



**GSFC**  
**UNIVERSITY**  
EDUCATION RE-ENVISIONED

# COURSE CURRICULUM

## B.Sc. Biotechnology

Batch:2022-2023  
Academic Year: 2023-24  
Updated on: July, 2023

## VISION

- GSFCU strives to be the best compact boutique institution with a futuristic approach, encouraging student centric culture and sharpened focus on developing industry ready & employable students with all-round development.

## MISSION

- Establish an institution, which promotes creativity and innovation.
- Develop unique quality standards for academic excellence and pedagogical innovations.
- Remain agile through learning ecosystem with flexible processes & systems.
- Holistic growth for industry readiness.

No.	Programme Outcomes (POs)	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
<b>PO1</b>	Basic Knowledge: To impart knowledge regarding basic concepts of applied chemical sciences.	Remembering and Understanding	Explain, Describe, Discuss, Recall, Locate
<b>PO2</b>	Interdisciplinary approach: To explain the relationships between chemical sciences, biological sciences, physical sciences and mathematical sciences.	Application and Analysing	Apply, Practice, Interpret, Select, Correlate
<b>PO3</b>	Practical learning: To perform procedures as per laboratory standards in the areas of Chemical Sciences and to think analytically.	Analysing	Compare, Classify, Select, Investigate
<b>PO4</b>	Effective Communication and social Interaction: To communicate effectively in terms of reading, writing, speaking and delivering the view to others.	Understanding	Explain, Describe, outline, Predict, Summarize
<b>PO5</b>	Ethics: To culminate and understand the moral values for any of the subjects with respect to good practices and humanity.	Evaluating	Judge, Assess, Estimate, Predict, Argue
<b>PO6</b>	Environment and Sustainability: To explain the importance of ecological balance along with conservation of natural resources for human wellbeing.	Creating	Construct, Develop, Produce

No.	Programme Specific Outcomes (PSOs)	Blooms' Taxonomy Domain	Blooms' Taxonomy SubDomain
<b>PSO1</b>	Students will gain and apply knowledge of scientific concepts such as chemistry, physics, mathematics, organic chemistry, inorganic chemistry, physical chemistry, analytical chemistry and computer applications in chemistry to solve problems related to the field of Chemistry.	Remembering and Understanding	Explain, Describe, Discuss, Recall, Locate
<b>PSO2</b>	Students will be able to demonstrate learning skills to work as a team in a multidisciplinary environment.	Application and Analysing	Apply, Practice, Interpret, Select, Correlate
<b>PSO3</b>	Students will be able to design and develop sustainable solutions to major environmental/biological problems by applying appropriate chemistry tools.	Analysing	Compare, Classify, Select, Investigate
<b>PSO4</b>	Students will be able to demonstrate effective writing and oral communication skills.	Understanding	Explain, Describe, outline, Predict, Summarize
<b>PSO5</b>	Students will have knowledge and understanding of norms and ethics in the field of chemistry.	Evaluating	Judge, Assess, Estimate, Predict, Argue
<b>PSO6</b>	Students will be able to design, perform experiments, analyze and interpret data for investigating complex problems in chemistry and related fields.	Creating	Construct, Develop, Produce

### Mapping of POs & PSOs:

	PO1	PO2	PO3	PO4	PO5	PO6
<b>PSO1</b>	3	3	2	3	3	2
<b>PSO2</b>	2	3	2	3	3	2
<b>PSO3</b>	2	2	3	2	2	2
<b>PSO4</b>	3	2	3	3	2	2
<b>PSO5</b>	2	3	3	2	3	2
<b>PSO6</b>	3	2	3	2	2	3
<b>Avg.</b>	2.5	2.5	2.7	2.5	2.5	2.2

1: Slight (Low); 2: Moderate (Medium); 3: Substantial (High); 0 None

### Definition of Credit:

1 Hour. Lecture (L) per week	1 credit
1 Hour Tutorial (T) per week	1 credit
4 Hours Practical (P) per week	2 credit
2 Hours Practical (P) per week	1 credit
1 Hour Practical (P) per week	0.5 credit
3 Hours Experiential learning	1 credit

### Course code Definitions:

Lecture	L
Tutorial	T
Practical	P
Basic Science Courses	BSC
Engineering Science Courses	ESC
Humanities and Social Sciences including Management courses	HSMC
Professional core courses/Major (Core)	PCC
Professional Elective courses/Minor Stream	PEC
Open Elective courses	OEC
Laboratory course	LC
Mandatory courses	MC
Non-credit courses	NC
Project (Experiential learning)	PROJ
Experiential learning ex. Internship, Industrial Visit, Field visit, etc.	EL
Multidisciplinary courses	MDC
Ability Enhancement Course	AEC
Skill Enhancement Course	SCE
Value Added Courses	VAC

### Structure of Undergraduate Programme:

Sr. No.	Category	Credit Breakup
1	Professional core courses - <b>Major (Core)</b>	78
2	Professional Elective courses relevant to chosen specialization/branch - <b>Minor Stream</b>	48
4	Project work, seminar and internship in industry or elsewhere	8
5	Mandatory Courses [Environmental Sciences, Induction Programme, Indian Constitution, Essence of Indian Knowledge Tradition]	(non-credit)
	Total	<b>134</b>

**Table: Minimum Credit Requirement**

S.No.	Broad Category of Course	Minimum Credit Requirement
		3-year UG
<b>1</b>	<b>Major (Core) (50% of total credit )</b> BSBO111 Cell Biology BSBO112 Molecular Biology BSBO211 Biomolecules BSBO212 Metabolism BSBO301 Genetics BSBO302 General Microbiology BSBO303 Basics of Development Biology BSBO401 Mammalian & Plant Physiology BSBO402 Recombinant DNA Technology BSBO403 Enzymology BSBO501 Bioanalytical Tools BSBO502 Virology BSBO601 Immunology BSBO602 Bioinformatics & Drug Discovery, Design and Development	<b>84</b>
<b>2</b>	<b>Ability Enhancement Courses (AEC)</b> AECC101 Fundamentals of English AECC201 Communication Skills in English AECC301 Entrepreneurship Development AECC401 Environmental Science AECC501 Disaster Risk Management AECC601 Indian Constitution	<b>12</b>
<b>3</b>	<b>Skill Enhancement Courses (SEC) (from major &amp; Minor)</b> SECC101 Foundation Course SECC104 Internship SECC204 Internship SECC304 Internship SECC404 Internship SECC504 Internship	<b>12</b>
<b>4</b>	<b>Summer Internship ( mainly from Major &amp; Minor)</b> SECC104 Internship SECC204 Internship SECC304 Internship SECC404 Internship SECC504 Internship	<b>10</b>
	<b>Total</b>	<b>118</b>

## Category-wise Courses:

### Humanities & Social Sciences Courses

- i. Number of Humanities & Social Science Courses: 2
- ii. Credits: 4

Sr. No.	Course Code	Course Name	Sem	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	AECC101	Fundamentals of English	I	2	0	0	2	2	0	0	2
2.	AECC201	Communication Skills in English	II	2	0	0	2	2	0	0	2
3	AECC301	Entrepreneurship Development	III	2	0	0	2	2	0	0	2
4	AECC401	Environmental Science	IV	2	0	0	2	2	0	0	2
5	AECC501	Disaster Risk Management	V	2	0	0	2	2	0	0	2
		<b>Total</b>									<b>10</b>

### Note:

**L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester**

### Basic Science Course- Discipline Specific Generic Electives

- i. Number of Basic Science Course: 108
- ii. Credits: 18

Sr. No.	CourseCode	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	BSMA115	Mathematics – I	I	5	0	1	6	5	0	1	6
2.	BSPY215	Physics – II	II	4	4	0	8	4	2	0	6
3.	BSPY307	Physics – III	III	4	4	0	8	4	2	0	6
4.	BSMA307	Mathematics – III	III	5	0	1	6	5	0	1	
5.	BSCM307	Chemistry – I	III	4	4	0	8	4	2	0	
6.	BSPY407	Physics – IV	IV	4	4	0	8	4	2	0	

7.	BSMA407	Mathematics – IV	IV	5	0	1	6	5	0	1	6
8.	BSCM407	Chemistry – II	IV	4	4	0	8	4	2	0	
9.	BSBO503	Animal & Plant Biotechnology	V	4	4	0	8	4	2	0	6
10.	BSBO504	Virology	V	4	4	0	8	4	2	0	
11.	BSBO505	Ecology & Evolution	V	4	4	0	8	4	2	0	6
12.	BSBO506	Research Methodology	V	4	4	0	8	4	2	0	
15.	BSBO603	Environmental Biotechnology	VI	4	4	0	8	4	2	0	6
16.	BSBO604	Genomics & Proteomics	VI	4	4	0	8	4	2	0	
17.	BSBO605	Biosafety, Bioethics & IPR	VI	4	4	0	8	4	2	0	6
18.	BSBO606	Medical Biotechnology	VI	4	4	0	8	4	2	0	
		<b>Total</b>		74	64	2	140	74	32	2	<b>48</b>

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### Professional Core Courses

- Number of Professional Core Courses: 14
- Credits: 84

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	BSBO111	Cell Biology	I	3	2	0	5	3	1	0	4
2.	BSBO112	Molecular Biology	I	3	2	0	5	3	1	0	4
3.	BSBO211	Biomolecules	II	3	2	0	5	3	1	0	4
4.	BSBO212	Metabolism	II	3	2	0	5	3	1	0	4
5.	BSBO301	Genetics	III	4	4	0	8	4	2	0	6
6.	BSBO302	General Microbiology	III	4	4	0	8	4	2	0	6
7.	BSBO303	Basics of Development Biology	III	4	4	0	8	4	2	0	6
8.	BSBO401	Mammalian & Plant Physiology	IV	4	4	0	8	4	2	0	6
9.	BSBO402	Recombinant DNA Technology	IV	4	4	0	8	4	2	0	6
10.	BSBO403	Enzymology	IV	4	4	0	8	4	2	0	6



11.	BSBO501	Bioanalytical Tools	V	4	4	0	8	4	2	0	6
12.	BSBO502	Bioprocess technology	V	4	4	0	8	4	2	0	6
13.	BSBO601	Immunology	VI	4	4	0	8	4	2	0	6
14.	BSBO602	Bioinformatics & Drug Discovery, Design and Development	VI	4	4	0	8	4	2	0	6
<b>Total</b>				<b>56</b>	<b>56</b>		<b>112</b>	<b>56</b>	<b>28</b>		<b>84</b>

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### Professional Elective Courses-

- (i) Number of Professional Elective Course: 108
- (ii) Credits: 16

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	BSMA115	Mathematics – I	I	5	0	1	6	5	0	1	6
2.	BSPY215	Physics – II	II	4	4	0	8	4	2	0	6
3.	BSPY307	Physics – III	III	4	4	0	8	4	2	0	6
4.	BSMA307	Mathematics – III	III	5	0	1	6	5	0	1	
5.	BSBO307	Chemistry – I	III	4	4	0	8	4	2	0	
6.	BSPY407	Physics – IV	IV	4	4	0	8	4	2	0	6
7.	BSMA407	Mathematics – IV	IV	5	0	1	6	5	0	1	
8.	BSBO407	Chemistry – II	IV	4	4	0	8	4	2	0	
9.	BSBO503	Animal & Plant Biotechnology	V	4	4	0	8	4	2	0	6
10.	BSBO504	Virology	V	4	4	0	8	4	2	0	
11.	BSBO505	Ecology & Evolution	V	4	4	0	8	4	2	0	6
12.	BSBO506	Research Methodology	V	4	4	0	8	4	2	0	
13.	BSBO603	Environmental Biotechnology	VI	4	4	0	8	4	2	0	6
14.	BSBO604	Genomics & Proteomics	VI	4	4	0	8	4	2	0	

15.	BSBO605	Biosafety, Bioethics & IPR	VI	4	4	0	8	4	2	0	6
16.	BSBO606	Medical Biotechnology	VI	4	4	0	8	4	2	0	
		<b>Total</b>		67	52	3	122	67	26	3	<b>48</b>

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### Project Work, Seminar and Internship In Industry Or Elsewhere

- Number of Project Work, Seminar And Internship In Industry Or Elsewhere: 5
- Credits: 10

Sr. No.	CourseCode	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	SECC101	Industrial Internship	I	0	0	0	2	0	0	0	2
2.	SECC201	Industrial Internship	II	0	0	0	2	0	0	0	2
3.	SECC301	Industrial Internship	III	0	0	0	2	0	0	0	2
4.	SECC401	Industrial Internship	IV	0	0	0	2	0	0	0	2
5.	SECC501	Industrial Internship	V	0	0	0	2	0	0	0	2
		<b>Total</b>					<b>10</b>				<b>10</b>

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### Ability Enhancement Courses

- Number of Ability Enhancement Courses: 6
- Credits: 12

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme (Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	AECC101	Fundamentals of English	I	2	0	0	2	2	0	0	2
2.	AECC201	Communication Skills in English	II	2	0	0	2	2	0	0	2
3.	AECC301	Entrepreneurship Development	III	2	0	0	2	2	0	0	2
4.	AECC401	Environmental Studies	IV	2	0	0	2	2	0	0	2

5.	AECC501	Disaster Risk Management	V	2	0	0	2	2	0	0	2
6.	AECC601	Indian Constitution	VI	2	0	0	2	2	0	0	2
		<b>Total</b>		<b>12</b>			<b>12</b>	<b>12</b>			<b>12</b>

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### Skill Enhancement Compulsory/Elective Courses

- i. Number of Skill Enhancement Courses: 12
- ii. Credits: 16

Sr. No.	Course Code	Course Name	Semester	Teaching Scheme(Hours/week)				Teaching Credit			
				L	P	T	Total	L	P	T	Total
1.	SECC101	Industrial Internship	I	0	2	0	2	0	2	0	2
2.	SECC102	Foundation Course	I	2	0	0	2	2	0	0	2
3.	SECC201	Industrial Internship	II	0	2	0	2	0	2	0	2
4.	SECC301	Industrial Internship	III	0	2	0	2	0	2	0	2
5.	SECC401	Industrial Internship	IV	0	2	0	2	0	2	0	2
6.	SECC501	Industrial Internship	V	0	2	0	2	0	2	0	2
Skill Enhancement Elective Courses											
7.	BSBO305	Biophysics	III	2	0	0	2	2	0	0	2
8.	BSBO306	Analytical Clinical Biochemistry	III	2	0	0	2	2	0	0	
9.	BSBO307	Molecular Diagnostics	III	2	0	0	2	2	0	0	
10.	BSBO405	Biostatistics	IV	2	0	0	2	2	0	0	2
11.	BSBO406	Industrial Fermentations	IV	2	0	0	2	2	0	0	
12.	BSBO407	Nanomaterials	IV	2	0	0	2	2	0	0	
		<b>Total</b>		<b>14</b>	<b>10</b>	<b>00</b>	<b>24</b>	<b>14</b>	<b>10</b>	<b>00</b>	<b>16</b>

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### About the Program:

Science is the basic foundation of any technological and engineering creation. In view of the changing scenario at the national and international level in the field of Science and Technology, there is a great demand for basic sciences with considerable knowledge of its applications. GSFC University is committed to high academic standards.

The B.Sc. (Hons.) Biotechnology Program is an Honours Degree which is designed for Six Semesters (Three Years) in such a way that a good basic foundation of subjects is laid and applications along with recent developments are covered. Students will also get theoretical and practical knowledge by undergoing industrial internship after every semester.

The more focused specialization course of Biotechnology is designed to full fill recent demands of industrial career. The B.Sc. (Hons.) Biotechnology Program provides an opportunity to make a career in R&D, Industries and Academic Institutions. Opportunity for the placement may be provided by the Institute.

Semester – I							
Sr. No.	Course Code	Course Title	L	T	P	C	Marks
A. Major							
1	BSBO111	Cell Biology	3	0	1	4	150
2	BSBO112	Molecular Biology	3	0	1	4	150
B. Minor							
3	BSMA115	Mathematics – I	5	1	0	6	150
C. Multidisciplinary Additional Credits under Choice Based Credit System (Any One)							
4	CBCS103	Indian History and culture	2	0	0	2	100
5	CBCS104	Air Pollution Control	2	0	0		
6	CBCS105	Python Programming	2	0	0		
7	CBCS106	Basic of Chemical Engineering	2	0	0		
8	CBCS109	Management Principles & Practices	2	0	0		
9	CBCS110	MS Office & Applications	2	0	0		
D. Ability Enhancement Course							
10	AECC101	Fundamentals of English	2	0	0	2	50
E. Skill Enhancement Course							
11	SECC104	Internship	0	0	2	2	50
F. Value Added Course							
12	VACC101	Foundation Course	0	0	2	2	50
Total						22	700

## Teaching Scheme Semester – I

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
	A. Major Courses															
1.	BSBO111	Cell Biology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
2.	BSBO112	Molecular Biology	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	B. Minor Courses															
3.	BSMA105	Mathematics-I	5	0	1	6	5	0	1	6	20	45	75	150	0	150
	C. Multidisciplinary Courses (Any one)															
4.	CBCS103	Indian History & Culture	2	0	0	2	2	0	0	2	20	40	40	100	00	100
5.	CBCS104	Air Pollution Control														
6.	CBCS105	Python Programming														
7.	CBCS109	Management Principles & Practices														
8.	CBCS110	MS Office & Applications														
	D. Ability Enhancement Courses															
9.	AECC101	Fundamentals of English	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	E. Skill Enhancement Courses															
10.	SECC101	Industrial Internship	0	2	0	2	0	2	0	2	00	00	00	50	00	50

	F. Value Added Courses															
11.	VACC101	Foundation Course	0	2	0	0	0	2	0	2	00	00	00	50	00	50
	Total									22						700

**Note:** L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

COURSE CODE BSBO111	COURSE NAME Cell Biology	SEMESTER I
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
45	30	00	75	3	1	0	4

<b>Course Pre-requisites</b>	School Level Understanding of Biology and a keen interest in learning.
<b>Course Category</b>	Professional Core Courses
<b>Course focus</b>	Employability
<b>Rationale</b>	The subject "Cell Biology" provides a comprehensive understanding of life's foundation through units on cell structure, organelles, and functions. It covers molecular aspects, the endomembrane system, cell division, and essential research tools, fostering insights into biology's intricate workings.
<b>Course Revision/ Approval Date :</b>	07/11/2023
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<b>To enable the student to:</b> <ol style="list-style-type: none"> <li>1. Gain the basic knowledge and understanding of basic concept and structure of cells and cell organelles.</li> <li>2. Understand the molecular structure and function of major organelles.</li> <li>3. Understand and analyze the role of endomembranous cell organelles</li> <li>4. Learn and understand cell division and cell cycle.</li> </ol> Understand and apply the basic tools in cell biology.

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Basic concept of cell and structure of organelles</b> Introduction to the concept of cell and evolution of eukaryotic cells. General structure and constituents of cell. Similarities and distinction between plant and animal cells. Structure, composition and function of cell wall and the cell membrane. Membrane transport.	20%	9
<b>Unit 2: Molecular structure and function of major organelles</b> Nucleus - Nuclear envelope, nuclear pore complex and nuclear lamina. Chromatin – Molecular organization. Chloroplast, Mitochondria, Lysosomes, Peroxisomes, Vacuoles.	20%	9
<b>Unit 3: The Endomembrane system</b> Endoplasmic reticulum, Golgi Apparatus, Ribosomes, Ribosomes in relation to cell growth and division. Cytoskeleton: structure, composition and function. Cilia and flagella, Centrioles, Extracellular matrix and Cell	20%	9



adhesion in cell cycle regulation		
<b>Unit 4: Cell division and cell cycle</b> Mitosis and Meiosis. Eukaryotic cell cycle. Cell cycle control in prokaryotes and eukaryotes.	20%	9
<b>Unit 5: Basic tools in cell biology</b> Basics of Microscopy, Microtomy, Density gradient centrifugation. Staining techniques.	20%	9

List Of Practical	Weightage	Contact hours
1. Good Laboratory Practice and Safety in Microbiology & Biotechnology Lab.	2%	2
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope) used in the microbiology laboratory.	2%	2
3. Preparation of various stains	2%	2
4. Simple staining of plant sections	2%	2
5. Simple staining of bacterial culture and wet mount of Hay infusion	2%	2
6. Separation of Cell organelles by Sucrose Gradient (Virtual Demo).	2%	2
7. Negative staining	2%	2
8. Observation of various stages of mitosis by permanent slides	2%	2
9. Observation of various stages of meiosis by permanent slides	2%	2
10. Sterility practices in cell and tissue culture	2%	2
11. Cell culture, preservation and revival of Animal Cell Culture (Demo) & Preservation of Bacterial culture by Glycerol stock method	2%	2
12. Measurement of cell viability of yeast cell by MTT or (Methylene blue) Trypan blue assays.	2%	2
13. Revision	2%	2
14. Revision	2%	2
15. Revision	2%	2

### Instructional Method and Pedagogy:

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments. Practical exercises are designed to understand the theory as taught in classroom.

<b>Course Outcomes:</b>	<b>Blooms' Taxonomy Domain</b>	<b>Blooms' Taxonomy Sub Domain</b>
<b>After successful completion of the above course, students will be able to:</b> CO1: Understand the structure, composition and function of cell organelles.	Remember, Understanding	Describe
CO2: To describe physiological processes and molecular mechanisms regulated by cell organelles.	Remember, Understanding, apply	Explain
CO3: Understand and analyze the role of endomembranous system.	Understanding, Analyze	Explain
CO4: Understand the principal and types of cell signaling.	Understanding	Describe
CO5: Remember, understand and apply the basic tools in cell biology.	Remember, Understanding	Describe

#### **Learning Resources**

1. <b>Reference books:</b>
1. Essential Cell Biology by Bruce Alberts, Dennis Bray, Karen Hopkin and Alexander Johnson.
2. Karp, G. Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons.
3. De Robertis, E.D.P. and De Robertis, E.M.F. Cell and Molecular Biology. VIII Edition.
4. Cooper, G.M. and Hausman, R.E. The Cell: A Molecular Approach. V Edition. ASM Press
2. <b>Journal &amp; Periodicals:</b>
1. Journal of Cell Biology
2. Trends in Cell Biology
3. Cell Biology International
4. Science
3. <b>Other Electronic resources : NPTEL</b>

<b>Evaluation Scheme</b>	<b>Total Marks = 150</b>
<b>Theory: Mid semester Marks</b>	20 marks
<b>Theory: End Semester Marks</b>	40 marks

<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Research Paper Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	35 marks
	Viva	10 marks
	Journal	05 marks
	<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	-	-	1	1
CO2	2	2	1	-	-	1
CO3	1	1	-	-	1	1
CO4	1	1	-	-	-	-
CO5	2	2	2	-	1	2

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	-	-
CO2	3	2	-	-	-	1
CO3	2	-	1	-	-	-
CO4	1	1	-	-	1	-
CO5	3	2	2	1	2	-

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO112</b>	<b>COURSE NAME</b> <b>Molecular Biology</b>	<b>SEMESTER- I</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
45	30	00	75	3	1	0	4

<b>Course Pre-requisite</b>	School Level Understanding of Biology and a keen interest in learning.
<b>Course Category</b>	Core Professional
<b>Course Focus</b>	Employability
<b>Rationale</b>	The molecular biology course explores fundamental aspects of genetic material, replication, transcription, and translation. It delves into DNA's role as hereditary material, its structures in diverse organisms, replication mechanisms, transcription processes, and translation machinery, fostering a deep understanding of gene expression.
<b>Course Revision/ Approval date</b>	07/11/2023
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<b>To enable the student to:</b> <ol style="list-style-type: none"> <li>1. Understand the historic perspective, types and structure of genetic material.</li> <li>2. Gain knowledge about DNA replication mechanism in both prokaryotes and eukaryotes</li> <li>3. Comprehend the process of transcription in prokaryotes and eukaryotes</li> <li>4. Familiarize with post-transcriptional processing.</li> <li>5. Develop an understanding of translation in both prokaryotes and eukaryotes.</li> </ol>

<b>Course Content</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1: Structures and types of Genetic Material</b> DNA as heritable material, Structure and types of DNA in prokaryotes and eukaryotes, Salient features of double helix, Genome organization in Prokaryotes and Eukaryotes.	20%	9
<b>Unit 2: Replication of DNA</b> Types of replication in Prokaryotes and Eukaryotes, Enzymes and proteins involved in DNA replication. Mechanism of DNA replication in Prokaryotes and Eukaryotes, Telomere replication, Various models of DNA replication.	20%	9

<b>Unit 3: Transcription in Prokaryotes and Eukaryotes</b> Structure, Function and Biological Properties of RNA, The structure and function of gene, promoters and terminators. Transcription Initiation, elongation and Termination, RNA polymerases.	20%	9
<b>Unit 4: Post-Transcriptional Processing</b> Concept of introns and exons, RNA splicing, concept of alternative splicing, Polyadenylation and capping, Processing of rRNA.	20%	9
<b>Unit 5: Translation (Prokaryotes and Eukaryotes)</b> The Genetic Code, Codons and anti-codons, the ribosomes. Translation mechanism in prokaryotes and eukaryotes. Gene Expression in Prokaryotes: the LAC Operon. Gene expression in Eukaryotes.	20%	9

List Of Practical	Weightage	Contact hours
1: Good Laboratory Practice and Safety in Molecular Biology Lab.	2%	2
2: To study the principle and applications of important instruments (pH meter, Centrifuge, Spectrophotometer, Electrophoretic unit) used in the Molecular Biology laboratory.	2%	4
3: To study the principle and applications of important instruments (pH meter, Centrifuge, Spectrophotometer, Electrophoretic unit) used in the Molecular Biology laboratory.	2%	4
4: Pipetting skills	2%	2
5: Basic calculations (normality, molarity, weight conversion) used in molecular biology	2%	2
6: Preparation of solutions for Molecular Biology experiments	2%	2
7: Virtual Lab demonstrations: DNA Isolation, Purification and quantitation	2%	2
8: Virtual Lab demonstrations: RNA Isolation, Purification and quantitation	2%	2
9: Virtual Lab demonstrations: Protein Isolation, Purification and quantitation	2%	2
10: Model Building – DNA structure, replication	2%	2
11: Revision	2%	2
12: Revision	2%	2
13: Revision	2%	2

**Instructional Method and Pedagogy:**

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments. Practical exercises are designed to understand the theory as taught in classroom.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
<b>After successful completion of the above course, students will be able to:</b> CO1: Understand basic concepts of molecular biology including genome, DNA, RNA	Remember, Understanding	Describe
CO2: Understand and compare the mechanisms of DNA replication in both prokaryotes and eukaryotes and differentiate between them.	Remember, Understanding, Analyze	Explain, Compare
CO3: Understand and compare the mechanisms of DNA transcription in both prokaryotes and eukaryotes and differentiate between them.	Remember, Understanding, Analyze	Explain, Compare
CO4: Understand and compare the post transcriptional modifications of RNA and concepts of splicing and capping.	Remember, Understanding, Analyze	Explain, Describe, Compare
CO5: Understand and compare the mechanisms of translation in both prokaryotes and eukaryotes and differentiate between them	Remember, Understanding, Analyze	Describe, Compare

### Learning Resources

1. <b>Reference books</b>	<ol style="list-style-type: none"> <li>1. Molecular Biology of the Cell by Bruce Alberts, Alexander Johnson, Julian Lewis, et al.</li> <li>2. Principles of Molecular Biology by Burton E. Tropp</li> <li>3. Essential Cell Biology by Bruce Alberts, Dennis Bray, Karen Hopkin and Alexander Johnson.</li> <li>4. Cooper, G.M. and Hausman, R.E. The Cell: A Molecular Approach. V Edition. ASM Press</li> <li>5. Molecular Biology by David P. Clark and Nanette J. Pazdernik</li> </ol>
2. <b>Journal &amp; Periodicals</b>	<ol style="list-style-type: none"> <li>1. Journal of Molecular Biology</li> <li>2. Nucleic Acid Research</li> <li>3. Molecular Biology Reports</li> <li>4. Current Science</li> </ol>
3. <b>Other Electronic resources:</b>	NPTEL

Evaluation Scheme	Total Marks
<b>Theory: Mid semester Marks</b>	20 marks
<b>Theory: End Semester Marks</b>	40 marks

<b>Theory: Continuous Evaluation Component Marks</b>		
	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Research Paper Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>		
	Attendance	05 marks
	Practical Exam	35 marks
	Viva	10 marks
	Journal	05 marks
	<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	1	1	1
CO2	2	1	-	-	1	1
CO3	2	1	-	-	1	1
CO4	2	1	-	-	1	1
CO5	2	1	-	-	1	1

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	-	2
CO2	1	1	-	1	1	1
CO3	1	1	-	-	1	1
CO4	1	1	-	-	-	1
CO5	1	1	-	-	-	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BSMA115	COURSE NAME Mathematics-I	SEMESTER- I
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total hours	Lecture	Practical	Tutorial	Total Credit
75	00	15	90	5	0	1	6

<b>Course Pre-requisites</b>	Knowledge of basic precalculus concepts and skills
<b>Course Category</b>	Generic Elective
<b>Course Focus</b>	Skill Development
<b>Rationale</b>	This course involves the basics of Trigonometry and inverse trigonometry. Also develop the concepts of Limit, continuity, differentiation and integration of functions of one variable and basic applications of it. students will also get to know about Matrices, determinants and their applications.
<b>Course Revision/ Approval date</b>	14 <sup>th</sup> March 2020
<b>Course Objectives (As per Blooms' Taxonomy)</b>	To enable the student to: 1: <b>Demonstrate</b> knowledge of basic precalculus concepts and skills. 2: <b>Evaluate</b> limits, recognize continuity and use the properties of continuous functions. 3: <b>Find</b> derivatives of algebraic and trigonometric functions using the definition or basic rules of differentiation. 4: <b>Find</b> rates of change, solve related rate problems, Find extreme values in optimization problems. 5: <b>Apply</b> the concepts and methods described in the syllabus, solve problems using linear algebra and will know a number of applications of linear algebra..

Course Content	Weightage	Contact hours
<b>Unit 1:</b> Trigonometry and its identities, inverse trigonometric functions, Concept of a limit and functions, Continuity and derivative of elementary functions, Rules of differentiation (without proof), Chain rule (without proof), differentiation of implicit functions.	20%	12
<b>Unit 2:</b> Indeterminate forms, L. Hospital's rules, Applications of Derivatives: maxima and minima of function. Standard integration formulae, Integration by the method of substitution	20%	12
<b>Unit 3:</b> Integration by parts, Integration by the method of partial fractions, definite integration, fundamental theorem of	20%	12



calculus Applications of Integrations: Area and volume		
<b>Unit 4:</b> Introduction to matrices, different types of matrices, Elementary operations on matrices and types of matrices, Symmetric and skew-symmetric matrices, Hermitian and skew-Hermitian matrices. Rank of a matrix. Row Reduced Echelon form of a matrix and matrix inversion using it. Determinant of $2 \times 2$ and $3 \times 3$ matrices. Inverse of a square matrix.	20%	12
<b>Unit 5:</b> Homogeneous and Non-homogeneous linear equations. Application of matrices in solving a system of simultaneous linear equations. Eigen values, Eigen vectors and the characteristic equation of a matrix. Cayley Hamilton theorem (without proof) and its use in finding inverse of a matrix.	20%	12

List Of Tutorial	Weightage	Contact hours
<b>Unit 1:</b> Problem solving Examples on limit, continuity and differentiation.	20%	3
<b>Unit 2:</b> Problem solving on Indeterminant forms and L'Hospital's Rule.	20%	3
<b>Unit 3:</b> Problem solving on Integration.	20%	3
<b>Unit 4:</b> Problem solving on Matrices and Determinants.	20%	3
<b>Unit 5:</b> Problem solving on solving system of linear equations, Eigenvalue and eigenvalues and Cayley Hamilton theorem.	20%	3

**Instructional Method and Pedagogy:** Chalk-Talk, Classroom Discussions, Notes, Use of GeoGebra Toolbox.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
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After successful completion of the above course, students will be able to:		
CO1: Demonstrate knowledge of trigonometry. Evaluate limits, recognize continuity and differentiation, and use the properties of continuous functions.	Demonstrate, Apply	Describe, Define, Examine, Find
CO2: Understand concepts of derivatives of algebraic and trigonometric functions and Apply it to find rates of change, solve related rate problems and find extreme values in optimization problems.	Understand, Apply	Describe, Define, Examine, Find
CO3: Apply concepts of definite and Indefinite integration to solve real-life problems.	Apply	Demonstrate & Examine, Find
CO4: Demonstrate basic knowledge of matrices and determinants and apply it to find the inverse of a matrix.	Apply	Describe, Define, Examine, Find
CO5: Apply concepts of linear algebra to solve a system of linear equations	Understand, Remember, Apply	Define, State, Demonstrate & Examine, Find

Learning Resources	
<b>1</b>	<b>Reference Books:</b> 1. Shanti Narayan, Integral Calculus, S.Chand & Co.Ltd,1999. 2. Shanti Narayan, Differential Calculus, S.Chand & Co. Ltd,1999. 3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons Inc, 1983. 4. G.B. Thomas Jr. and R.L. Finney, Calculus and Analytic Geometry, Addison-Wesley Publishers, 1999
<b>2</b>	<b>Journals &amp; Periodicals:</b> 1. Annals of Mathematics 2. Journal of the American Mathematical Society (JAMS) 3. SIAM Journal on Applied Mathematics 4. The Mathematical Diary
<b>3</b>	<b>Other Electronic Resources:</b> GeoGebra Toolbox : <a href="https://www.geogebra.org/">https://www.geogebra.org/</a>

Evaluation Scheme	Total Marks		
<b>Theory: Mid semester Marks</b>	20 marks		
<b>Theory: End Semester Marks</b>	40 marks		
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	

	Open Book Assignment		10 marks
	<b>Total</b>		<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks	
	Practical Exam	20 marks	
	Viva	10 marks	
	Journal	10 marks	
	Discipline	05 marks	
	<b>Total</b>	<b>50 Marks</b>	

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	0	1	0	1
CO2	2	2	0	0	1	1
CO3	2	2	0	0	1	1
CO4	2	2	1	0	1	1
CO5	3	3	2	1	0	3

### Mapping of POs & Cos

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	0	1	1	0
CO2	1	2	1	1	0	0
CO3	1	2	1	1	0	0
CO4	1	2	1	2	0	0
CO5	1	1	3	2	0	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>CBCS103</b>	<b>COURSE NAME</b> <b>Indian History and Culture</b>	<b>SEMESTER</b> <b>I</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	30	2	2	0	0	2

<b>Course Pre-requisites</b>	An inquisitive mind, a voracious appetite for reading, a knack for analysis, good vocabulary, willingness to learn and accept different school of thoughts.
<b>Course Category</b>	Generic Elective
<b>Course focus</b>	
<b>Rationale</b>	
<b>Course Revision/ Approval Date:</b>	28-03-2020
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li><b>Study</b> the chronology of major events that happened in India</li> <li><b>Understand</b> the political, social economic, and cultural landscape of India and how it kept on changing and evolving</li> <li><b>Understand</b> the various characters that shaped the destiny of India</li> <li><b>Explore</b> the reasons why India kept on attracting people from all over the world.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Ancient India</b> <ul style="list-style-type: none"> <li>The Harappan Civilization</li> <li>Early States and Economies (c.600 BCE-600 CE)</li> <li>Early Societies (c. 600 BCE-600 CE)</li> </ul>	20%	6
<b>Unit 2: Culture &amp; Religion</b> <ul style="list-style-type: none"> <li>Cultural Developments</li> <li>Perceptions of Society</li> <li>Changes in Religious Beliefs and Devotional Texts</li> </ul>	20%	6

<b>Unit 3: Mediaeval age</b> <ul style="list-style-type: none"> <li>An Imperial Capital: Vijayanagara</li> <li>Agrarian Society and the Mughal Empire</li> <li>The Mughal Courts</li> </ul>	20%	6
<b>Unit 4: Colonialism</b> <ul style="list-style-type: none"> <li>Colonialism And The Countryside: Exploring Official Archives</li> <li>1857 Revolt and its Representation</li> </ul>	20%	6
<b>Unit 5: Freedom struggle</b> <ul style="list-style-type: none"> <li>Civil Disobedience and Beyond</li> <li>Partition: Politics, Memories, Experiences</li> <li>Framing The Constitution: The Beginning of a New Era</li> </ul>	20%	6

**Instructional Method and Pedagogy:** History involves a lot of storytelling and analysis. Hence, it will be mix of stories, videos, maps, discussions, role plays, power point presentations, timelines

Learning Resources	
1.	Reference Books: <ul style="list-style-type: none"> <li>Bashar A. L., 1954, The Wonder That was India</li> <li>Sarkar Sumit, Modern India, 1885-1948</li> <li>Baron De, Bipan Chandra and Amlesh Tripathi, Freedom Struggle, NBT, Delhi</li> <li>Grover B. L., A New Look on Modern India History, Delhi</li> </ul>
2.	Journals & Periodicals: <ul style="list-style-type: none"> <li>Indian Economic and Social History Review: SAGE Journals</li> <li>Indian Historical Review: SAGE Journals</li> </ul>
3.	Other Electronic Resources: <p> <a href="https://knowindia.gov.in/culture-and-heritage/ancient-history.php">https://knowindia.gov.in/culture-and-heritage/ancient-history.php</a>  <a href="https://en.wikipedia.org/wiki/Culture_of_India">https://en.wikipedia.org/wiki/Culture_of_India</a> <a href="https://www.livescience.com/28634-indian-culture.html">https://www.livescience.com/28634-indian-culture.html</a> <a href="https://www.everyculture.com/Ge-It/India.html">https://www.everyculture.com/Ge-It/India.html</a>  <a href="https://www.youtube.com/watch?v=IK3oqU2WNY0">https://www.youtube.com/watch?v=IK3oqU2WNY0</a>  <a href="https://www.youtube.com/watch?v=5TvF-kfqlUI">https://www.youtube.com/watch?v=5TvF-kfqlUI</a>  <a href="https://www.youtube.com/watch?v=VL9Xd9fhn4">https://www.youtube.com/watch?v=VL9Xd9fhn4</a> </p>

