling students to learn the concept of aerobic, anaerobic and alcoholic fermentation leading to the production of cheese, butter, yoghurt, etc.

**Credits: 04**

**Semester VI**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	History and development of fermentation industry: Types of fermentations processes. Design of typical batch fermentor, Agitation, Aeration, pH, Temperature and dissolved oxygen. Factors affecting fermentor design. Types of fermenters, Computational control of fermenters Primary and secondary metabolite materials. Primary and secondary screening, Strain development strategies. Sterilization of fermentor, media and air. Raw material availability, quality, processes and pretreatment of raw Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Induction, nutritional repression, carbon catabolite repression, crab tree effect, feedback inhibition and feedback repression.	18
II	Creation/procedures for developing mutants of the desired microbes with the stable capacity of producing desired metabolites. Isolation and preservation of different types of mutants induction resistant, feedback inhibition resistant. Concept for overproduction of metabolites. Fermentations of recombinant microbial cells for large-scale production of genetically. Downstream processing.	24

### TEXT BOOK:

- Principle of Fermentation Technology by Stanbury, O.F

### REFERENCE BOOKS:

- Murray Moo -Young, Comprehensive Biotechnology, Vol. 1 & III.
- Microbes & Fermentation, A. Lel and Kotlers Richard J. Mickey, Oriffin Publication
- Industrial Fermentations- Leland, N. Y. Chemical Publishers.
- Prescott and Dunn's- Industrial Microbiology.
- Biotechnology Series, Rehm, Reed & Weinheim, Verlag-Chemie.
- Biochemical Engg., Aiba, Humphrey & Miller, Academic Press.
- Fermentations & Enzyme technology, Wang & Humphrey, Wiley & Inter Science



**FOCUS:** This course focuses on Entrepreneurship, Skill development aligned with all COs.

**COURSE OUTCOMES:** After completing this course, student will able:

CO1-Understand basic concepts of fermentation technology. (*Understand*)

CO2 - Understand design, working, computational control and applications of Bioreactor/Fermenter. (*Understand and Analyze*)

CO3 - Understand principles and strategies involved in media formulation and strain development. (*Analyze*)

CO4 - Understand the concept of feedback mechanisms such as inhibition and repression. (*Analyze*)

CO5 - Understand the concept of recombinant microbial cells and their significance in fermentation technology. (*Understand and Analyze*)

CO6 - Understand downstream processing and factors affecting the phenomena. (*Analyze*)

CO7 -To develop novel ideas in the area of fermentation technologies and their applications agents. (*Create*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

Cos	POs/ PSOs
C01	P01, P03, P05, P07, P08/PS02
C02	P01, P02, P03, P04, P07, P08/PS01, PS03
C03	P01, P03, P07, P08, P09/PS01, PS03
C04	P02, P03, P05, P05, P08, P010/PS01, PS02
C05	P01, P02, P03, P05, P07, P08, P010/PS02, PS03
C06	P02, P03, P05, P07, P08, P09/PS01, PS03
C07	P01, P02, P03, P04, P07, P08/PS01, PS03

## BSBE 0011: ROLES OF BIOTECHNOLOGY IN FORENSIC SCIENCE

**OBJECTIVES:** Forensic technology implies the concepts of molecular biology, biochemistry and immunology to critically investigate crime scene. The course helps students to explore the techniques of molecular biology such as DNA fingerprinting; RFLP; RAPD; AFLP; PCR & STR analysis. Course also introduces the concept of forensic entomology, and the use of 12S rRNA for identification of tissue based samples and their practical applications.

**Credits: 04**

**Semester VI**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> <li>Introduction to forensic Sciences;</li> <li>Genomic sequences present within the DNA &amp; their types (Unique/ Moderate &amp; highly repetitive DNA sequences); Minisatellites &amp; Microsatellites.</li> <li>Identification of animal species for processed meat products.</li> <li>Biotechnology Techniques utilized in DNA profiling (DNA fingerprinting);</li> </ul>	18
II	<ul style="list-style-type: none"> <li>Restriction fragment length polymorphism (RFLP); Random amplified polymorphic DNA (RAPD); Amplified fragment length polymorphism (AFLP); Microsatellites; PCR amplifications; STR analysis.</li> <li>Application of DNA profiling in crime investigation and detection.</li> <li>Paternity detection. Identification of animal species using collagen fingerprinting from bone marrow.</li> <li>Identification of contaminated meat/ tissue based identification of the corpse of different animals using molecular approach (12S rRNA mitochondrial based).</li> </ul>	24

### TEXT BOOK:

- Forensics for Dummies, M.K.Sateesh, DP Lyle, John Wiley & Sons (23 April 2004).