Evaluation Scheme	Total Marks		
<b>Theory: Mid semester Marks</b>	20 marks		
<b>Theory: End Semester Marks</b>	40 marks		
<b>Theory: Continuous Evaluation Component</b>	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	

<b>Marks</b>	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>

<b>COURSE CODE</b> <b>CBCS104</b>	<b>COURSE NAME</b> <b>Air Pollution Control</b>	<b>SEMESTER</b> <b>I</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	30	2	2	0	0	2

<b>Course Pre-requisites</b>	<b>Environmental Studies</b>
<b>Course Category</b>	Generic Elective
<b>Course focus</b>	
<b>Rationale</b>	
<b>Course Revision/ Approval Date:</b>	28-03-2020
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li><b>Impart</b> Fundamental knowledge about awareness of air pollution</li> <li><b>Understand</b> the various sources which contribute in degradation of air quality</li> <li><b>Understand</b> assessing the air quality through air quality index</li> <li><b>Understand</b> various air pollution control methods and equipment's used by industries</li> <li><b>Understand</b> the importance of extreme air Pollution due to Acid Rain, Global Warming in Environment.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Introduction to Air Pollution:</b> Air and its composition, Air Pollution, Sources of air pollution and its classification, Major air Pollutants and their characteristics, Specific group pollutants such as CFC, GHG etc. Air Pollutants from various industrial sectors. Impact of air pollution on human health and vegetation.	10%	4

<b>Unit 2: Pollutant Dispersion:</b> Concept of atmospheric stability. Adiabatic and Environmental Lapse rate. Plume behavior. Effect of topography, terrain and structure on Pollutant dispersion. Effect of wind on Pollutant dispersion. Concept of Maximum mixing Depth and ventilation Coefficient. Plume Rise and Effective stack height.	20%	6
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<b>Unit 3: Air Quality:</b> Introduction to Air quality index and Comprehensive Environmental Pollution Index etc. and its application. Sampling and measurement of air pollutants. Introduction to National Ambient AirQuality Standards	20%	6
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<b>Unit 4: Impacts of Air Pollution:</b> Extreme air Pollution scenarios: Acid Rain, Global Warming, Smog, Ozone layer depletion etc. Various treaties and protocols: Kyoto Protocol and Montreal Protocol etc	20%	6
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<b>Unit 5: Control methods and equipment:</b> Introduction to control methods and equipment for Particulate matter and gases. Design and working of scrubbers, Electrostatic Precipitator, Gravity settlers, Cyclone separator, Filter bags etc. Other mechanisms of air pollution control such as Biochemical Processes, catalytic Processes etc.	30%	8
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<b>Instructional Method and Pedagogy:</b> Presentation, Videos, Chalk-Duster and Notes
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Learning Resources	
1.	Reference Books: <ul style="list-style-type: none"> <li>Air Pollution. Physical and Chemical Fundamentals, Sainfeld, J.H. McGraw Hill, N.Y. 1975.</li> <li>Environmental Pollution Control and Engineering, Rao C.S., NewAge International (P) Limited, 1st Ed., 1991. Air Pollution, Perkin, H.G. McGraw Hill 1974</li> </ul>
2.	Journals & Periodicals: Environmental Pollution, Environmental Science & Technology
3.	Other Electronic Resources: <a href="http://www.envis.nic.in">http://www.envis.nic.in</a>

Evaluation Scheme	Total Marks		
<b>Theory: Mid semester Marks</b>	20 marks		
<b>Theory: End Semester Marks</b>	40 marks		
<b>Theory: Continuous Evaluation Component</b>	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	



<b>Marks</b>	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>

<b>COURSE CODE</b> <b>CBCS105</b>	<b>COURSE NAME</b> <b>Python Programming</b>	<b>SEMESTER</b> <b>I</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
<b>30</b>	<b>0</b>	<b>30</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

<b>Course Pre-requisites</b>	<b>Introduction to Programming Concepts</b>
<b>Course Category</b>	Generic Elective
<b>Course Focus</b>	
<b>Rationale</b>	
<b>Course Revision/ Approval Date:</b>	28-03-2020
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li>1. Application development using Python <b>Understand</b> therapeutic aspects of various drugs</li> <li>2. Learning of Python Libraries</li> <li>3. Learning analysis of data using Python</li> <li>4. Use of Python in Research</li> </ol>

<b>Course Content (Theory)</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1: Introduction to Python Programming:</b> <b>Theory:</b> The Context of Software Development – Software Learning Programming with Python	20%	6
<b>Unit 2:</b> <b>Theory:</b> Values & Variables, Expressions, Arithmetic, Conditional Statements	20%	6
<b>Unit 3:</b> <b>Theory:</b> Functions, Objects	20%	6
<b>Unit 4:</b> <b>Theory:</b> Lists, Dictionaries	20%	6
<b>Unit 5:</b> <b>Theory:</b> Tuples, Class Design	20%	6

**Instructional Method and Pedagogy:** Computer based learning Presentation, Chalk-Duster and Notes

### Course Outcome:\*

After successful completion of the above course, students will be able to:

CO1: Develop applications using Python

CO2: Students will work on multidiscipline projects

CO3: They will work on various libraries

CO4: Students can take up research projects

### Learning Resources

1	Reference Books: 1.
2	Journals & Periodicals:
3	Other Electronic Resources:

Evaluation Scheme	Total Marks		
<b>Theory: Mid semester Marks</b>	20 marks		
<b>Theory: End Semester Marks</b>	40 marks		
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	
	Article Review	10 marks	
	<b>Total</b>	<b>40 Marks</b>	

COURSE CODE CBCS109	COURSE NAME Management Principles & Practices	SEMESTER I
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	30	2	2	0	0	2

Course Pre-requisites	H.S.C. from any stream
Course Category	Generic Elective
Course focus	
Rationale	
Course Revision/ Approval Date:	24-03-2020
Course Objectives (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li><b>Impart</b> Fundamental principles of Management</li> <li><b>Understand</b> basic management functions to accomplish business objectives.</li> <li><b>Understand</b> the various functional areas of management.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Introduction to Management</b> Definition, Functions, Process, Scope and Significance of Management, Nature of Management, Managerial Roles and Managerial Skills, Difference between Management and Administration.	20%	6
<b>Unit 2: Evolution of management thought:</b> Early Management, Classical Approach - Scientific Management, Administrative Management, Neo - Classical Approach - Hawthorne Experiments, Modern Approach- System and Contingency approach	20%	6
<b>Unit 3: Planning</b> Meaning & Definition of Planning, Nature and Importance of Planning, Planning Process, Types of Plans	15%	4
<b>Unit 4: Organizing &amp; Staffing</b> Nature & Significance of Organization, Organization Structures, Types, Advantages & Disadvantages., Recruitment & Selection	25%	8

<b>Unit 5: Direction &amp; Control</b> <b>Direction:</b> Meaning, Definition, Features, Principles. <b>Control:</b> Meaning, Definitions, Process, Reasons for Resistance to control <b>Methods:</b> TQM, Budgetary Control, Break Even Control, Kaizen, Six Sigma	20%	6
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**Instructional Method and Pedagogy:** Presentation, Case study, Assignment, Chalk-Duster and Notes

Course Outcome:*	Blooms' Taxonomy Domain *	Blooms' Taxonomy SubDomain*
After successful completion of the above course, students will be able to:	Cognitive	Provide
CO1: <b>Provide</b> a broad and integrative introduction to the theories and practices of Management.		Understand
CO2: <b>Understand</b> the role, challenges, and opportunities of management in contributing to the successful operations and performance of organizations.		Expand
CO3: <b>Expand</b> the basic areas of the management process and functions from an organizational viewpoint		

Learning Resources	
1.	<b>Reference Books:</b> 1. Harold Koontz and Heinz Weihrich, Essentials of Management: An International and Leadership Perspective, McGraw Hill Education. 2. Stephen P Robbins and Madhushree Nanda Agrawal, Fundamentals of Management: Essential Concepts and Applications, Pearson Education. 3. George Terry, Principles of Management, Richard D. Irwin 4. Griffin, Management Principles and Application, Cengage Learning 5. Peter F Drucker, Practice of Management, Mercury Books, London
2.	<b>Journals &amp; Periodicals:</b> 1. Journal of Management 2. Prabandhan : Indian Journal of Management 3. Journal of International Management 4. Journal of Management and Organization
3.	<b>Other Electronic Resources:</b> <a href="http://www.omicsonline.org">www.omicsonline.org</a>

Evaluation Scheme	Total Marks		
<b>Theory: Mid semester Marks</b>	20 marks		
<b>Theory: End Semester Marks</b>	40 marks		
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	
	Article Review	10 marks	
	<b>Total</b>	<b>40 Marks</b>	

COURSE CODE CBCS110	COURSE NAME MS Office & Applications	SEMESTER I
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	30	2	2	0	0	2

Course Pre-requisites	Basic knowledge of computer, typing.
Course Category	Generic Elective
Course focus	
Rationale	
Course Revision/ Approval Date:	28-03-2020
Course Objectives (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li><b>Create</b> and edit any text document in MS Word.</li> <li><b>Impart</b> the knowledge and awareness of creating formula's for estimation and charts for data interpretation in MS Excel.</li> <li><b>Create</b> at the level of detail that is appropriate for your project using MS Project.</li> <li><b>Create</b> the presentations that include text, graphics, animation, and transitions.</li> <li><b>Understand</b> the working around email in MS Outlook.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Introduction About MS Word</b> Creating, editing, saving and printing text documents, Font and paragraph formatting, Simple character formatting, Inserting tables, smart art, page breaks, Using lists and styles, Working with images, Using Spelling and Grammar check, Understanding document properties, Mail Merge	20%	6

<b>Unit 2:</b> Spreadsheet basics, Creating, editing, saving and printing spreadsheets, Working with functions & formulas, Modifying worksheets with color & auto - formats, Graphically representing data: Charts & Graphs, Speeding data entry: Using Data Forms, Analyzing data: Data Menu, Subtotal, Filtering Data, Formatting worksheets, Securing & Protecting spreadsheets	20%	6
<b>Unit 3: MS Project</b> Introduction, Initiation, Planning, Execution, Controlling, Closure.	20%	6
<b>Unit 4: MS PowerPoint</b> Opening, viewing, creating, and printing slides, Applying auto layouts, Adding custom animation, Using slide transitions, Graphically representing data: Charts & Graphs, Creating Professional Slide for Presentation.	20%	6
<b>Unit 5: MS Outlook</b> Introduction to Microsoft Outlook, Configuring Outlook, Creating and Sending Email Messages, Organizing Mail, Using the Calendar, Setting Reminders, Sharing and Alerts.	20%	6

**Instructional Method and Pedagogy:** Presentation, Videos, Chalk-Duster and Notes

Course Outcome:*	Blooms' Taxonomy Domain*	Blooms' Taxonomy SubDomain*
After successful completion of the above course, students will be able to:	Cognitive	Create
CO1: <b>Create</b> a format and edit documents like letters, report, applications, templates, etc. in MS Word.		
CO2: <b>Apply</b> computational methods in MS Excel for estimation, optimization of various properties and work on the data interpretation based on charts.		Apply
CO3: <b>Create</b> a standardized and manage the work break down structure consisting of tasks, costs, work, and resources.		Create
CO4: <b>Create</b> a presentation based on students' option, ideas, project details, etc. using MS PowerPoint.		Create
CO5: <b>Create</b> own address, constitute text body for email, provide necessary attachments, schedule events and meeting, etc. using MS Outlook.		Create

### Learning Resources



1.	Reference Books: 1. Microsoft Office 2016, by Joan Lambert and Curtis Frye, Microsoft Press. 2. Microsoft Office 2010 on demand, by Steve Johnson, Pearson Education India. 3. Microsoft Office 2016 all-in-one for dummies, by Wallace Wang, Wiley. 4. Microsoft Office 2019 for dummies, by Wallace Wang, Wiley. 5. Mastering MS Office, by Bittu Kumar, V&S Publishers. 6. MS Office, by S. S. Shrivastava, Laxmi Publications.
2.	Journals & Periodicals:
3.	Other Electronic Resources: <a href="https://edu.gcfglobal.org/en/subjects/office/">https://edu.gcfglobal.org/en/subjects/office/</a>

Evaluation Scheme	Total Marks		
<b>Theory: Mid semester Marks</b>	20 marks		
<b>Theory: End Semester Marks</b>	40 marks		
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	
	Article Review	10 marks	
	<b>Total</b>	<b>40 Marks</b>	

<b>COURSE CODE</b> <b>AECC101</b>	<b>COURSE NAME</b> <b>Fundamentals of English</b>	<b>SEMESTER- I</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
30	00	00	30	2	0	0	2

<b>Course Pre-requisites</b>	Student should have cleared 12th Science
<b>Course Category</b>	Mandatory Course
<b>Course focus</b>	Skills Development
<b>Rationale</b>	It enables humanity to experience the benefits of chemistry when we apply it in the exploitation of materials and energy.
<b>Course Revision/ Approval Date:</b>	
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<p>To enable the student to:</p> <ol style="list-style-type: none"> <li>1. Emphasize the development of listening and reading skills among learners</li> <li>2. Equip them with writing skills needed for academic as well as workplace context</li> <li>3. Enable learners of science develop their basic communication skills in English</li> <li>4. Strengthen the fundamentals in English Language.</li> <li>5. Build up the confidence to communicate with the world.</li> </ol>

<b>Course Content</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1: Language Basics</b> Parts of speech, word formation, prefix- suffix, synonyms, antonyms, homophones and standard abbreviations	<b>20%</b>	<b>6</b>
<b>Unit 2: Elementary Reading/Writing Skills</b> Types of the sentences, structures of the sentences, use of phrases and clauses, punctuation, creative writing and coherence, comprehension, essay, paragraph writing, creative writing	<b>30%</b>	<b>9</b>
<b>Unit 3: Elementary Spoken Skills</b> Greetings, farewell and introduction, making an apology, accepting an apology, making an appointment, JAM	<b>30%</b>	<b>9</b>
<b>Unit 4: Presentation Skills</b> Group Discussion, Debate, Public Speaking, Discussion on a specific purpose.	<b>20%</b>	<b>6</b>

<b>Unit 5: Practicing and Identifying the Common Error</b> Tense, subject-verb agreement, noun-pronoun agreement, articles, prepositions, modal auxiliaries, voice, reported speech	<b>20%</b>	<b>6</b>
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**Instructional Method and Pedagogy:**

Classroom Lecture, Case Studies, Quizzes, Presentations, Role Play, Expert Lecture (Consultant)

<b>Course Outcomes:</b>	<b>Blooms' Taxonomy Domain</b>	<b>Blooms' Taxonomy Sub Domain</b>
After successful completion of the above course, students will be able to:		
CO1: To emphasize the development of listening and reading skills among learners	Understand, Analyse, Remember	Define, Classify & Demonstrate
CO2: To equip them with writing skills needed for academic as well as workplace context	Analyse, Apply, Understand	Classify, Describe & Demonstrate
CO3: To enable learners of Engineering and Technology to develop their basic communication skills in English	Understand, remember	Define, Describe & Demonstrate
CO4: To strengthen the fundamentals in English Language.	Remember, Analyse	Define Describe
CO5: To build up the confidence to communicate with the world.	Understand, Apply	Define, Classify, Describe & Demonstrate

<b>Learning Resources</b>	
<b>1.</b>	Reference Books : 1. Murphy, Raymond "Murphy's English Grammar with CD" Cambridge University Press, 2004. 2. Thorpe, Edgar and Showick Thorpe "Basic Vocabulary" Pearson Education India, 2012. 3. Green, David. "Contemporary English Grammar Structures and Composition" MacMillan Publishers, New Delhi, 2010. 4. Wren & Martin (2001), English Grammar & Composition, New York
<b>3.</b>	<b>Journal &amp; Periodicals</b> 1. The Journal' Basic English Grammar 2. Fluent U' English Language and Cultural Journal 3. The Journal of English Academics' 4. Elsevier' The research on language 5. Index Noedicus : A Cumulative Index to English Language Periodicals 6. The Illustrated English Language Periodicals
<b>4.</b>	<b>Other Electronic Resources</b> 1. Wordsworth - Language software 2. Jam board

Evaluation Scheme	Total Marks				50 Marks
<b>Theory: Mid semester Marks</b>	20 marks				
<b>Theory: End Semester Marks</b>	40 marks				
<b>Theory: Continuous Evaluation Component Marks</b>		Attendance	05 marks		
		MCQs	10 marks		
		Skill enhancement activities / case study	15 marks		
		Presentation/ miscellaneous activities	10 marks		
		<b>Total</b>	<b>40 Marks</b>		

### Mapping of PSOs & Cos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	1	0	3	3
CO2	1	1	1	0	3	3
CO3	1	1	1	0	3	2
CO4	1	1	1	0	3	3
CO5	1	1	1	0	3	3

### Mapping of POs & Cos

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	2	0
CO2	3	3	3	3	2	0
CO3	3	2	3	3	2	0
CO4	3	1	3	3	3	0
CO5	3	2	2	3	2	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Semester – II							
Sr. No.	Course Code	Course Title	L	T	P	C	Marks
A. Major							
1	BSBO211	Biomolecules	3	0	1	4	150
2	BSBO212	Metabolism	3	0	1	4	150
B. Minor							
3	BSPY215	Physics – I	4	0	2	6	150
C. Multidisciplinary Additional Credits under Choice Based Credit System (Any One)							
4	CBCS202	Introduction to Social Work	2	0	0	2	100
5	CBCS203	Web Design Fundamentals	2	0	0		
6	CBCS204	Introduction to Design Engineering	2	0	0		
7	CBCS205	Introduction to Automotive System	2	0	0		
8	CBCS211	Accounting for Non – Management Students	2	0	0		
9	CBCS212	Personal Finance	2	0	0		
D. Ability Enhancement Course							
10	AECC201	Communication Skills inEnglish	2	0	0	2	50
E. Skill Enhancement Course							
11	SECC201	Internship	0	0	2	2	50
F. Value Added Course							
12	VACC201	NCC/Sports	0	0	2	2	50
Total						22	700

## Teaching Scheme Semester – II

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
	A. Major Courses															
1.	BSBO211	Biomolecules	3	2	0	5	3	1	0	4	20	40	40	100	50	150
2.	BSBO212	Metabolism	3	2	0	5	3	1	0	4	20	40	40	100	50	150
	B. Minor Courses															
3.	BSPY215	Physics - I	5	0	1	6	5	0	1	6	20	45	75	150	0	150
	C. Multidisciplinary Courses (Any one)															
4.	CBCS202	Introduction to Social Work	2	0	0	2	2	0	0	2	20	40	40	100	00	100
5.	CBCS203	Web Design Fundamentals														
6.	CBCS204	Introduction to Design Engineering														
7.	CBCS205	Introduction to Automotive System														
8.	CBCS211	Accounting for Non – Management Students														
9.	CBCS212	Personal Finance														
	D. Ability Enhancement Courses															
10.	AECC201	Communication Skills in English	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	E. Skill Enhancement Courses															

10.	SECC201	Industrial Internship	0	2	0	2	0	2	0	2	00	00	00	50	00	50
	F. Value Added Courses															
11.	VACC101	NCC/Sports	0	2	0	0	0	2	0	2	00	00	00	50	00	50
	<b>Total</b>									<b>22</b>						<b>700</b>

**Note:** L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

<b>COURSE CODE</b> <b>BSBO211</b>	<b>COURSE NAME</b> <b>Biomolecules</b>	<b>SEMESTER- II</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
45	30	00	75	3	1	0	4

<b>Course Pre-requisite</b>	School Level Understanding of Biological molecules and a keen interest in learning.
<b>Course Category</b>	Core Professional
<b>Course Focus</b>	Employability
<b>Rationale</b>	Comprehensive understanding of biomolecules, their functions, and biological roles. It discusses about the structure, functions, and properties of carbohydrates, lipids, nucleic acids, amino acids, proteins, and enzymes, providing a foundation in biochemistry and molecular biology for understanding life processes.
<b>Course Revision/ Approval date</b>	09/11/2023
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<b>To enable the student:</b> <ol style="list-style-type: none"> <li>1. To understand the structure, function, and properties of carbohydrates and analyze its significance in biological processes.</li> <li>2. To remember the structure, functions and classification of lipids.</li> <li>3. To understand and remember physical and chemical properties of nucleic acids and analyse its significance.</li> <li>4. To understand and analyse the structure and function of amino acids.</li> <li>5. To understand the nomenclature of enzymes and its significance..</li> </ol>

<b>Course Content</b>	<b>Weightage</b>	<b>Contact Hours</b>
<b>Unit 1: Carbohydrates</b> Structure, Function and properties of Monosaccharides, Disaccharides and Polysaccharides, Glycoprotein's and their biological functions.	20%	9
<b>Unit 2: Lipids</b> Structure and functions –Classification, nomenclature and properties of fatty acids, essential fatty acids. Phospholipids, sphingolipids, glycolipids, cerebrosides, gangliosides, Prostaglandins, Cholesterol.	20%	9
<b>Unit 3: Nucleic acids</b> Structure and functions: Physical & chemical properties of Nucleic acids, Nucleosides & Nucleotides, purines & pyrimidines,. Biologically important nucleotides, Double helical model of DNA structure and forces responsible for A, B & Z – DNA, denaturation and renaturation of DNA, types of RNA.	20%	9
<b>Unit 4: Amino acids</b> A historical prospective. Amino acids & Proteins: Structure & Function. Structure and properties of Amino acids, Types of proteins and their	20%	9



classification. Different Level of structural organization of proteins, Protein Purification. Denaturation and renaturation of proteins. Fibrous and globular proteins.		
<b>Unit 5: Enzymes</b> Nomenclature and classification of Enzymes, Holoenzyme, apoenzyme, Cofactors coenzyme, prosthetic groups, metalloenzymes, monomeric & oligomeric enzymes and Vitamins.	20%	9

List Of Practical	Weightage	Contact hours
1. Qualitative test for Carbohydrate: Iodine test	2%	2
2. Qualitative test for Carbohydrate: Benedict test	2%	2
3. Identification of sugars – char (Molisch, Iodine, Benedict, Barfoed, Seiwanoﬀ, Osazone)	2%	2
4. Identification of sugars – char (Molisch, Iodine, Benedict, Barfoed, Seiwanoﬀ, Osazone)	2%	2
5. Qualitative test for lipids: solubility, translucent, acrolein, Hubbles test for saturated/unsaturated lipids, saponification, Burchard test for cholesterol	2%	2
6. Qualitative test for lipids: solubility, translucent, acrolein, Hubbles test for saturated/unsaturated lipids, saponification, Burchard test for cholesterol	2%	2
7. Measure Saponification value of oil/fat	2%	2
8. Detection of DNA by Diphenyl Amine method	2%	2
9. Detection of RNA by Orcinol method	2%	2
10. Qualitative test for proteins: Biuret, Nin-hydrin spot, Sulphur	2%	2
11. Detect presence of protein from various samples (egg white, germinating sprouts)	2%	2
12. Revision	2%	2
13. Revision	2%	2
14. Revision	2%	2
15. Revision	2%	2

#### Instructional Method and Pedagogy:

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments. Practical exercises are designed to understand the theory as taught in classroom.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able:		
CO1: Understand and analyze the structural diversity of carbohydrates and glycoproteins, and their roles in biological functions.	Understand, Analyse, Remember	Define, Classify & Demonstrate
CO2: Classify lipids by structure and function, analyze their roles in cellular processes, and evaluate essential fatty acids' significance in nutrition and health.	Analyse, Apply, Understand	Classify, Describe & Demonstrate
CO3: Explain the physical and chemical properties of nucleic acids, including DNA structure, RNA types, and the importance of nucleotides.	Understand, remember	Explain, Describe & Demonstrate
CO4: Analyze the historical context of amino acids and proteins, classify proteins, evaluate	Remember, Analyse	Define Describe

their structural organization, and explain denaturation processes.		
CO5: Describe enzyme nomenclature and classification, identify enzyme components, explain cofactors, and evaluate the role of vitamins in enzymatic reactions.	Understand, Apply	Define, Classify, Describe & Demonstrate

### Learning Resources

1. <b>Reference Books</b>		
1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.		
2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists.		
3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA.		
4. Biochemistry by U Satyanarayan		
2. <b>Journals &amp; Periodicals:</b>		
1. JBC		
2. Current Science		
3. <b>Other Electronic resources:</b>		
1. NPTEL		

Evaluation Scheme	Total Marks = 150											
Theory: Mid semester Marks	20 marks											
Theory: End Semester Marks	40 marks											
Theory: Continuous Evaluation Component Marks	<table><tr><td>Attendance</td><td>05 marks</td></tr><tr><td>MCQs</td><td>10 marks</td></tr><tr><td>Open Book Assignment</td><td>15 marks</td></tr><tr><td>Research Paper Review</td><td>10 marks</td></tr><tr><td><b>Total</b></td><td><b>40 Marks</b></td></tr></table>		Attendance	05 marks	MCQs	10 marks	Open Book Assignment	15 marks	Research Paper Review	10 marks	<b>Total</b>	<b>40 Marks</b>
Attendance	05 marks											
MCQs	10 marks											
Open Book Assignment	15 marks											
Research Paper Review	10 marks											
<b>Total</b>	<b>40 Marks</b>											
Practical Marks	<table><tr><td>Attendance</td><td>05 marks</td></tr><tr><td>Practical Exam</td><td>35 marks</td></tr><tr><td>Viva</td><td>10 marks</td></tr><tr><td>Journal</td><td>05 marks</td></tr><tr><td><b>Total</b></td><td><b>50 Marks</b></td></tr></table>		Attendance	05 marks	Practical Exam	35 marks	Viva	10 marks	Journal	05 marks	<b>Total</b>	<b>50 Marks</b>
Attendance	05 marks											
Practical Exam	35 marks											
Viva	10 marks											
Journal	05 marks											
<b>Total</b>	<b>50 Marks</b>											

### Mapping of PSOs & Cos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
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CO1	2	1	1	0	1	1
CO2	2	0	1	0	1	1
CO3	2	1	1	0	0	1
CO4	1	2	1	0	1	1
CO5	2	1	1	0	1	1

### Mapping of POs & Cos

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	0	1	0
CO2	3	2	2	0	1	0
CO3	3	2	1	0	0	0
CO4	3	2	2	0	1	0
CO5	3	2	0	0	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO212</b>	<b>COURSE NAME</b> <b>Metabolism</b>	<b>SEMESTER- II</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
45	30	00	75	3	1	0	4

<b>Course Pre-requisite</b>	School Level Understanding of Biological molecules pathways and a keen interest in learning.
<b>Course Category</b>	Core Professional
<b>Course Focus</b>	Employability
<b>Rationale</b>	This course provides a comprehensive study of cellular metabolism, covering the breakdown and synthesis of carbohydrates, lipids, amino acids, and nucleotides. Students will gain insights into energy production and biomolecule regulation, enhancing their understanding of vital biological processes.
<b>Course Revision/ Approval date</b>	09/11/2023
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<b>To enable the student :</b> <ol style="list-style-type: none"> <li>1. To remember, understand and analyze the knowledge of carbohydrate metabolism.</li> <li>2. To apply the knowledge of carbohydrate metabolism to explain cellular respiration process.</li> <li>3. To remember, understand and apply the lipid metabolism.</li> <li>4. To remember, understand and apply the amino acid metabolism.</li> <li>5. To remember, understand and apply the nucleic acids metabolism.</li> </ol>

<b>Course Content</b>	<b>Weightage</b>	<b>Contact Hours</b>
<b>Unit 1: Carbohydrate metabolism-I</b> Glycolysis: Fate of pyruvate under aerobic and anaerobic conditions and regulation. HMP, PPP, Gluconeogenesis, Glycogenolysis and glycogen synthesis.	20%	9
<b>Unit 2: Carbohydrate metabolism-II</b> TCA cycle, it's central role, interactions, organization, reactions, regulation. Electron Transport Chain, Oxidative phosphorylation	20%	9
<b>Unit 3: Lipid metabolism</b> Triglyceride, cholesterol, phospholipid, lipoproteins and eicosanoids. $\beta$ -oxidation of fatty acids, ketogenesis, Fatty Acid synthesis. Synthesis of membrane phospholipids in prokaryotes and eukaryotes.	20%	9
<b>Unit 4: Amino acid metabolism</b> Nitrogen cycle, incorporation of ammonia into biomolecules. Transamination, Deamination and Urea Cycle. Overview of amino	20%	9

acid synthesis		
<b>Unit 5: Nucleotide metabolism</b> Metabolic specializations in Microorganisms. <i>De novo</i> synthesis of purine and pyrimidine nucleotides. Biosynthesis of deoxyribonucleotides	20%	9

List Of Practical	Weightage	Contact hours
1. Sugar fermentation of microorganisms.	2%	2
2. Estimation of reducing and non-reducing sugar	2%	2
3. Blood glucose estimation	2%	2
4. Estimation of HDL & LDL	2%	2
5. Estimation of serum urea	2%	2
6. Estimation of serum uric acid.	2%	2
7. Estimation of serum creatinine.	2%	2
8. Demonstration of enzyme assay	2%	2
9. Detection of amino acid by paper chromatography	2%	2
10. Determination of pyruvate by 2,4- dinitrophenyl hydrazine method	2%	2
11. Measurement of free radicals by spectrophotometric method	2%	2
12. Revision	2%	2
13. Revision	2%	2
14. Revision	2%	2
15. Revision	2%	2

#### Instructional Method and Pedagogy:

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments.  
Practical exercises are designed to understand the theory as taught in classroom.

Learning Resources	
1.	<b>Reference Books</b> 1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co. 2. Buchanan, B., Gruissem, W. and Jones, R. (2000) Biochemistry and Molecular Biology of Plants. American Society of Plant Biologists. 3. Nelson, D.L., Cox, M.M. (2004) Lehninger Principles of Biochemistry, 4th Edition, WH Freeman and Company, New York, USA. 4. Biochemistry by U Satyanarayan
2.	<b>Journals &amp; Periodicals:</b> 1. JBC 2. Current Science
3.	<b>Other Electronic resources:</b> 1. NPTEL

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		

CO1: Analyze glycolysis pathways, evaluate pyruvate fate in aerobic and anaerobic conditions, and explain regulation mechanisms in glycolysis-related processes.	Understand, Analyse, Remember	Evaluate, Classify & Demonstrate
CO2: Analyze the TCA cycle's central role, its interactions, reactions, and regulation, and evaluate the electron transport chain and oxidative phosphorylation.	Analyze, Apply, Understand	Classify, Describe & Demonstrate
CO3: Analyze lipid structures including triglycerides, cholesterol, and phospholipids, and evaluate metabolic pathways such as $\beta$ -oxidation, ketogenesis, and fatty acid synthesis.	Analyze, Understand, remember	Define, Describe & Demonstrate
CO4: Analyze the nitrogen cycle, evaluate the incorporation of ammonia into biomolecules, and explain transamination, deamination, and the urea cycle.	Remember, Analyze	Explain, Describe
CO5: Understand metabolic adaptations in microorganisms, evaluate de novo synthesis pathways of purine and pyrimidine nucleotides, and explain deoxyribonucleotide biosynthesis.	Understand, Apply	Define, Classify, Describe & evaluate

Evaluation Scheme	Total Marks = 150											
Theory: Mid semester Marks	20 marks											
Theory: End Semester Marks	40 marks											
Theory: Continuous Evaluation Component Marks	<table><tr><td>Attendance</td><td>05 marks</td></tr><tr><td>MCQs</td><td>10 marks</td></tr><tr><td>Open Book Assignment</td><td>15 marks</td></tr><tr><td>Research Paper Review</td><td>10 marks</td></tr><tr><td>Total</td><td>40 Marks</td></tr></table>		Attendance	05 marks	MCQs	10 marks	Open Book Assignment	15 marks	Research Paper Review	10 marks	Total	40 Marks
Attendance	05 marks											
MCQs	10 marks											
Open Book Assignment	15 marks											
Research Paper Review	10 marks											
Total	40 Marks											
Practical Marks	<table><tr><td>Attendance</td><td>05 marks</td></tr><tr><td>Practical Exam</td><td>35 marks</td></tr><tr><td>Viva</td><td>10 marks</td></tr><tr><td>Journal</td><td>05 marks</td></tr></table>		Attendance	05 marks	Practical Exam	35 marks	Viva	10 marks	Journal	05 marks		
Attendance	05 marks											
Practical Exam	35 marks											
Viva	10 marks											
Journal	05 marks											

	<b>Total</b>	<b>50 Marks</b>
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### Mapping of PSOs & Cos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	0	0	1
CO2	2	2	2	0	0	1
CO3	2	2	2	0	0	1
CO4	2	2	2	0	1	1
CO5	2	2	2	0	1	1

### Mapping of POs & Cos

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	0	1	1
CO2	3	2	1	0	1	1
CO3	3	2	1	0	1	0
CO4	2	2	1	0	0	1
CO5	2	2	0	0	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BSPY215	COURSE NAME Physics – I	SEMESTER- II
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total hours	Lecture	Practical	Tutorial	Total Credit
60	60	00	120	4	2	0	6

<b>Course Pre-requisites</b>	Understanding of basic physics up to school level (10+2 level).
<b>Course Category</b>	Minor (Compulsory)
<b>Course focus</b>	Skill development
<b>Rationale</b>	The fundamental concepts of physics help in understanding the laws of nature and the behaviour of diverse materials under specific conditions. This course is designed to help in understanding the fundamentals of new and emerging technologies that cut across traditional science disciplines, to pursue graduate studies in science.
<b>Course Revision/ Approval Date:</b>	
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<p>To enable the student to:</p> <ol style="list-style-type: none"> <li>1: To <b>understand &amp; remember</b> the basic laws of optical concepts and <b>apply</b> these concepts to <b>understand</b> the working of different optical instruments.</li> <li>2: To <b>understand &amp; remember</b> the basic quantities governing in the regime of electricity and electronics and <b>analyse</b> respective phenomena in allied areas.</li> <li>3: To get the knowledge of electromagnetism and their <b>applications</b>.</li> <li>4: To <b>understand</b> the fundamental building blocks of matter and <b>remember</b> their behaviour to under different conditions.</li> <li>5: <b>Understand</b> the basics of advanced instrumentation.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Applied optics</b>  Principles of Ray and Wave Optics, Electronic eye, Human eye, Sensors, Optical Microscopic techniques, Optical properties of material: Dielectric constant, refractive index, optical density, birefringence, absorption coefficient, optically sensitive material/system.	20%	12
<b>Unit 2: Fundamentals of electricity and electronics</b>  Insulators, conductors and semiconductors, current, potential. EMF and resistors, Ohm's law, Kirchhoff's laws, Intrinsic and Extrinsic semiconductors, Diodes (PN, Zener, LED, Photodiode, Solar Cell) & Transistors (BJT) with I-V Characteristics, Photosynthesis, Wearable Electronic devices.	20%	12



<b>Unit 3: Electrostatics and Magnetostatics</b>  Electrostatic force and electric field, capacitor: Fundamentals & Application, Magnetic force, magnetic field and magnetization, Hall effect, application of hall effect, Piezoelectric Effect, application of piezoelectric effect, Hysteresis.  EM Waves, Emission and absorption spectrum, Application of EM Waves.	20%	12
<b>Unit 4: Properties of matter</b>  States of matter, interconversion, Mechanical properties of matter (strength, hardness, toughness, creep), Elastic modulus, types of elastic modulus, stress-strain diagram, Introduction and application of nano-materials, composite materials, Ecofriendly materials.	20%	12
<b>Unit 5: Instrumentation Physics</b> Fundamental of optical microscopy, scanning electron microscopy. transmission electron microscopy, X-ray diffractometer, Raman effect and its applications	20%	12

List Of Practical	Weightage	Contact hours
1: To <b>determine</b> the wavelength of source light and radius of curvature of the given convex lens by measuring the diameters of Newton's rings.	4%	4
2: <b>Determination</b> of wavelength of given light source using spectrometer diffraction grating.	4%	4
3. <b>Measurement</b> of charge and discharge characteristics of a capacitor.	4%	4
4: To plot the I-V characteristics of the solar cell and hence <b>determine</b> the fill factor	4%	4
5. To <b>study</b> the half wave rectifier using diodes.	4%	4
6. To <b>study</b> the full wave rectifier using diodes.	4%	4
7: To <b>measure</b> the Hall voltage, current density and hall coefficient of given semiconductor material.	4%	4
8: Magnetic effect of current: (i) To <b>study</b> the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph. (ii) <b>Determination</b> of the radius of the coil using a given laboratory setup.	4%	4
9: To <b>determine</b> the magnetic dipole moment of a bar magnet using deflection magnetometer	4%	4
10: To <b>determine</b> the young's modulus of elasticity of given wire using Searl's method	4%	4
11. To <b>determine</b> the young's modulus of elasticity of metal bar	4%	4
12. To <b>determine</b> the concentration of a solution using UV spectroscopy	4%	4
13. Revision of experiments	4%	4
14. Revision of experiments	4%	4

15. Revision of experiments	4%	4
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#### Instructional Method and Pedagogy:

Utilizing models, Power point Presentations, films on various topics of physics, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of physics. The hands-on sessions during laboratory sessions will help students to apply the concepts learnt and analyse the results and draw conclusions.

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: <b>Describe &amp; demonstrate</b> the fundamental concepts related to optics and working principles of various optical instruments.	Remember & Understand	Define, Classify, Describe, Demonstrate
CO2: <b>Define &amp; classify</b> different electric and electronic materials and <b>demonstrate &amp; analyse</b> the working of different electronic systems.	Understand, Remember, Analyse & Apply	Define, Classify, Describe, Demonstrate & Examine
CO3: <b>Define</b> the fundamental notions related to electrostatics & magnetostatics and, <b>explain</b> the basics of EM waves, their <b>classification</b> and respective applications.	Understand, Remember, Assess & Apply	Define, Classify, Describe & Demonstrate
CO4: <b>Classify</b> the materials based on their properties and <b>analyse</b> their behaviour under different conditions.	Understand, Analyse	Classify, Describe, Demonstrate & Examine
CO5: <b>Describe</b> the fundamental notions and working principles related to the advanced instrumentation techniques and <b>analyse</b> their applications in allied areas.	Understand & Analyse	Describe & Demonstrate

Learning Resources	
1.	Reference Books: 1. Jearl Walker, David Halliday, Robert Resnick, <b>Fundamentals of Physics</b> , Wiley, 2011. 2. D. C. Tayal, <b>Electricity and Magnetism</b> , Himalaya Publishing House, 1988. 3. F. A. Jenkins and H. E White, Fundamentals of Optics, McGraw-Hill Publishing, 4 <sup>th</sup> edition, 2001. 4. Ch Sateesh Kumar, M. Muralidhar Singh, Ram Krishna, Advanced Materials Characterization, 1 <sup>st</sup> Edition, CRC press, 2023.
2.	Journals & Periodicals: 1. Journal of Undergraduate Reports in Physics (JURP) 2. Journal of Young Investigators (JYI) 3. Columbia Undergraduate Science Journal (CUSI) 4. Student Journal of Physics (SJP) 5. Indian Journal of Physics (IJP)

3.	Other Electronic Resources: <b>Feynman Lectures in Physics:</b> <a href="https://www.feynmanLectures.caltech.edu/">https://www.feynmanLectures.caltech.edu/</a>
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Evaluation Scheme	Total Marks												
<b>Theory: Mid semester Marks</b>	20 marks												
<b>Theory: End Semester Marks</b>	40 marks												
<b>Theory: Continuous Evaluation Component Marks</b>	<table> <tr> <td>Attendance</td><td>05 marks</td></tr> <tr> <td>MCQs</td><td>10 marks</td></tr> <tr> <td>Open Book Assignment</td><td>15 marks</td></tr> <tr> <td>Article Review</td><td>10 marks</td></tr> <tr> <td><b>Total</b></td><td><b>40 Marks</b></td></tr> </table>	Attendance	05 marks	MCQs	10 marks	Open Book Assignment	15 marks	Article Review	10 marks	<b>Total</b>	<b>40 Marks</b>		
Attendance	05 marks												
MCQs	10 marks												
Open Book Assignment	15 marks												
Article Review	10 marks												
<b>Total</b>	<b>40 Marks</b>												
<b>Practical Marks</b>	<table> <tr> <td>Attendance</td><td>05 marks</td></tr> <tr> <td>Practical Exam</td><td>20 marks</td></tr> <tr> <td>Viva</td><td>10 marks</td></tr> <tr> <td>Journal</td><td>10 marks</td></tr> <tr> <td>Discipline</td><td>05 marks</td></tr> <tr> <td><b>Total</b></td><td><b>50 Marks</b></td></tr> </table>	Attendance	05 marks	Practical Exam	20 marks	Viva	10 marks	Journal	10 marks	Discipline	05 marks	<b>Total</b>	<b>50 Marks</b>
Attendance	05 marks												
Practical Exam	20 marks												
Viva	10 marks												
Journal	10 marks												
Discipline	05 marks												
<b>Total</b>	<b>50 Marks</b>												

### Mapping of PSOs & Cos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	1	1	0	1
CO2	1	2	0	1	0	0
CO3	1	2	0	1	0	1
CO4	1	2	0	1	0	0
CO5	1	2	1	1	1	1

### Mapping of POs & Cos

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	0	1	1	1
CO2	1	2	0	1	1	1
CO3	1	2	1	1	1	1
CO4	1	2	1	1	1	1
CO5	2	2	2	1	2	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>CBCS202</b>	<b>COURSE NAME</b> <b>Introduction to Social Work</b>	<b>SEMESTER</b> <b>II</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	30	2	2	0	0	2

<b>Course Pre-requisites</b>	
<b>Course Category</b>	Generic Elective
<b>Course focus</b>	
<b>Rationale</b>	
<b>Course Revision/ Approval Date:</b>	
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li>To know the basic values and principles of Social Work</li> <li>To equip candidates with the knowledge of working with people and the ability in problem solving through Field experience</li> <li>To promote among students a sense of commitment and dedication to strive for equity, social justice, social harmony and peace</li> <li>To sensitize the students to involve themselves for the cause of poor, subaltern under privileged and disadvantaged section of the society.</li> <li>To develop confidence among the students to feel themselves as change agents for Social change and transformation.</li> </ol>

Course Content	Weightage	Contact hours
<b>Unit 1: An Introduction to Social Work</b> <b>Theory:</b> <ol style="list-style-type: none"> <li>Social Work: Concept, Meaning, Definition and Objectives</li> <li>Social Work: Nature, Scope and Functions</li> <li>Emergence of Social Work: UK, USA, India</li> <li>Development of Social Work Education in India</li> </ol> <b>Practical:</b> (Give the list of Experiments)	20%	6

<b>Unit 2: Values and Ethics in Social Work Practice</b> <b>Theory:</b> 1. Assumptions and Values of the Social Work 2. Codes of Ethics 3. Principles of Social Work 4. Social Work and its Relation to Human Rights and Social Justice <b>Practical:</b> (Give the list of Experiments)	20%	6
<b>Unit 3: Social Work Profession in India</b> <b>Theory:</b> 1. Profession: Meaning Definition and Attributes 2. Professionalization of Social Work in India 3. Issues and Challenges before Social Work Profession 4. Status of Social Work Profession in India <b>Practical:</b> (Give the list of Experiments)	20%	6
<b>Unit 4: Social Work Philosophy &amp; Methods</b> <b>Theory:</b> 1. Basic values and Ethics, Philosophy and Principles of social work, 2. Types, Functions and Agencies of social control <b>Practical:</b> (Give the list of Experiments)	20%	6
<b>Unit 5: Approaches and Ideologies</b> <b>Theory:</b> 1. Professional v/s Voluntary Approaches to Social Work 2. Ideology of Action Groups and Social Movements 3. Generalist Approach to Social Work Practice 4. Influence of Political Ideology on Social Welfare Policies and Programmes <b>Practical:</b> (Give the list of Experiments)	20%	6

**Instructional Method and Pedagogy:** Presentation, Videos, Chalk-Duster and Notes

Course Outcomes	1. Social Work curriculum is designed to provide a variety of Opportunities to develop and enhance skills.
	2. The course work will Aid learning, observation and analysis of the realities and experience participation in social intervention.
	3. The learner is encouraged to move to being an independent worker.
	4. Will introduce students to their social responsibilities and contribute to the society
	5. will update students on various governmental and non-governmental organizations and their workings
Additional Information to enhance learning	Block Field Work with reputed GOs, NGOs and INGOs

Learning Resources	
1.	Textbook: 1. Skidmore, Rex A.(1982), Introduction to Social Work, New Jersey, Thackeray, Milton G. Prentice-Hall, Englewood Cliffs. 2. Singh, D. K. and Bhartiya, A.K. (2010). Social Work: Concept and Methods. Lucknow: New Royal Book Company. 3. Reamer & Fredric (2005) Social Work Values and Ethics, NewDelhi : Rawat Publication
2.	Reference books: 1. Annie Pullen-Sansfaçon (2013), The Ethical Foundations of Social Work, Stephen Cowden Routledge, □ Banks, S. (1995). 2. Ethics and Values in Social Work: Practical Social Work Series, London: Macmillan Press Ltd. □ Compton, B. R. (1980). 3. Introduction to Social Welfare and Social Work. Illinois: The Dorsey Press. □ Desai, Murli, (2006). 4. Ideologies and social Work: Historical and Contemporary Analyses, Rawat Publication, New Delhi □ Friedlander, Walter A. (1977) 5. Concepts and Methods of Social Work, New Delhi: Prentice Hall of India Pvt. Ltd □ Heun, Linda R., Heun, Richard E. (2001) 6. Developing Skills for Human Interaction, London: Charles E. Merrill Co. □ Jacob, K. K. (Ed.) (1994) Social Work Education in India – Retrospect and Prospect Udaipur, Himansu Publications. □ Joseph, Sherry (Ed.) (2000) Social Work: In the Third Millennium (Some Concerns and Challenges), Sriniketan, Department of Social Work, Visva-Bharati. □ National Association of Social Workers. (2008). Code of Ethics of the National Association of Social Workers. Washington, D.C.: NASW Press. □ O’Hagan, Kieran, 4. Kingsley, Jessica (2003) Competence in Social Work Practice- A Practical Guide for Professionals, London
3.	Journal
4.	Periodicals
5.	Other Electronic resources

Evaluation Scheme		Total Marks	
<b>Theory: Mid semester Marks</b>		20 marks	
<b>Theory: End Semester Marks</b>		40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	
	Article Review	10 marks	
	<b>Total</b>	<b>40 Marks</b>	

<b>COURSE CODE</b> <b>CBCS203</b>	<b>COURSE NAME</b> <b>Web Design</b> <b>Fundamentals</b>	<b>SEMESTER</b> <b>II</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	30	2	2	0	0	2

<b>Course Pre-requisites</b>	Fundamentals of Internet and Web
<b>Course Category</b>	Generic Elective
<b>Course focus</b>	
<b>Rationale</b>	
<b>Course Revision/ Approval Date:</b>	
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li>1. To develop the fundamental understanding of Web Design and learning the development of Professional Website</li> <li>2. To understand the basics of web design using HTML 5</li> <li>3. To learn the fundamentals of scripting using JavaScript</li> <li>4. To understand the presentation and design aspects of web page using CSS</li> <li>5. To learn the website development using Content Management System (CMS)</li> </ol>

Course Content	Weightage	Contact Hours
<b>Unit I: Introduction to Web Development</b> World Wide Web and Hypermedia, Hypertext Design, Introduction to HTML, HTML Elements & Tags, Formatting, Links, Images, Tables, Web Forms, Form Elements, Formatting Tags, Images, Multimedia	20%	6
<b>Unit II: HTML 5</b> Semantic Elements, Form Elements, Form Attributes, Form Input Types, Media Elements, Canvas, SVG	20%	6
<b>Unit III: Java Script</b> Understanding Java Script, Java Script Variables, String, Array, Objects, Functions, Conditional Statements, Looping Statement, Understanding & Managing the Events, Working with Document Object Model (DOM)	20%	6
<b>Unit IV: Cascading Style Sheets(CSS)</b> Introduction, CSS Box Model, Managing Borders, Backgrounds, Text Effects, Transitions, Animation, Multiple Columns, Inline, Internal and External CSS	20%	6
<b>Unit V: Developing Website using CMS</b>	20%	6

Introduction of Content Management System(CMS), CMS with WordPress, Google Sites, Magento Fundamentals of Webhosting Introduction to Bootstrap		
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**Instructional Method and Pedagogy:** Demonstration with Hands-on Practice, Powerpoint Presentation

Course Outcomes	After the successful completion of this course, students will be able to:
	1. Understand the concepts of Website Development
	2. Design Web Site using different presentation styles
	3. Demonstrate the Dynamic Website Development
	4. Understand the concept of Web Hosting and Management

Learning Resources	
1.	Textbook: 1. Sams Teach Yourself HTML, CSS and JavaScript, All in One by Julie C. Meloni, Pearson Education, Inc.
2.	Reference Book: 1. HTML 5 Black Book, Dreamtech Press

Evaluation Scheme	Total Marks		
<b>Theory: Mid semester Marks</b>	20 marks		
<b>Theory: End Semester Marks</b>	40 marks		
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	
	Article Review	10 marks	
	<b>Total</b>	<b>40 Marks</b>	



<b>COURSE CODE</b> <b>CBCS204</b>	<b>COURSE NAME</b> <b>Introduction to Design Engineering</b>	<b>SEMESTER</b> <b>II</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	30	2	2	0	0	2

<b>Course Pre-requisites</b>	Fundamentals of Internet and Web
<b>Course Category</b>	Generic Elective
<b>Course focus</b>	
<b>Rationale</b>	
<b>Course Revision/ Approval Date:</b>	
<b>Course Objectives</b> (As per Blooms' Taxonomy)	1. To familiarize the students with Engineering Design process and induce design thinking.

Course Content	Weightage	Contact hours
<b>Unit 1: Introduction: Engineering design</b> meaning and significance Definition, considerations and assumptions; role of a designer, design vocabulary: design levels and design process	10%	6
<b>Unit 2: Problem Definition: Need &amp; Goal</b> Objective tree – illustrative examples; market analysis and information gathering; identification of needs and user requirements; Functions and specifications. Quality Function Deployment (QFD) method – House of Quality – Kano model for customer satisfaction.	30%	8
<b>Unit 3: Conceptual design: generation of alternative concepts</b> Design space – Morphological chart and design thinking; Brainstorming – creativity – developing concepts from functions; Illustrative cases.	30%	8
<b>Unit 4: Concepts evaluation and selection</b> Decision matrix; applying metrics to objectives towards selection of preferred concepts. Numerical evaluation matrices - Priority checkmark method – The best-of-class chart.	30%	8

**Instructional Method and Pedagogy:** Project Based Learning Peer Based Learning Interactive Sessions

Course Outcomes	After the successful completion of this course, students will be able to:
	1. identify problems, gather data, prepare need statements, generate alternative conceptual solutions and choose the best concept

### Learning Resources

1.	Textbooks: Engineering Design – a project based introduction, Clive L. Dym, Patrick Little and Elizabeth J Orwin, Wiley India edition, 2016.
2.	Reference Books: Engineering design process, Yousef Haik and Tamer Shahin, Cengage Learning, 2011.

Evaluation Scheme	Total Marks		
<b>Theory: Mid semester Marks</b>	20 marks		
<b>Theory: End Semester Marks</b>	40 marks		
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	
	Article Review	10 marks	
	<b>Total</b>	<b>40 Marks</b>	

<b>COURSE CODE</b> <b>CBCS205</b>	<b>COURSE NAME</b> <b>Introduction to</b> <b>Automotive System</b>	<b>SEMESTER</b> <b>II</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
30	0	30	2	2	0	0	2

<b>Course Pre-requisites</b>	Fundamentals of Internet and Web
<b>Course Category</b>	Generic Elective
<b>Course focus</b>	
<b>Rationale</b>	
<b>Course Revision/ Approval Date:</b>	
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li>1. To give knowledge about fundamentals of Automotive engineering.</li> <li>2. To enable student to understand main systems and assemblies essential for Automobile.</li> <li>3. To provide students knowledge about modern vehicle technology.</li> <li>4. To enable students to understand basic automotive concepts of off road vehicles.</li> <li>5. To enable students to understand alternative fuels and energy systems.</li> </ol>

<b>Course Content</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1:</b> <ul style="list-style-type: none"> <li>Automotive Engines</li> <li>Material Science and Technology</li> </ul>	20%	06
<b>Unit 2:</b> <ul style="list-style-type: none"> <li>Automotive Chassis</li> <li>Vehicle Body Engineering</li> <li>Industrial Engineering</li> </ul>	20%	06
<b>Unit 3:</b> <ul style="list-style-type: none"> <li>Automotive Pollution and Control</li> <li>Quality Control and Reliability Engineering</li> <li>Automotive Electrical Systems and Electronics</li> </ul>	20%	06
<b>Unit 4:</b> <ul style="list-style-type: none"> <li>Operations Research and Industrial Management</li> <li>Ethics in Engineering and Transport Management</li> </ul>	20%	06

**Instructional Method and Pedagogy:** Hands on activities/ Power Point Presentation/ Chalk/ Duster, Power Point Presentation

Course Outcomes	1. Students will get knowledge about fundamentals of Automotive engineering.
	2. Students will understand main systems and assemblies essential for Automobile.
	3. Students will have basic knowledge about modern vehicle technology.
	4. Students will understand basic automotive concepts of off road vehicles.
	5. Students will understand alternative fuels and energy systems.

#### Learning Resources

1.	Textbooks: 1. Karoly Jarmai and Betti Bollo, <a href="#">Vehicle and Automotive Engineering</a> , Springer Publications
2.	Reference Books: 1. Nikolaos Gkikas, <a href="#">Automotive Ergonomics Driver Vehicle Interaction</a> , CNC Publications
3.	Journals & Periodicals: 1. Automotive Engineering, SAE International
5.	Other Electronic Resources: 1. Automotive Engineering, Study.com

Evaluation Scheme	Total Marks		
<b>Theory: Mid semester Marks</b>	20 marks		
<b>Theory: End Semester Marks</b>	40 marks		
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	
	Article Review	10 marks	
	<b>Total</b>	<b>40 Marks</b>	

<b>COURSE CODE</b> <b>CBCS211</b>	<b>COURSE NAME</b> <b>Accounting for Non – Management Students</b>	<b>SEMESTER</b> <b>II</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	30	2	2	0	0	2

<b>Course Pre-requisites</b>	Fundamentals of Internet and Web
<b>Course Category</b>	Generic Elective
<b>Course focus</b>	
<b>Rationale</b>	
<b>Course Revision/ Approval Date:</b>	
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li>1. To demystify debits and credits</li> <li>2. To read a financial statement</li> <li>3. To understand corporate transactions</li> <li>4. To put together an income statement</li> </ol>

Course Content	Weightage	Contact hours
Unit 1: Introducing Accounting and financial statements • Generally Accepted Accounting Principles	20%	6
Unit 2: Financial Statements • Balance Sheet and its Components • The Income Statement	20%	6
Unit 3 Double-Entry Accounting • The General Journal • The General Ledger • Adjusting Journal Entries • Closing Journal Entries	20%	6
Unit 4: Forms of Business Organisations • Sole Proprietorship • Partnership • Corporation	20%	6
Unit 5: Financial Statement Analysis • Ratio Analysis • Trend Analysis • Comparative Statement Analysis	20%	6

**Instructional Method and Pedagogy:** Hands on activities/ Power Point Presentation/ Chalk/ Duster

	1. The candidate will gain the ability to read, interpret and analyse financial statements.
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<b>Course Outcomes</b>	2. Analyse financial statements to assess financial performance and position of a company.
<b>Additional Information to enhance learning</b>	Any site visit required or expert talk required on specific topics.

<b>Learning Resources</b>	
1.	Textbook: Accounting for Non-Accountants, Dr. Wayne A Label
2.	Reference books: The Essentials of Finance and Accounting for Nonfinancial Managers by Edward Fields Finance for Non-Financial Managers by Gene Sicillinao
3.	Journal & Periodicals: Journal of Accounting, Auditing & Finance: SAGE Journals Accounting & Finance: Wiley Online Library Journal of Finance and Accounting: Science Publishing Group

<b>Evaluation Scheme</b>	<b>Total Marks</b>			
<b>Theory: Mid semester Marks</b>	20 marks			
<b>Theory: End Semester Marks</b>	40 marks			
<b>Theory: Continuous Evaluation Component Marks</b>		Attendance	05 marks	
		MCQs	10 marks	
		Open Book Assignment	15 marks	
		Article Review	10 marks	
		<b>Total</b>	<b>40 Marks</b>	

<b>COURSE CODE</b> <b>CBCS212</b>	<b>COURSE NAME</b> <b>Personal Finance</b>	<b>SEMESTER</b> <b>II</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
<b>30</b>	<b>0</b>	<b>30</b>	<b>2</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

<b>Course Pre-requisites</b>	Domain Knowledge of Income and Saving
<b>Course Category</b>	Generic Elective
<b>Course focus</b>	
<b>Rationale</b>	
<b>Course Revision/ Approval Date:</b>	
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li>1. To equip the students basic knowledge of finance theory</li> <li>2. To understand the important of financial status</li> <li>3. To know the allocation of funds in different financial instruments</li> <li>4. To implement and monitor the financial plan.</li> </ol>

<b>Course Content</b>	<b>Weight age</b>	<b>Contact hours</b>
<b><u>Unit 1: Introduction</u></b> <ol style="list-style-type: none"> <li>1. Planning Personal Finances:</li> <li>2. Personal Finance Basics</li> <li>3. Time Value Of Money</li> </ol>	20%	5 Hours
<b><u>Unit 2 Managing Funds</u></b> <ol style="list-style-type: none"> <li>1. Managing Personal Finances:</li> <li>2. Financial Services: Saving Plans And Payment Accounts</li> <li>3. Introduction To Consumer Credit, Choosing A Source Of Credit</li> </ol>	15%	5 Hours
<b><u>Unit 3: Insuring resources:</u></b> <ol style="list-style-type: none"> <li>1. Property And Motor Vehicle Insurance,</li> <li>2. Health, Disability And Long Term Care Insurance And</li> <li>3. Life Insurance</li> </ol>	15%	5 Hours
<b><u>Unit 4: Investing Financial Resources</u></b> <ol style="list-style-type: none"> <li>1. Investing Fundamentals,</li> <li>2. Investing in stocks, Bonds, Mutual funds, Real estate</li> </ol>	30%	8 Hours
<b><u>Unit 5 Practical</u></b> :Prepare a Financial Plan for aPerson / Manager / Entrepreneur / Director	20%	7 Hours

**Instructional Method and Pedagogy:** Case analysis, Power Point Presentation/ Chalk/  
Duster

<b>Course Outcomes</b>	1. Familiarize with income and importance of financial goals
	2. Know the importance of retirement planning
	3. Understand methodology of revision of financial goals

<b>Learning Resources</b>	
1.	Textbooks: Personal Finance, Jack R. Kapoor, Les R. Dlabay, Robert J. Hughes, McGraw- Hill Higher Education
2.	Reference Books: 1. V.K. Singhania, Taxman's direct taxes planning and management, Taxmann 2. Corporate Tax Planning, McGraw- Hill Higher Education
3.	News Paper 1. Economic Times 2. Business Standard
4	News Channel CNBC NDTV Profit

<b>Evaluation Scheme</b>	<b>Total Marks</b>		
<b>Theory: Mid semester Marks</b>	20 marks		
<b>Theory: End Semester Marks</b>	40 marks		
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks	
	MCQs	10 marks	
	Open Book Assignment	15 marks	
	Article Review	10 marks	
	<b>Total</b>	<b>40 Marks</b>	



COURSE CODE AECC201	COURSE NAME Communication Skills in English	SEMESTER II
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	00	00	30	30	00	00	2

<b>Course Pre-requisites</b>	Student should have cleared First Semester of Bachelor of Science
<b>Course Category</b>	Mandatory Course
<b>Course focus</b>	Communicational Skills
<b>Rationale</b>	It enables humanity to experience the benefits of chemistry when we apply it in the exploitation of materials and energy.
<b>Course Revision/ Approval Date:</b>	14/03/2023
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<ol style="list-style-type: none"> <li>1. To enable learners, develop their basic communication skills in English.</li> <li>2. To equip them with writing skills needed for academic as well as workplace context.</li> <li>3. To prepare students for professional communication at world level.</li> <li>4. To develop corporate communicational attitude.</li> <li>5. To strengthen digital communication using technological modules and expertise.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Communicative Skills</b> Basics of Communication, Verbal & Non-verbal, Communication, Barriers to Effective Communication, Strategies of Effective Communication	20%	6
<b>Unit 2: Grammar &amp; Vocabulary:</b> Types of sentences, Synonyms, Antonyms, Tenses - Past, Present & Future, Homophones, Modals, Verb forms, Phrasal Verbs, Error correction, commonly misused words, technical terms	15%	5
<b>Unit 4: Writing Skills &amp; Speaking Skills:</b> Letter writing - Complaint & Leave, Article, Precise writing, Report writing, Note-taking and Note-making, Creative Writing Introducing self, Interview Skills, Public Speaking, Debates, Role plays, Group Discussion.	25%	7
<b>Unit 3: Listening &amp; Reading Skills:</b> Definitions (Listening & Reading), Types of Listening, Barriers to Effective Listening, Traits of a Good Listener, Types of Reading, Techniques of Effective Reading, Reading Tasks (Critical &	30%	9

Inferential)		
<b>Unit 4: Writing Skills &amp; Speaking Skills:</b> Letter writing - Complaint & Leave, Article, Precise writing, Report writing, Note-taking and Note-making, Creative Writing Introducing self, Interview Skills, Public Speaking, Debates, Role plays, Group Discussion.	<b>25%</b>	<b>7</b>
<b>Unit 5: ICT/ Digital/ E-Skills:</b> Computer Assisted Language Learning (CALL), Mobile Assisted Language Learning (MALL), Emails, Blogs, Digital/ E-Portfolio, Filling Online Application Forms	<b>20%</b>	<b>6</b>

Course Objectives	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1: To emphasize the development of listening and reading skills among learners	Understand, Analyse, Remember	Define, Classify & Demonstrate
CO2: To equip them with writing skills needed for academic as well as workplace context	Analyse, Apply, Understand	Classify, Describe & Demonstrate
CO3: To enable learners of Engineering and Technology develop their basic communication skills in English	Understand, remember	Define, Describe & Demonstrate
CO4: To strengthen the fundamentals in English Language.	Remember, Analyse	Define Describe
CO5: To build up the confidence to communicate with the world.	Understand, Apply	Define, Classify, Describe & Demonstrate

Learning Resources	
1.	Textbook: An Introduction to Professional English and Soft Skills by B K Das
2.	Reference Books : 1. Murphy, Raymond.(1998), Intermediate English Grammar, New York 2. Wren & Martin (2001), English Grammar & Composition, New York 3. Mudambadithaya G.S.,(2002) English Grammar and composition 4. Digne, Flinders and Sweeney(2010) Cambridge University press 5. Lupton, Mary Jane (1998). <i>Maya Angelou: A Critical Companion</i> . Westport, : Greenwood Press. ISBN 978-0-313-303225. 6. Booher, Diana. (2004), <i>Booher's Rules of Business Grammar</i> , OUPUr, Penny (2002), <i>Grammar Practice Activities</i> , OUP

Evaluation Scheme	Total Marks			
<b>Theory: Mid semester Marks</b>	20 marks			
<b>Theory: End Semester Marks</b>	40 marks			
<b>Theory: Continuous Evaluation Component Marks</b>		Attendance	05 marks	
		MCQs	10 marks	
		Skill enhancement activities / case study	15 marks	
		Presentation/ miscellaneous activities	10 marks	
		<b>Total</b>	<b>40 Marks</b>	

### Mapping of PSOs & Cos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	1	0	3	3
CO2	1	1	1	0	3	3
CO3	1	1	1	0	3	2
CO4	1	1	1	0	3	3
CO5	1	1	1	0	3	3

### Mapping of POs & Cos

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	2	3
CO2	3	3	3	3	2	3
CO3	3	2	3	3	2	2
CO4	3	1	3	3	3	3
CO5	3	2	2	3	2	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Semester – III							
Sr.No.	Course Code	Course Title	L	T	P	C	Marks
<b>A. Ability Enhancement Compulsory Course</b>							
1	AECC301	Entrepreneurship Development	2	0	0	2	100
<b>B. Skill Enhancement Courses</b>							
<b>a) Skill Enhancement compulsory course</b>							
2	SECC304	Internship	0	0	2	2	50
<b>b) Skill Enhancement Electives (Any One)</b>							
3	BSBO305	Biophysics	2	0	0	2	50
4	BSBO306	Analytical Clinical Biochemistry	2	0	0	2	50
5	BSBO307	Molecular Diagnostics	2	0	0	2	50
<b>C. Core Course</b>							
6	BSBO301	Genetics	4	0	2	6	150
7	BSBO302	General Microbiology	4	0	2	6	150
8	BSBO303	Basics of Development Biology	4	0	2	6	150
<b>D. Elective Course</b>							
<b>a) Discipline Specific Generic Electives (Any One)</b>							
9	BSPY307	Physics - III	4	0	2	6	150
10	BSMA307	Mathematics - III	5	1	0	6	150
11	BSCM 307	Chemistry – I	4	0	2	6	150
Total						30	800

## Teaching Scheme Semester – III

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
	A. Ability Enhancement Compulsory Course															
1	AECC301	Entrepreneurship Development	2	0	0	2	2	0	0	2	20	40	40	100	00	100
	B. Skill Enhancement Courses															
	a) Skill Enhancement compulsory course															
2	SECC301	Internship	0	2	0	2	0	0	2	2	00	00	00	00	50	50
	b) Skill Enhancement Electives (Any One)															
3	BSBO305	Biophysics	2	0	0	2	2	0	0	2	20	40	40	50	00	50
4	BSBO306	Analytical Clinical Biochemistry	2	0	0	2	2	0	0	2						
5	BSBO307	Molecular Diagnostics	2	0	0	2	2	0	0	2						
	C. Core Course															
6	BSMB301	Genetics	4	4	0	8	4	2	0	6	20	40	40	100	50	150
7	BSBO302	General Microbiology	4	4	0	8	4	2	0	6	20	40	40	100	50	150
8	BSMB303	Basics of Developmental Biology	4	4	0	8	4	2	0	6	20	40	40	100	50	150

	D. Elective Course															
	a) Discipline Specific Generic Electives (Any One)															
	BSPY307	Physics - III	4	4	0	8	4	2	0	6	20	40	40	100	50	150
	BSMA307	Mathematics - III	5	0	1	6	5	1	0	6						
	BSCM307	Chemistry – I	4	4	0	8	4	2	0	6						
		Total								30						800

<b>COURSE CODE</b> <b>AECC301</b>	<b>COURSE NAME</b> <b>ENTREPRENEURSHIP</b> <b>DEVELOPMENT</b>	<b>SEMESTER</b> <b>III</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	0	30	2	0	0	2

<b>Course Pre-requisites</b>	Knowledge and skills of entrepreneurship.
<b>Course Category</b>	Ability Enhancement Compulsory Course
<b>Course focus</b>	Entrepreneurship
<b>Rationale</b>	Entrepreneurs have been instrumental in spurring social change and improving the way people live and work. They help raise the standard of living for everyone by creating jobs and making products safer, less expensive, and more functional.
<b>Course Revision/ Approval Date:</b>	14/03/2020
<b>Course Objectives (As per Blooms' Taxonomy)</b>	To enable the student to: 1: Students will develop skills for evaluating, articulating, refining, and pitching a new product or service offering 2: Identify the elements of success of entrepreneurial ventures 3: Analyze Feasibility of the project (Financial and Non-Financial) and interpret business plan. 4: Demonstrate and present successful work, collaboration and division of tasks in a multidisciplinary and multicultural team. 5: Demonstrate understanding and application of the tools necessary to create sustainable and viable Businesses.

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Entrepreneurship</b> Concept, knowledge and skills requirement; characteristic of successful entrepreneurs; role of entrepreneurship in economic development; entrepreneurship process; factors impacting emergence of entrepreneurship; managerial vs. entrepreneurial approach and emergence of entrepreneurship. Entrepreneurial Motivation.	<b>20%</b>	<b>6</b>

<b>Unit 2: Creativity and Entrepreneurship</b> Steps in Creativity; Product Design & Influencing Factors (Legal, Ethical & Environmental); Generating business idea –sources of new ideas, methods of generating ideas, creative problem solving, opportunity recognition; environmental scanning, competitor and industry analysis.	20%	6
<b>Unit 3: Feasibility Study (Non-financial Aspects)</b> Market feasibility, Technical feasibility, operational feasibility, Legal feasibility, Human Resource Feasibility, Supply Feasibility.	20%	6
<b>Unit 4: Feasibility Study (financial Aspects)</b> Cost classification- Fixed vs. Variable; Cost Determination- Material, Labour, Overheads; Product Profitability- Concepts of Break-even, Margin of Safety, Angle of Incidence, Key-factor, Profit-Volume ratio; Balance Sheet & Profit & Loss Account- Concepts & Structure; Budgeting; Financing Schemes from Government, specially schemes for women; Venture Capital & Angel Investing	20%	6
<b>Unit 5: Detailed Project Report &amp; Business Plan</b> Project Report- components; Preparation of Business Plan; Pitching the Business Plan, Attracting Angel Investors. (A group of THREE students will prepare a DPR, and Business Plan on selected product or service in the course as a Project/Assignment.	20%	6

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
<p>After successful completion of the above course, students will be able to:</p> <p><b>CO1</b> Students will develop skills for evaluating, articulating, refining, and pitching a new product or service offering.</p> <p><b>CO2</b> Identify the elements of success of entrepreneurial ventures</p> <p><b>CO3</b> Analyze Feasibility of the project (Financial and Non-Financial) and interpret business plan</p> <p><b>CO4</b> Demonstrate and present successful work, collaboration and division of tasks in a multidisciplinary and multicultural team.</p> <p><b>CO5:</b> Demonstrate understanding and application of the tools necessary to create sustainable and viable Businesses</p>	<p>Evaluate</p> <p>Apply and Understand</p> <p>Analyse</p> <p>Create and Understand</p> <p>Create and Understand</p>	<p>Define, Classify and describe</p> <p>Define, Classify, Describe, Demonstrate and Examine</p> <p>Define, Classify, Describe, Demonstrate and Examine</p> <p>Define, Classify, Describe, Demonstrate and Examine</p> <p>Define, Describe and Demonstrate</p>



Learning Resources			
1.	<b>Textbook:</b> 1. Fundamentals of Entrepreneurship. 2.Managing Entrepreneurship.		
2.	<b>Reference books</b> 1. Holt DH. Entrepreneurship: New Venture Creation. 2. Kaplan JMPatterns of Entrepreneurship.ship. 3 Gupta CB, Khanka SS. Entrepreneurship and Small Business Management, Sultan Chand & Sons.		
3.	Journal - International Journal of Entrepreneurship.		
4.	Periodicals - <a href="https://www.jemi.edu.pl/">https://www.jemi.edu.pl/</a>		
5.	Other Electronic resources: <a href="https://innovation-entrepreneurship.springeropen.com/">https://innovation-entrepreneurship.springeropen.com/</a>		
Evaluation Scheme		Total Marks	
Theory: Midsemester Marks		20 marks	
Theory: End Semester Marks		40 marks	
Theory: Continuous Evaluation Component Marks		Attendance	05 marks
		MCQs	10 marks
		Open Book Assignment	15 marks
		Article Review	10 marks
		Total	40 Marks

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	3	2	0
CO2	2	0	1	1	3	0
CO3	2	0	1	0	0	0
CO4	2	3	2	2	0	1
CO5	3	1	3	2	1	2

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	3	1	1
CO2	1	2	1	1	3	1
CO3	2	2	3	2	2	2
CO4	2	2	1	3	2	2
CO5	2	2	3	3	2	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO305</b>	<b>COURSE NAME</b> <b>BIOPHYSICS</b>	<b>SEMESTER</b> <b>III</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	0	30	2	0	0	2

<b>Course Pre-requisites</b>	Understanding of basic sciences up to school level (10+2 level).
<b>Course Category</b>	Mandatory courses
<b>Course focus</b>	Employability
<b>Rationale</b>	It equips biotechnologists with a strong foundation in the physical principles underlying biological systems, enabling them to contribute to research, innovation, and technological advancements in biotechnology both at the national and international levels. It is important in understanding biological processes, molecular modeling, biophysical techniques, biomolecular engineering, instrumentation, international collaboration, and emerging technologies.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> <b>(As per Blooms' Taxonomy)</b>	<p>Course Objectives: Students will be able to:</p> <ol style="list-style-type: none"> <li>1. To provide introductory knowledge of Biophysics to the students</li> <li>2. To familiarize students with relevant applications required for study of biological systems</li> <li>3. To enable the students to address any elementary thermodynamic problems in biological systems</li> <li>4. To familiarize the student with chemical thermodynamics of biological systems</li> <li>5. To familiarize students with modern developments in the area of biomaterials</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Building Blocks &amp; Structure of Living State :</b> Atoms and ions, molecules essential for life, what is life. Living state interactions: Forces and molecular bonds, electric & thermal interactions, electric dipoles, casimir interactions, domains of physics in biology.	<b>20%</b>	<b>6</b>

<b>Unit 2: Heat Transfer in biomaterials :</b> Heat Transfer Mechanism, The Heat equation, Joule heating of tissue. Living State Thermodynamics: Thermodynamic equilibrium.	<b>20%</b>	<b>6</b>
<b>Unit 3: Thermodynamics:</b> First law of thermodynamics and conservation of energy. Entropy and the second law of thermodynamics, Physics of many particle systems, two state systems, continuous energy distribution, Composite systems, Casimir contribution of free energy, Protein folding and unfolding.	<b>20%</b>	<b>6</b>
<b>Unit 4: Thermodynamics:</b> Open systems and chemical thermodynamics: Enthalpy, Helmholtz Free energy, Gibbs Free Energy and chemical potential.	<b>20%</b>	<b>6</b>
<b>Unit 5: Thermodynamics:</b> Activation energy and rate constants, enzymatic reactions, ATP hydrolysis & synthesis, Entropy of mixing, The grand canonical ensemble, Haemoglobins.	<b>20%</b>	<b>6</b>

<b>Course Outcome:</b>	<b>Blooms' Taxonomy Domain</b>	<b>Blooms' Taxonomy Sub Domain</b>
After successful completion of the above course, students will be able to:  <b>CO1</b> Students will have sufficient knowledge of Biophysics for undergraduate studies  <b>CO2</b> Students will be familiar with concepts that help them prepare for modern courses like Bioinstrumentation.  <b>CO3</b> Students will be able to understand and appreciate the interdisciplinary nature of the modern researches  <b>CO4</b> Students will be able to prepare working models on Biophysical systems  <b>CO5</b> Students will be able to continue learning through various e-resources	Understand  Understand and Create  Evaluate and Analyse  Remember, Apply and Create  Understand and apply	Describe  Describe  Describe and Explain  Describe and classify  Classify and Explain

<b>Learning Resources</b>	
1.	Reference Books: I. Introductory Biophysics, J. Claycomb, JQP Tran, Jones & Bartlett Publishers. II. Aspects of Biophysics, Hughe S W, John Willy and Sons. III. Essentials of Biophysics by P Narayanan, New Age International.