### REFERENCE BOOK:

- Molecular forensics, R. Rapley, D. Whitehouse, Wiley Sciences 2007.

**FOCUS:** This course focuses on Entrepreneurship, Skill development aligned with CO4, CO7 & CO9.

**COURSE OUTCOMES:** After completing this course, student will able:

After completing this course, student will able to

CO1. Understand characteristics of DNA and its primary, secondary and tertiary structure.

**(Understand)**

CO2. Understand Complexity and organization of genome in different organism. **(Understand)**

CO3. Understand the DNA recombination and repair mechanism. **(Understand)**

CO4. Understand the semi-conservative mode of replication in prokaryotes and eukaryotes.

**(Understand)**

CO5. Analyzed the complex genetic disorders of humans. **(Understand and Analyse)**

CO6. Describe process of transcription in prokaryotes & eukaryotes. **(Understand)**

CO7. Analyze nature & causes of cancer and the genes involved in cancer. **(Understand and**

**Analyse)**

CO8 Describe Operon concept, bacterial gene regulation & eukaryotic gene regulation.

**(Understand)**

CO9. Analyze the genetic code and describe the Translation and post translation modification process. **(Understand and Analyse)**

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P03, P04, P05, P07, P08/PS02
CO2	P01, P02, P03, P04, P07, P08/PS01, PS03
CO3	P01, P03, P05, P07, P08/PS01, PS03
CO4	P01, P02, P03, P05, P06, P08/PS01, PS03
CO5	P01, P02, P03, P04, P07, P08, P09/PS01, PS02
CO6	P01, P02, P03, P05, P07, P08, P010/PS01, PS02
CO7	P01, P02, P03, P04, P07, P08/PS01, PS03
CO8	P01, P03, P05, P07, P08/PS01, PS03
CO9	P01, P03, P04, P05, P07, P08/PS02

### BSBE 0018: CHEMISTRY- III

**OBJECTIVES:** Impart sufficient qualitative/quantitative analytical and synthetic chemical knowledge and skills to students. Impart a disciplined approach to conceptualizing chemical problems in numerical terms .Predict products of chemical reactions.Explain patterns of chemical reactions.

**Credits: 04**

**Semester VI**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<p><b>Chemistry in daily life:-</b> chemicals in medicine and health care, chemicals in food, Dyes, chemistry of rocket propellants</p> <p><b>Pesticides</b></p> <p>General introduction to pesticides (natural and synthetic), benefits and adverse effects, synthesis and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,); Organophosphates (Malathion, Parathion ); Carbamates (Carbofuran and carbaryl); Quinones ( Chloranil) ,Anilides (Alachlor and Butachlor).</p> <p><b>Nanochemistry:-</b> Introduction to nanochemistry</p>	18
II	<p><b>Electro Chemistry</b> ,Galvanic Cells, Electro chemical cells, electrical energy and the EMF, electrical energy galvanic cells, Reversible and irreversible cell, Notations used in Cell diagrams, Reversible electrodes, Measurement of EMF, Weston standard cell, electrode potential, measurement of electrode potential. Electrode Potential and Equilibrium constant liquid junction potential, concentration cells, application of concentration cells.</p> <p><b>Thermodynamics – I</b></p> <p>Definitions of thermodynamic terms :- System, Surrounding etc. Types of Systems intensive and extensive properties. State and path functions and their differentiates Thermodynamic process, concept of heat &amp; work.</p> <p>First Law of thermodynamics : Statement, definition of internal energy and enthalpy Heat capacity, Heat capacities at constant volume and pressure and their relationship. Joule’s Law : Joule – Thonson Coeffeciant and Inversion temperature. Calculation of <math>W</math> <math>1</math> <math>q</math> <math>dU</math> and <math>dH</math> for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.</p>	24

**TEXT BOOK:**

1. M.M.N. Tandon, “Unified Chemistry for B.Sc. Second Year”: Shivalal Agarwal & Co.,2016

**REFERENCE BOOKS:**

- 2.S.Glasstone, “Textbook of Physical Chemistry”: D. Van Nostrand Co., Princeton, NJ ,1961
- 3.R.D.Madan, “Modern Inorganic Chemistry”: S. Chand Publishing,2019
4. I.L. Finar, “Organic Chemistry Vol. 1”:Pearson,2002