2.	Journals & Periodicals: 1. Journal of Young Investigators (JYI) 2. Biophysics – Frontiers
3.	Other Electronic Resources: 1. For detailed further study: Physics of Biological systems ( <a href="https://onlinecourses.nptel.ac.in/noc20_ph02/preview">https://onlinecourses.nptel.ac.in/noc20_ph02/preview</a> )

Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Research Paper Review	10 marks
	<b>Total</b>	<b>40 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	0	2	0	1
CO2	1	1	1	1	1	1
CO3	1	2	1	1	1	1
CO4	1	2	1	1	0	1
CO5	1	0	0	1	0	0

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	0	2	1	0
CO2	1	1	1	2	1	0
CO3	1	2	1	1	1	1
CO4	1	1	0	2	1	0
CO5	1	0	0	1	0	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO306</b>	<b>COURSE NAME</b> <b>ANALYTICAL CLINICAL</b> <b>BIOCHEMISTRY</b>	<b>SEMESTER</b> <b>III</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	0	30	2	0	0	2

<b>Course Pre-requisites</b>	Understanding of basic sciences up to school level (10+2 level).
<b>Course Category</b>	Mandatory courses
<b>Course focus</b>	Employability
<b>Rationale</b>	It holds significant importance in disease diagnosis, treatment monitoring, disease prevention, research and development, global collaboration, and public health impact. It plays a critical role in healthcare and biomedical advancements, contributing to improved patient care, disease management, and public health outcomes. This course is supported by its national significance in healthcare and clinical diagnostics, disease prevention and management, pharmacokinetics, and research and development. Internationally, analytical clinical biochemistry is recognized for standardization, quality control, global collaboration, accreditation, and its role in addressing global health challenges.
<b>Course Revision/ Approval Date:</b>	14/03/2020
<b>Course Objectives</b> <b>(As per Blooms' Taxonomy)</b>	<p>Course Objectives: Students will be able to:</p> <ol style="list-style-type: none"> <li>1: To enable the student to acquire the basic knowledge to critically evaluate the methodologies relevant to Clinical Chemistry.</li> <li>2: Provide an overview of analytical techniques used in research and clinical laboratories.</li> <li>3: Link taught topics to laboratory practicals.</li> <li>4: Use a blended learning approach to the teaching of Analytical Biochemistry by incorporating lectures, concept-directed tasks and tutorials.</li> <li>5: Develop a critical awareness of analytical techniques and the analysis/interpretation of data.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Overview</b> Overview of proteins & their structure, Organization of clinical laboratory, Introduction to instrumentation and automation in clinical biochemistry laboratories safety regulations and first aid. General comments on specimen collection, types of specimen for biochemical analysis. Precision, accuracy, quality control, precautions and limitations.	20%	6
<b>Unit 2: Metabolism:</b> Overview of metabolism; Assessment of Nutritional status, BMI, Biochemical assessment; Basal metabolic panel, Comprehensive metabolic panel, CBC, ROS assessment, Glucose tolerance test (GTT) and glycosylated Hb, Differential diagnosis of B12 and folate.	20%	6
<b>Unit 3: Lipids:</b> Classification. Biological importance of triglycerides and phosphoglycerides and cholesterol; Lipid membrane, Liposomes and their biological functions and underlying applications. Lipoproteins. Properties, functions and biochemical functions of steroid hormones. Biochemistry of peptide hormones	20%	6
<b>Unit 4: Thermodynamics :</b> Structure of DNA (Watson-Crick model) and RNA, Genetic Code, Biological roles of DNA and RNA, Introduction to Gene therapy. Enzymes: Nomenclature, classification, effect of pH, temperature on enzyme activity, enzyme inhibition. Enzymes in disease diagnosis with suitable examples.	20%	6
<b>Unit 5: Biochemistry of disease:</b> A diagnostic approach by blood/ urine analysis. Blood: Composition and functions of blood, blood coagulation. Blood collection and preservation of samples. Anemia, Regulation, estimation and interpretation of data for blood sugar, urea, creatinine, cholesterol and bilirubin. Urine: Collection and preservation of samples. Formation of urine. Composition and estimation of constituents of normal and pathological urine	20%	6

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
<b>CO1</b> Students will have sufficient knowledge of Biophysics for undergraduate studies	Understand	Describe
<b>CO2</b> Students will be familiar with concepts that help them prepare for modern courses like Bioinstrumentation.	Understand and Create	Describe

<b>CO3</b> Students will be able to understand and appreciate the interdisciplinary nature of the modern researches	Evaluate and Analyse	Describe and Explain
<b>CO4</b> Students will be able to prepare working models on Biophysical systems	Remember, Apply and Create	Describe and classify
<b>CO5</b> Students will be able to continue learning through various e-resources	Understand and apply	Classify and Explain

Learning Resources	
1.	Reference Books: I. T.G. Cooper: Tool of Biochemistry. II. Keith Wilson and John Walker: Practical Biochemistry. III. Alan H Gowenlock: Varley's Practical Clinical Biochemistry. IV. . Thomas M. Devlin: Textbook of Biochemistry. V. Jeremy M. Berg, John L Tymoczko, Lubert Stryer: Biochemistry. VI. G. P. Talwar and M Srivastava: Textbook of Biochemistry and Human Biology. VII. A.L. Lehninger: Biochemistry. VIII. O. Mikes, R.A. Chalmers: Laboratory Handbook of Chromatographic Method
2.	Journals & Periodicals: 3. Journal of Biological Inorganic Chemistry
3.	4. Other Electronic Resources: 5. <a href="https://www.aacc.org/">https://www.aacc.org/</a>

Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Research Paper Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
	<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	1	1	0	0

CO2	1	1	1	2	1	1
CO3	1	1	2	2	1	1
CO4	0	0	1	1	1	1
CO5	0	0	1	1	0	1

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1	1	1
CO2	1	1	2	2	1	2
CO3	1	2	2	2	1	1
CO4	1	1	2	1	2	1
CO5	1	2	2	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None



<b>COURSE CODE</b> <b>BSBO307</b>	<b>COURSE NAME</b> <b>MOLECULAR</b> <b>DIAGNOSTICS</b>	<b>SEMESTER</b> <b>III</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	0	30	2	0	0	2

<b>Course Pre-requisites</b>	Understanding of basic sciences up to school level (10+2 level).
<b>Course Category</b>	Mandatory courses
<b>Course focus</b>	Employability
<b>Rationale</b>	Molecular diagnostics enables early detection of diseases, accurate diagnosis, and monitoring of treatment effectiveness. It plays a crucial role in infectious disease control, genetic testing, and precision medicine. By providing rapid and accurate results, it improves patient care, facilitates targeted therapies, and contributes to public health initiatives. Nationally, it equips graduates with the skills to contribute to disease diagnosis, personalized medicine, and public health initiatives. Internationally, molecular diagnostics is a recognized field that drives advancements in precision medicine, infectious disease control, and genetic testing.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> <b>(As per Blooms' Taxonomy)</b>	<p>Course Objectives: Students will be able to:</p> <p>1: The course will describe the techniques commonly used in diagnostics and molecular pathology laboratories and the underlying principles and applications, advantages and limitations of each technique</p> <p>2: Sensitize students about recent advances in diagnostics and various facets of molecular medicine which has potential to profoundly alter many aspects of modern medicine including pre- or post-natal analysis of genetic diseases and identification of individuals predisposed to disease ranging from common cold to cancer</p> <p>3: Adequate knowledge about recent advances and technological developments in the field of diagnostics</p> <p>4: The objectives of this course are to sensitize students about recent advances in molecular biology.</p> <p>5: Expertise to perform any diagnostic test with an ability to troubleshoot</p>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Enzyme Immunoassays</b> Comparison of enzymes available for enzyme immunoassays, conjugation of enzymes. Solid phases used in enzyme immunoassays. Homogeneous and heterogeneous enzyme immunoassays. Enzyme immunoassays after immuno blotting.	20%	6
<b>Unit 2: Enzyme immuno histochemical techniques:</b> Use of polyclonal or monoclonal antibodies in enzymes immuno assays. Applications of enzyme immunoassays in diagnostic microbiology	20%	6
<b>Unit 3: Molecular techniques in clinical microbiology</b> Applications of PCR, RFLP, Nuclear hybridization methods, Single nucleotide polymorphism and plasmid finger printing in clinical microbiology	20%	6
<b>Unit 4: Laboratory tests:</b> Laboratory tests in chemotherapy: Susceptibility tests: Micro-dilution and macro-dilution broth procedures.	20%	6
<b>Unit 5: Susceptibility tests:</b> Diffusion test procedures. Susceptibility tests: Tests for bactericidal activity. Automated procedures for antimicrobial susceptibility tests.	20%	6

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:  <b>CO1</b> Apply the knowledge acquired in the field of Molecular Diagnostics to make decisions on clinical tests to be applied to particular diagnostic queries  <b>CO2</b> Incorporate both in silico and lab based techniques as part of a combined molecular diagnostics strategy  <b>CO3</b> Identify the role and importance of molecular diagnostics such as real-time PCR, epidemiological genotyping, microfluidics, bio-imaging and sequencing technologies  <b>CO4</b> Explain how genetic principles apply to the transmission of disease  <b>CO5</b> Perform selected laboratory techniques, interpret results and prepare reports	Understand and Apply   Remember   Understand   Analyze   Evaluate and Create	Describe and Explain   Describe and Explain   Classify and Explain   Classify and Explain   Explain

Learning Resources	
1.	<p>Reference Books:</p> <p>I. Practical Biochemistry, Principles and Techniques, Keith Wilson and John Walker</p> <p>II. Bioinstrumentation, Webster</p> <p>III. Advanced Instrumentation, Data Interpretation, and Control of Biotechnological Processes, J.F. Van Impe, Kluwer Academic</p> <p>IV. . Ananthanarayan R and Paniker CKJ. (2005). Textbook of Microbiology. 7th edition (edited by Paniker CKJ). University Press Publication.</p> <p>V. Brooks GF, Carroll KC, Butel JS and Morse SA. (2007). Jawetz, Melnick and Adelberg's Medical Microbiology. 24th edition. McGraw Hill Publication.</p> <p>VI. Goering R, Dockrell H, Zuckerman M and Wakelin D. (2007). Mims' Medical Microbiology. 4th edition. Elsevier.</p>
2.	<p>Journals &amp; Periodicals:</p> <p>1. Journal of Molecular Diagnostics, Nature reviews</p> <p>2. Current science</p>
3.	<p>Other Electronic Resources:</p> <p>2. NPTEL and UGC pathsala, Edx courses.</p>

Evaluation Scheme	Total Marks	
<b>Theory: Mid semester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Research Paper Review	10 marks
	<b>Total</b>	<b>40 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	2	1	0
CO2	1	1	1	1	0	0
CO3	2	2	2	2	1	1
CO4	2	2	2	2	0	1
CO5	1	1	1	1	1	2

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	2	2	2
CO2	1	1	1	1	1	1

CO3	1	1	1	1	1	1
CO4	1	1	1	1	1	1
CO5	0	1	0	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO301</b>	<b>COURSE NAME</b> <b>GENETICS</b>	<b>SEMESTER</b> <b>III</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
60	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Understanding of basic sciences up to school level (10+2 level).
<b>Course Category</b>	Mandatory courses
<b>Course focus</b>	Employability
<b>Rationale</b>	It provides students with a strong foundation in the principles and applications of genetics. It equips them with the necessary knowledge and skills to contribute to various fields of biotechnology, including biomedical research, agriculture, environmental sciences, and genetic engineering.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> <b>(As per Blooms' Taxonomy)</b>	<b>Course Objectives:</b> <ol style="list-style-type: none"> <li>1. To gain knowledge on the fundamental molecular principles of genetics</li> <li>2. To understand the basics of genetic mapping</li> <li>3. To understand the genetic basis of cancer</li> <li>4. To understand the concepts of evolution and population genetic</li> <li>5. To gain knowledge on microbial genetics</li> </ol>

<b>Course Content (Theory)</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1: Introduction</b> Historical developments in the field of genetics. Organisms suitable for genetic experimentation and their genetic significance. Mendelian genetics: Mendel's experimental design, monohybrid, di-hybrid and tri hybrid crosses, Law of segregation & Principle of independent assortment. Verification of segregates by test and back crosses, Chromosomal theory of inheritance, Allelic interactions: Concept of dominance, recessiveness, incomplete dominance, codominance, semi-dominance, pleiotropy, multiple allele, pseudoallele, essential and lethal genes, penetrance and expressivity. Introduction to operon: Structure, Definition, Types and function.	<b>20%</b>	<b>12</b>

<b>Unit 2: Non allelic interactions, Sex determination and sex linkage:</b> Non allelic interactions: Interaction producing new phenotype complementary genes, epistasis (dominant & recessive), duplicate genes and inhibitory genes. Extra chromosomal inheritance: Rules of extranuclear inheritance, maternal effects, maternal inheritance, cytoplasmic inheritance, organelle heredity, genomic imprinting. Sex determination and sex linkage: Mechanisms of sex determination, Environmental factors and sex determination, sex differentiation, Barr bodies, dosage compensation, genetic balance theory, Fragile-X syndrome and chromosome, sex influenced dominance, sex limited gene expression, sex linked inheritance.	<b>20%</b>	<b>12</b>
<b>Unit 3: Genetic linkage, crossing over and chromosome mapping:</b> Linkage and Recombination of genes in a chromosome crossing over, Cytological basis of crossing over, Molecular mechanism of crossing over, Crossing over at four strand stage, Multiple crossing overs Genetic mapping. Microbial Genetics: Discovery & Mechanism of Transformation, Transduction and Conjugation Phage Genetics: Features of T4 genetics, Genetic basis of lytic versus lysogenic switch of phage lambda.	<b>20%</b>	<b>12</b>
<b>Unit 4: Chromosome and gene mutations:</b> Definition and types of mutations, causes of mutations, Physical and chemical mutagens; Molecular basis of mutations, Ames test for mutagenic agents, screening procedures for isolation of mutants and uses of mutants, variations in chromosomes structure - deletion, duplication, inversion and translocation (reciprocal and Robertsonian), position effects of gene expression, chromosomal aberrations in human beings, abnormalities – Aneuploidy and Euploidy.	<b>20%</b>	<b>12</b>
<b>Unit 5: Evolution and population genetics:</b> Inbreeding and outbreeding, Hardy Weinberg law (prediction, derivation), allelic and genotype frequencies, changes in allelic frequencies, systems of mating, evolutionary genetics, natural selection.	<b>20%</b>	<b>12</b>

<b>List Of Practical</b>	<b>Weightage</b>	<b>Contact hours</b>
1: Problems based on Mendelian Genetics	<b>10%</b>	<b>2</b>
2: Mendelian deviations in dihybrid crosses.	<b>10%</b>	<b>4</b>
3. Demonstration of - Barr Body	<b>12%</b>	<b>4</b>
4. Perform Karyotyping using Onion root tip	<b>12%</b>	<b>4</b>
5. Pedigree charts of some common characters like blood group, colour blindness and PTC tasting.	<b>10%</b>	<b>4</b>
6. Demonstration of Bacterial Conjugation	<b>12%</b>	<b>4</b>
7. Study the effect of chemical and physical (UV) mutagens on bacterial cells	<b>12%</b>	<b>4</b>
8. Study of polyploidy in onion root tip by colchicine treatment	<b>12%</b>	<b>4</b>
9. Visit to Nature History Museum and submit a report	<b>10%</b>	<b>4</b>

#### **Instructional Method and Pedagogy:**

**Audio-Visual Lectures, Quizzes, PPT, Demonstration, Video, Case studies**

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
<b>CO1</b> Describe the fundamental molecular principles of genetics	Remember	Describe
<b>CO2</b> Understand the relationship between phenotype and genotype in human genetic traits.	Understand and apply	Classify and Explain
<b>CO3</b> Describe the basics of genetic mapping	Analyse	Explain and examine
<b>CO4</b> Understand the genetic basis of cancer	Understand and evaluate	Define and explain
<b>CO5</b> Understand how evolution and population genetics go hand in hand	Understand and create	Explain and examine

Learning Resources						
1 .	Reference Books: 1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. VIII Edition John Wiley & Sons. 2. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings. 3. Russell, P. J. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings. 4. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. IX Edition. Introduction to Genetic Analysis, W. H. Freeman & Co					
2 .	Journals & Periodicals: 1. Genetics 2. Nature Genetics					
3 .	Other Electronic Resources: <a href="https://ghr.nlm.nih.gov/resources#inheritance">https://ghr.nlm.nih.gov/resources#inheritance</a>					
Evaluation Scheme		Total Marks				
Theory: Midsemester Marks		20 marks				
Theory: End Semester Marks		40 marks				
Theory: Continuous Evaluation Component Marks		<table><tr><td>Attendance</td><td>05 marks</td></tr><tr><td>MCQs</td><td>10 marks</td></tr></table>	Attendance	05 marks	MCQs	10 marks
Attendance	05 marks					
MCQs	10 marks					

		Open Book Assignment	15 marks
		Research Paper Review	10 marks
		<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>		Attendance	05 marks
		Practical Exam	30 marks
		Viva	10 marks
		Journal	05 marks
		<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	2	2	2	2
CO2	1	1	1	1	1	1
CO3	2	2	2	2	2	2
CO4	2	2	2	2	2	2
CO5	1	1	1	1	1	1

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	1	1	0
CO2	1	2	2	2	2	1
CO3	1	1	1	1	1	0
CO4	1	0	1	1	1	1
CO5	1	2	2	2	2	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None



<b>COURSE CODE</b> <b>BSBO302</b>	<b>COURSE NAME</b> <b>GENERAL</b> <b>MICROBIOLOGY</b>	<b>SEMESTER</b> <b>III</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Understanding of basic sciences up to school level (10+2 level).
<b>Course Category</b>	Mandatory courses
<b>Course focus</b>	Employability
<b>Rationale</b>	It provides a foundational understanding of microorganisms, their roles in health, disease, and the environment. It equips students with practical laboratory skills, critical thinking abilities, and a basis for advanced study in microbiology and related fields, preparing them for careers in healthcare, research, industry, and environmental sciences. It helps students understand local microbial communities, infectious diseases prevalent in their region, and strategies for their control. Nationally, it contributes to public health initiatives, disease surveillance, and food safety regulations. Internationally, it enables students to comprehend global health challenges, emerging infectious diseases, and pandemics.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> <b>(As per Blooms' Taxonomy)</b>	Course Objectives: 1: Identify categories of microorganisms and analyze their classification and their diversity. 2: Know how to cultivate and control microbial growth 3: Growth characteristics of microorganisms 4: To know important microorganisms in food and methods of food preservation 5: To know microbial pollutants of water

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Introduction and History</b> Fundamentals, History and Evolution of Microbiology. Classification of microorganisms: Microbial taxonomy, criteria used to include molecular approaches, Microbial phylogeny and current classification of bacteria. Microbial Diversity: Distribution and characterization Prokaryotic and Eukaryotic cells.	<b>20%</b>	<b>12</b>

<b>Unit 2: Morphology and cell structure</b> Morphology and cell structure of major groups of microorganisms eg. Bacteria, Algae, Fungi, Protozoa and Unique features of viruses. Cultivation and Maintenance of microorganisms: Nutritional categories of micro-organisms	<b>20%</b>	<b>12</b>
<b>Unit 3: Methods of isolation and growth</b> Methods of isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria Microbial growth: Growth curve, Generation time, synchronous batch and continuous culture, measurement of growth and factors affecting growth of bacteria	<b>20%</b>	<b>12</b>
<b>Unit 4: : Microbial Metabolism</b> Metabolic pathways, amphi-catabolic and biosynthetic pathways Bacterial Reproduction, Endospores and sporulation in bacteria. Control of Microorganisms: By physical, chemical and chemotherapeutic Agents.	<b>20%</b>	<b>12</b>
<b>Unit 5: Food and Water microbiology</b> Important microorganism in food Microbiology: Moulds, Yeasts, bacteria. Major food born infections and intoxications, Preservation of various types of foods. Fermented Foods. Bacterial pollutants of water, coliforms and non coliforms. Sewage composition and its disposal.	<b>20%</b>	<b>12</b>

<b>List Of Practical</b>	<b>Weightage</b>	<b>Contact hours</b>
1: Study of air microflora	<b>10%</b>	<b>4</b>
2: Preparation of Winogradsky's column and study of different groups of Microorganisms	<b>10%</b>	<b>4</b>
3. Study of Fungal structures by wet mount	<b>10%</b>	<b>4</b>
4. Study of the following protozoans and algae using permanent slides: Amoeba, Entamoeba, Paramecium, Plasmodium, Volvox,	<b>10%</b>	<b>4</b>
5. Preparation of media & sterilization methods	<b>10%</b>	<b>4</b>
6. Staining methods: simple staining, Gram staining, spore staining, negative staining, hanging drop	<b>10%</b>	<b>4</b>
7. Pure culture study of bacteria & their biochemical characterization (E. coli, S. aureus, Bacillus, Streptococci)	<b>10%</b>	<b>4</b>
8. Methods of Isolation of bacteria from different sources (streaking, spreading, pouring) & Cultivation of anaerobic bacteria	<b>10%</b>	<b>4</b>
9. Determination of bacterial cell size by micrometry	<b>10%</b>	<b>4</b>
10. Study of Growth curve of E. coli	<b>10%</b>	<b>4</b>
11. Enumeration of microorganism - total & viable count	<b>10%</b>	<b>4</b>
12. Study microorganism responsible for food spoilage	<b>10%</b>	<b>4</b>

**Instructional Method and Pedagogy:** (Max. 100 words)

**PPT, Demonstration, Video, Case study**

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: <b>CO1</b> Identify categories of microorganisms and analyze their classification and diversity	Understand and Remember	Describe
<b>CO2</b> Know how to cultivate microorganisms	Create	Explain and examine
<b>CO3</b> Identify and demonstrate how to control microbial growth	Understand and Evaluate	Explain and examine
<b>CO4</b> Know how microorganisms carry out their metabolism	Apply	Define and explain
<b>CO5</b> Demonstrate role of microbes in food and as pollutants in water	Analyse	Classify and Explain

Learning Resources	
1	Reference Books: 1. Pelczar MJ, Chan ECS and Krieg NR. (1993). Microbiology. 5th edition. McGraw Hill Book Company. 2. D.K Maheshwari (1999) A textbook of Microbiology 3. Alexopoulos CJ, Mims CW, and Blackwell M. (1996). Introductory Mycology. 4th edition. John and Sons, Inc. 4. Jay JM, Loessner MJ and Golden DA. (2005). Modern Food Microbiology. 7th edition, CBS Publishers and Distributors, Delhi, India. 5. Kumar HD. (1990). Introductory Phycology. 2nd edition. Affiliated East Western Press. 6. Madigan MT, Martinko JM and Parker J. (2009). Brock Biology of Microorganisms. 12th edition. Pearson/Benjamin Cummings. 7. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An Introduction. 9th edition. Pearson Education. 8. Willey JM, Sherwood LM, and Woolverton CJ. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
2	Journals & Periodicals: 1. Current Opinion in Microbiology 2. Current Science 3. Microbiology Today 4. Science Daily
3	Other Electronic Resources: 3. MH Education 4. NPTEL

Evaluation Scheme	Total Marks
Theory: Midsemester Marks	20 marks
Theory: End Semester Marks	40 marks

<b>Theory: Continuous Evaluation Component</b>		Attendance	05 marks	
<b>Marks</b>		MCQs	10 marks	
		Open Book Assignment	15 marks	
		Research Paper Review	10 marks	
		<b>Total</b>	<b>40 Marks</b>	
<b>Practical Marks</b>				
		Attendance	05 marks	
		Practical Exam	30 marks	
		Viva	10 marks	
		Journal	05 marks	
		<b>Total</b>	<b>50 Marks</b>	

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	1	1	1	2
CO2	3	2	1	2	2	3
CO3	2	2	1	2	2	2
CO4	1	1	1	1	1	1
CO5	2	2	3	1	1	2

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	2	2	2
CO2	2	2	3	2	2	1
CO3	2	2	2	1	2	0
CO4	1	1	0	2	2	1
CO5	1	2	1	2	2	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO303</b>	<b>COURSE NAME</b> <b>BASICS OF</b> <b>DEVELOPMENTAL</b> <b>BIOLOGY</b>	<b>SEMESTER</b> <b>III</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	0	90	4	2	0	6

<b>Course Pre-requisites</b>	Understanding of basic sciences up to school level (10+2 level).
<b>Course Category</b>	Mandatory courses
<b>Course focus</b>	Employability
<b>Rationale</b>	It helps in understanding organismal development, manipulating cell fate, utilizing stem cells, exploring genetic and epigenetic regulation, comprehending evolutionary processes, facilitating interdisciplinary approaches, and aligning with international standards in the field. It holds national importance by contributing to agricultural advancements, human health and medicine, conservation efforts, biotechnological innovations, workforce development, international competitiveness, and informed policy and regulation. Internationally, it facilitates global research collaboration, drives biomedical advances, contributes to species conservation and sustainable agriculture, fosters comparative developmental biology studies, influences ethical and policy considerations, and promotes academic and professional mobility.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> <b>(As per Blooms' Taxonomy)</b>	Course Objectives: Students will be able to:  1: To differentiate the process of spermatogenesis and oogenesis. 2: To elucidate the mechanism of fertilization 3: To describe the events that occur from the formation of a zygote to gastrulation 4: To attain a basic conceptual knowledge of the principal cellular mechanisms of development 5: To understand organogenesis and histogenesis, as well as pathology related to mechanisms of development and differentiation.

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Gametogenesis:</b> Definition, scope & historical perspective of development biology. Gametogenesis – Spermatogenesis, Oogenesis.	5%	5
<b>Unit 2: Fertilization:</b> Definition, mechanism, types of fertilization. Different types of eggs on the basis of yolk.	5%	5
<b>Unit 3: Early embryonic development Cleavage :</b> Definition, types, patterns & mechanism Blastulation: Process, types & mechanism Gastrulation: Morphogenetic movements–epiboly, emboly, extension, invagination, convergence, de-lamination. Formation & differentiation of primary germ layers, Fate Maps in early embryos.	30%	20
<b>Unit 4: Embryonic Differentiation:</b> Cell commitment and determination- the epigenetic landscape: a model of determination and differentiation, control of differentiation at the level of genome, transcription and post-translation level Concept of embryonic induction: Primary, secondary & tertiary embryonic induction, Neural induction and induction of vertebrate lens.	30%	20
<b>Unit 5: Organogenesis:</b> Neurulation, notogenesis, development of vertebrate eye. Fate of different primary germ layers Development of behaviour: constancy & plasticity, Extra embryonic membranes, placenta in Mammals.	10%	10

List Of Practical	Weightage	Contact hours
1. Identification of developmental stages of chick and frog embryo using permanent mounts	15	2
2. Preparation of a temporary stained mount of chick embryo	15	2
3. Study of developmental stages of Anopheles	20	4
4. Study of the developmental stages of Drosophila from stock culture/ photographs	20	4
5. Life cycle of earth worm	15	4
6. Life cycle of frog	15	4

### Instructional Method and Pedagogy:

Audiovisuals, Seminars, Quiz, PPT, Demonstration, Case studies

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
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After successful completion of the above course, students will be able to:		
<b>CO1</b> Describe the process of spermatogenesis, oogenesis.	Understand and Remember	Describe
<b>CO2</b> Describe the process of fertilization	Understand and Remember	Describe
<b>CO3</b> Name, describe and order the main stages of development common to most multicellular organisms.	Evaluate and analyse	Describe and Classify
<b>CO4</b> Describe the main anatomical changes that occur during development.	Apply	Describe and explain
<b>CO5</b> Identify the cellular behaviours that lead to morphological change during development	Understand and Create	Classify and Explain

Learning Resources	
1.	<p>Reference Books:</p> <ol style="list-style-type: none"> <li>1. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.</li> <li>2. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.</li> <li>3. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill</li> <li>4. Tortora GJ, Derrickson B (2014) Principles of Anatomy and Physiology, Wiley</li> <li>5. T. Subramoniam (2002) Developmental Biology, Alpha Science international</li> <li>6. Richard M. Twyman (2001) Instant Notes Developmental Biology, Oxford; New York: BIOS Scientific</li> <li>7. Jonathan M. W. Slack (2012) Essential Developmental Biology, 3rd Edition, Wiley-Blackwell</li> </ol>
2.	<p>Journals &amp; Periodicals:</p> <ol style="list-style-type: none"> <li>1. Development</li> <li>2. Developmental Biology</li> <li>3. Differentiation</li> <li>4. Developmental Cell</li> <li>5. Journal of Developmental Biology</li> <li>6. Frontiers in Cell and Developmental Biology</li> <li>7. BMC Developmental Biology</li> <li>8. EvoDevo</li> <li>9. Annual Review of Cell and Developmental Biology</li> <li>10. Seminars in Cell and Developmental Biology</li> <li>11. In Vitro Cellular &amp; Developmental Biology - Animal</li> <li>12. Current Opinion in Genetics &amp; Development</li> <li>13. Mechanisms of Development</li> </ol>

3.	<p>Other Electronic Resources:</p> <ol style="list-style-type: none"> <li>1. Nature Education Knowledge Project</li> <li>2. Developmental Biology Courses and Learning Resources</li> <li>3. Developmental Biology Interactive</li> <li>4. Collaborative Resources for Learning Developmental Biology Login to CoRe All</li> </ol>
	Videos Images Submit Advanced Search.

Evaluation Scheme	Total Marks										
<b>Theory: Midsemester Marks</b>	20 marks										
<b>Theory: End Semester Marks</b>	40 marks										
<b>Theory: Continuous Evaluation Component Marks</b>	<table> <tr> <td>Attendance</td><td>05 marks</td></tr> <tr> <td>MCQs</td><td>10 marks</td></tr> <tr> <td>Open Book Assignment</td><td>15 marks</td></tr> <tr> <td>Research Paper Review</td><td>10 marks</td></tr> <tr> <td><b>Total</b></td><td><b>40 Marks</b></td></tr> </table>	Attendance	05 marks	MCQs	10 marks	Open Book Assignment	15 marks	Research Paper Review	10 marks	<b>Total</b>	<b>40 Marks</b>
Attendance	05 marks										
MCQs	10 marks										
Open Book Assignment	15 marks										
Research Paper Review	10 marks										
<b>Total</b>	<b>40 Marks</b>										
<b>Practical Marks</b>	<table> <tr> <td>Attendance</td><td>05 marks</td></tr> <tr> <td>Practical Exam</td><td>30 marks</td></tr> <tr> <td>Viva</td><td>10 marks</td></tr> <tr> <td>Journal</td><td>05 marks</td></tr> <tr> <td><b>Total</b></td><td><b>50 Marks</b></td></tr> </table>	Attendance	05 marks	Practical Exam	30 marks	Viva	10 marks	Journal	05 marks	<b>Total</b>	<b>50 Marks</b>
Attendance	05 marks										
Practical Exam	30 marks										
Viva	10 marks										
Journal	05 marks										
<b>Total</b>	<b>50 Marks</b>										

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	1	3	1	1
CO2	0	1	2	2	1	1
CO3	1	1	2	2	1	2
CO4	2	1	2	2	1	2
CO5	1	1	2	2	1	2

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	0	2	2	0
CO2	1	0	0	2	2	0
CO3	1	1	1	2	1	1
CO4	1	0	2	2	1	1
CO5	0	0	1	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None



<b>COURSE CODE</b> <b>BSPY307</b>	<b>COURSE NAME</b> <b>PHYSICS-III</b>	<b>SEMESTER</b> <b>III</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	30	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Understanding of basic physics up to school level (10+2 level).
<b>Course Category</b>	Generic Elective
<b>Course focus</b>	Employability
<b>Rationale</b>	To gain basic knowledge of physics.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> <b>(As per Blooms' Taxonomy)</b>	To enable the student to: 1: <b>Understand</b> the physical significance of mathematical operations. 2: <b>Employ</b> the knowledge of electrostatics in daily life applications. 3: <b>Understand</b> the basics of magnetostatics and its applications. 4: <b>Remember</b> the laws of thermodynamics and their <b>applications</b> . 5: <b>Explain</b> the thermodynamic potentials and transport properties.

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Vector Analysis</b> Scalar and Vector product, gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors	<b>12%</b>	<b>6</b>
<b>Unit 2: Electrostatics</b> Electrostatic Field, Electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem - Electric field due to a point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor. Electric potential as a line integral of electric field, electric potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere. Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel-plate, spherical and cylindrical condenser. Energy per unit volume in the electrostatic field. Dielectric medium, Polarization, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric	<b>23%</b>	<b>14</b>
<b>Unit 3: Magnetostatics</b> Biot-Savart's law and its applications - straight conductor, circular coil,	<b>23%</b>	<b>14</b>

<p>solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law. Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para- and ferromagnetic materials.</p> <p>Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils.</p> <p>Energy stored in the magnetic field.</p>		
<p><b>Unit 4: : Laws of Thermodynamics</b></p> <p>Thermodynamic Description of system: Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamic Processes, Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle &amp; theorem, Entropy changes in reversible &amp; irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics,</p> <p>Unattainability of absolute zero</p>	22%	14
<p><b>Unit 5: Thermodynamic Potentials</b></p> <p>Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thomson Effect, Clausius-Clapeyron Equation, Expressions for (CP – CV), CP/CV, TdS equations. Kinetic Theory of Gases: Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (without derivation of expressions) and its applications to specific heat of gases; mono-atomic and diatomic gases.</p>	20%	12

List Of Practical	Weightage	Contact hours
1: <b>Study</b> of working and characteristics of a Van de Graff generator	8	3
2: <b>Determination</b> of the magnetic moment of a given magnet using magnetometer at Gauss A and Gauss B position using Deflection magnetometer.	14	4
3: <b>Determination</b> of the ratio of magnetic moment of the given bar magnets using Vibration magnetometer.	14	4
4: To <b>study</b> the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph and <b>calculate</b> the radius of the coil using given laboratory setup.	14	4
5: To <b>verify</b> Stefan-Boltzmann law of thermal radiation by electrical method.	8	3
6: To <b>verify</b> the relation between the thermal emfs of a thermocouple and temperature difference between two hot junctions and verify Seebeck Effect.	14	4
7: <b>Determine</b> the molar heat capacities of air at constant volume Cv and at constant pressure Cp.	14	4
8: To <b>determine</b> the Coefficient of Thermal Conductivity of Copper by Searle's Method.	14	4

**Instructional Method and Pedagogy:** (Max. 100 words)  
**PPT, Demonstration, Video, Case study**

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: <b>CO1 Describe</b> the physical significance of mathematical operations.	Understanding	Describe
<b>CO2 Employ</b> the knowledge of electrostatics in daily life applications.	Understand and Apply	Explain and examine
<b>CO3 Explain</b> the use of magnetostatics in various applications	Understand and Apply	Explain and examine
<b>CO4 Interpret</b> the laws of thermodynamics and <b>understand</b> its applications	Remember and Understand	Define and explain
<b>CO5 Explain</b> the thermodynamic potentials and transport properties	Understanding	Classify and Explain

Learning Resources	
1.	Reference Books: 1. C. Chattopadhyay, R. Rakshit, <b>Electricity and Magnetism</b> (with Electro-Magnetic Theory and Special Theory of Relativity), Current Distributors, 1989. 2. Brij Nandan Lal, N. Subrahmanyam, Heat Thermodynamics and Statistical Physics, S. Chand Limited, 2008.
2.	Journals & Periodicals: Journal of Undergraduate Reports in Physics (JURP), Society of Physics Students.
3.	Other Electronic Resources: <b>Feynman Lectures in Physics:</b> <a href="https://www.feynmanlectures.caltech.edu/">https://www.feynmanlectures.caltech.edu/</a>

Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component</b>	Attendance	05 marks

<b>Marks</b>		MCQs	10 marks	
		Open Book Assignment	15 marks	
		Research Paper Review	10 marks	
		<b>Total</b>	<b>40 Marks</b>	
<b>Practical Marks</b>		Attendance	05 marks	
		Practical Exam	20 marks	
		Viva	10 marks	
		Journal	10 marks	
		Discipline	05 marks	
		<b>Total</b>	<b>50 Marks</b>	

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	0	0	0	1
CO2	1	1	0	0	0	1
CO3	1	1	0	0	0	1
CO4	1	2	0	0	0	1
CO5	1	2	0	0	0	1

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	0	0	0
CO2	1	1	1	0	0	0
CO3	1	1	2	0	0	0
CO4	1	2	2	0	0	1
CO5	1	2	2	0	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BSMA307	COURSE NAME MATHEMATICS-III	SEMESTER III
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
75	0	15	90	5	0	1	6

<b>Course Pre-requisites</b>	Basic knowledge of algebra and calculus. Basic knowledge of derivatives and integration.
<b>Course Category</b>	Discipline Specific elective course
<b>Course focus</b>	Skill development
<b>Rationale</b>	To gain basic knowledge of mathematics.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<p>1: <b>Solve:</b> Make the students familiarise with the ways of solving complicated mathematical problems numerically</p> <p>2: <b>Understand:</b> To help them become familiar with MATLAB and other convenient numerical software such as Microsoft Excel and with simple programming</p> <p>3: <b>Recognize, Find:</b> Obtain numerical solutions to non-algebraic equations and system of linear equations.</p> <p>4: <b>Understand:</b> Describe and understand of the several errors and approximation in numerical methods</p> <p>5: <b>Understand, Find:</b> Understanding of several available Solution techniques for differential Equations in One Variable. Study of Curve Fitting and Interpolation.</p>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1:</b> <b>Errors:</b> Notions of round off, truncation and other errors, Errors in numerical computations <b>Solution of Algebraic and Transcendental Equations:</b> Bisection, False position, Iterative Method, Newton Raphson Method, Secant Method. Solution using Matlab	20%	15
<b>Unit 2:</b> <b>Solution of system of Linear Equations:</b> Gauss Elimination method, Gauss Jordan Method, LU decomposition method, Gauss Jacobi Method, Gauss Seidel method. Solution using Matlab	20%	15

<b>Unit 3:</b> <b>Interpolation:</b> Newton's forward and backward interpolation, Newton's divided difference interpolating polynomials, Lagrange Interpolating polynomials. Solution using Matlab.	20%	15
<b>Unit 4:</b> <b>Numerical Differentiation:</b> First and second order differentiation Equations of Equally Spaced Data. Solution using Matlab. <b>Numerical Integration:</b> Trapezoidal rule, Simpson's one third and 3/8th rule. Solution using Matlab	20%	15
<b>Unit 5:</b> <b>Numerical methods for Solution of ordinary differential equation:</b> Taylor's series method, Euler's method, Modified Euler's method, Runge Kutta forth ordered method, Milne's Predictor Corrector Method. Finite element method to solve second order ODE. Solution using Matlab. <b>Curve Fittings:</b> General Linear Least Squares, Fitting of quadratic and exponential curves. Solution using Matlab.	20%	15

List Of Practical Tutorial	Weightage	Contact hours
<b>Unit 1:</b> Introduction to Matlab, Programming using Matlab, Programs for Bisection, Regula-falsi, Secant and Newton-Raphson Method	20%	3
<b>Unit 2:</b> Arrays and Matrices in Matlab, solving system of linear equations using Matlab	20%	3
<b>Unit 3:</b> Difference table, Newton's forward and Backward difference interpolation, Newton's divided difference table, program for Lagrange's interpolation Method	20%	3
<b>Unit 4:</b> Programs on Trapezoidal rule, Simpson's one third and 3/8th rule	20%	3
<b>Unit 5:</b> Programing for euler's Method and 2D and 3D plots	20%	3

**Instructional Method and Pedagogy: Chalk board**

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
<p>After successful completion of the above course, students will be able to:</p> <p><b>CO1</b> Apply, solve: Apply numerical methods to find out solution of non-algebraic equations using different methods under different conditions, and numerical solution of system of algebraic equations.</p> <p><b>CO2</b> Demonstrate, find: Apply various interpolation methods and finite difference concepts</p> <p><b>CO3</b> Demonstrate: Work out numerical differentiation and integration whenever and wherever routine methods are not applicable</p> <p><b>CO4</b> Solve: Work numerically on the ordinary differential equations using different methods through the theory of finite differences.</p> <p><b>CO5</b> Understand: Work numerically on the partial differential equations using different methods through the theory of finite differences.</p>	<p>Apply</p> <p>Demonstrate</p> <p>Solve</p> <p>Understand</p>	<p>Apply</p> <p>Demonstrate, Find, Classify</p> <p>Describe</p> <p>Solve</p> <p>Understand</p>

Learning Resources	
1.	<p>Reference Books:</p> <p><b>Style:</b> name of the authors, title, publisher, city of publication and year of publication. i.e. Taylor J. R., An Introduction to Error Analysis, Oxford University Press, Mill Valley, CA, USA, 1982</p>
2.	<p>Journals &amp; Periodicals:</p> <p><b>Style:</b> name of the journal, volume (issue number), range of pages, and year.</p>
3.	<p>Other Electronic Resources:</p> <p><b>Style:</b> Author or Organization, name of the site, complete address of the site, date visited i.e. Danish Wind Industry Association, Aerodynamics of Wind Turbines: Lift, <a href="http://www.windpower.org/tour/wtrb/lift.htm">http://www.windpower.org/tour/wtrb/lift.htm</a>, Aug 16, 2002</p>

Evaluation Scheme	Total Marks	
Theory: Midsemester Marks	20 marks	
Theory: End Semester Marks	40 marks	
Theory: Continuous Evaluation Component Marks	Attendance	05 marks
	MCQs	10 marks

		Open Book Assignment	15 marks
		Open Book Assignment	10 marks
		<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>		Attendance	05 marks
		Practical Exam	20 marks
		Viva	10 marks
		Journal	10 marks
		Discipline	05 marks
		<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	1	0	0	2
CO2	1	2	1	1	0	2
CO3	1	2	1	1	0	0
CO4	2	2	1	0	0	0
CO5	1	2	2	0	0	0

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	2	1	0	0
CO2	1	1	1	1	0	0
CO3	1	1	1	1	0	0
CO4	1	1	1	1	0	0
CO5	3	1	1	1	0	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None



<b>COURSE CODE</b> <b>BSCM307</b>	<b>COURSE NAME</b> <b>CHEMISTRY-I</b>	<b>SEMESTER</b> <b>III</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Basic knowledge of physical and organic chemistry.		
<b>Course Category</b>	Generic Elective		
<b>Course focus</b>	Employability		
<b>Rationale</b>	The concepts of physical chemistry help in understanding the Chemical Energetics Review of thermodynamics and the Laws of Thermodynamics and importance of Chemical Equilibrium. The fundamental concepts of organic chemistry help in understanding the chemistry of halogenated hydrocarbons, phenols, ethers, epoxides, reactions of Carbonyl Compounds.		
<b>Course Revision/ Approval Date :</b>	14/03/2020		
<b>Course Objectives</b> <b>(As per Blooms' Taxonomy)</b>	To enable the student to: 1. To impart the knowledge of thermodynamics . 2. Concept of chemical equilibrium and ionic equilibria. 3. To understand basic organic chemistry reactions. 4. Detailed explanation of preparation and reactions of alkyl and aryl halides. 5. Preparation of alcohols and phenols and the reactions involving them. 6. Knowledge of preparation of ethers and different types of reactions.		
Course Content (Theory)		Weightage	Contact hours
<b>Unit 1:</b> Chemical Energetics Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature of Third Law of thermodynamics and calculation of absolute entropies of substances.		<b>20%</b>	<b>12</b>

<p><b>Unit 2:</b> Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction Relationships between <math>K_p</math>, <math>K_c</math> and <math>K_x</math> for reactions involving ideal gases Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis- calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts applications of solubility</p>	<p><b>20%</b></p>	<p><b>12</b></p>
<p><b>Unit 3:</b> Functional group approach for the following reactions (preparations &amp; reactions) to be studied in context to their structure. Aromatic hydrocarbons Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel- (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene) Alkyl Halides (Up to 5 Carbons) Types of Nucleophilic Substitution (<math>SN_1</math>, <math>SN_2</math> and <math>SN_i</math>) reactions. Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite &amp; nitro formation, nitrile &amp; isonitrile formation. substitution. Aryl Halides Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer &amp; Gattermann reactions. Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by OH group) and effect of nitro substituent. Benzyne Mechanism: <math>KNH_2/NH_3</math> (or <math>NaNH_2/NH_3</math>). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides</p>	<p><b>20%</b></p>	<p><b>12</b></p>
<p><b>Unit 4:</b> Alcohols and Phenols (Up to 5 Carbons) Alcohols: Preparation: hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. <math>KMnO_4</math>, acidic dichromate, conc. <math>HNO_3</math>). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement. Phenols: (Phenol case) Preparation: Cumene hydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben Hoesch Condensation, Schotten Baumann Reaction.</p>	<p><b>20%</b></p>	<p><b>12</b></p>
<p><b>Unit 5:</b> Ethers (aliphatic and aromatic): Cleavage of ethers with HI. Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde) Preparation: from acid chlorides and from nitriles. Reactions Reaction with HCN, ROH, <math>NaHSO_3</math>, <math>NH_2</math>-G derivatives. Iodoform test. Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction.</p>	<p><b>20%</b></p>	<p><b>12</b></p>

**Instructional Method and Pedagogy:**

PPT, Demonstration, Video, Case study

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: <b>CO1:</b> Interpret the Laws of thermodynamics.  <b>CO2:</b> Explain the free energy changes during chemical equilibria. <b>CO3:</b> Recognise the fundamentals of Organic chemistry, electrophilic and nucleophilic reactions. <b>CO4:</b> Explain the properties, preparation and reactions of alcohols and phenols <b>CO5:</b> Explain the different types of reactions of aldehydes and ketones.	Understanding  Understand and Apply Understand and Apply Remember and Understand Understanding	Describe  Explain and examine Explain and examine Define and explain Classify and Explain

Learning Resources	
1.	Textbook/ Reference books: 1. T. W. Graham Solomons: Organic Chemistry, John Wiley and Sons. 2. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman. . H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985). 3. I.L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S. 4. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall. 5. Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand. 6. G. M. Barrow: Physical Chemistry Tata McGraw-Hill (2007). 7. G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004). 8. J. C. Kotz, P. M. Treichel & J. R. Townsend: General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009). 9. B. H. Mahan: University Chemistry 3rd Ed. Narosa (1998).
2.	Journals & Periodicals: Journal: Journal of Chemical Sciences Periodicals: Chemistry Today
3.	Other Electronic Resources: Other Electronic resources: NPTEL, SWAYAM, MERLOT (Links available in GSFC University Link).

Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks

		Research Paper Review	10 marks	
		<b>Total</b>	<b>40 Marks</b>	
<b>Practical Marks</b>				
		Attendance	05 marks	
		Practical Exam	20 marks	
		Viva	10 marks	
		Journal	10 marks	
		Discipline	05 marks	
		<b>Total</b>	<b>50 Marks</b>	

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	1	0	0	2
CO2	1	2	1	1	0	2
CO3	1	2	1	1	0	0
CO4	2	2	1	0	0	0
CO5	1	2	2	0	0	0

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	2	1	0	0
CO2	1	1	1	1	0	0
CO3	1	1	1	1	0	0
CO4	1	1	1	1	0	0
CO5	3	1	1	1	0	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Semester – IV							
Sr. No.	Course Code	Course Title	L	T	P	C	Marks
<b>A. Ability Enhancement Compulsory Course</b>							
1	AECC401	Environmental Science	2	0	0	2	100
<b>B. Skill Enhancement Courses</b>							
<b>a) Skill Enhancement compulsory course</b>							
2	SECC304	Internship	0	0	2	2	50
<b>b) Skill Enhancement Electives (Any One)</b>							
3	BSBO405	Biostatistics	2	0	0	2	50
4	BSBO406	Industrial Fermentations	2	0	0	2	50
5	BSBO407	Nanomaterials	2	0	0	2	50
<b>C. Core Course</b>							
6	BSBO401	Mammalian & Plant Physiology	4	0	2	6	150
7	BSBO402	Recombinant DNA Technology	4	0	2	6	150
8	BSBO403	Enzymology	4	0	2	6	150
<b>D. Elective Course</b>							
<b>a) Discipline Specific Generic Electives (Any One)</b>							
9	BSPY407	Physics - IV	4	0	2	6	150
10	BSMA407	Mathematics - IV	4	0	2	6	150
11	BSCM 407	Chemistry – II	4	0	2	6	150
Total						30	800

## Teaching Scheme

### Semester – IV

Sr. No.	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
A. Ability Enhancement Compulsory Course																
1	AECC401	Environmental Science	2	0	0	2	2	0	0	2	20	40	40	100	0	100
B. Skill Enhancement Courses																
a) Skill Enhancement compulsory course																
2	SECC304	Internship	0	2	0	2	0	2	0	2	0	0	0	0	50	50
b) Skill Enhancement Electives (Any One)																
3	BSBO405	Biostatistics	2	0	0	2	2	0	0	2	20	40	40	50	0	50
4	BSBO406	Industrial Fermentations														
5	BSBO407	Nanomaterials														
C. Core Course																
6	BSBO401	Mammalian & Plant Physiology	4	4	0	6	4	2	0	6	20	40	40	100	50	150
7	BSBO402	Recombinant DNA Technology	4	4	0	6	4	2	0	6	20	40	40	100	50	150
8	BSBO403	Enzymology	4	4	0	6	4	2	0	6	20	40	40	100	50	150

D. Elective Course																
a) Discipline Specific Generic Electives (Any One)																
9	BSBO407	Physics - IV	4	4	0	6	4	2	0	6	20	40	40	100	50	150
10	BSMA407	Mathematics - IV	5	0	1	6	5	0	1	6						
11	BSCM407	Chemistry – II	4	4	0	6	4	2	0	6						
		Total					20	10	1	30			200	550	250	800

**Note:** L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

COURSE CODE AECC401	COURSE NAME ENVIRONMENTAL SCIENCE	SEMESTER IV
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	0	30	2	0	0	2

<b>Course Pre-requisites</b>	10 +2 (With Arts/Science/Commerce)
<b>Course Category</b>	Ability Enhancement Compulsory Course.
<b>Course focus</b>	Employability
<b>Rationale</b>	Discuss subject importance (Max 100 words) The fundamental concepts of environmental studies help in understanding the ecosystem and biogeochemical cycle that connects humans with their biosphere. Moreover, understanding pollution & treatment to treat a variety of pollution will enhance problem-solving skills of the students.
<b>Course Revision/ Approval Date:</b>	14/03/2020
<b>Course Objectives (As per Blooms' Taxonomy)</b>	To enable the student to: <ol style="list-style-type: none"> <li><b>Remember:</b> To acquire an awareness of and sensitivity to the total environment and its allied problems.</li> <li><b>Understand:</b> To make educated judgments about environmental issues.</li> <li><b>Apply:</b> Develop skills and a commitment to act independently and collectively to environmental sustainability</li> <li><b>Analyse:</b> Students can able to debate environmental science with use of appropriate scientific information</li> <li><b>Create:</b> Engaging with students of all disciplines to think critically, ethically, and creatively when evaluating environmental issues.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1:</b> Introduction of Ecology Ecology-Objectives and Classification Concepts of an ecosystem-structure & function of ecosystem components of ecosystem, Hydrological cycle, carbon cycle, oxygen cycle, Nitrogen cycle, Sulphur cycle	20%	6
<b>Unit 2:</b> Unit 2: Ecological pyramids of various ecosystems Forest Ecosystem, Grassland Ecosystem, Desert Ecosystem, Aquatic ecosystem, Estuarine Ecosystem.	20%	6
<b>Unit 3:</b> Air pollution and its control Introduction, Classification of air pollutants, air pollutants and their effects, acid rain, photochemical smog, particulates. Characteristics and biochemical effects of some important air pollutants, Effect of air pollutants on man and environment, Air quality standard, air monitoring and control of air pollution	20%	6





<b>Unit 4:</b> Water pollution and its control Introduction, Classification of water pollutants, physical, chemical and biological characteristics of waste water, waste water treatment: Primary treatment- Sedimentation, coagulation, equalization, neutralization, secondary treatment-aerobic treatment-aerated lagoons, trickling filter, activated sludge process, oxidation ditch process, oxidation pond, anaerobic treatment-anaerobic sludge digestion, sludge treatment and disposal and tertiary treatment-evaporation, ion exchange, adsorption, chemical precipitation, Electrodialysis, reverse osmosis.	20%	6
<b>Unit 5:</b> Solid and hazardous waste: pollution, treatment and disposal Introduction, Classification and origin, characteristics of solid wastes, objectives and considerations in solid waste management, methods of solid waste treatment and disposal - composting, land filling, thermal processes- incineration, pyrolysis, recycling and reuse of solid waste-co-disposal, bioconversion.	20%	6

#### Instructional Method and Pedagogy:

Utilizing models, PowerPoint Presentations, group discussions, and seminars are some of the methods adopted to improve the student's ability to grasp the principles of environmental studies.

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Subdomain
After successful completion of the above course, students will be able to:		
<b>CO1:</b> Skills for identifying environmental problems: Evaluate information from popular electronic and print media	Understand & remember	Define, Classify & Describe
<b>CO2:</b> Interdisciplinary - When encountering environmental problems students will assess necessary scientific concepts and data, consider likely social dynamics, and establish integral cultural contexts	Understand, Remember & Analyse	Define, Classify, Describe, Demonstrate & Examine
<b>CO3:</b> Communication - Students will communicate with precision, effective art, and sound rhetoric in writing, in speech, and in digital media	Understand, Remember & Apply	Define, Classify, Describe & Demonstrate
<b>CO4:</b> Research - When faced with questions that lie	Understand,	Define, Classify,

beyond their current knowledge base, students will actively research data, concepts, histories, and narratives necessary for adequate consideration of the issue.	Remember, Apply & Analyse	Describe, Demonstrate & Examine
<b>CO5:</b> Intellectual Flexibility - Students will possess the intellectual flexibility necessary to view environmental questions from multiple perspectives, prepared to alter their understanding as they learn new ways of understanding.	Understand, Remember, Analyse & Apply	Define, Describe & Demonstrate

Learning Resources	
1.	<p>Reference/Text Books:</p> <ol style="list-style-type: none"> <li>1. Fundamentals of Ecology by EP Odum Cengage</li> <li>2. Big Questions in Ecology &amp; Evolution by TN Sherratt &amp; DM Wilkinson, Oxford.</li> <li>3. Ecology: Experimental Analysis of Distribution &amp; Abundance by CJ Krebs, Pearson Education, London</li> <li>4. Concept of Ecology by EJ Kormondy, Pearson Education, London</li> <li>5. Conservation Biology: Voices from the Tropics. By Sodhi, N.S., Gibson, L. &amp; Raven, P.H. (eds) John Wiley &amp; Sons</li> <li>6. Plastic and Environment by RE Hester and RM Harrison, Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK</li> <li>7. Fundamental concepts in Environmental studies by DD Mishra, S. Chand Publishing, India</li> <li>8. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology by PS Verma and VK Agarwal, S. Chand Publication, India</li> <li>9. Fundamentals of Ecology by PD Sharma, Rastogi Publications</li> </ol>
2.	<p>Journals &amp; Periodicals:</p> <ol style="list-style-type: none"> <li>1. Environmental Pollutants and Bioavailability</li> <li>2. Clean Air Journal</li> <li>3. Emerging Contaminants</li> <li>4. Environment: Science and Policy for Sustainable Development</li> <li>5. Annual Review of Environment and Resources</li> <li>6. Renewable Energy</li> <li>7. Renewable &amp; Sustainable Energy Reviews</li> </ol>
3.	<p>Other Electronic Resources:</p> <ol style="list-style-type: none"> <li>1. Green.tv—supported by UNEP—broadband TV channel for films about environmental issues.</li> <li>2. Climate Change TV—funded by companies, governments and organisations, and produced by the magazine Responding to Climate Change—the world's first web channel specific to climate change videos.</li> <li>3. Terra: The Nature of Our World video podcast produced in conjunction with the Master of Fine Arts program in Science &amp; Natural History Filmmaking at Montana State University, Filmmakers for Conservation, and PBS—weekly video show about science and natural history.</li> </ol>

Evaluation Scheme	Total Marks
<b>Theory: Midsemester Marks</b>	20 marks
<b>Theory: End Semester Marks</b>	40 marks



<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	0	1	0	3	0	0
CO2	0	3	0	3	0	1
CO3	0	2	0	3	0	0
CO4	0	2	0	3	0	0
CO5	0	2	0	3	0	1

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	0	0	0	2	2	2
CO2	0	1	1	3	3	3
CO3	0	1	0	1	1	1
CO4	0	0	0	2	2	2
CO5	0	0	0	3	3	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO401</b>	<b>COURSE NAME</b> <b>MAMMALIAN &amp; PLANT</b> <b>PHYSIOLOGY</b>	<b>SEMESTER</b> <b>IV</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
60	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Understanding of basic sciences up to school level (10+2 level).
<b>Course Category</b>	Mandatory courses
<b>Course focus</b>	Employability
<b>Rationale</b>	It provides students with insights into the physiological processes of local mammalian and plant species for studying human health and diseases. Nationally and internationally it reflects the interdisciplinary nature of biotechnology and its reliance on understanding the physiological processes in living organisms. It equips students with a strong foundation in physiological principles and prepares them for diverse career paths in the field of biotechnology.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<p>Course Objectives: Students will be able to:</p> <ol style="list-style-type: none"> <li>1. To learn physiology of respiratory, excretory, digestive, endocrine and nervous systems.</li> <li>2. To understand role of macro and micronutrients in growth and development.</li> <li>3. To learn process of photosynthesis.</li> <li>4. To get information about nitrogen fixation.</li> <li>5. To understand role of plant growth regulators on plant physiology.</li> </ol>

<b>Course Content (Theory)</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1: Respiratory and Excretion system</b> Blood: its cellular and chemical composition, blood clotting Respiratory system: diffusion of oxygen and carbon dioxide, transport of oxygen, role of hemoglobin, dissociation curve of oxyhemoglobin and its significance, Bohr's effect, transport of CO <sub>2</sub> and chloride shift. Various buffer systems of the blood, acidosis, alkalosis. Excretion: modes of excretion, Ornithine cycle, Mechanism of urine formation. Role of lung and kidney in regulation of acid base balance.	<b>25%</b>	<b>15</b>
<b>Unit 2: Digestive System:</b> Different components, digestion and absorption of carbohydrates, lipids and proteins. Endocrine: brief outline of various endocrine glands and their physiological roles, storage and secretion of hormones. Nervous System: Nerve cells, nerve fibres, nerve impulse and neurotransmission, chemical and electrical synapses, functional properties of nerve fibres, action potential, the reflex action and reflex arc.	<b>25%</b>	<b>15</b>



<b>Unit 3: Micro &amp; macro nutrients:</b> Criteria for identification of essentiality of nutrients, roles and deficiency systems of nutrients, mechanism of uptake of nutrients, mechanism of food transport.	<b>5%</b>	<b>3</b>
<b>Unit 4: Photosynthesis:</b> Photosynthesis pigments, concept of two photo systems, photophosphorylation, calvin cycle, CAM plants, photorespiration, compensation point. Nitrogen metabolism- inorganic & molecular nitrogen fixation, nitrate reduction and ammonium assimilation in plants	<b>20%</b>	<b>12</b>
<b>Unit 5: Growth and development:</b> Definitions, phases of growth, growth curve, growth hormones (auxins, gibberlins, cytokinins, abscisic acid, ethylene). Physiological role and mode of action, seed dormancy and seed germination, concept of photoperiodism and vernalization.	<b>25%</b>	<b>15</b>

<b>List Of Practical</b>	<b>Weightage</b>	<b>Contact hours</b>
1. Finding the coagulation time of blood.	<b>8%</b>	<b>4</b>
2. Determination of blood groups.	<b>8%</b>	<b>4</b>
3. Counting of mammalian RBCs.	<b>12%</b>	<b>4</b>
4. Determination of TLC and DLC.	<b>8%</b>	<b>4</b>
5. Demonstration of action of an enzyme.	<b>8%</b>	<b>2</b>
6. Determination of Hemoglobin.	<b>8%</b>	<b>2</b>
7. Separation of photosynthetic pigments by paper chromatography.	<b>8%</b>	<b>4</b>
8. Demonstration of opening & closing of stomata.	<b>8%</b>	<b>2</b>
9. Demonstration of guttation on leaf tips of grass and garden nasturtium.	<b>8%</b>	<b>2</b>
10. Demonstration of aerobic respiration.	<b>8%</b>	<b>2</b>
11. Demonstration of plasmolysis by Tradescantia leaf peel.	<b>8%</b>	<b>2</b>
12. Preparation of root nodules from a leguminous plant.	<b>8%</b>	<b>2</b>

<b>Instructional Method and Pedagogy:</b> Group discussion, Chalk and board, Audiovisuals, Seminars, Quiz, PPT, Demonstration, Case studies
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<b>Course Outcome:</b>	<b>Blooms' Taxonomy Domain</b>	<b>Blooms' Taxonomy Sub Domain</b>
After successful completion of the above course, students will be able to: <b>CO1</b> The organization, properties and functions of the nervous, respiratory, excretion, digestion and excretion system <b>CO2</b> Hormonal regulation of physiological processes. <b>CO3</b> Movement of water and solutes as well as water balance and uptake of nutrients <b>CO4</b> The control of cell differentiation and tissue development by hormones and other regulating substances	Understand and Remember  Remember  Understand and Apply Apply, Analyse and Create	Describe and Explain  Describe and classify Describe and Explain Describe



<b>CO5</b> Control of flowering and seed development and photosynthesis and nitrogen metabolism	Analyse and evaluate	Classify and Explain
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Learning Resources	
1.	<p>Reference Books:</p> <ol style="list-style-type: none"> <li>1. Guyton, A.C. &amp; Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. /W.B. Saunders Company.</li> <li>2. HD Singh Handbook of Basic Human Physiology, S.Chand Publications</li> <li>3. S. Mukherjee, S. Mukherji A. K. Ghosh Plant Physiology, New Central Book Agency</li> <li>4. SN Pandey and BK Sinha Plant Physiology S Chand Publications</li> <li>5. Campbell, N. A. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin, Cummings.</li> <li>6. VK Jain (19th Edition), Fundamentals of Plant Physiology, S. Chand Publishing House</li> <li>7. BP Pandey Modern Practical Botany (three volume set), S.Chand Publication</li> <li>8. PS Verma and PC Shrivastava Advanced Practical Zoology, S. Chand Publications</li> <li>9. Sarada Subrahmanyam, K Madhavankutty &amp; H D Singh Textbook of Human Physiology</li> <li>10. Tortora, G.J. &amp; Grabowski, S. (2006). Principles of Anatomy &amp; Physiology. XI Edition. John wiley &amp; sons, Inc.</li> <li>11. Sherwood, L. &amp; Ward, C. (2016) Human Physiology: From Cells to Systems</li> <li>12. Derrickson, B. (2017). Human physiology. Hoboken, NJ: John Wiley &amp; Sons.</li> <li>13. Hopkins, W.G. and Huner, P.A. 2008 Introduction to Plant Physiology. John Wiley and Sons.</li> <li>14. Taiz L. and Zeiger 2010 Plant Physiology (fifth edition), Sinauer Associates</li> <li>15. Lincoln Taiz; Eduardo Zeiger; Ian Max Moller; Angus Murphy 2014 Plant Physiology and Development Sinauer Associates</li> <li>16. Mauseth, J.D. 1988 Plant Anatomy. The Benjamin/Cummings Publisher, USA</li> <li>17. Plant Physiology and Development, Sixth Edition by Lincoln Taiz, Eduardo Zeiger, Ian M. Møller, and Angus Murphy, published by Sinauer Associates</li> </ol>
2.	<p>Journals &amp; Periodicals:</p> <ol style="list-style-type: none"> <li>6. Mammal Review</li> <li>7. Mammalian Biology</li> <li>8. Journal of Mammalogy</li> <li>9. Mammalia</li> <li>10. Plant physiology</li> <li>11. Journal of Plant Physiology</li> <li>12. Trends in Plant Science</li> <li>13. Annual Review of Plant Biology</li> <li>14. Annual Review of Physiology</li> <li>15. Plant Physiology Reports</li> <li>16. Acta Physiologies' Plantarum</li> <li>17. Frontiers in Plant Science- Plant Physiology</li> <li>18. The Plant Journal</li> <li>19. Plant and Cell Physiology</li> </ol>
3.	<p>Other Electronic Resources:</p> <ol style="list-style-type: none"> <li>3. Plant Physiology Latest Research and News</li> <li>4. Plant Physiology and Development, Sixth Edition Companion Website</li> </ol>

Evaluation Scheme	Total Marks	
<b>Theory: Mid semester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>		
	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Research Paper Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	30 marks
	Viva	10 marks
	Journal	05 marks
	<b>Total</b>	<b>50 Marks</b>

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	1	2	1	0
CO2	1	2	1	2	0	1
CO3	0	2	1	2	0	0
CO4	2	1	3	1	1	3
CO5	2	1	2	1	1	3

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	1	2	1	0
CO2	2	1	1	2	0	0
CO3	1	1	1	1	0	0
CO4	1	1	2	2	2	1
CO5	1	1	1	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE <b>BSBO402</b>	COURSE NAME <b>RECOMBINANT DNA TECHNOLOGY</b>	SEMESTER <b>IV</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Fundamental knowledge of genes, genomes and genetic engineering.
<b>Course Category</b>	Professional Core Course
<b>Course focus</b>	Employability
<b>Rationale</b>	To have an overview of different molecular tools and applications. The subject also explains genetic engineering in plants and animals.
<b>Course Revision/ Approval Date:</b>	14/03/2020
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<ol style="list-style-type: none"> <li>1. <b>Remember</b> To learn mechanisms of gene cloning.</li> <li>2. <b>Apply</b> Practical aspects of recombinant DNA technology.</li> <li>3. <b>Analyses</b> Practical aspects of recombinant DNA technology.</li> <li>4. <b>Create</b> Model organisms in recombinant DNA technology</li> <li>5. <b>Understand</b> Recombinant gene expression system.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Theory:</b> Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication.	<b>20%</b>	<b>12</b>
<b>Unit 2: Theory</b> Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR. Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription.	<b>20%</b>	<b>12</b>



<b>Unit 3: Theory</b> Genome mapping, DNA fingerprinting, Applications of Genetic Engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice. Therapeutic products produced by genetic engineering blood proteins, human hormones, immune modulators and vaccines (one example each).	20%	12
<b>Unit 4: Theory</b> Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).	20%	12
<b>Unit 5: Theory</b> Genetic engineering in plants: Use of Agrobacterium tumefaciens and A. rhizogenes, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.	20%	12

List Of Practical	Weightage	Contact hours
1. Isolation of chromosomal DNA from E. coli	20%	12
2. Plasmid DNA isolation		
3. Qualitative and quantitative analysis of DNA using spectrophotometer	20%	12
4. Demonstration of PCR		
5. Making competent cells		
6. Transformation of competent cells		
7. Restriction digestion of DNA	20%	12
8. Demonstration of Agarose gel electrophoresis.	20%	12
9. Isolation of chromosomal DNA from plant cells.	20%	12

**Instructional Method and Pedagogy:** Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments. Practical exercises are designed to understand the theory as taught in classroom.

Course Objectives:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:	Understand and Analyse	Explain, Describe, Discuss, Recall, Locate
<b>CO1</b> Explain the mechanisms of gene cloning.	Apply and create	Apply, Practice, Interpret, Select, Correlate
<b>CO2</b> Explain the mechanisms of gene cloning.	Remember	Compare, Classify, Select, Investigate
<b>CO3</b> Discuss the practical aspects of applying recombinant DNA technology.	Understand and evaluate	Construct, Develop, Produce
<b>CO4</b> Discuss the practical aspects of applying recombinant DNA technology.	Create	Explain, Describe, outline, Predict, Summarize
<b>CO5</b> Explain the significance of model organisms in recombinant DNA technology, describe recombinant gene expression systems.		

Learning Resources	
1.	<b>Reference books:</b> <ol style="list-style-type: none"> <li>1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.</li> <li>2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Appling the Genetic Revolution. Elsevier Academic Press, USA.</li> <li>3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology-Principles and Applications of recombinant DNA. ASM Press, Washington.</li> <li>4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.</li> <li>5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press.</li> </ol>
2.	<b>Journals &amp; Periodicals</b> <ol style="list-style-type: none"> <li>6. Current Science in RDNA technology</li> <li>7. Advances in R-DNA Technology</li> </ol>
3.	Other Electronic resources: NPTEL

Evaluation Scheme	Total Marks	
<b>Theory: Mid semester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	30 marks
	Viva	10 marks
	Journal	05 marks
	<b>Total</b>	<b>50 Marks</b>

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	1	2	1	1
CO2	1	2	2	1	1	2
CO3	1	1	2	2	1	1
CO4	1	1	2	1	1	1
CO5	2	1	2	1	1	1

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2	2	2	0
CO2	2	2	2	2	1	1
CO3	1	1	1	1	1	1
CO4	1	1	1	2	1	0
CO5	2	1	2	1	2	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BSBO403	COURSE NAME ENZYMOLGY	SEMESTER IV
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Understanding of basic sciences up to school level (10+2 level).
<b>Course Category</b>	Mandatory courses
<b>Course focus</b>	Employability
<b>Rationale</b>	It provides a fundamental understanding of enzyme structure, function, and kinetics, enabling biotechnologists to design and optimize enzymatic processes, develop biocatalysts, and contribute to industrial applications, diagnostics, therapeutics, agriculture, and environmental sustainability. Nationally and internationally it is significant in optimizing bioprocesses and developing enzyme-based solutions for various applications in biotechnology.
<b>Course Revision/ Approval Date:</b>	14/03/2020
<b>Course Objectives (As per Blooms' Taxonomy)</b>	Course Objectives: Students will be able to: 1: To learn the fundamentals of enzyme structure and function. 2: To understand kinetics of soluble and immobilized enzymes. 3: To gain knowledge on large scale production of enzymes. 4: To understand the current applications and future potential of enzymes. 5: To gain knowledge on enzyme engineering and its uses.