**FOCUS:** This course focuses on Employability aligned with CO2, CO4 & CO6.

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1: Derive the Relation for Cp and Cv, Joule–Thomson coefficient etc. (*Create*)

CO2: Understand the chemistry of pesticides and their harmful effects. (*Understand*)

CO3: Calculate work of expansion, entropy changes in reversible and irreversible processes and enthalpy of a reaction. (*Remember*)

CO4: Apply chemistry and nanochemistry in daily use. (*Apply*)

CO5: Deduce laws of thermodynamics. (*Analyze*)

CO6: Evaluate electrodes and their potential. (*Evaluate*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

<b>Cos</b>	<b>POs/ PSOs</b>
C01	P01, P02, P03, P05, P06, P07, P08/PS01, PS03
C02	P01, P02, P05, P07, P08/PS02, PS03
C03	P01, P04, P05, P06, P07, P08, P010/PS01, PS02
C04	P02, P03, P05, P06, P07, P08, P09/PS02, PS03
C05	P01, P02, P05, P07, P08, P010/PS01, PS02
C06	P01, P04, P05, P06, P07, P08, P09/PS01, PS03

## BSBE 0013: HUMAN PHYSIOLOGY

### OBJECTIVES:

- Demonstrate knowledge of the anatomy and physiology of human organs and organ systems
- Demonstrate a basic knowledge of molecular / biochemical processes
- Demonstrate an understanding of the impact of evolutionary forces on the human organism
- Demonstrate an understanding of the ecological context of humans

**Credits: 04**

**Semester VI**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<p><b>Digestive system:</b> Organization of Gastro Intestinal Tract (Overview of Buccal cavity, Oesophagus, Stomach, Small intestine, Large intestine, Liver and Pancreas). Digestive Enzymes, Secretion of saliva, Gastric juice, Intestinal juice, Bile. Digestion and absorption of Carbohydrate, Lipid and Protein.</p> <p><b>Circulatory system:</b> Structure of Heart, Arterial system, Venous system, Portal system, Conducting system of heart, Heart beat, Arterial Blood Pressure, ECG, Artificial pace maker, Blood coagulation, Disorders of Circulatory System (Hyper tension, Atherosclerosis, Myocardial infarction, Rheumatic heart disease).</p>	18
II	<p><b>Endocrinology:</b> Properties of Hormones, Function and Disease associated with Hypo and Hyper secretion of Hormones secreted by Pituitary gland, Pineal gland, Hypothalamus, Thyroid gland, Parathyroid gland, Thymus gland, Adrenal gland, Pancreas, Gonads, Kidney and Placenta. Pheromones, Mechanism of hormone action. Nerve Impulse Transmission, Neurotransmitter</p> <p><b>Respiration:</b> Hemoglobin and myoglobin, Transport of Oxygen and Carbon dioxide in Blood, Oxygen dissociation curve, Bohr's effect and Haldane's effect, Common respiratory disorders (Hiccup, Hypoxia, Bronchitis, Asthma, Pneumonia, Diphtheria).</p> <p><b>Excretion:</b> Excretory system : Kidney, Ureter and Urinary bladder, Urea formation, Urine formation, Composition of urine, Acid base balance, Haemodialysis, Renal stone.</p>	24

### TEXT BOOK:

- Element of Human Anatomy, Physio and Health by Goyal, Ramesh K

## REFERENCE BOOKS:

- Animal Physiology by Kunt Schmidt, Neilson, Cambridge University Press Cambridge.
- Physiology of Mammals & other vertebrates by Marshall & Hughes. Cambridge University Press Cambridge.
- Animal Physiology by Roger Eckert & David Randall, CBS Publishers & Distributors, Delhi.
- Text of Animal Physiology by Hurt & Mathur, S.Chand & Co. New Delhi.
- Text of Animal Physiology by N agbushanam, Kodarkar & Sarojini, Oxford & IBI Pub. New Delhi.
- Comparative Animal Physiology (Environment & Metabolic Animal Physiology,) by CLadd Prosser, Wiley-Liss, Publication, New York
- Comparative Animal Physiology (Neural & Integrative Animal Physiology) C. Ladd Prosser, Wiley-Liss, Publication New York.
- Human Physiology, Vol.I & II by Dr.C.C.Chatterjee, Medical applied, Agency, Calcutta.

**FOCUS:** This course focuses on Employability aligned with CO2, CO3 & CO6

**COURSE OUTCOME:** After completing this course –

CO1: Understand the physiological aspects of human and other vertebrates (*Understand*)

CO2: Understand the physiological processes of animals and relationship of organ systems (*Understand*)

CO3: Develop a working knowledge of physiological systems and be able to associate anatomical areas with their specific function (*knowledge*)

CO4: Identify and describe structural differences of major physiological systems (*Understand*)

CO5: Understand important physiological challenges animals face and the processes animals deal with them (*Understand*)

CO6: Interactions and interdependence of physiological and biochemical processes (*Understand*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
C01	P02, P03, P04, P05, P07, P08/PS02, PS03
C02	P01, P02, P03, P05, P06, P08/PS01, PS03
C03	P02, P03, P04, P07, P08, P09/PS01, PS02
C04	P01, P02, P03, P05, P07, P08, P010/PS01, PS02
C05	P02, P03, P04, P07, P08, P09/PS02, PS03
C06	P01, P03, P05, P07, P08/PS01, PS02

## BSBE 0014: ENVIRONMENTAL BIOTECHNOLOGY

**OBJECTIVES:** Main OBJECTIVES of environmental biotechnology are the conservation of resources via the recycling of waste materials. The recoveries of more valuable products such as metals, oils, and vitamins are important aspects of this technology. Use of microorganisms in recovery of minerals of commercial interest is also an interesting area. Reclaiming organically polluted water, application of microbes to degrade compounds, use of animal waste as fertilizer.

**Credits: 04**

**Semester VI**

**L–T–P: 4–0–0**

Module No.	Content	Teaching Hours
I	<ul style="list-style-type: none"> <li>● <b>Introduction, Importance and Scope of Environment Biotechnology.</b></li> <li>● <b>Renewable and Non-Renewable Resources of Energy.</b></li> <li>● <b>Conventional fuels and their impact on Environment</b> – Firewood, Animal wastes, Coal, Petroleum and Animal oils.</li> <li>● <b>Modern fuels and their impact on environment</b> – Methanogenic Bacteria, Biogas Production, Microbial Hydrogen Production, Conversion of Sugar to Alcohol, Gasohol.</li> <li>● <b>Effect of Green Revolution and Industrial Revolution on Environment.</b></li> <li>● Degradation of Pesticides and Other Toxic Chemicals by Microorganism like <i>B. thuringensis</i>.</li> <li>● Degradation of Aromatic, Hydrocarbons and Petroleum Products.</li> <li>●</li> </ul>	18
II	<ul style="list-style-type: none"> <li>● <b>Treatment of Domestic and Industrial Wastes-</b> Primary, Secondary and Tertiary Treatments .</li> <li>● <b>Waste Water Pollution (Sewage) Treatment Process</b> - Septic tank, Mechanical and Biological Treatment, Trickling Filters, Activated Sludge Process, Oxidation Ponds, Anaerobic Sludge Digestion.</li> <li>● <b>Solid Waste Disposal-</b> Sanitary Landfills, Composting, Vermicompost.<b>Biofertilizers-</b> Definition, Distinguished Features of Biofertilizers and Organic Manures.</li> <li>● Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil, Algal and fungal biofertilizers (VAM)</li> <li>● <b>Bioleaching-</b> Ore Leaching and Role of Microbes in Mines (copper, and Uranium)</li> <li>● Environmental significance of Genetically modified microbes, plants and animals .</li> <li>● Bio-assessment of environmental quality.</li> </ul>	24



### TEXT BOOK:

- Fundamental of Environmental Studies by Bharrgava, D.S

### REFERENCE BOOKS:

- John E Smith – Biotechnology, Cambridge University Press
- Prescott & Dunn - Industrial Microbiology, AVI publishing Co. USA
- Mukerji, Singh & Garg - Frontiers in applied Microbiology, Prink House India, Lucknow
- Pepler & Perlman – Microbial Technology, Academic Press, New York
- Nicholas C Price – Fundamentals of Enzymology
- Chaplin & Bueke – Enzyme technology
- Moses and Capes – Biotechnology- the Science and Business

**FOCUS:** This course focuses on Employability, Skill development aligned with all COs.

**COURSE OUTCOMES:** After completing this course, student will able:

**CO1-** Understand the core concepts of environmental biotechnology and gain in-depth knowledge about importance and scope of environmental biotechnology. (*Remember and Understand*)

**CO2-** Gain in-depth knowledge about non-renewable, renewable and green energy resources, their utilization and environmental impact. (*Remember, Understand and Apply*)