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Introduction and Enzyme reaction concept</b> Enzyme classification (rationale, overview and specific examples) Zymogens and their activation (Proteases and Prothrombin). Enzyme substrate complex: concept of E-S complex, binding sites, active site, specificity, Kinetics of enzyme activity, Michaelis-Menten equation and its derivation, Different plots for the determination of Km and Vmax and their physiological significance, factors affecting initial rate, E, S, temp. & pH. Collision and transition state theories, Significance of activation energy and free energy.	20%	12
<b>Unit 2: Enzyme Substrate reactions:</b> Two substrate reactions (Random, ordered and ping-pong mechanism) Enzyme inhibition: types of inhibition, determination of Ki, suicide inhibitor. Mechanism of enzyme action: General mechanistic principle, factors associated with catalytic efficiency: proximity, orientation, distortion of strain, acidbase, nucleophilic and covalent catalysis.	25%	15



Techniques for studying mechanisms of action, chemical modification of active site groups, specific examples: chymotrypsin, lysozyme, GPDH, aldolase, RNase, Carboxypeptidase and alcohol dehydrogenase. Enzyme regulation: Product inhibition, feedback control, covalent modification.		
<b>Unit 3: Enzyme Interaction:</b> Allosteric enzymes with special reference to aspartate transcarboxylase and phosphofructokinase. Qualitative description of concerted and sequential models. Negative cooperativity and half site reactivity. Enzyme - Enzyme interaction, Protein ligand binding, measurements analysis of binding isotherm, cooperativity, Hill and scatchard plots, kinetics of allosteric enzymes. Isoenzymes– multiple forms of enzymes with special reference to lactate dehydrogenase. Multienzyme complexes. Ribozymes. Multifunctional enzyme-eg Fatty Acid synthase.	25%	15
<b>Unit 4: Enzyme Technology:</b> Methods for large scale production of enzymes. Immobilized enzyme and their comparison with soluble enzymes, Methods for immobilization of enzymes. Immobilized enzyme reactors. Application of Immobilized and soluble enzyme in health and industry. Application to fundamental studies of biochemistry. Enzyme electrodes.	15%	9
<b>Unit 5: Enzyme Engineering:</b> Thermal stability and catalytic efficiency of enzyme, site directed mutagenesis and enzyme engineering– selected examples, Delivery system for protein pharmaceuticals, structure function relationship in enzymes, structural motifs and enzyme evolution. Methods for protein sequencing. Methods for analysis of secondary and tertiary structures of enzymes. Protein folding invitro & in vivo.	15%	9

List Of Practical	Weightage	Contact hours
1. Isolation of an enzyme from any natural resource (amylase, protease, xylanase, pectinase)	10%	12
2. Effect of temperature, pH, substrate concentration and enzyme concentration on enzyme action	10%	4
3. Quantitative estimation of proteins by Bradford/Lowry's method	10%	4
4. Production and Purification of Enzyme	10%	4
5. Immobilization of Enzyme Amylase	10%	4
6. Native gel electrophoresis of proteins	10%	4
7. SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions	10%	4

**Instructional Method and Pedagogy:**

Group discussion, Chalk and board, Audiovisuals, Seminars, Quiz, PPT, Demonstration, Case studies

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: <b>CO1</b> Describe structure, functions and the mechanisms of action of enzymes <b>CO2</b> Learn kinetics of enzyme catalyzed reactions and enzyme inhibitory and regulatory process <b>CO3</b> Understand how to perform immobilization of enzymes <b>CO4</b> Understand wide applications of enzymes and their future potential <b>CO5</b> Explain engineering methods used for enzymes.	Remember  Understand & Apply Analyse & Create  Create  Create	Describe and Classify  Describe and Explain Explain  Describe and Explain Explain

Learning Resources	
1.	1. Harper's illustrated Biochemistry by Robert K. Murray, David A Bender, Kathleen M. Botham, Peter J. 2. Kennelly, Victor W. Rodwell, P. Anthony Weil. 28th Edition, McGrawHill, 2009. 3. Biochemistry, Donald Voet and Judith Voet, 2nd Edition, Publisher: John Wiley and Sons, 1995. 4. Biochemistry by Mary K. Campbell & Shawn O. Farrell, 5th Edition, Cengage Learning, 2005. 5. Fundamentals of Enzymology Nicholas Price and Lewis Stevens Oxford University Press 1999 6. Fundamentals of Enzyme Kinetics Athel Cornish-Bowden Portland Press 2004 7. Practical Enzymology Hans Bisswanger Wiley-VCH 2004 8. The Organic Chemistry of Enzyme-catalyzed Reactions Richard B. Silverman Academic Press 2002
2.	Journals & Periodicals: 9. Enzyme and Microbial Technology 10. The Scientist
3.	Other Electronic Resources: 11. <a href="https://www.brenda-enzymes.org/">https://www.brenda-enzymes.org/</a>

Evaluation Scheme	Total Marks
<b>Theory: Mid semester Marks</b>	20 marks
<b>Theory: End Semester Marks</b>	40 marks

B.Sc. Biotechnology Curriculum Evaluation Component  Marks	Theory Curriculum	
	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Research Paper Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
Practical Marks	Practical Curriculum	
	Attendance	05 marks
	Practical Exam	30 marks
	Viva	10 marks
	Journal	05 marks
	<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	1	0	2	0	1
CO2	3	1	1	2	1	2
CO3	3	2	2	2	0	2
CO4	3	2	1	2	1	2
CO5	3	1	1	2	3	3

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	0	0	1	0	0
CO2	3	2	3	1	2	0
CO3	3	3	3	1	0	1
CO4	3	3	3	1	1	3
CO5	2	3	1	1	2	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO405</b>	<b>COURSE NAME</b> <b>BIOSTATISTICS</b>	<b>SEMESTER</b> <b>IV</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	0	30	2	0	0	2

<b>Course Pre-requisites</b>	Understanding of basic sciences up to school level (10+2 level).
<b>Course Category</b>	Mandatory courses
<b>Course focus</b>	Employability
<b>Rationale</b>	It equips students with the skills to collect, analyze, and interpret biological data, enabling them to make informed decisions in experimental design, data analysis, and result interpretation. Biostatistics provides a foundation for statistical analysis in research, quality control, and regulatory compliance, ensuring accurate and reliable data-driven insights in biotechnological applications and research studies. The national and international significance lies in its ability to ensure rigorous data analysis, experimental design, and interpretation. It empowers biotechnologists to generate reliable results, meet regulatory standards, and contribute to evidence-based research and applications in biotechnology both locally and globally.
<b>Course Revision/ Approval Date:</b>	14/03/2020
<b>Course Objectives (As per Blooms' Taxonomy)</b>	Course Objectives: Students will be able to: 1: Define and distinguish between populations and samples 2: Define and distinguish between population parameters and sample statistics. 3: Compute a sample mean, sample variance, and sample standard deviation 4: Compute a population mean, population variance, and population standard deviation. 5: Explain what is meant by statistical inference

<b>Course Content (Theory)</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1: Concept of sampling</b> Concept of sampling, Introduction to Probability, basic results and theorems of Probability.	<b>20%</b>	<b>6</b>
<b>Unit 2: Concept of random variable</b> Concept of random variable, Probability distribution of random variable, Expectation and variance.	<b>20%</b>	<b>6</b>
<b>Unit 3: Application of distribution theories</b> Study of Binomial, Poisson and Normal Distribution, Application of this distribution in Bio – Sciences.	<b>20%</b>	<b>6</b>



<b>Unit 4: Enzyme Technology:</b> Basic principles of statistical inference, Point estimation, Internal estimation, Statistical Hypothesis framing.	<b>20%</b>	<b>6</b>
<b>Unit 5: Test and verification of statistical data:</b> Test of Significance, p- value, t – test, F – test, chi – square test, ANOVA etc.	<b>20%</b>	<b>6</b>

**Instructional Method and Pedagogy:**  
**Chalk and Board & PPT**

<b>Course Outcome:</b>	<b>Blooms' Taxonomy Domain</b>	<b>Blooms' Taxonomy Sub Domain</b>
After successful completion of the above course, students will be able to: <b>CO1</b> Biostatistics is the application of statistical principles to questions and problems in medicine, public health or biology. <b>CO2</b> A more realistic approach is to study samples or subsets of a population. <b>CO3</b> The discipline of biostatistics provides tools and techniques for collecting data and then summarizing, analysing, and interpreting it. <b>CO4</b> In biostatistics one analyses samples in order to make inferences about the population. <b>CO5</b> This module introduces fundamental concepts and definitions for biostatistics.	Understand  Remember  Apply and Create  Analyse and Evaluate  Understand	Describe and Classify  Describe and Explain  Describe and Classify  Describe and Explain  Explain

<b>Learning Resources</b>	
	<ol style="list-style-type: none"> <li>1. Danial W (2004) Biostatistics: A foundation for Analysis in Health Sciences, John Wiley and Sons Inc.</li> <li>2. Le CT (2003) Introductory biostatistics. 1st edition, John Wiley, USA</li> <li>3. Glaser AN (2001) High Yield TM Biostatistics. Lippincott Williams and Wilkins, USA.</li> </ol>
2.	<b>Journals &amp; Periodicals:</b> <ol style="list-style-type: none"> <li>1. International Journal of Clinical Biostatistics and Biometrics</li> <li>2. Biostatistics (Oxford university press)</li> <li>3. The International Journal of Biostatistics</li> </ol>
3.	<b>Other Electronic Resources:</b> <ol style="list-style-type: none"> <li>1. Excel analysis tool box</li> <li>2. Table</li> </ol>

Evaluation Scheme	Total Marks
<b>Theory: Mid semester Marks</b>	20 marks
<b>Theory: End Semester Marks</b>	40 marks
<b>Theory: Continuous Evaluation Component Marks</b>	<div>Attendance 05 marks</div> <div>MCQs 10 marks</div> <div>Open Book Assignment 15 marks</div> <div>Research Paper Review 10 marks</div> <div><b>Total 40 Marks</b></div>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	0	1	1	0
CO2	1	2	1	1	0	1
CO3	1	2	2	2	1	1
CO4	1	2	2	2	0	1
CO5	0	1	1	1	0	0

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	0	0	1	0	0
CO2	1	1	0	1	0	0
CO3	1	1	1	1	1	1
CO4	1	1	1	1	1	1
CO5	1	0	0	1	0	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO406</b>	<b>COURSE NAME</b> <b>INDUSTRIAL</b> <b>FERMENTATIONS</b>	<b>SEMESTER</b> <b>IV</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	0	30	2	0	0	2

<b>Course Pre-requisites</b>	Understanding of basic sciences up to school level (10+2 level).
<b>Course Category</b>	Skill enhancement elective
<b>Course focus</b>	Employability
<b>Rationale</b>	It provides students with essential knowledge and skills related to large-scale production of biotechnological products. It prepares them for careers in industrial biotechnology by providing insights into fermentation processes, optimization, scale-up, and bioreactor design, fostering industry-relevant expertise. Nationally, it will help in contributing to the development of local biomanufacturing capabilities, economic growth, and innovation in sectors such as pharmaceuticals, biofuels, and food processing. It is relevant to the global biotechnology industry, too. It equips students with skills applicable to international biomanufacturing processes, fostering collaboration and knowledge sharing, and preparing graduates to contribute to global advancements in sectors such as healthcare, renewable energy, and bioproducts.
<b>Course Revision/ Approval Date:</b>	14/03/2020
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<p>Course Objectives: Students will be able to:</p> <ol style="list-style-type: none"> <li>1: Demonstrate the understanding of production of industrially important chemicals, biochemicals and therapeutic products.</li> <li>2: Know the use of microbes in the production of biofuels, bioinsecticides, antibiotics.</li> <li>3: Know how to overproduce industrially important microbial metabolites.</li> <li>4: Demonstrate downstream and Upstream processes involved in enzyme extraction.</li> <li>5: Demonstrate design and operation of fermentation systems.</li> </ol>

<b>Course Content (Theory)</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1: Introduction and production of industrial biochemicals</b> Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid.	<b>20%</b>	<b>6</b>

<b>Unit 2: Biofuels</b> Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes Microbial polysaccharides; Microbial insecticides; microbial flavors and fragrances, newer antibiotics, fermentations and transformations.	20%	6
<b>Unit 3: Over Production of microbial metabolite</b> Over production of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity.	20%	6
<b>Unit 4: Immobilization techniques in industrial processing:</b> Enzyme and cell immobilization techniques in industrial processing. Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth.	20%	6
<b>Unit 5: Methods of extraction:</b> Ultra centrifugation, liquid extraction, ion exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations.	20%	6

**Instructional Method and Pedagogy:**

Power point, Audio visuals, Chalk & Board, Quiz, Assignment, Case studies, Quiz, etc

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: <b>CO1</b> Demonstrate the importance of microorganisms in production of various beneficial products. <b>CO2</b> Enlist various factors involved in growth of microorganisms. <b>CO3</b> Evaluate factors that contribute in enhancement of product formation during the fermentation process. <b>CO4</b> Demonstrate the upstream and downstream processes involved in enzyme extraction. <b>CO5</b> Demonstrate the basic engineering principles of Fermentation Technology.	Understand  Understand and Remember Analyse and Evaluate Create  Apply	Describe and Classify Describe and Classify Describe and Classify Describe and Explain Explain

Learning Resources	
1.	<p>References:</p> <ol style="list-style-type: none"> <li>1. K. Sukesh (2010) An Introduction to Industrial Microbiology, S.Chand Publications</li> <li>2. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.</li> <li>3. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.</li> <li>4. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.</li> <li>5. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.</li> </ol>
2.	<p>Journals &amp; Periodicals:</p> <ol style="list-style-type: none"> <li>1. Microbial Cell Factories</li> <li>2. Microbial Biotechnology</li> <li>3. Microbiological Research</li> <li>4. Journal of Industrial Microbiology &amp; Biotechnology</li> <li>5. Microbiology Today</li> <li>6. Science Daily</li> <li>7. Current Science</li> </ol>
3.	<p>Other Electronic Resources:</p> <ol style="list-style-type: none"> <li>1. sciencemag.org</li> <li>2. NPTEL</li> </ol>

Evaluation Scheme	Total Marks										
<b>Theory: Mid semester Marks</b>	20 marks										
<b>Theory: End Semester Marks</b>	40 marks										
<b>Theory: Continuous Evaluation Component Marks</b>	<table> <tr> <td>Attendance</td><td>05 marks</td></tr> <tr> <td>MCQs</td><td>10 marks</td></tr> <tr> <td>Open Book Assignment</td><td>15 marks</td></tr> <tr> <td>Research Paper Review</td><td>10 marks</td></tr> <tr> <td><b>Total</b></td><td><b>40 Marks</b></td></tr> </table>	Attendance	05 marks	MCQs	10 marks	Open Book Assignment	15 marks	Research Paper Review	10 marks	<b>Total</b>	<b>40 Marks</b>
Attendance	05 marks										
MCQs	10 marks										
Open Book Assignment	15 marks										
Research Paper Review	10 marks										
<b>Total</b>	<b>40 Marks</b>										

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	1	1	1	0
CO2	0	1	2	2	0	1
CO3	1	1	2	2	0	2
CO4	1	1	2	2	1	2
CO5	1	1	1	2	1	1

### Mapping of POs & COs



	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	2	0	0
CO2	2	0	0	2	0	0
CO3	2	1	0	2	1	0
CO4	1	1	1	2	2	1
CO5	1	1	1	2	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO407</b>	<b>COURSE NAME</b> <b>NANOMATERIALS</b>	<b>SEMESTER</b> <b>IV</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
30	0	0	30	2	0	0	2

<b>Course Pre-requisites</b>	Understanding of basic sciences up to school level (10+2 level).
<b>Course Category</b>	Skill enhancement elective
<b>Course focus</b>	Employability
<b>Rationale</b>	It provides students with a comprehensive understanding of the principles, synthesis methods, and applications of nanomaterials in biotechnology. It prepares them for emerging fields like nanomedicine, biosensors, and nanobiotechnology, fostering innovation and interdisciplinary approaches in biotechnological research and development. It equips students with knowledge and skills related to nanotechnology applications in biotechnology, promoting innovation in healthcare, agriculture, environmental remediation, and materials science, thereby contributing to national development and competitiveness. It prepares students to contribute to international research collaborations, technological innovations, and applications of nanomaterials in fields such as medicine, environmental sustainability, and energy, promoting global progress in biotechnological applications and interdisciplinary research.
<b>Course Revision/ Approval Date:</b>	14/03/2020
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<p>Course Objectives: Students will be able to:</p> <ol style="list-style-type: none"> <li><b>1:</b> Impart basic understanding of material properties at nanoscale</li> <li><b>2:</b> Impart basic understanding of the techniques used in production of nanoparticles</li> <li><b>3:</b> Impart basic understanding of the types and applications of nanoparticles</li> <li><b>4:</b> Impart fundamentals of the characterization of nanoparticles</li> <li><b>5:</b> Impart basic understanding of the equipment commonly used in Nanotechnology</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Introduction and production of industrial biochemicals</b> Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size Effects in nano systems.	20%	6
<b>Unit 2: Quantum confinement:</b> Applications of Schrodinger equation – Infinite potential well, potential step, potential box, quantum confinement of carriers in 3D, 2D, 1D nanostructures and its consequences.	20%	6
<b>Unit 3:</b> Top down and Bottom up approach, Photolithography. Ball milling. Gas phase condensation. Vacuum deposition. Physical vapor deposition (PVD): Thermal evaporation, E-beam Evaporation, Pulsed Laser deposition. Chemical vapor deposition (CVD).	20%	6
<b>Unit 4:</b> Sol-Gel. Electro Deposition. Spray pyrolysis. Hydrothermal synthesis. Preparation through colloidal methods. MBE growth of quantum dots	20%	6
<b>Unit 5:</b> Carrier transport in nanostructures. Coulomb blockade effect, thermionic emission, tunneling and hopping conductivity. Defects and impurities: Deep level and surface defects. Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells).	20%	6

**Instructional Method and Pedagogy:** (Max. 100 words)

**Power point, Audio visuals, Chalk & Board, Quiz, Assignment, Case studies, Quiz, etc**



Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to: <b>CO1</b> Understand the properties of nanomaterials, and how they are different from bulk materials.	Understand and Remember	Describe and Classify
<b>CO2</b> Apply the understanding gained in classes about choosing the right materials for different applications, while also taking care of safety related aspects.	Apply	Describe and Classify
<b>CO3</b> Understand the physical principles behind functioning of nanomaterials.	Analyse	Describe and Classify
<b>CO4</b> Understand and apply appropriate characterization techniques.	Apply and Create	Describe and Explain
<b>CO5</b> Understand the working of the equipment used in production of nanoparticles.	Apply and Evaluate	Explain

Learning Resources	
1.	References: 1. Introduction to Nanoparticles by C. P. Poole and F. J. Owens 2. Nanoparticles: From theory to applications by G. Schmidt 3. Chemistry of Nanoparticles: Synthesis, properties, and applications by C. N. R. Rao et al
2.	Journals & Periodicals: 20. Nanomaterials 21. Nano Materials Science
3.	Other Electronic Resources: 5. Feynman Lectures in Physics: <a href="https://www.feynmanlectures.caltech.edu/">https://www.feynmanlectures.caltech.edu/</a> 6. -There is plenty of room at the bottom (https://web.pa.msu.edu/people/yang/Rfeynman_plentySpace.pdf)

Evaluation Scheme	Total Marks
<b>Theory: Mid semester Marks</b>	20 marks
<b>Theory: End Semester Marks</b>	40 marks

<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Research Paper Review	10 marks
	<b>Total</b>	<b>40 Marks</b>

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	2	2	1	1
CO2	2	1	2	2	0	1
CO3	1	1	1	1	0	1
CO4	1	0	1	1	1	2
CO5	1	1	1	1	1	1

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	0	2	0	0
CO2	1	1	0	1	0	0
CO3	0	1	0	1	0	0
CO4	1	0	1	1	1	0
CO5	1	1	1	1	0	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSPY407</b>	<b>COURSE NAME</b> <b>PHYSICS-IV</b>	<b>SEMESTER</b> <b>IV</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
60	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Fundamental knowledge of concepts related to physics up to school (10+2) level.
<b>Course Category</b>	Professional Elective Courses (PEC)
<b>Course focus</b>	Employability
<b>Rationale</b>	Discuss subject importance (Max 100 words) The fundamental concepts of physics help in understanding the laws of nature and the behaviour of different physical entities/phenomena under specific conditions. This understanding when applied to solve numerical problems will help in enhancing the aptitude and problem-solving skills of the students.
<b>Course Revision/ Approval Date:</b>	14/03/2020
<b>Course Objectives (As per Blooms' Taxonomy)</b>	To enable the student to: <b>1:</b> To <b>understand</b> & <b>remember</b> fundamental principles of waves mechanics. <b>2:</b> To <b>understand</b> , <b>remember</b> and <b>analyse</b> different concepts related to the modern theory of radiation. <b>3:</b> To <b>understand</b> the basic concepts related to wave mechanics and <b>apply</b> & <b>assess</b> the phenomenon using experimental setup. <b>4:</b> To <b>understand</b> the concepts related to diffraction thereby its <b>application</b> & <b>analyse</b> of the phenomenon using experimental setup. <b>5:</b> To <b>understand</b> , <b>remember</b> and <b>analyse</b> the phenomenon related to electromagnetic wave propagation.

<b>Course Content (Theory)</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1: Wave Motion</b> Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity.	<b>10%</b>	<b>6</b>



<b>Unit 2: Theory of Radiation</b> Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. Fundamentals of electromagnetic radiation and related spectrum. Overview of basic applications of Electromagnetic radiation. LASERS, and related safety aspects. Optical Fibers and their applications.	20%	12
<b>Unit 3: Wave Optics</b> Electromagnetic nature of light. Definition and Properties of wavefront. Huygens Principle. Interference: Division of amplitude and division of wavefront. Young's Double Slit experiment. Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: measurement of wavelength and refractive index. Michelson's Interferometer: (1) Idea of form of fringes (no theory needed), (2) Determination of wavelength, (3) Wavelength difference, (4) Refractive index, and (5) Visibility of fringes.	30%	18
<b>Unit 4: Wave Optics</b> Diffraction: Fraunhofer diffraction - Single slit; Double Slit. Multiple slits and Diffraction grating. Fresnel Diffraction: Halfperiod zones. Zone plate. Fresnel Diffraction pattern of a straight edge, a slit and a wire using half-period zone analysis. Polarization: Transverse nature of light waves. Plane polarized light – production and analysis. Circular and elliptical polarization	20%	12
<b>Unit 5: Maxwell's equations and Electromagnetic wave propagation</b> Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.	20%	12

List of Practical	Weightage	Contact hours
1: Sonometer: To <b>determine</b> the frequency of A.C. Mains using Sonometer.	8%	3
2: Melde's Experiment: To <b>determine</b> the frequency of an electrically maintained tuning fork by transverse and longitudinal mode of vibration.	12%	4
3: Stefan-Boltzmann's law: To <b>verify</b> Stefan-Boltzmann law of thermal radiation by electrical method.	8%	3
4: Newton's ring: To <b>determine</b> the wavelength of source light and radius of curvature of the given convex lens by measuring the diameters of Newton's rings.	14%	4
5: Michelson's Interferometer: Using Michelson's Interferometer to <b>determine</b> the refractive index of a glass plate.	14%	4
6: Diffraction Grating - <b>Determining</b> wavelength of a given light source using a diffraction grating.	14%	4

7: To <b>study</b> variation of refractive index with (a) temperature of the liquid sample. (b) wavelength of the light source.	<b>14%</b>	<b>4</b>
8: Spectrometry: (i) <b>Determination</b> of angle of Prism. (ii) <b>Determination</b> of refractive index of prism using spectrometer.	<b>14%</b>	<b>4</b>

### Instructional Method and Pedagogy:

Utilizing models, Powerpoint Presentations, films on various topics of physics, group discussions and seminars are some of the methods adopted to improve the student ability to grasp the principles of physics. The hands-on sessions during laboratory sessions will help students to apply the concepts learnt and analyse the results and draw conclusion.

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
CO1 The students will be able to <b>understand</b> & <b>remember</b> fundamental principles of waves mechanics.	Understand & remember	Define, Classify & Describe
CO2 The students will be able to <b>understand</b> , <b>remember</b> and <b>analyse</b> different concepts related to the modern theory of radiation.	Understand, remember & analyse	Define, Classify, Describe & Examine
CO3 The student will be able to <b>understand</b> the basic concepts related to wave mechanics and <b>apply</b> & <b>assess</b> the phenomenon using experimental setup.	Understand, apply and analyse	Define, Describe, Demonstrate & Examine
CO4 The students will be able to <b>understand</b> the concepts related to diffraction thereby its <b>application</b> & <b>analyse</b> of the phenomenon using experimental setup.	Understand, apply and analyse	Define, Describe, Demonstrate & Examine
CO5 The students will be able to <b>understand</b> , <b>remember</b> and <b>analyse</b> the phenomenon related to electromagnetic wave propagation.	Understand, remember and analyse	Define, Describe & Examine

Learning	Resources
1.	<p>Reference/Text Books:</p> <ol style="list-style-type: none"> <li>1. A. Srivastava, R.K. Shukla Practical physics electricity, magnetism, electronics and optics, 2/e, New Age International, 2018.</li> <li>2. E. M. Purcell, Electricity and Magnetism, McGraw-Hill Education, 1986.</li> <li>3. D. Chattopadhyay and P.C. Rakshit, Electricity and magnetism: with electromagnetic theory and special theory of relativity, New Central Book Agency, 2017.</li> <li>4. D.J. Griffiths, Introduction to Electromagnetism, 4/e, Cambridge University Press 2017.</li> <li>5. B. Lal, P.S. Hemne, N. Subrahmanyam, Heat thermodynamics and statistical physics, S. Chand Publishing, 2010,</li> </ol>
2.	<p>Journals &amp; Periodicals:</p> <ol style="list-style-type: none"> <li>1. Journal of Undergraduate Reports in Physics (JURP)</li> <li>2. Journal of Young Investigators (JYI)</li> <li>3. Columbia Undergraduate Science Journal (CUSI)</li> <li>4. Student Journal of Physics (SJP)</li> <li>5. Indian Journal of Physics (IJP)</li> </ol>
3.	<p>Other Electronic Resources:</p> <p>Richard Feynman, Feynman Lectures in Physics: <a href="https://www.feynmanLectures.caltech.edu/">https://www.feynmanLectures.caltech.edu/</a></p>

Examination Scheme	Total Marks										
<b>Theory: Mid semester Marks</b>	20 marks										
<b>Theory: End Semester Marks</b>	40 marks										
<b>Theory: Continuous Evaluation Component Marks</b>	<table> <tr> <td>Attendance</td><td>05 marks</td></tr> <tr> <td>MCQs</td><td>10 marks</td></tr> <tr> <td>Open Book Assignment</td><td>15 marks</td></tr> <tr> <td>Open Book Assignment</td><td>10 marks</td></tr> <tr> <td><b>Total</b></td><td><b>40 Marks</b></td></tr> </table>	Attendance	05 marks	MCQs	10 marks	Open Book Assignment	15 marks	Open Book Assignment	10 marks	<b>Total</b>	<b>40 Marks</b>
Attendance	05 marks										
MCQs	10 marks										
Open Book Assignment	15 marks										
Open Book Assignment	10 marks										
<b>Total</b>	<b>40 Marks</b>										

Practical Marks		
	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	0	1	0	0
CO2	1	1	1	1	0	1
CO3	1	2	1	1	0	0
CO4	1	2	1	1	0	0
CO5	1	1	1	1	0	1

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	0	1	0	0	0	1
CO2	0	2	2	0	1	1
CO3	1	2	2	0	0	0
CO4	1	2	2	0	0	0
CO5	0	1	1	0	0	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSCM407</b>	<b>COURSE NAME</b> <b>CHEMISTRY II</b>	<b>SEMESTER</b> <b>IV</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
60	60	00	120	04	02	00	06

<b>Course Pre-requisites</b>	Basic knowledge of physical and organic chemistry
<b>Course Category</b>	Generic elective
<b>Course focus</b>	Employability
<b>Rationale</b>	Fusion of various sciences is occurring at a rapid pace. Biochemists and microbiologists need indepth knowledge in Chemistry. To fill this gap the course, namely, Chemistry II, is inducted into the curriculum.
<b>Course Revision/ Approval Date:</b>	14/03/2023
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li>1. To impart the knowledge of solution state and the laws governing thereof.</li> <li>2. To equip the students with the indepth knowledge of Phase equilibria and their industrial relevance</li> <li>3. To make the students skilled in operating electroanalytical devices, like, pH meter, potentiometer and conductometry by imparting fundamental knowledge of electrochemistry</li> <li>4. To impart knowledge pertaining to carboxylic acids, Amines and diazonium Salts.</li> <li>5. To equip the students with knowledge of amino acids, peptides and proteins and the properties and conversions thereof.</li> </ol>

<b>Course Content (Theory)</b>	<b>Weightage %</b>	<b>Contact hours</b>
Unit 1: Solutions Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperaturecomposition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction.	20	12



Unit 2: Phase Equilibrium Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clapeyron-Clausius equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, $\text{FeCl}_3\text{-H}_2\text{O}$ and Na-K.	<b>20</b>	<b>12</b>
Unit 3: Conductance Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions. Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations Electrochemistry Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: $G$ , $H$ and $S$ from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode and quinhydrone electrode. Potentiometric titrations -qualitative treatment (acid-base and oxidation-reduction).	<b>20</b>	<b>12</b>
Unit 4: Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure. Carboxylic acids and their derivatives Carboxylic acids (aliphatic and aromatic) Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Volhard - Zelinsky Reaction. Carboxylic acid derivatives (aliphatic): (Upto 5 carbons) Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation. Amines and Diazonium Salts Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with $\text{HNO}_2$ , Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation. Diazonium salts: Preparation: from aromatic amines. Reactions: conversion to benzene, phenol, dyes.	<b>20</b>	<b>12</b>
Unit 5: Amino Acids, Peptides and Proteins: Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis.	<b>20</b>	<b>12</b>

<p>Zwitterion, Isoelectric point and Electrophoresis. Reactions of Amino acids: ester of <math>-\text{COOH}</math> group, acetylation of <math>-\text{NH}_2</math> group, complexation with <math>\text{Cu}^{2+}</math> ions, ninhydrin test. Overview of Primary, Secondary, 20% 12 Activating Prior Knowledge by Random Questioning, Introducing the topic to be taught after getting the expected response from the students, Developing hypothesis by Lecture and Discussion, Quizzes Intended to Consolidate Knowledge (QUICK) Curriculum, B.Sc. (H) Biotechnology, School of Science Page 66 of 94 Tertiary and Quaternary Structure of proteins. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C-terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) &amp; C- activating groups and Merrifield solid-phase synthesis. Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation</p>		
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List of Practicals	Weightage	Contact hours
1. To determine the relative viscosity of ethyl acetate with water using Ostwald's viscometer	15	4
2. To determine the Critical Micellar Concentration (CMC) of a given surfactant Sodium Dodecyl Sulphate (SDS) using conductivity method	15	4
3. To study the effect of temperature on rate of reaction between hypo solution and HCl	15	4
4. To prepare sodium tris-oxalato ferrate (III)	15	4
5. Preparation of ammonium nickel (II) sulfate hexahydrate, $(\text{NH}_4)_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$	15	4
6. To prepare hexakis thiourea plumbus (II) nitrate hexahydrate	15	4
7. To prepare tetraamine copper sulphate	10	4

#### Instructional Method and Pedagogy:

Classroom lecture, discussion, question and answer method, Case studies, quizzes, presentations, role play, expert lecture(Consultant)

Course outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
<p>After successful completion of the above course, students will be able to:</p> <p><b>CO1:</b> Understand the laws governing the solution state and apply the same for practical utility</p> <p><b>CO2:</b> Understand phase rule, phase equilibria, phase diagrams and their industrial utility</p> <p><b>CO3:</b> Understand and apply the concepts of electrochemistry</p> <p><b>CO4:</b> Synthesize and convert amino acids, diazonium salts and carboxylic acids</p> <p><b>CO5:</b> Synthesize amino acids, peptides and proteins and study their properties and conversions thereof.</p>	<p>Understand and apply</p> <p>Understand and apply</p> <p>Understand and apply</p> <p>Create</p> <p>Create</p>	

Learning resources	
1	<p>Reference books:</p> <p>Samuel Glasstone, Elements of Physical Chemistry</p> <p>Arun Bhal, B S Bhal, G D Tuli, Essentials of Physical Chemistry</p> <p>Puri, Sharma, Pathania, Principles of Physical Chemistry</p> <p>G. M. Barrow: Physical chemistry Tata McGraw-Hill (2007).</p> <p>Nelson, D. L. &amp; Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W.H.</p> <p>G. W. Castellan: Physical Chemistry 4th Ed. Narosa (2004).</p> <p>J. C. Kotz, P. M. Treichel, J. R. Townsend, General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).</p> <p>B. H. Mahan: University Chemistry, 3rd Edn. Narosa (1998).</p> <p>R. H. Petrucci, General Chemistry, 5th Edn., Macmillan Publishing Co.: New York (1985).</p>

	<p>Morrison, R. T. &amp; Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).</p> <p>Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).</p> <p>Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).</p>
2	<p>Journals &amp; Periodicals:</p> <p>Journal of Chemical Sciences</p> <p>Energy and Environmental Science</p> <p>Journal of Chemical Education</p>
3	<p>Other Electronic Resources:</p> <p>NPTTEL, SWAYAM, MERLOT (Links available in GSFC University Link)</p>

Evaluation Scheme		Total Marks	
<b>Theory: Mid semester Marks</b>		20 marks	
<b>Theory: End Semester Marks</b>		40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>		Attendance	05 marks
		MCQs	10 marks
		Open Book Assignment	15 marks
		Open Book Assignment	10 marks
		<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>		Attendance	05 marks
		Practical Exam	20 marks
		Viva	10 marks
		Journal	10 marks
		Discipline	05 marks
		<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	3	2	1	1	3
CO2	1	2	1	1	1	1
CO3	3	3	3	1	1	3
CO4	3	3	3	1	1	3
CO5	3	3	3	1	1	3

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	2	1	1	3
CO2	1	2	1	1	1	1
CO3	3	3	3	1	1	3
CO4	3	3	3	1	1	3
CO5	3	3	3	1	1	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Semester – V							
Sr.No.	Course Code	Course Title	L	T	P	C	Marks
<b>A. Ability Enhancement Compulsory Course</b>							
1	AECC501	Disaster Risk Management	2	0	0	2	100
<b>B. Skill Enhancement Courses</b>							
<b>a) Skill Enhancement compulsory courses</b>							
2	SECC504	Internship	0	0	2	2	50
<b>C. Core Course</b>							
3	BSBO501	Bioanalytical Tools	4	0	2	6	150
4	BSBO502	Bioprocess technology	4	0	2	6	150
<b>D. Discipline Specific Generic Electives (Any Two)</b>							
5	BSBO503	Animal & Plant Biotechnology	4	0	2	6	150
6	BSBO504	Virology	4	0	2	6	150
7	BSBO505	Ecology & Evolution	4	0	2	6	150
8	BSBO506	Research Methodology	4	0	2	6	150
Total						28	750

### Teaching Scheme Semester – V

Sr. No	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
			A. Ability Enhancement Compulsory Course													
1	BSEN501	Disaster Risk Management	2	0	0	2	2	0	0	2	20	40	40	100	00	100
			B. Skill Enhancement Courses													
			a) Skill Enhancement compulsory courses													
2	SECC504	Internship	0	2	0	2	0	0	0	0	0	0	0	0	50	50
			C. Core Course													
3	BSBO501	Bioanalytical Tools	4	4	0	8	4	2	0	6	20	40	40	100	50	150
4	BSBO502	Bioprocess technology	4	4	0	8	4	2	0	6	20	40	40	100	50	150
			D. Discipline Specific Generic Electives (Any Two)													
5	BSBO503	Animal & Plant Biotechnology	4	4	0	8	4	2	0	6	20	40	40	100	50	150
6	BSBO504	Virology	4	4	0	8	4	2	0	6	20	40	40	100	50	150
7	BSBO505	Ecology & Evolution	4	4	0	8	4	2	0	6	20	40	40	100	50	150
8	BSBO506	Research Methodology	4	4	0	8	4	2	0	6	20	40	40	100	50	150
		<b>Total</b>								<b>28</b>						<b>750</b>

**Note:** L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

<b>COURSE CODE</b> <b>BSEN501</b>	<b>COURSE NAME</b> <b>DISASTER RISK</b> <b>MANAGEMENT</b>	<b>SEMESTER</b> <b>V</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Hour s</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
30	0	0	30	2	0	0	2

<b>Course Pre-requisites</b>	Students should have basic knowledge about Immunity.
<b>Course Category</b>	Ability Enhancement Compulsory Course
<b>Course focus</b>	Employability
<b>Rationale</b>	To have an overview of inter-relationship between disaster and development and various disaster management frameworks and strategies.
<b>Course Revision/ Approval Date:</b>	14/03/2020
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<b>1. Remember</b> To introduce inter-relationship between disaster and development. <b>2. Apply</b> To introduce types of disasters with case studies and create awareness. <b>3. Analyses</b> To study the effective use of science for mitigating disasters <b>4. Create</b> To study case study of various famous disasters. <b>5. Understand</b> To introduce various disaster management frameworks and strategies adopted at national and international levels.