**CO3-** Analyze the impact of green revolution and industrialization on earth and environment and aid the students to formulate and solve environmental problems by utilizing the concept of environmental biotechnology. (*Evaluate, Analyze and Create*)

**CO4-** Understand the current applications of biotechnology to environmental quality assessment, monitoring and remediation of contaminated environments. (*Understand and Analyze*)

**CO5-** Examine various aspects and prospects of biodegradation and bioremediation strategies of xenobiotics/pollutants. (*Analyze and Apply*)

**CO6-** Learn about the biology and functions of the microbes in the environment their role in bioleaching, nitrogen fixation, plant growth promotion and soil health management. Understand the issues related to environmental release of genetically engineered microorganisms. (*Understand, Apply and Create*)

**CO7-** Learn the concepts of solid waste management through technological applications for waste processing and their disposals. (*Analyze and Evaluate*)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P02, P03, P04, P05, P07, P08/PS02, PS03
CO2	P01, P03, P06, P07, P08/PS02

C03	P01, P03, P05, P06, P07, P08/PS01, PS03
C04	P01, P03, P05, P07, P08/PS01, PS03
C05	P01, P02, P03, P05, P06, P08/PS01, PS03
C06	P01, P02, P03, P04, P07, P08, P09/PS01, PS02
C07	P01, P02, P03, P05, P07, P08, P010/PS01, PS02

## BSBE 0015: CLINICAL BIOCHEMISTRY

**OBJECTIVES:** The objective of this course is to develop an understanding of specialized technologist biochemistry of clinical laboratories in hospitals.

**Credits: 04**

**Semester-VI**

**L:T:P- 4:0:0**

Module No.	Content	Teaching Hours
I	<p><b>Basic concepts of Clinical Biochemistry</b> A brief review of Units and abbreviations used in expressing concentrations and standard solutions. specimen collection and processing (Blood, urine, faeces). Anti-coagulant preservatives for blood and urine. Transport of specimens.</p> <p><b>Disorders of mineral metabolism</b> Hypo-Hypercalcemia, Hypo- Hyperphosphatemia, Disorders of amino acids, steroids and vitamins, Disorders of erythrocyte metabolism: hemoglobinopathy, thalassemia &amp; anemia. Biochemical Hazards of dangerous environment pollutants.</p> <p><b>Inborn errors of metabolism</b> Introduction, clinical importance, phenyl ketonuria, cystinuria, alkaptonuria, Fanconi's syndrome, galactosemia, albinism, tyrosinemia, and hamophilia.</p>	18
II	<p><b>Clinical drugs</b> Fluid &amp; electrolyte balance and imbalance in various diseases. Function tests of pancreas, gastric, Thyroid, Kidney and liver. Direct, indirect wander wall's test &amp; their clinical significance.</p> <p><b>Clinical drugs</b> Mechanism of drug action- Penicillin, Tetracycline, Streptomycin, Chloramphenicol &amp; Sulphonamides. Apoptosis: Carcinogens, Cancerous growth &amp; Chemotherapy, radioactivity: radioisotopes in medicine</p> <p><b>Clinical enzymology</b> Enzyme patterns in acute pancreatitis, liver damage, bone disorder, myocardial infarction and muscle wasting. Cerebrospinal fluid (CSF) chemistry and clinical significance. Biochemistry of detoxification, Xenobiotic metabolism. Metal ion toxicity, chelation therapy, antioxidant therapy. Biochemistry of Ageing, Cancer, AIDS. Functional and non-Functional plasma enzymes. Isoenzymes with examples.</p>	24

### TEXT BOOK:

- Text book of Clinical Biochemistry - Carl A. Burdis and Edward R Ashwood
- Clinical chemistry in diagnosis and treatment- Philip D. Mayne
- Clinical chemistry- William Hoffman

### REFERENCE BOOKS:

Text book of Medical Biochemistry- Dr. M.N. Chatterjee and Rane Shinde

**FOCUS:** This course focuses on Entrepreneurship, Skill development aligned with all COs.

**COURSE OUTCOMES:** After completing this course, student will able:

CO1- Understand units and abbreviations used in expressing concentrations and standard solutions, specimen (Blood, urine, faeces) collection and processing and transport. *(Understand, Analyze and Apply)*

CO2- Understand disorders of mineral metabolism (Ca & P), erythrocyte metabolism. *(Understand)*

CO3- Understand inborn errors of metabolism- cause, symptoms & treatment. *(Understand)*

CO4- Learn and understand mechanism of drug action Penicillin, Tetracycline, Streptomycin, Chloramphenicol & Sulphonamides. *(Understand, Analyze and Apply)*

CO5- Analyze Enzyme patterns in acute pancreatitis, liver damage, bone disorder, myocardial infarction and muscle wasting. *(Analyze)*

CO6- Student will able to learn Biochemistry of Ageing, Cancer, AIDS. *(Understand & Remembering)*

CO7- Learn and understand application of radioisotopes in medicines. *(Understand & Remembering)*

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO2, PO3, PO4, PO5, PO7, PO8/PSO2, PSO3
CO2	PO1, PO3, PO6, PO7, PO8/PSO1
CO3	PO2, PO3, PO4, PO5, PO7, PO8/PSO2, PSO3
CO4	PO1, PO2, PO3, PO5, PO6, PO8/PSO1, PSO3
CO5	PO2, PO3, PO4, PO7, PO8, PO9/PSO1, PSO2
CO6	PO1, PO2, PO3, PO5, PO7, PO8, PO10/PSO1, PSO2
CO7	PO2, PO3, PO4, PO7, PO8, PO9/PSO2, PSO3

**BSBC 0813: ANIMAL BIOTECHNOLOGY LAB**

**OBJECTIVES:** To develop skills of the students in the area of animal biotechnology and to learn about cell culture techniques.

**Credits: 02**

**Semester VI**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>Demonstration and working of laminar air flow, autoclave, hot air oven, BOD incubator, CO2 incubator water bath, Centrifuges and microscopes.</li> <li>Washing and sterilization of glasswares for <i>in vitro</i> culture</li> <li>Washing and sterilization of filter assemblies</li> <li>Preparation and sterilization of culture media and reagents.</li> <li>Isolation of lymphocytes from blood.</li> <li>Counting of viable cells by trypan blue dye with the help of haemocytometer.</li> <li>Preparation of primary culture from spleen.</li> <li>Feeding of cells growing in monolayer.</li> <li>Subculture of monolayer/ suspension cultures</li> <li>Splenocyte proliferation assay by MTT dye method</li> <li>To evaluate the effect of drugs on cell proliferation.</li> <li>Coning of monolayer cells.</li> <li>Cryopreservation of cultured cells.</li> </ul>	30

**FOCUS:** This course focuses on Employability aligned with CO1.

**COURSE OUTCOMES:** After completing this course, student will able:

CO1- To learn aseptic handling of tissues as well as various animal tissue culture methods.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO5, PO7, PO8, PO10/PSO2, PSO3

## BSBC 0814: GENOMICS AND PROTEOMICS LAB

**OBJECTIVES:** To inculcate in students, adequate bioinformatics skills so as to identify computational possibilities in life-science research

**Credits: 02**

**Semester VI**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Phylogenetic Analysis using Phylip: Botstraping, distance based and character based methods</li> <li>• Molecular DOCKING using Hex/AutoDock</li> <li>• Introduction to PERL Programming for Bioinformatics</li> <li>• Elementary statistics using R</li> </ul>	30

**FOCUS:** This course focuses on Employability aligned with all CO1.

**COURSE OUTCOMES:** After completing this course, student will able:

CO1- To effectively use tools and techniques used in genomics & proteomics

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO2, PO3, PO5, PO7, PO8, PO10/PS01, PS02

## BSBE 08010: FERMENTATION TECHNOLOGY LAB

**OBJECTIVES:** Learn the components of fermentor designing and use of fermentation technology in development of different fermented food products and applications in food science. Main aim of these experiments to make safe, high quality fermented food and beverages products that are profitable to all segments of society..

**Credits: 02**

**Semester VI**

**L–T–P: 0–0–3**

Module No.	Content	Lab Hours
I	<ul style="list-style-type: none"> <li>• Introduction to different fermentor used in food industries by video.</li> <li>• Mantling and dismantling of Bioreactor for study of its components.</li> <li>• To study the Growth kinetics in batch fermentation process.</li> <li>• Isolation of <i>Aspergillus niger</i> fungi and its characterization.</li> <li>• Prepration of different media used in fermented food product.</li> <li>• Prepration of vinegar and wine from fruit and plant juice.</li> <li>• Isolation Gluten from different flour and its use in Bread making.</li> <li>• Prepration of filter using glass wool used in different fermentor.</li> <li>• Study the rheology of the different fermentation broth.</li> <li>• Screening of different microbes used in fermented food products.</li> </ul>	30