<b>Course Content (Theory)</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1:</b> Understanding the Concepts and Definitions of Disaster, Hazard, Vulnerability Risk, Capacity Disaster and Development, and Disaster Management Fundamental of Disasters-Types, Trends, Causes, Consequences and Control: Geological Disasters, Hydro-Meteorological Disasters, Biological Disasters, Technological Disasters, and Man-made Disasters. Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.	<b>20%</b>	<b>6</b>



<b>Unit 2:</b> Disaster Management Cycle and Framework-Disaster Management Cycle – Paradigm Shift in Disaster Management, Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, Zonation, Micro zonation, Prevention and Mitigation of Disasters, Early Warning System, Preparedness, Capacity Development; Awareness, During Disaster – Evacuation – Disaster Communication – Search and Rescue, Emergency Operation Centre– Incident Command System – Relief And Rehabilitation. Post -disaster Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action, Sendai framework.	20%	6
<b>Unit 3:</b> Disaster Management in India Disaster Profile of India – Mega Disasters of India and Lessons Learnt, Disaster, Management Act 2005 – Institutional and Financial Mechanism, National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies. Disaster Management Act in relation to COVID 19 Pandemic.	20%	6
<b>Unit 4:</b> Role of Science and Technology in Disaster Management Geo-informatics in Disaster Management (RS, GIS, GPS and RS), Disaster Communication System (Early Warning and Its Dissemination), Land, Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non-Structural Mitigation of Disasters, S&T Institutions for Disaster Management in India.	20%	6
<b>Unit 5:</b> Disaster Case Studies Various Case Studies on Disaster and Development, Disaster Prevention and Control, Risk Analysis and Management. Case study relating to COVID -19 to be explored.	20%	6

**Instructional Method and Pedagogy:**

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:  <b>CO1</b> Possess awareness to mitigate the effects of disaster.	Remember	Explain, Describe, Discuss, Recall, Locate

<b>CO2</b> Know local disaster management policies, regulations and authorities.	Apply	Apply, Practice, Interpret, Select, Correlate
<b>CO3</b> Contribute in capacity building measures to mitigate disasters.	Analyses and Evaluation	Compare, Classify, Select, Investigate
<b>CO4</b> Understanding role of science in mitigating disasters.	Create	Construct, Develop, Produce
<b>CO5</b> Contribute to safe society by the study of various disasters.	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>Alexander, D., Natural Disasters, Kluwer Academic London.</li> <li>Asthana, N. C., Asthana P., Disaster Management, Aavishkar Publishers.</li> <li>Carter, N., Disaster Management: A Disaster Manager's Handbook, Asian Development Bank.</li> <li>Collins, A.E., Disaster and Development, Routledge.</li> <li>Coppola, D.P., Introduction to International Disaster Management, 2<sup>nd</sup> Edition, Elsevier Science.</li> <li>Goyal, S.L., Encyclopedia of Disaster Management (Vols. 1-3), Deep &amp; Deep, New Delhi</li> <li>Gupta, A.K., Nair, S.S., Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi.</li> <li>Ibrahimbegovic, A., Zlatar, M., Damage Assessment and Reconstruction after War or Natural Disaster, Springer.</li> <li>Menshikov, V.A., Perminov, A.N., Urlichich, Y.M., Global Aerospace Monitoring and Disaster</li> <li>Modh, S., Introduction to Disaster Management, Macmillan Publishers India</li> <li>Srivastava, H.N., Gupta, G.D., Management of Natural Disasters in Developing Countries, Daya Publishers, NIDM AND NIDMA publications</li> </ol>
2.	<p>Journals &amp; Periodicals GSDMJ, disaster management act</p>

5	Other Electronic resources:GIDM, NIDM,
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Evaluation Scheme	Total Marks										
<b>Theory: Midsemester Marks</b>	20 marks										
<b>Theory: End Semester Marks</b>	40 marks										
<b>Theory: Continuous Evaluation Component Marks</b>	<table> <tr> <td>Attendance</td><td>05 marks</td></tr> <tr> <td>MCQs</td><td>10 marks</td></tr> <tr> <td>Open Book Assignment</td><td>15 marks</td></tr> <tr> <td>Article Review</td><td>10 marks</td></tr> <tr> <td><b>Total</b></td><td><b>40 Marks</b></td></tr> </table>	Attendance	05 marks	MCQs	10 marks	Open Book Assignment	15 marks	Article Review	10 marks	<b>Total</b>	<b>40 Marks</b>
Attendance	05 marks										
MCQs	10 marks										
Open Book Assignment	15 marks										
Article Review	10 marks										
<b>Total</b>	<b>40 Marks</b>										

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	0	3	2	0	1	1
CO2	1	1	1	1	1	1
CO3	3	2	3	0	2	2
CO4	2	1	2	1	1	0
CO5	1	0	3	1	0	0

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	0	1	0	2	1	3
CO2	1	1	1	1	1	0
CO3	0	1	1	2	1	0
CO4	0	0	1	3	0	0
CO5	0	0	2	2	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BSBO501	COURSE NAME BIOANALYTICAL TOOLS	SEMESTER V
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	-	120	4	0	2	6
<b>Course Pre-requisites</b>		Students should possess basic knowledge about biological analytical tools for deep understanding of theory and practical.					
<b>Course Category</b>		Core Professional					
<b>Course focus</b>		Employability					
<b>Rationale</b>		To understand the principle of various biophysical techniques.					
<b>Course Revision/ Approval Date :</b>		14/03/2020					
<b>Course Objectives (As per Blooms' Taxonomy)</b>		<ol style="list-style-type: none"> <li><b>Remember</b> To gain knowledge on the various techniques for bimolecular separation and purification.</li> <li><b>Apply</b> To understand the principle of various biophysical techniques.</li> <li><b>Analyses</b> To understand the instrumentation and application of various techniques.</li> <li><b>Create</b> To learn various biophysical techniques for characterization of the biomolecules.</li> <li><b>Understand</b> To solve diverse analytical problems and develop an analytical mindset.</li> </ol>					

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1:</b> Simple microscopy, phase contrast microscopy, fluorescence and electron microscopy (TEM and SEM)	20%	12
<b>Unit 2:</b> pH meter, absorption and emission spectroscopy, Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infra-red).	20%	12
<b>Unit 3:</b> Centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.	10%	6
<b>Unit 4:</b> Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC.	25%	15

<b>Unit 5:</b> Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE). Introduction to agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.	<b>25%</b>	<b>15</b>
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<b>List Of Practical</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>1:</b> Demonstration of Fluorescence microscope	<b>10%</b>	<b>4</b>
<b>2:</b> Preparation of protoplasts/spheroplast from leaves/ Bacteria	<b>10%</b>	<b>4</b>
<b>3:</b> Verify Beer's and Lambert's law using KMnO <sub>4</sub>	<b>10%</b>	<b>4</b>
<b>4:</b> Separation of cellular components using sucrose gradient	<b>10%</b>	<b>4</b>
<b>5:</b> Separation of Serum and blood cells	<b>10%</b>	<b>4</b>
<b>6:</b> Paper, TLC and column chromatography of amino acids, lipids and plant pigments	<b>20%</b>	<b>8</b>
<b>7:</b> Working of HPLC, GC (Demo)	<b>20%</b>	<b>8</b>
<b>8:</b> SDS PAGE of Protein	<b>10%</b>	<b>4</b>
<b>9:</b> Native Gel electrophoresis of Protein	<b>10%</b>	<b>4</b>

#### **Instructional Method and Pedagogy:**

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

<b>Course Outcomes:</b>	<b>Blooms' Taxonomy Domain</b>	<b>Blooms' Taxonomy Sub Domain</b>
After successful completion of the above course, students will be able to:  <b>CO1</b> Assimilate the principles and applications of centrifuge, electrophoresis.	Remember	Explain, Describe, Discuss, Recall, Locate

<b>CO2</b> Employ the knowledge for the separation of proteins/peptides by selecting appropriate separation techniques.	Apply	Apply, Practice, Interpret, Select, Correlate
<b>CO3</b> Characterize certain functionalities of biomolecules by using spectroscopic techniques.	Analyses and Evaluation	Compare, Classify, Select, Investigate
<b>CO4</b> Assimilate the principles and applications of chromatography in research and related experiments.	Create	Construct, Develop, Produce
<b>CO5</b> Plan experiments for separations and purifications of biomolecules.	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. Douglas A. Skoog, James J. Leary; Principles of instrumental analysis. ISBN: 0-03-075398-8</li> <li>2. Willard, H.H., Merritt L.L. Dean J.A. and Settle F.A., "Instrumental Methods of Analysis &amp; quot;, 7th Ed., Wadsworth Publishing Co., 1986.</li> <li>3. Instrumentation measurements and analysis – 2nd edition (2003). Nakra and Choudhari, Tata Mc Graw Hill, India.</li> <li>4. K. Wilson, J. M. Walker, Eds., Principles and techniques of biochemistry and molecular biology (Cambridge University Press, Cambridge, UK: New York, 7th ed., 2009).</li> <li>5. I. D. Campbell, Biological spectroscopy (Benjamin/Cummings Pub. Co, Menlo Park, Calif, 1984), Biophysical techniques series</li> <li>6. D. L. Spector, R. D. Goldman, Eds., Basic methods in microscopy: protocols and concepts from cells: a laboratory manual (Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y, 2006).</li> <li>7. R. F. Boyer, Modern experimental biochemistry (Benjamin Cummings, San Francisco, 3rd ed., 2000)</li> </ol>
2.	<p>Journals &amp; Periodicals Analytical methods</p> <p>Chromatography Today, The Scientist</p>
5	<p>Other Electronic resources</p> <p><a href="https://edu.rsc.org/resources/analysis">https://edu.rsc.org/resources/analysis</a></p>

Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	<b>Total</b>	<b>50 Marks</b>

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	0	1	1
CO2	2	2	2	1	2	2
CO3	1	2	2	2	2	2
CO4	2	2	1	1	2	2
CO5	2	2	2	1	2	2

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	1	2	2
CO2	2	2	2	3	1	1
CO3	3	2	3	2	2	1
CO4	1	1	2	2	2	2
CO5	2	2	2	2	2	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO502</b>	<b>COURSE NAME</b> <b>BIOPROCESS</b> <b>TECHNOLOGY</b>	<b>SEMESTER</b> <b>V</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	-	120	4	0	2	6

<b>Course Pre-requisites</b>	Basic knowledge of bioprocess technology.
<b>Course Category</b>	Core Professional
<b>Course focus</b>	Employability
<b>Rationale</b>	Students will get an overview of biological and biochemical technology in a bioprocess
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li><b>1. Remember</b> Know-how of biological and biochemical technology in a bioprocess.</li> <li><b>2. Apply</b> Process of production of biological products</li> <li><b>3. Analyses</b> Technical know-how on the design and operation of industrial practices.</li> <li><b>4. Create</b> On the successful completion of the subject, the student get an overall understanding of structure of atoms, molecules and chemical bonds.</li> <li><b>5. Understand</b> Gains knowledge on enzyme kinetics.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1:</b> Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fed batch and Continuous culture	<b>20%</b>	<b>12</b>
<b>Unit 2:</b> Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes.	<b>20%</b>	<b>12</b>



<b>Unit 3:</b> Principles of upstream processing – Media preparation, Inocula development and sterilization. Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa.	<b>20%</b>	<b>12</b>
<b>Unit 4:</b> Bioprocess measurement and control system with special reference to computer aided process control. Introduction to downstream processing.	<b>20%</b>	<b>12</b>
<b>Unit 5:</b> Product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.	<b>20%</b>	<b>12</b>

<b>List Of Practical</b>	<b>Weightage</b>	<b>Contact hours</b>
1: Screening and Isolation of industrially important microorganism from natural resource (enzyme/ antibiotic/organic acid producer)	<b>10%</b>	<b>4</b>
2: Calculation of thermal death point (TDP) of a microbial sample.	<b>10%</b>	<b>4</b>
3: Effect of pH on growth of bacteria	<b>10%</b>	<b>4</b>
4: Design and parts of bioreactor (Demo & Student presentation)	<b>10%</b>	<b>4</b>
5: Measure the dissolved oxygen in the fermentation broth	<b>10%</b>	<b>4</b>
6: Preparation of Inoculum (cell count of yeast cell using haemocytometer)	<b>10%</b>	<b>4</b>
7: Preparation of fermentation media	<b>10%</b>	<b>4</b>
8: Product recovery and Purification	<b>10%</b>	<b>4</b>
9: Antibiotic Assay	<b>10%</b>	<b>4</b>
10: Effluent treatment	<b>10%</b>	<b>4</b>
11: Production and Analysis of Ethanol	<b>10%</b>	<b>4</b>
12: Production and Analysis of amylase	<b>10%</b>	<b>4</b>

#### **Instructional Method and Pedagogy:**

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
<p>After successful completion of the above course, students will be able to:</p> <p><b>CO1</b> Describe the principle and applications of bioprocess technology.</p> <p><b>CO2</b> Apply fundamental calculation in bioprocessing.</p> <p><b>CO3</b> Illustrate the schematic diagram of upstream and downstream processing for product recovery and purification.</p> <p><b>CO4</b> Discuss the important aspects in bioprocess technology for the commercialization purpose of biotechnology products.</p> <p><b>CO5</b> Applying the concept of Enzyme</p>	<p>Remember</p> <p>Apply</p> <p>Analyses and Evaluation</p> <p>Create</p> <p>Understand</p>	<p>Explain, Describe, Discuss, Recall, Locate</p> <p>Apply, Practice, Interpret, Select, Correlate</p> <p>Compare, Classify, Select, Investigate</p> <p>Construct, Develop, Produce</p> <p>Explain, Describe, outline, Predict, Summarize</p>

Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. PMDoran(2013) Bioprocess Engineering Principles.</li> <li>2. Pogaku (2015) Advances in Bioprocess Technology</li> <li>3. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.</li> <li>4. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.</li> <li>5. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited</li> <li>6. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.</li> </ol>

2.	<b>Journals &amp; Periodicals</b> <ol style="list-style-type: none"> <li>1. The Journal of Bioprocess Technology.</li> <li>2. The Journal of Biochemical Engineering and Bioprocess Technology.</li> <li>3. Food and Bioprocess Technology.</li> <li>4. Bioprocess and biotechniques.</li> <li>5. Science Daily</li> </ol>
5	<b>Other Electronic resources</b> <ol style="list-style-type: none"> <li>1. <a href="https://bioprocessing.weebly.com/bioprocess-technology">https://bioprocessing.weebly.com/bioprocess-technology</a>.</li> <li>2. sciencemag.org</li> <li>3. NPTEL</li> </ol>

<b>Evaluation Scheme</b>	<b>Total Marks</b>	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	1	2	2
CO2	3	1	1	1	1	1



CO3	2	2	2	1	2	1
CO4	2	1	1	1	2	1
CO5	2	1	1	1	1	1

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	2	2
CO2	3	1	1	1	1	1
CO3	2	2	2	1	2	1
CO4	2	1	1	1	2	1
CO5	2	1	1	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO503</b>	<b>COURSE NAME</b> <b>ANIMAL AND PLANT</b> <b>BIOTECHNOLOGY</b>	<b>SEMESTER</b> <b>V</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	-	120	4	0	2	6

<b>Course Pre-requisites</b>	Basic knowledge of animal and plants tissue culture.
<b>Course Category</b>	Core Professional
<b>Course focus</b>	Employability
<b>Rationale</b>	Students will get an overview of plants and animal tissue culture and animal biotechnology.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> <b>(As per Blooms' Taxonomy)</b>	<ol style="list-style-type: none"> <li>1. <b>Remember</b> Theory and Applications of biotechnological techniques in the laboratory will provide students with the basic understanding of the molecular mechanisms that underlie cellular processes in animal and plants, with reference examples on important Mediterranean cultivars utilized in advanced Agricultural / Horticultural and Pharmaceutical Industry.</li> <li>2. <b>Apply</b> The subject covers animal molecular biology, recombinant DNA technology, production of transgenic animals, reproductive biotechnology, biotechnology in animal breeding and ethics.</li> <li>3. <b>Analyses</b> Intended to introduce the student to the principles and practical considerations of animal cell and tissue culture.</li> <li>4. <b>Create</b> Intended to introduce the student to the principles and practical considerations of animal cell and tissue culture.</li> <li>5. <b>Understand</b> The objectives of this course are to introduce students to the principles, practices and application of animal and plant biotechnology, animal genomics, genetic transformation and molecular breeding of animals.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1:</b> Gene transfer methods in Animals – Microinjection, Embryonic Stem cell, gene transfer, Retrovirus & Gene transfer. Introduction to transgenesis. Transgenic Animals – Mice, Cow, Pig, Sheep, Goat, Bird, Insect. Animal diseases need help of Biotechnology – Foot-and mouth disease, Coccidiosis, Trypanosomiasis, and Theileriosis.	20%	10
<b>Unit 2:</b> Animal propagation – Artificial insemination, Animal Clones. Conservation Biology – Embryo transfer techniques. Introduction to Stem Cell Technology and its applications. Introduction to Genetic modification in Medicine - gene therapy, types of gene therapy. Problems & ethics	20%	10
<b>Unit 3:</b> Introduction, Cryo and organogenic differentiation. Types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. Micropopagation Axillary bud proliferation, Meristem and shoot tip culture, cud culture, organogenesis, embryogenesis, advantages and disadvantages of micropopagation.	20%	10
<b>Unit 4:</b> In vitro haploid production, Significance and use of haploids, Ploidy level and chromosome doubling, diploidization, Gynogenic haploids, factors effecting gynogenesis, chromosome elimination techniques for production of haploids in cereals.	20%	7
<b>Unit 5:</b> Protoplast Isolation and fusion Methods of protoplast isolation, Protoplast development, Somatic hybridization, identification and selection of hybrid cells, Cybrids, Potential of somatic hybridization limitations. Soma clonal variation Nomenclature, methods, applications basis and disadvantages. Plant Growth Promoting bacteria. Nitrogen fixation, Nitrogenase, Hydrogenase, Nodulation, Biocontrol of pathogens.	20%	8

List Of Practical	Weightage	Contact hours
<b>1:</b> Sterilization techniques: Theory and Practical: Glass ware sterilization, Media sterilization, Laboratory sterilization	10%	4
<b>2:</b> Sources of contamination and decontamination measures	10%	4
<b>3:</b> DNA isolation from animal tissue	10%	4
<b>4:</b> Quantification of isolated DNA	10%	4
<b>5:</b> Resolving DNA on Agarose Gel	10%	4
<b>6:</b> Preparation of Hanks Balanced salt solution	10%	4
<b>7:</b> Preparation of Minimal Essential Growth medium	10%	4
<b>8:</b> Isolation of lymphocytes for culturing	10%	4
<b>9:</b> Preparation of simple growth nutrient (knop's medium), full strength, half strength, solid and liquid	10%	4

<b>10:</b> Preparation of complex nutrient medium (Murashige & Skoog's medium)	<b>10%</b>	<b>4</b>
<b>11:</b> To selection, Prune, sterilize and prepare an explant for culture	<b>10%</b>	<b>4</b>
<b>12:</b> Significance of growth hormones in culture medium	<b>10%</b>	<b>4</b>
<b>13:</b> To demonstrate various steps of Micropropagation	<b>10%</b>	<b>4</b>

### Instructional Method and Pedagogy:

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
<b>CO1</b> Familiar with sterile techniques, media preparation, DNA extraction methods, gene isolation and nucleotide sequence analysis	Remember	Explain, Describe, Discuss, Recall, Locate
<b>CO2</b> Acquainted with principles, technical requirement, scientific and commercial applications in Plant Biotechnology	Apply	Apply, Practice, Interpret, Select, Correlate
<b>CO3</b> Able to support methodologies in plant tissue/cell culture to plant improvement, as well as DNA handling with PCR- based detection diagnostic tools	Analyses and Evaluation	Compare, Classify, Select, Investigate
<b>CO4</b> Motivated to set goals towards pursuing graduate school and higher-level positions, such as lab manager and key scientist in plant / Animal biotechnological research institutes and industries.	Create	Construct, Develop, Produce
<b>CO5</b> Able to describe the contribution 'functional genomics' is making and is likely to make in animal biotechnology now and in the future.	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California, USA.</li> <li>2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.</li> <li>3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.</li> <li>4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman &amp; Co., N.Y., USA.</li> <li>5. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA genes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.</li> <li>6. Bhojwani, S.S. and Razdan 2004 Plant Tissue Culture and Practice.</li> <li>6. Brown, T. A. Gene cloning and DNA analysis: An Introduction. Blackwell Publication.</li> <li>7. Gardner, E.J. Simmonns, M.J. Snustad, D.P. 2008 8th edition Principles of Genetics. Wiley India.</li> <li>8. Raven, P.H., Johnson, GB., Losos, J.B. and Singer, S.R. 2005 Biology. Tata MC Graw Hill.</li> <li>9. Reinert, J. and Bajaj, Y.P.S. 1997 Applied and Fundamental Aspects of Plant Cell, Tissue and Organ Culture. Narosa Publishing House.</li> <li>10. Sambrook &amp; Russel. Molecular Cloning: A laboratory manual. (3rd edition)</li> <li>11. Slater, A., Scott, N.W. &amp; Fowler, M.R. 2008 Plant Biotechnology: The Genetic Manipulation of Plants, Oxford University Press.</li> <li>12. Russell, P.J. 2009 Genetics – A Molecular Approach. 3rd edition. Benjamin Co</li> </ol>
2.	<p>Journals &amp; Periodicals</p> <p>Cell reports and Molecular endocrinology</p>
5	<p>Other Electronic resources</p> <p>NPTL and UGC pathasala, Edx courses</p>

Evaluation Scheme	Total Marks
Theory: Midsemester Marks	20 marks
Theory: End Semester Marks	40 marks
Theory: Continuous	



<b>Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	<b>Total</b>	<b>50 Marks</b>

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	3	1	2	1	1
CO2	2	2	1	2	1	1
CO3	2	2	1	2	1	1
CO4	1	1	1	2	1	1
CO5	1	1	1	2	0	1

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	2	1
CO2	2	2	3	1	2	1
CO3	2	2	1	1	2	1
CO4	2	1	2	1	2	1
CO5	2	1	1	1	2	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BSBO504	COURSE NAME VIROLOGY	SEMESTER V
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	-	120	4	0	2	6

<b>Course Pre-requisites</b>	Basic knowledge of microbial world and viruses.		
<b>Course Category</b>	Core Professional		
<b>Course focus</b>	Employability		
<b>Rationale</b>	Students will get an overview of types of viruses, their replication strategies and mechanisms for development of viral infectious diseases.		
<b>Course Revision/ Approval Date :</b>	14/03/2020		
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li><b>Remember</b> The course will give an overview of types of viruses, their replication strategies and mechanisms for development of viral infectious diseases.</li> <li><b>Apply</b> The distinctive characteristics between prokaryotes, eukaryotes and viruses. The biological, chemical and physical properties of viruses. The principles of viral taxonomy</li> <li><b>Analyses</b> The structure of viruses and their replicative cycle</li> <li><b>Create</b> The bases of viral genetic variability and the principles of viral evolution.</li> <li><b>Understand</b> The interaction virus-host and mechanisms of disease.</li> </ol>		
Course Content (Theory)		Weightage	Contact hours
<b>Unit 1: Nature and Properties of Viruses</b> Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses Isolation, purification and cultivation of viruses' Viral taxonomy: Classification and nomenclature of different groups of viruses		25%	15
<b>Unit 2: Bacteriophages</b> Diversity, classification, one step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage.		25%	15

<b>Unit 3: Viral Transmission, Salient features of viral nucleic acids and Replication</b> Modes of viral transmission: Persistent, non-persistent, vertical and horizontal Salient features of viral Nucleic acid : Unusual bases (TMV, T4 phage), overlapping genes ( $\phi$ X174, Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B), long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing (TMV) Viral multiplication and replication strategies: Interaction of viruses with cellular receptors and entry of viruses. Replication strategies of viruses as per Baltimore classification (phi X 174, Retroviridae, Vaccinia, Picorna). Assembly, maturation and release of virions.	<b>20%</b>	<b>12</b>
<b>Unit 4: Viruses and Cancer</b> Introduction to oncogenic viruses Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes.	<b>20%</b>	<b>12</b>
<b>Unit 5: Prevention &amp; control of viral diseases</b> Antiviral compounds and their mode of action Interferon and their mode of action General principles of viral vaccination <b>Applications of Virology</b> Use of viral vectors in cloning and expression, Gene therapy and Phage display.	<b>10%</b>	<b>06</b>

<b>List Of Practical</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>1:</b> Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique.	<b>20%</b>	<b>12</b>

#### **Instructional Method and Pedagogy:**

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

<b>Course Outcomes:</b>	<b>Blooms' Taxonomy Domain</b>	<b>Blooms' Taxonomy Sub Domain</b>
After successful completion of the above course, students will be able to:  <b>CO1</b> Understand the structure and life cycle of viruses as well as viral evolution.	Remember	Explain, Describe, Discuss, Recall, Locate



<b>CO2</b> Know the mechanisms of host immune responses to viral infections.	Apply	Apply, Practice, Interpret, Select, Correlate
<b>CO3</b> Understand the pathogenesis of viral infections.	Analyses and Evaluation	Compare, Classify, Select, Investigate
<b>CO4</b> Understand the methodological approaches in diagnostic investigation of infectious diseases.	Create	Construct, Develop, Produce
<b>CO5</b> Understand the epidemiology of infections.	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. Bos L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.</li> <li>2. Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.</li> <li>3. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.</li> <li>4. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.</li> <li>5. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecularbiology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.</li> <li>6. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.</li> <li>7. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.</li> <li>8. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.</li> <li>9. Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.</li> </ol>
2.	<p>Journals &amp; Periodicals</p> <ol style="list-style-type: none"> <li>1. Journal of Virology.</li> <li>2. Retrovirology.</li> <li>3. Annual Review of Virology.</li> </ol>
5	<p>Other Electronic resources</p> <ol style="list-style-type: none"> <li>1. Archives of Virology.</li> <li>2. mBio.</li> <li>3. Future of Virology.</li> </ol>

Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	<b>Total</b>	<b>50 Marks</b>

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	2	3	1	2	1
CO2	2	2	3	1	2	1
CO3	2	2	2	1	2	3
CO4	2	2	2	1	2	3
CO5	2	2	3	1	2	1

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	0	1	1	0
CO2	3	2	0	0	1	0
CO3	3	1	3	0	2	2
CO4	3	1	3	0	2	2
CO5	3	2	3	0	2	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO505</b>	<b>COURSE NAME</b> <b>ECOLOGY AND</b> <b>EVOLUTION</b>	<b>SEMESTER</b> <b>V</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	-	120	4	0	2	6

<b>Course Pre-requisites</b>	Basic knowledge of bioprocess technology.
<b>Course Category</b>	Professional Elective/Core Professional/Generic Elective/Courses Offered by other departments/Open Electives
<b>Course focus</b>	Employability
<b>Rationale</b>	Students will get an overview of ecosystem structure and to learn about ecosystem function.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li><b>1. Remember</b> To understand ecosystem structure.</li> <li><b>2. Apply</b> To learn about ecosystem function.</li> <li><b>3. Analyses</b> To understand process of major biogeochemical cycles.</li> <li><b>4. Create</b> To learn about history of evolution with the help of fossil records.</li> <li><b>5. Understand</b> To know about variation and evolutionary principles.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1:</b> Development & Evolution of Ecosystem. Principles & Concepts of Ecosystem. Structure of ecosystem. Strata of an ecosystem. Types of ecosystem including habitats. Cybernetics & Homeostasis. Biological control of chemical environment	<b>20%</b>	<b>12</b>
<b>Unit 2:</b> Energy transfer in an Ecosystem. Food chain, food web, Energy budget, Production & decomposition in a system. Ecological efficiencies, Trophic structure & energy pyramids	<b>20%</b>	<b>12</b>

<b>Unit 3:</b> Ecological energetic, principles pertaining to limiting factors, Bio-geochemical cycles (N, C, P cycles)	<b>20%</b>	<b>12</b>
<b>Unit 4:</b> Major Events in History of Life, Lamarckism, Darwinism, Neo-Darwinism Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny	<b>20%</b>	<b>12</b>
<b>Unit 5:</b> Organic variations; Isolating Mechanisms; Natural selection (Example: Industrial melanism); Types of natural selection (Directional, Stabilizing, Disruptive), Artificial selection. Biological species concept. Macro-evolutionary Principles (example: Darwin's Finches) Mass extinction (Causes, Names of five major extinctions, K-T extinction in detail), Role of extinction in evolution	<b>20%</b>	<b>12</b>

<b>List Of Practical</b>	<b>Weightage</b>	<b>Contact hours</b>
1. Study of all the biotic and abiotic components of any simple ecosystem- natural pond or terrestrial ecosystem or human modified ecosystem. 2. Determination of population density in a terrestrial community or hypothetical community by quadrat method and calculation of the Simpson's and Shannon- Weiner diversity index for the same community. 3. Principle of GPS (Global Positioning System)	<b>20%</b>	<b>12</b>
1. Study of all the biotic and abiotic components of any simple ecosystem- natural pond or terrestrial ecosystem or human modified ecosystem. 2. Study of the life table and fecundity table, plotting of the three types of survivorship curves from the hypothetical data.	<b>20%</b>	<b>12</b>
1. Study of the types of soil, their texture by sieve method and rapid tests for – pH, chlorides, nitrates, carbonates and organic carbon	<b>20%</b>	<b>12</b>
1. Study of fossil evidences from plaster cast models and pictures 2. Study of homology and analogy from suitable specimens/ pictures/Charts: Phylogeny of horse with diagrams/ cut outs of limbs and teeth of horse ancestors b) Darwin's Finches with diagrams/ cut outs of beaks of different species	<b>20%</b>	<b>12</b>
1. Classification of non-chordate and chordate phyla 3. Study any five endangered/ threatened species- one from each class. 2. Visit to NaturalHistory Museum and submission of report	<b>20%</b>	<b>12</b>

#### **Instructional Method and Pedagogy:**

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
<p>After successful completion of the above course, students will be able to:</p> <p><b>CO1</b> Skills required to identifying adaptive features of animals and plants due to evolution.</p> <p><b>CO2</b> Students are able to demonstrate knowledge of the fundamentals of Ecology and Evolution.</p> <p><b>CO3</b> Students will be able to describe the history and development of evolutionary thought.</p> <p><b>CO4</b> Students will be able to list and describe the evidence for evolution.</p> <p><b>CO5</b> Students will be able to describe the mechanisms by which evolution occurs.</p>	<p>Remember</p> <p>Apply</p> <p>Analyses and Evaluation</p> <p>Create</p> <p>Understand</p>	<p>Explain, Describe, Discuss, Recall, Locate</p> <p>Apply, Practice, Interpret, Select, Correlate</p> <p>Compare, Classify, Select, Investigate</p> <p>Construct, Develop, Produce</p> <p>Explain, Describe, outline, Predict, Summarize</p>



Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. What Darwin Didn't Know: The Modern Science of Evolution by Scott Solomon, The Teaching Company</li> <li>2. Life Finds a Way: What Evolution Teaches Us About Creativity by Andreas Wagner, Basic Books</li> <li>3. The theory of evolution by John Maynard Smith, Cambridge University Press</li> <li>4. Big Questions in Ecology and Evolution by Thomas N. Sherratt and David M. Wilkinson Oxford University Press</li> <li>5. Life Changing: How Humans are Shaping the Course of Evolution by Helen Pilcher, Bloomsbury Sigma Books</li> <li>6. Discovering Evolutionary Ecology: Bringing Together Ecology and Evolution by Peter J. Mayhew, Oxford University Press, USA</li> <li>7. Life on Earth: An Encyclopedia of Biodiversity, Ecology, and Evolution by Niles Eldredge</li> <li>8. Clonality: The Genetics, Ecology, and Evolution of Sexual Abstinence in Vertebrate Animals by John Avise, Oxford University Press, USA</li> <li>9. Natural Selection: Domains, Levels, and Challenges By George C. Williams, Oxford University Press</li> <li>10. Alien Species and Evolution: The Evolutionary Ecology of Exotic Plants, Animals, Microbes, and Interacting Native Species by George W. Cox</li> </ol>
2.	<p>Journals &amp; Periodicals</p> <ol style="list-style-type: none"> <li>1. Ecology and Evolution</li> <li>2. Frontiers in Ecology and Evolution</li> <li>3. Nature Ecology and Evolution</li> <li>4. Annual Review of Environment and Resources</li> <li>5. Nature Energy</li> <li>6. Perspectives in Ecology and Conservation</li> <li>7. Trends in Ecology and Evolution</li> </ol>
3.	<p>Other Electronic resources</p> <p>Nature Education Knowledge Project</p>

Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component</b>	Attendance	05 marks

<b>Marks</b>		MCQs	10 marks
		Open Book Assignment	15 marks
		Article Review	10 marks
		<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>		Attendance	05 marks
		Practical Exam	20 marks
		Viva	10 marks
		Journal	10 marks
		Discipline	05 marks
		<b>Total</b>	<b>50 Marks</b>

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	1	0	1	3	2
CO2	3	1	0	1	2	2
CO3	3	1	0	1	0	1
CO4	2	1	0	1	0	0
CO5	3	1	0	1	1	2

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	0	1	3	2
CO2	3	1	0	1	2	2
CO3	3	1	0	1	0	1
CO4	2	1	0	1	0	0
CO5	3	1	0	1	1	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO506</b>	<b>COURSE NAME</b> <b>RESEARCH</b> <b>METHODOLOGY</b>	<b>SEMESTER</b> <b>V</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	-	120	4	0	2	6

<b>Course Pre-requisites</b>	Basic knowledge of Research Methodology.
<b>Course Category</b>	Core Professional
<b>Course focus</b>	Employability
<b>Rationale</b>	Students will get an overview of Methodology of research and handling processes
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li><b>1. Remember</b> The objective of this course is to familiarize students with the research methodology and importance of project writing.</li> <li><b>2. Apply</b> understand some basic concepts of research and its methodologies.</li> <li><b>3. Analyses</b> Students should understand a general definition of research design</li> <li><b>4. Create</b> Students should know why educational research is undertaken, and the audiences that profit from research studies.</li> <li><b>5. Understand</b> Students should be able to identify the overall process of designing a research study from its inception to its report.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1:</b> Theory: Basic concepts of Research: definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research. Defining the Research Problem: Selecting and defining a research problem, Reviewing and conducting literature search, Developing a research plan.	20%	12
<b>Unit 2:</b> Theory: Data collection and documentation of observations: Methods of data collection, Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissues specimens and application of scale bars.	20%	12
<b>Unit 3:</b> Theory: Model organisms in biology (A Brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics-Transcriptional regulatory network. Designing of Experiment: Different experimental designs – single and multifactorial design, Making measurements and sources of error in measurements	20%	12
<b>Unit 4:</b> Theory: General laboratory practices: Common calculations in laboratories. Understanding the details on the label of reagent bottles. Molarity and normality of common acids and bases. Preparation of solutions. Dilutions. Percentage solutions. Molar, molal and normal solutions. Technique of handling micropipettes; Knowledge about common toxic chemicals and safety measures in their handling.	20%	12
<b>Unit 5:</b> Theory: The art of scientific writing and its presentation: Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Powerpoint presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism	20%	12

List Of Practical	Weightage	Contact hours
1. Each student will be asked to make presentation about the project including literature available, objective sought and work plan including methodologies as described above.	20%	12
2. The student will write standard operating protocols (SOPs) and identify requirement for equipment and reagents.	20%	12
3. Experiments based on chemical calculations	20%	12
4. Poster presentation on defined topics.	20%	12

5. Technical writing on topics assigned.	20%	12
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### Instructional Method and Pedagogy:

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
<b>CO1</b> Understand some basic concepts of research and its methodologies.	Remember	Explain, Describe, Discuss, Recall, Locate
<b>CO2</b> Identify appropriate research topics.	Apply	Apply, Practice, Interpret, Select, Correlate
<b>CO3</b> Select and define appropriate research problem and parameters .	Analyses and Evaluation	Compare, Classify, Select, Investigate
<b>CO4</b> Prepare a project proposal (to undertake a project).	Create	Construct, Develop,
<b>CO5</b> Organize and conduct research (advanced project) in a more appropriate manner .	Understand	Produce Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.</li> <li>2. Research in Education (1992) 6th ed., Best, J.W. and Kahn, J.V., Prentice Hall of India Pvt. Ltd. At the Bench: A Laboratory Navigator (2005)</li> <li>3. Barker, K., Cold Spring Harbor Laboratory Press (New York), ISBN: 978-087969708-2. 51</li> <li>4. Research Methodology - Methods and Techniques (2004) 2nd ed., Kothari C.R., New Age International Publishers.</li> <li>5. Research Methodology: A Step by Step Guide for Beginners (2005) 2nd ed., Kumar R., Pearson Education</li> </ol>
2.	<p>Journals &amp; Periodicals</p> <ol style="list-style-type: none"> <li>1. Journal of Mixed Method Research</li> <li>2. Journal of Research practice.</li> <li>3. Survey Research Methods</li> </ol>
5	<p>Other Electronic resources NPTEL</p>

Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks

		<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>			
		Attendance	05 marks
		Practical Exam	20 marks
		Viva	10 marks
		Journal	10 marks
		Discipline	05 marks
		<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	0	1	2	3	1	0
CO2	1	1	1	1	1	0
CO3	0	1	1	2	1	0
CO4	0	0	1	3	0	0
CO5	0	0	2	2	1	0

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	0	1	2	3	1	0
CO2	1	1	1	1	1	0
CO3	0	1	1	2	1	0
CO4	0	0	1	3	0	0
CO5	0	0	2	2	1	0

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

Semester – VI							
Sr.No.	Course Code	Course Title	L	T	P	C	Marks
<b>A. Ability Enhancement Compulsory Course</b>							
1	AECC601	Indian Constitution	2	0	0	2	100
<b>B. Core Course</b>							
2	BSBO601	Immunology	4	0	2	6	150
3	BSBO602	Bioinformatics & Drug Discovery, Design and Development	4	0	2	6	150
<b>C. Discipline Specific Generic Electives (Any Two)</b>							
4	BSBO503	Environmental Biotechnology	4	0	2	6	150
5	BSBO504	Genomics & Proteomics	4	0	2	6	150
6	BSBO505	Biosafety, Bioethics & IPR	4	0	2	6	150
7	BSBO506	Medical Biotechnology	4	0	2	6	150
Total						26	700



### Teaching Scheme Semester– VI

Sr. No	Course Code	Course Name	Teaching Scheme (Hours/week)				Teaching Credit				Evaluation Scheme					
			L	P	T	Total	L	P	T	Total	Theory: MS Marks	Theory: CEC Marks	Theory: ES Marks	Theory Marks	Practical Marks	Total Marks
			A. Ability Enhancement Compulsory Course													
1	AECC601	Indian Constitution	2	0	0	2	2	0	0	2	20	40	40	100	00	100
			B. Core Course													
2	BSBO601	Immunology	4	4	0	8	4	2	0	6	20	40	40	100	50	150
3	BSBO602	Bioinformatics & Drug Discovery, Design and Development	4	4	0	8	4	2	0	6	20	40	40	100	50	150
			C. Discipline Specific Generic Electives (Any Two)													
4	BSBO603	Environmental Biotechnology	4	4	0	8	4	2	0	6	20	40	40	100	50	150
5	BSBO604	Genomics & Proteomics	4	4	0	8	4	2	0	6	20	40	40	100	50	150
6	BSBO605	Biosafety, Bioethics & IPR	4	4	0	8	4	2	0	6	20	40	40	100	50	150
7	BSBO606	Medical Biotechnology	4	4	0	8	4	2	0	6	20	40	40	100	50	150
		<b>Total</b>								<b>26</b>						<b>750</b>

**Note:** L = Lecture, P = Practice, T= Tutorial, MS - Mid Semester, CEC - Continuous Evaluation Component, ES - End Semester

<b>COURSE CODE</b> <b>AECC601</b>	<b>COURSE NAME</b> <b>INDIAN CONSTITUTION</b>	<b>SEMESTER</b> <b>VI</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
30	0	0	30	2	0	0	2

<b>Course Pre-requisites</b>	10 +2 (With Arts/Science/Commerce)
<b>Course Category</b>	Ability Enhancement Compulsory Course.
<b>Course focus</b>	Skill development
<b>Rationale</b>	The fundamental concepts of Indian Constitution help in understanding the role of government and framework of Indian Constitution. This subject also enables the students to understand the administrative organizational structure of India.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> (As per Blooms' Taxonomy)	To enable the student: <ol style="list-style-type: none"> <li>1. To understand Indian Constitution.</li> <li>2. To know the framework of Indian Constitution.</li> <li>3. To aware role of government of the union.</li> <li>4. To aware role of the state government.</li> <li>5. To understand administration organization.</li> </ol>

<b>Course Content (Theory)</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1: Constitution – Strategies and Principles</b> <ol style="list-style-type: none"> <li>1. Meaning and important of constitution</li> <li>2. Making of Indian constitution – sources</li> <li>3. Salient Features of Indian constitution.</li> </ol>	<b>20%</b>	<b>6</b>
<b>Unit 2: Fundamental Rights and Directive Principles</b> <ol style="list-style-type: none"> <li>1. Fundamental Rights</li> <li>2. Fundamental Duties</li> <li>3. Directive Principles</li> </ol>	<b>20%</b>	<b>6</b>

<b>Unit 3: Government of the Union</b> 1. President of India – Election and powers 2. Prime Minister and council of ministers 3. Lok Sabha – composition and Powers 4. Rajya Sabha – Composition and Powers.	20%	6
<b>Unit 4: Government of the States &amp; The Judiciary</b> 1. Governor – Powers 2. Chief Minister and Council of ministers 3. Legislative Assembly – Composition and Powers 4. Legislative Council – Composition and Powers 5. Features of judiciary system in India 6. Supreme Court – Structure and Jurisdiction.	20%	6
<b>Unit 5: Administrative Organization and Constitution</b> 1. Federalism in India – features 2. Local Government – Panchyats and Powers and functions 73rd and 74th Amendments 3. Election Commission – Organization and functions 4. Citizen Oriented Measure – RTI and PIL – Provisions and Significance.	20%	6

#### Instructional Method and Pedagogy:

Utilizing models, PowerPoint Presentations, group discussions, and seminars are some of the methods adopted to improve the student's ability to grasp the principles of environmental studies.