**FOCUS:** This course focuses on Entrepreneurship, Skill development aligned with all CO1.

**COURSE OUTCOMES:** After completing this course, student will able:

CO1- To expertise in fermentation technology, handling of Bioreactor and production of fermented food and beverages so that students can get the job in food and beverages industries.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P03, P04, P05, P07, P09/PS01, PS03

## **BSBE 0811: ROLE OF BIOTECHNOLOGY IN FORENSIC SCIENCE LAB**

**OBJECTIVES:** Forensic technology implies the concept of molecular biology, biochemistry and immunology to critically investigate crime scene. Practical's will help students to gain an insight in the techniques used in forensic sciences such as blood group analysis, paternity detection, RFLP, RAPD and PCR analysis

**Credits: 02**

**Semester VI**

**L–T–P: 0–0–3**

<b>Module No.</b>	<b>Content</b>	<b>Lab Hours</b>
I	<ul style="list-style-type: none"> <li>• Introduction to forensic Sciences laboratory, precaution during collection of samples from Crime spot.</li> <li>• Circumstantial Evidences (causes of death: Case studies (poisoning, choking, stabbing, suffocating, drowning etc)</li> <li>• Calculating the time of death (Biological versus clinical death)</li> <li>• Blood group testing</li> <li>• Paternity Analysis (Pedigree analysis)</li> <li>• Isolation of genomic DNA</li> <li>• DNA fingerprinting analysis</li> <li>• Use of PCR in amplification of Genomic DNA</li> <li>• Restriction fragment length polymorphism (RFLP)</li> </ul>	30

**FOCUS:** This course focuses on Entrepreneurship, Skill development aligned with all CO1.

**COURSE OUTCOMES:** After completing this course, student will able:

CO1- To enhance practical applications of students to uptake challenging problems associated with criminal investigations; tissue based identification of corpse, forensic entomology, and paternity detection so as to enable them to choose forensic investigations as a career avenue. (STD. placed in forensic Lab's; DRDO-CEPTM; etc.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

<b>COs</b>	<b>POs/ PSOs</b>
CO1	P01, P02, P03, P04, P05, P07, P09/PS02, PS03



**BSBE 0818: CHEMISTRY- III LAB**

**OBJECTIVES:** Predict products of chemical reactions. Explain patterns of chemical reactions. Demonstrate common chemical laboratory techniques, chemical instrumentation and other appropriate technology. Demonstrate ability to work in a cooperative environment, understanding of safe laboratory practice.

**Credits: 02**

**Semester VI**

**L–T–P : 0–0–3**

Module No.	Content	Lab Hours
I	<p><b><u>Physical:</u></b></p> <p>(1) Heat of neutralization of a strong acid and a strong base. (2) Partition coefficient determination.</p> <p><b><u>Inorganic:-</u></b></p> <p>(1) Preparation of the following inorganic compounds : (i) Prussian blue from iron fillings. (ii) Chrome alum. (iii) Cuprannionium Sulphate (iv) Cuprous Chloride. (v) Potassium trioxalatochromate</p> <p>(2) Preparation and Crystallisation: (i) Acetylation (ii) Nitration. (iii) AZO – dye formation.</p>	30

**FOCUS:** This course focuses on Skill development aligned with all CO1 & CO2.

**COURSE OUTCOMES:** After completion of course, the student will be able to:

CO1- Understand chemical reactions in terms of structure and analytical knowledge.

CO2- Students will master basic research skills.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01,P02, P03, P04, P05, P06, P07, P08, P010/PS01, PS03
CO2	P02, P03, P04, P05, P06, P08, P09/PS02

## BSBE0813: HUMAN PHYSIOLOGY LAB

**OBJECTIVES:** The purpose of this laboratory course is to give you experience with the scientific investigation of human physiological processes. You will measure the ways in which the body responds to varying stimuli and observe how those responses contribute to the maintenance of homeostasis. The labs are not only designed to support physiological concepts learned in lecture, but to demonstrate the process of scientific investigation as well. We firmly believe the journey is just as important as the destination and experimental methodology will be emphasized.

**Credits: 2**

**Semester VI**

**L–T–P:0-0-3**

Content	Lab hrs.
<ul style="list-style-type: none"> <li>• Check the presence of glucose in the given sample</li> <li>• Histological slides of different organ of mammals</li> <li>• Blood grouping testing</li> <li>• Check the permanent slides of meiosis and mitosis</li> <li>• Barr body test</li> <li>• Quantitative analysis of glucose and cholesterol test</li> <li>• Demonstrate the presence of protein in the given sample</li> <li>• DLC and RBC count</li> <li>• Demonstrate Widal test</li> <li>• Check hemoglobin, RBC ,WBC and platelets using hematology analyzer</li> <li>• To check the percentage of hemoglobin by hemoglobinometer</li> <li>• To check blood pressure: Systolic and Diastolic Blood Pressure</li> </ul>	30

**FOCUS:** This course focuses on Skill development aligned with all COs.

**COURSE OUTCOMES:** After completing this course, student will able:

CO1- Describe with detail the functioning of specific body systems at both the cellular level and at the system level to predict a response to changes in homeostasis (**Understand**)

CO2- Apply your understanding of the individual systems to interactions between multiple systems (**Apply**)

CO3 - Develop a working knowledge of physiological systems and be able to associate anatomical areas with their specific function (**knowledge**)

CO4 - Understand important physiological challenges animals face and the processes animals deal with them (**Understand**)

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

<b>COs</b>	<b>POs/ PSOs</b>
C01	P01, P02, P04, P05, P08/PS01, PS02
C02	P01, P02, P03, P04, P05, P07/PS02, PS03
C03	P01, P02, P04, P05, P08, P010/PS01, PS03
C04	P01, P02, P03, P05, P07, P09/PS01, PS02

## BSBE0814: ENVIRONMENT SCIENCE LAB

**OBJECTIVES:** The main objective of this course is to provide the practical exposure of environmental pollutants in water, air and soil to the students. The environmental science prepares you for career success in natural resources and conservation, public health, environmental monitoring and remediation, industrial environmental management.

**Credit: 2**

**Semester: VI**

**L:T:P -0:0:3**

Content	Lab hrs.
<ul style="list-style-type: none"> <li>• Determination of moisture content of soil samples.</li> <li>• Collection, processing and storage of effluent samples.</li> <li>• Determination of chemical oxygen demand in waste water sample.</li> <li>• Determination of dissolved oxygen in waste water sample.</li> <li>• Determination of total dissolved solids in waste water sample.</li> <li>• Analysis of total hardness of waste water sample.</li> <li>• Determination of total alkalinity in waste water sample.</li> <li>• Determination of chlorine in waste water sample.</li> </ul>	30

**FOCUS:** This course focuses on Entrepreneurship, Skill development aligned with all CO1

**COURSE OUTCOMES:** After completing this course, student will able:

CO1-To handle the various pollutants present in air, water and soil and also

CO2-To develop a sense of community responsibility by becoming aware of scientific issues in the larger social context.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	PO1, PO3, PO4, PO6, PO8, PO10/PSO1, PSO3
CO2	PO1, PO2, PO4, PO5, PO7, PO9/PSO2

## BSBE0815: CLINICAL BIOCHEMISTRY LAB

**OBJECTIVES:** The objective of course is to impart knowledge about the methods of measurement and determination of glucose, cholesterol, ALT, AST, Serum creatine, Serum albumin, hormones in physiological fluids.

**Credit: 2**

**Semester: VI**

**L:T:P-0:0:3**

Content	Lab hrs.
<ul style="list-style-type: none"> <li>• Estimation of serum blood glucose</li> <li>• Estimation of serum cholesterol</li> <li>• Estimation of ALT and AST</li> <li>• Estimation of serum creatine and albumin</li> <li>• Estimation of serum T3, T4 and TSH.</li> <li>• Estimation of FSH and LH.</li> <li>• HCG based pregnancy test.</li> <li>• Estimation of serum electrolytes.</li> </ul>	30

**FOCUS:** This course focuses on Employability, Skill development aligned with all CO1

**COURSE OUTCOMES:** After completing this course, student will able:

CO1- To understand the design, operation and performance of the approaches used to measure glucose, cholesterol, ALT, AST, serum creatine, serum albumin and hormones.

CO2- To develop practical skills necessary for understanding and independent solving problems in the field of biochemistry using a standard methodology.

Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	POs/ PSOs
CO1	P01, P03, P04, P05, P07, P08, P09/PS02, PS03
CO2	P01, P03, P04, P06, P08, P010/PS01, PS02

## **BSBC 0815: PROJECT WORK**

**Credits: 5**

**Semester VI**

**L–T–P:**

<b>Module No.</b>	<b>Content</b>	<b>Teaching Hours</b>
<b>I</b>	Project work	2 months