Course Outcome:	Blooms' Taxonomy Domain	Blooms' Taxonomy Subdomain
After successful completion of the above course, students will be able to:		
<b>CO1:</b> Analyse importance of Indian constitution	Understand	Define, Classify & Describe
<b>CO2:</b> Analyse importance of Indian constitution	Apply	Define, Classify, Describe, Demonstrate & Examine
<b>CO3:</b> Know powers of state and union government.	Analyses and Evaluation	Define, Classify, Describe & Demonstrate

<b>CO4:</b> Understand administration of Indian Constitution	Apply & analyse	Define, Classify, Describe, Demonstrate & Examine
<b>CO5:</b> Understand administration of Indian Constitution.	Remember & apply	Define, Describe & Demonstrate
<b>Learning Resources</b>		
1.	<b>Reference/Text Books:</b> <ol style="list-style-type: none"> <li>1. Indian's Constitution by M.V. Pylee, New Delhi S. Chand Publication</li> <li>2. The Constitutional Law of India by J.N. Panday Allahabad Central Law Agency</li> <li>3. Constitution of India by National Portal of India</li> <li>4. <a href="https://www.india.gov.in/sites/upload-files/coi_part_full.pdf">https://www.india.gov.in/sites/upload-files/coi_part_full.pdf</a>.</li> </ol>	
2.	<b>Journals &amp; Periodicals:</b> <ol style="list-style-type: none"> <li>1. Constitution of India</li> <li>2. National Portal of India.</li> </ol>	
3.	<b>Other Electronic Resources:</b> <ol style="list-style-type: none"> <li>1. <a href="https://legislative.gov.in/constitution-of-india">https://legislative.gov.in/constitution-of-india</a></li> </ol>	

Evaluation Scheme	Total Marks										
<b>Theory: Midsemester Marks</b>	20 marks										
<b>Theory: End Semester Marks</b>	40 marks										
<b>Theory: Continuous Evaluation Component Marks</b>	<table> <tr> <td>Attendance</td><td>05 marks</td></tr> <tr> <td>MCQs</td><td>10 marks</td></tr> <tr> <td>Open Book Assignment</td><td>15 marks</td></tr> <tr> <td>Article Review</td><td>10 marks</td></tr> <tr> <td><b>Total</b></td><td><b>40 Marks</b></td></tr> </table>	Attendance	05 marks	MCQs	10 marks	Open Book Assignment	15 marks	Article Review	10 marks	<b>Total</b>	<b>40 Marks</b>
Attendance	05 marks										
MCQs	10 marks										
Open Book Assignment	15 marks										
Article Review	10 marks										
<b>Total</b>	<b>40 Marks</b>										

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	0	1	0	3	0	0
CO2	0	3	0	3	0	1
CO3	0	2	0	3	0	0



CO4	0	2	0	3	0	0
CO5	0	2	0	3	0	1

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	0	0	0	2	3	1
CO2	0	1	1	2	3	1
CO3	0	1	0	2	3	3
CO4	0	0	0	2	3	3
CO5	0	0	0	2	3	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

COURSE CODE BSBO601	COURSE NAME IMMUNOLOGY	SEMESTER VI
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
6	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Students should have basic knowledge about Immunity.
<b>Course Category</b>	Core Professional.
<b>Course focus</b>	Employability
<b>Rationale</b>	To have an overview of Immune response and its components. The subject also explains the regulation of immunoglobulin gene, major histocompatibility complexes, vaccines and vaccine development and immunodiagnostics.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<ol style="list-style-type: none"> <li>1. <b>Remember</b> Outline, compare and contrast the key mechanisms and cellular players of innate and adaptive immunity.</li> <li>2. <b>Apply</b> Elucidate the genetic basis for immunological diversity and the generation of adaptive immune responses.</li> <li>3. <b>Analyses</b> Outline key events and cellular players in antigen presentation, and how the nature of the antigen will shape resulting effectors responses.</li> <li>4. <b>Create</b> Understand and explain the basis of allergic diseases and immunodeficiencies related diseases.</li> <li>5. <b>Understand</b> The principles governing vaccination and the mechanisms of protection against disease.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1:</b> Immune Response Theory: An overview, components of mammalian immune system, molecular structure of Immunoglobulins or Antibodies. Humoral & Cellular immune responses, T- lymphocytes & immune response (cytotoxic T-cell, helper T-cell, suppressor T-cells), Tcell receptors, genome rearrangements during Blymphocyte differentiation, Antibody affinity maturation class switching, assembly of T-cell receptor genes by somatic recombination.	<b>20%</b>	<b>12</b>

<b>Unit 2:</b> Regulation of immunoglobulin gene expression Theory: Clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.	<b>20%</b>	<b>12</b>
<b>Unit 3:</b> Regulation of immunoglobulin gene expression Theory: Clonal selection theory, allotypes & idiotypes, allelic exclusion, immunologic memory, heavy chain gene transcription, genetic basis of antibody diversity, hypotheses (germ line & somatic mutation), antibody diversity.	<b>20%</b>	<b>12</b>
<b>Unit 4:</b> Vaccines & Vaccination Theory: Adjuvants, cytokines, DNA vaccines, recombinant vaccines, bacterial vaccines, viral vaccines, vaccines to other infectious agents, passive & active immunization.	<b>20%</b>	<b>12</b>
<b>Unit 5:</b> Immunodiagnostics Theory: Introduction to immunodiagnostics – RIA, ELISA. etc	<b>20%</b>	<b>12</b>

<b>List Of Practical</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>1:</b> Differential leucocytes count	<b>10%</b>	<b>4</b>
<b>2:</b> Total leucocytes count	<b>10%</b>	<b>4</b>
<b>3:</b> Total RBC count	<b>10%</b>	<b>4</b>
<b>4:</b> Separation of serum from blood	<b>10%</b>	<b>4</b>
<b>5:</b> Hemagglutination assay	<b>10%</b>	<b>4</b>
<b>6:</b> Hemagglutination inhibition assay	<b>10%</b>	<b>4</b>
<b>7:</b> Latex Agglutination Assay	<b>10%</b>	<b>4</b>
<b>8:</b> Single radial ImmunoAssay	<b>10%</b>	<b>4</b>
<b>9:</b> Double immunodiffusion test using specific antibody and antigen.	<b>10%</b>	<b>4</b>
<b>10:</b> Dot ELISA	<b>10%</b>	<b>4</b>
<b>11:</b> Sandwich ELISA	<b>10%</b>	<b>4</b>

#### **Instructional Method and Pedagogy:**

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
<p>After successful completion of the above course, students will be able to:</p> <p><b>CO1</b> Outline, compare and contrast the key mechanisms and cellular players of innate and adaptive immunity.</p> <p><b>CO2</b> Elucidate the genetic basis for immunological diversity and the generation of adaptive immune responses.</p> <p><b>CO3</b> Outline key events and cellular players in antigen presentation, and how the nature of the antigen will shape resulting effector responses</p> <p><b>CO4</b> Understand and explain the basis of allergic diseases and immunodeficiencies related diseases.</p> <p><b>CO5</b> Understand the principles governing vaccination and the mechanisms of protection against disease.</p>	<p>Remember</p> <p>Apply</p> <p>Analyses and Evaluation</p> <p>Create</p> <p>Understand</p>	<p>Explain, Describe, Discuss, Recall, Locate</p> <p>Apply, Practice, Interpret, Select, Correlate</p> <p>Compare, Classify, Select, Investigate</p> <p>Construct, Develop, Produce</p> <p>Explain, Describe, outline, Predict, Summarize</p>

Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley- Blackwell Scientific Publication, Oxford.</li> <li>2. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.</li> <li>3. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.</li> <li>4. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.</li> <li>5. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.</li> <li>6. Textbook: 1. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York</li> </ol>
2.	<p>Journals &amp; Periodicals</p> <ol style="list-style-type: none"> <li>1. Journal of Immunology</li> <li>2. Molecular Immunology</li> <li>3. Nature Review immunology</li> <li>4. The Scientist</li> </ol>
5	Other Electronic resources: <a href="https://www.immunology.org/">https://www.immunology.org/</a>



Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	<b>Total</b>	<b>50 Marks</b>

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	2	1	0	1	1	0
CO2	1	1	1	2	0	0
CO3	1	0	0	1	2	1
CO4	2	0	2	2	2	2
CO5	2	1	0	1	0	2

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	0	2	2	1
CO2	2	1	1	2	0	0
CO3	2	0	0	1	2	1
CO4	2	1	2	3	2	2
CO5	2	1	0	1	0	3

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE BSBO602</b>	<b>COURSE NAME BIOINFORMATICS AND INTRODUCTION TO DRUG DISCOVERY, DESIGN AND DEVELOPMENT</b>	<b>SEMESTER VI</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Students should have basic knowledge about fundamental theories and practices of bioinformatics and it will also provide an overview of the drug development process, focusing on drug development science, regulation.
<b>Course Category</b>	Core Professional.
<b>Course focus</b>	Employability
<b>Rationale</b>	To have an overview of the fundamental theories and practices of bioinformatics and an overview of the drug development process, focusing on drug development science, regulation.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<ol style="list-style-type: none"> <li><b>1. Remember</b> provide an overview of the drug development process, focusing on drug development science, regulation.</li> <li><b>2. Apply</b> to introduce the fundamental theories and practices of bioinformatics, which is an interdisciplinary thrust area merging Biology and Information Technology.</li> <li><b>3. Analyses</b> Safety evaluation, bioavailability, clinical trials, and the essentials of patent law.</li> <li><b>4. Create</b> drug development as a process involving target selection, lead discovery using computer-based methods and combinatorial chemistry/high-throughput screening.</li> <li><b>5. Understand</b> Understand biological databases, analysis of macromolecular Sequences and phylogenetic analysis.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1:</b> Basic Computer- MS-WORD, EXCEL, Microsoft PowerPoint, Adobe Photoshop Introduction to Bioinformatics: Introduction to Bioinformatics, Introduction to biological macromolecules, History of Bioinformatics, Scope of Bioinformatics Introduction to Biological databases, Nucleic acid databases: Introduction to biological databases in general, Classification- Primary, Secondary, Composite databases, Flat files in databases, various file formats, FASTA, GENBANK, Nucleic acid sequence databases- GENBANK, EMBL, DDBJ etc.	20%	12
<b>Unit 2:</b> Protein databases and specialized databases: Protein sequence and structure databases – UNIPROT, PIR, SWISS-PROT, PDB etc., Other databases of patterns/ motifs/ metabolic pathways/ Immunology/genetic disorders etc, Composite databases like NCBI, Data base searching, Bibliographic databases like PUBMED	20%	12
<b>Unit 3:</b> Genome databases and search protocol: Genome databases at NCBI, SANGER, TIGR etc. Secondary database search protocol, Use of Boolean operators	20%	12
<b>Unit 4:</b> Sequence alignment: Pairwise alignment techniques Global alignment, Local alignment, pairwise alignment techniques- continued, Significance of alignment- Z-score, P-score, E-value, Multiple sequence alignment-Dynamic programming Sequence alignment, BLAST analysis: Multiple sequence alignment techniques- continued- profile, Hidden Markov Model, BLAST analysis, E-value, Different types of BLAST, PSI-BLAST, PHI-BLAST.	20%	12
<b>Unit 5:</b> Introduction to Drug Discovery, Design and Development: Introduction to Drug Design and Development, Drug targets, Lead Identification and Modification, Computer-Aided Drug Design, Drug Delivery, Pre-clinical and Clinical Testing Overview and career opportunities	20%	12

List Of Practical	Weightage	Contact hours
<b>1:</b> Use of various tools in NCBI and Familiarizing with various databases like PROSITE, PUBMED, OMIM, KEGG etc.	20%	12
<b>2:</b> Retrieval of nucleotide and protein sequences from databases like GENBANK, UNIPROT etc and Homology modeling using SWISS-PROT	20%	12
<b>3:</b> Familiarizing with genome specific databases like TAIR, GENE db. Etc.	20%	12
<b>4:</b> Sequence alignment- Pairwise and Multiple Sequence alignment and Phylogeny analysis BLAST analysis and Variations in BLAST analysis.	20%	12

<b>5:</b> Use of visualizing software like PYMOL, CHIMERA and Using various web-based software for primer designing, sequence and structure analysis like PROTPARAM, PROCHECK etc.	<b>20%</b>	<b>12</b>
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### Instructional Method and Pedagogy:

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
After successful completion of the above course, students will be able to:		
<b>CO1</b> Basic Computer skills.	Apply	Explain, Describe, Discuss, Recall, Locate
<b>CO2</b> Acquire knowledge about various biological databases and how to retrieve and use data from these databases.	Understand	Apply, Practice, Interpret, Select, Correlate
<b>CO3</b> Understand the concepts involved in sequence alignment and phylogeny Analysis.	Remember	Compare, Classify, Select, Investigate
<b>CO4</b> Be able to describe the process of drug discovery and development .	Create	Construct, Develop, Produce
<b>CO5</b> Be able to discuss the challenges faced in each step of the drug discovery process.	Analyses and Evaluation	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. Mount DW Cold. 2001. Bioinformatics: Sequence and Genome Analysis. Spring.</li> <li>2. Attwood TK &amp; Parry-Smith DJ. 2003. Introduction to Bioinformatics. Pearson Education.</li> <li>3. Rastogi SC, Mendiratta N &amp; Rastogi P. 2004. Bioinformatics: Concepts, Skills and Applications. CBS</li> <li>4. Introduction to Bioinformatics. 2014- Arthur M Lesk Oxford University Press</li> <li>Drug Discovery and Development; Technology in Transition. HP Rang. Elsevier Ltd 1 st edition 2006.</li> </ol>

2.	Journals & Periodicals <a href="https://www.longdom.org/scholarly/drug-delivery-using-nanotechnology-journals-articles-ppts-list-747.html">https://www.longdom.org/scholarly/drug-delivery-using-nanotechnology-journals-articles-ppts-list-747.html</a>
5	Other Electronic resources: 1. <a href="https://www.ebi.ac.uk/training/online/course/bioinformatics-terrified-0">https://www.ebi.ac.uk/training/online/course/bioinformatics-terrified-0</a> 2. <a href="https://www.ebi.ac.uk/training/online/course/biomedical-data-ethical-legal-and-social-implication">https://www.ebi.ac.uk/training/online/course/biomedical-data-ethical-legal-and-social-implication</a> 3. <a href="https://www.ebi.ac.uk/training/online/course/bringing-data-life-data-management-biomolecular-sciences">https://www.ebi.ac.uk/training/online/course/bringing-data-life-data-management-biomolecular-sciences</a> 4. <a href="https://www.ebi.ac.uk/training/online/course/chebi-quick-tour">https://www.ebi.ac.uk/training/online/course/chebi-quick-tour</a> 5. <a href="https://www.ebi.ac.uk/training/online/course/chebi-online-chemical-dictionary-small-molecules">https://www.ebi.ac.uk/training/online/course/chebi-online-chemical-dictionary-small-molecules</a> 6. <a href="http://www.angelfire.com/ga2/nestsite2/bioinform.html">http://www.angelfire.com/ga2/nestsite2/bioinform.html</a> 7. <a href="https://pubs.acs.org/doi/full/10.1021/acs.jchemed.6b00596">https://pubs.acs.org/doi/full/10.1021/acs.jchemed.6b00596</a> 8. <a href="https://pharmafactz.com/tutorials-and-guides/">https://pharmafactz.com/tutorials-and-guides/</a>

Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	0	1	2	1	1
CO2	2	1	1	1	1	0
CO3	0	1	1	2	2	1



CO4	1	0	0	2	1	2
CO5	0	2	2	0	1	1

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	2	1	1
CO2	1	1	0	3	0	0
CO3	2	1	0	2	1	1
CO4	1	2	1	2	0	0
CO5	2	1	2	3	0	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO603</b>	<b>COURSE NAME</b> <b>ENVIRONMENTAL</b> <b>BIOTECHNOLOGY</b>	<b>SEMESTER</b> <b>VI</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
60	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Students should have basic knowledge about environmental science and students of all disciplines can think critically, ethically, and creatively when evaluating environmental issues
<b>Course Category</b>	Discipline Specific Course.
<b>Course focus</b>	Employability
<b>Rationale</b>	To have an overview of the environmental science and students of all disciplines can think critically, ethically, and creatively when evaluating environmental issues.
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> <b>(As per Blooms' Taxonomy)</b>	<ol style="list-style-type: none"> <li>1. <b>Remember</b> To make educated judgments about environmental issues</li> <li>2. <b>Apply</b> To acquire an awareness of and sensitivity to the total environment and its allied problems.</li> <li>3. <b>Analyses</b> To debate environmental science with use of appropriate scientific information.</li> <li>4. <b>Create</b> Engaging with students of all disciplines to think critically, ethically, and creatively when evaluating environmental issues</li> <li>5. <b>Understand</b> To understand how biotechnology can useful to solve environmental problems.</li> </ol>

<b>Course Content (Theory)</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1:</b> Conventional fuels and their environmental impact: Firewood, Plant, Animal, Water, Coal and Gas. Modern fuels and their environmental impact – Methanogenic bacteria, Biogas, Microbial hydrogen Production, Conversion of sugar to alcohol Gasohol	<b>30%</b>	<b>18</b>
<b>Unit 2:</b> Bioremediation of soil & water contaminated with oil spills, heavy metals and detergents Degradation of lignin and cellulose using microbes. Phyto-remediation. Degradation of pesticides and other toxic chemicals by micro-organisms- degradation aromatic and chlorinated hydrocarbons and petroleum products.	<b>30%</b>	<b>20</b>

<b>Unit 3:</b> Treatment of municipal waste and Industrial effluents. Bio-fertilizers. Role of symbiotic and asymbiotic nitrogen fixing bacteria in the enrichment of soil. Algal and fungal biofertilizers (VAM)	<b>20%</b>	<b>12</b>
<b>Unit 4:</b> Bioleaching, Enrichment of ores by microorganisms (Gold, Copper and Uranium).	<b>10%</b>	<b>5</b>
<b>Unit 5:</b> Environmental significance of genetically modified microbes, plants and animals.	<b>10%</b>	<b>5</b>

<b>List Of Practical</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>1:</b> Determination of Chlorine in Water	10%	4
<b>2:</b> Finding MPN (Most Probable Number) of the water sample	10%	4
<b>3:</b> Measure mineral and phenolphthelin Acidity	10%	4
<b>4:</b> Measure Alkalinity of Water	10%	4
<b>5:</b> Find Dissolved Oxygen (DO) of the water sample	10%	4
<b>6:</b> Find Chemical Oxygen Demand (COD) of the water sample	10%	4
<b>7:</b> Find Biological Oxygen Demand (BOD) of the water sample	10%	4
<b>8:</b> Find Standard Plate Count (SPC) of the sample	10%	4
<b>9:</b> Perform Presumptive test and Confirm test for Coliform	10%	4
<b>10:</b> Isolation of Biofertilizer from soil (N-fixer, Phosphate solubilizer, Siderophore producer)	10%	4
<b>11:</b> Ethanol Production from Agriculture waste	10%	4

#### **Instructional Method and Pedagogy:**

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

<b>Course Outcomes:</b>	<b>Blooms' Taxonomy Domain</b>	<b>Blooms' Taxonomy Sub Domain</b>
After successful completion of the above course, students will be able to: <b>CO1</b> Skills for identifying environmental problems: Evaluate information from popular electronic and print media.	Apply	Explain, Describe, Discuss, Recall, Locate
<b>CO2</b> Interdisciplinary - When encountering environmental problems students will assess necessary scientific concepts and data, consider likely social dynamics, and establish integral cultural contexts.	Remember	Apply, Practice, Interpret, Select, Correlate



<p><b>CO3</b> Communication - Students will communicate with precision, effective art, and sound rhetoric in writing, in speech, and in digital media.</p>	Analyses	Compare, Classify, Select, Investigate
<p><b>CO4</b> Research - When faced with questions that lie beyond their current knowledge base, students will actively research data, concepts, histories, and narratives necessary for adequate consideration of the issue.</p>	Create	Construct, Develop, Produce
<p><b>CO5</b> Intellectual Flexibility - Students will possess the intellectual flexibility necessary to view environmental questions from multiple perspectives, prepared to alter their understanding as they learn new ways of understanding.</p>	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. Alicia L. Ragout De Spencer, John F.T. Spencer (2004) Environmental Microbiology: Methods and Protocol, Humana Press, Totowa</li> <li>2. Milton Wainwright (2012) Introduction to Environmental Biotechnology, Springer Science Business Media LCC</li> <li>3. Gilbert Masters (2013) Principles of Environmental Engineering, Pearson Education Limited</li> <li>4. Metcalf &amp; Eddy (2013) Wastewater Engineering, McGraw-Hill</li> <li>5. RE Hester and RM Harrison (2018) Plastic and Environment, Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK</li> <li>6. JF Peirce, RF Weiner, and PA Vesilind (1998) Environmental Pollution and Control, Elsevier Science &amp; Technology Book</li> <li>7. T. Jindal (2018) Emerging Issues in Ecology and Environmental Science, <b>Case studies</b> from India, Springer Nature Switzerland</li> </ol>

2.	<p style="text-align: center;"><b>Journals &amp; Periodicals</b></p> <ol style="list-style-type: none"> <li>1. Environmental Pollutants and Bioavailability</li> <li>2. Clean Air Journal</li> <li>3. Emerging Contaminants</li> <li>4. Environment: Science and Policy for Sustainable Development</li> <li>5. Annual Review of Environment and Resources</li> <li>6. Renewable Energy</li> <li>7. Renewable &amp; Sustainable Energy Reviews</li> <li>8. Environmental Health</li> <li>9. Environment International</li> <li>10. International Journal of Environmental Research and Public Health</li> <li>11. Nature (Section: Environmental Biotechnology)</li> <li>12. Journal of Cleaner production</li> <li>13. Nature Energy</li> <li>14. Bioresource Technology</li> <li>15. Biofuels, Bioproducts and Biorefining</li> <li>16. Environmental Pollution</li> <li>17. Aquatic toxicology</li> <li>18. Marine Environmental Research</li> <li>19. Environmental international</li> <li>20. Ecotoxicology and Environmental Safety</li> <li>21. Waste management</li> <li>22. Current Opinion in Environmental Science &amp; Health</li> <li>23. Perspectives in Ecology and Conservation Trends in Ecology and Evolution</li> <li>24. The Environmental Magazine</li> <li>25. Natural History (magazine)</li> </ol>
	<ol style="list-style-type: none"> <li>26. Environment News Service</li> <li>27. The Environmentalist</li> <li>28. Green Builder Media</li> </ol>
5	<p><b>Other Electronic resources:</b></p> <ol style="list-style-type: none"> <li>1. Green.tv—supported by UNEP—broadband TV channel for films about environmental issues</li> <li>2. Climate Change TV—funded by companies, governments and organisations, and produced by the magazine Responding to Climate Change—the world's first web channel specific to climate change videos</li> <li>3. Terra: The Nature of Our World video podcast produced in conjunction with the Master of Fine Arts program in Science &amp; Natural History Filmmaking at Montana State University, Filmmakers for Conservation, and PBS— weekly video show about science and natural history</li> <li>4. Green Times Ahead—based in India—student run non-profit with a focus on evading the detrimental effects of air and water pollution, constantly involved in communal engagement</li> <li>5. Air quality index</li> <li>6. Nature Education Knowledge Project</li> </ol>

<b>Evaluation Scheme</b>	<b>Total Marks</b>
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<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	<b>Total</b>	<b>50 Marks</b>

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	1	2	1	2
CO2	2	1	1	1	1	1
CO3	2	1	1	2	2	1
CO4	1	1	2	2	1	2
CO5	0	2	2	0	1	2

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	0	0	1	1	0	1
CO2	1	1	0	1	0	0
CO3	1	1	0	2	1	1
CO4	1	0	1	2	1	1
CO5	0	1	0	1	1	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO604</b>	<b>COURSE NAME</b> <b>GENOMICS AND</b> <b>PROTEOMICS</b>	<b>SEMESTER</b> <b>VI</b>
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<b>Teaching Scheme (Hours)</b>				<b>Teaching Credit</b>			
<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Hours</b>	<b>Lecture</b>	<b>Practical</b>	<b>Tutorial</b>	<b>Total Credit</b>
60	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Students should have basic knowledge of knowledge concerning genomics and proteomics.
<b>Course Category</b>	Discipline Specific Course.
<b>Course focus</b>	Employability
<b>Rationale</b>	To have an overview of the basic knowledge of knowledge of genomics and proteomics.
<b>Course Revision/ Approval Date:</b>	14/03/2020
<b>Course Objectives</b> <b>(As per Blooms' Taxonomy)</b>	<p><b>Remember</b> Infer the basic concepts of genomics, transcriptomics and proteomics.</p> <p><b>Apply</b> List and discuss the use of genomics and proteomics in human health.</p> <p><b>Analyses</b> Suggest and outline solution to theoretical and experimental problems in Genomics.</p> <p><b>Create</b> Demonstrate various interactions that determine the properties of proteins.</p> <p><b>Understand</b> Use methodology involved in genomics and proteomics study.</p>

<b>Course Content (Theory)</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>Unit 1:</b> Introduction to Genomics, DNA sequencing methods – manual & automated: Maxam & Gilbert and Sangers method. Pyrosequencing, Genome Sequencing: Shotgun & Hierarchical(clone contig) methods	<b>20%</b>	<b>12</b>
<b>Unit 2:</b> Computer tools for sequencing projects: Genome sequence assembly software. Managing and Distributing Genome Data: Web based servers and softwares for genome analysis: ENSEMBL, VISTA, UCSC Genome Browser, NCBI genome. Selected Model Organisms' Genomes and Databases.	<b>20%</b>	<b>12</b>
<b>Unit 3:</b> Introduction to protein structure, Chemical properties of proteins. Physical interactions that determine the property of proteins. Short-range interactions, electrostatic forces, van der waal interactions, hydrogen bonds, Hydrophobic interactions.	<b>20%</b>	<b>12</b>

<b>Unit 4:</b> Determination of sizes (Sedimentation analysis, gel filtration, SDS-PAGE); Native PAGE, Determination of covalent structures – Edman degradation. Introduction to Proteomics, Analysis of proteomes. 2D-PAGE.	<b>20%</b>	<b>12</b>
<b>Unit 5:</b> Sample preparation, solubilization, reduction, resolution. Reproducibility of 2D-PAGE. Mass spectrometry-based methods for protein identification. De novo sequencing using mass spectrometric data.	<b>20%</b>	<b>12</b>

<b>List Of Practical</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>1:</b> Isolation of DNA from Eukaryotic Cell (Yeast)	10%	4
<b>2:</b> Utilisation of Nanodrop (Demo)	10%	4
<b>3:</b> Colony PCR of Bacterial isolates.	10%	4
<b>4:</b> Gradient PCR of Bacterial isolates.	10%	4
<b>5:</b> Optimisation of PCR conditions for Bacterial isolate (Demo)	10%	4
<b>6:</b> Rt-PCR (Demo)	10%	4
<b>7:</b> Protein precipitation and Purification.	10%	4
<b>8:</b> Quantification of Proteins via Bradford Lowry Method	10%	4
<b>9:</b> Native – PAGE	10%	4
<b>10:</b> SDS – PAGE	10%	4

#### **Instructional Method and Pedagogy:**

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

<b>Course Outcomes:</b>	<b>Blooms' Taxonomy Domain</b>	<b>Blooms' Taxonomy Sub Domain</b>
After successful completion of the above course, students will be able to:		
<b>CO1</b> Infer the basic concepts of genomics, transcriptomics and proteomics.	Remember	Explain, Describe, Discuss, Recall, Locate
<b>CO2</b> List and discuss the use of genomics and proteomics in human health.	Apply	Apply, Practice, Interpret, Select, Correlate
<b>CO3</b> Suggest and outline solution to theoretical and experimental problems in Genomics	Analyses	Compare, Classify, Select,

<b>CO4</b> Demonstrate various interactions that determine the properties of proteins  <b>CO5</b> Use methodology involved in genomics and proteomics study.	Create	Investigate  Construct, Develop, Produce
	Understand	Explain, Describe, outline, Predict, Summarize

Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. Genes IX by Benjamin Lewin, Johns and Bartlett Publisher, 2006.</li> <li>2. Modern Biotechnology, 2nd Edition, S.B. Primrose, Blackwell Publishing, 1987.</li> <li>3. Molecular Biotechnology: Principles and Applications of Recombinant DNA, 4th Edition,</li> <li>4. B.R. Glick, J.J. Pasternak and C.L. Patten, 2010.</li> <li>5. Molecular Cloning: A Laboratory Manual (3rd Edition) Sambrook and Russell Vol. I to III, 1989.</li> <li>6. Principles of Gene Manipulation 6th Edition, S.B. Primrose, R.M. Twyman and R.W. Old. Blackwell Science, 2001.</li> <li>7. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.</li> <li>8. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. IX Edition. Benjamin Cummings.</li> <li>9. Russell, P. J. (2009). iGenetics- A Molecular Approach. III Edition. Benjamin Cummings.</li> <li>10. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.</li> <li>11. Pevsner, J. (2009). Bioinformatics and Functional Genomics. II Edition. John Wiley &amp; Sons.</li> </ol>
2.	<p>Journals &amp; Periodicals</p> <ol style="list-style-type: none"> <li>1. Genomics, Proteomics and Bioinformatics</li> <li>2. BMC Genomics</li> <li>3. Journal of Proteomics</li> <li>4. Proteomics</li> <li>5. Science Daily</li> <li>6. Everyman's Science</li> </ol>
5	<p>Other Electronic resources:</p> <ol style="list-style-type: none"> <li>1. NCBI, ENSEMBL, VISTA, UCSC etc</li> <li>2. sciencemag.org</li> <li>3. NPTEL</li> </ol>

Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	20 marks
	Viva	10 marks
	Journal	10 marks
	Discipline	05 marks
	<b>Total</b>	<b>50 Marks</b>

#### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	2	2	2	1	2
CO2	2	2	2	1	1	1
CO3	2	1	1	2	2	1
CO4	1	0	2	2	1	0
CO5	2	2	2	2	1	0

#### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1	2	1
CO2	2	1	1	2	2	2
CO3	1	1	2	2	1	1
CO4	1	0	1	2	1	2
CO5	1	1	1	1	2	2

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO605</b>	<b>Course Name BIOSAFETY, BIOETHICS AND INTELLECTUAL PROPERTY RIGHTS</b>	<b>SEMESTER</b> <b>VI</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	0	120	4	2	0	6

<b>Course Pre-requisites</b>	Students should have basic knowledge of biosafety regulations, bioethics and Intellectual Property Rights (IPRs).
<b>Course Category</b>	Discipline Specific Course.
<b>Course focus</b>	Employability
<b>Rationale</b>	To have an overview of the basic knowledge of biosafety regulations, bioethics and Intellectual Property Rights (IPRs)
<b>Course Revision/ Approval Date :</b>	14/03/2020
<b>Course Objectives</b> (As per Blooms' Taxonomy)	<ol style="list-style-type: none"> <li>1. <b>Remember</b> To understand various aspects of biosafety regulations, bioethics used in biological materials in the laboratory in context of environment and human health and Intellectual Property Rights concerns arising from the commercialization of biotech products.</li> <li>2. <b>Apply</b> Students will gain awareness about Intellectual Property Rights (IPRs) to take measure for the protection of their ideas.</li> <li>3. <b>Analyses</b> They will be able to devise business strategies by taking account of IPRs.</li> <li>4. <b>Create</b> They will be able to assist in technology upgradation and enhancing competitiveness.</li> <li>5. <b>Understand</b> They will acquire adequate knowledge in the use of genetically modified organisms and its effect on human health.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1:</b> Introduction of Biosafety in the laboratory, General principles for the laboratory and environmental biosafety, Biosafety guidelines, Biosafety levels, laboratory biosecurity concepts, Regulatory framework; National and international biosafety policies and law.	<b>20%</b>	<b>12</b>
<b>Unit 2:</b> Health aspects of Biosafety; toxicology, allergenicity, antibiotic resistance, Risk management issues and containment. Radiation safety and non-radio isotopic procedure	<b>20%</b>	<b>12</b>



<b>Unit 3:</b> Good microbiological techniques and good laboratory practice (GLP), Basic principles of quality control (QA) and quality assurance (QC), Guidelines for QA and QC: raw materials, sterilization, media, stock cultures and products, Role of culture collection centre, public health laboratories and regulatory agencies.	<b>20%</b>	<b>12</b>
<b>Unit 4:</b> Concept of Intellectual properties, copyrights, trademarks, trade secrets, patents, geographical indications.	<b>20%</b>	<b>12</b>
<b>Unit 5:</b> Implications of intellectual property rights on the commercialization of biotechnology products. National and international patent act and amendments, patent filing.	<b>20%</b>	<b>12</b>

<b>List Of Practical</b>	<b>Weightage</b>	<b>Contact hours</b>
<b>1:</b> Understanding of the importance of good laboratory management and practices	<b>20%</b>	<b>12</b>
<b>2:</b> Lab SOPs/Protocols management.	<b>20%</b>	<b>12</b>
<b>3:</b> Lab QA/QC.	<b>20%</b>	<b>12</b>

#### **Instructional Method and Pedagogy:**

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

<b>Course Outcomes:</b>	<b>Blooms' Taxonomy Domain</b>	<b>Blooms' Taxonomy Sub Domain</b>
After successful completion of the above course, students will be able to:		
<b>CO1</b> To understand the application and limitations of Biological materials used in the laboratory and their safety.	Remember	Explain, Describe, Discuss, Recall, Locate
<b>CO2</b> To understand the regulations of handling and transport of biological agents / materials various aspects of biosafety regulations	Apply	Apply, Practice, Interpret, Select, Correlate
<b>CO3</b> To understand IPR values in terms of Innovation and originality of the products	Analyses	Compare, Classify, Select, Investigate
<b>CO4</b> To explore intellectual property guidelines and practices.	Create	Construct, Develop, Produce

**CO5** This course helps to adhere to the ethical practices appropriate to the discipline at all times and to adopt safe working practices relevant to the bioindustries & field of research.

Understand

Explain, Describe,  
outline, Predict,  
Summarize

Learning Resources	
1.	<p>Reference books:</p> <ol style="list-style-type: none"> <li>1. Biosafety in Microbiological and Biomedical Laboratories (BMBL) 5th Edition</li> <li>2. Richardson JH, Barkley WE, editors. Biosafety in microbiological and biomedical laboratories. 1st ed. Washington, DC. 1984.</li> <li>3. Harding AL, Byers KB. Epidemiology of laboratory-associated infections.</li> <li>4. Fleming DO, Hunt DL, editors. Biological safety: principles and practices. 3rd ed. Washington, DC: ASM Press; 2000:35-54.</li> <li>5. Bodenheimer, Jurisprudence – The Philosophy and Method of Law (1996) Universal, Delhi.</li> <li>6. Fitzgerald, (ed.) Salmond on Jurisprudence (1999) Tripathi, Bombay.</li> <li>7. Singh BD. 2007. Biotechnology: Expanding Horizon. Kalyani.</li> </ol>
2.	<p>Journals &amp; Periodicals</p> <ol style="list-style-type: none"> <li>1. <a href="https://www.researchgate.net/publication/314667237_Biosafety_Bioethics_and_IPR_Issues_in_Plant_Biotechnology">https://www.researchgate.net/publication/314667237_Biosafety_Bioethics_and_IPR_Issues_in_Plant_Biotechnology</a>.</li> <li>2. <a href="http://www.jnkvv.org/PDF/090420221517Syllabus%20(11%20files%20merged).pdf">http://www.jnkvv.org/PDF/090420221517Syllabus%20(11%20files%20merged).pdf</a></li> </ol>
5	<p>Other Electronic resources:</p> <ol style="list-style-type: none"> <li>1. <a href="https://online-learning.harvard.edu/course/fda-and-prescription-drugs-current-controversiescontext%20delta=0">https://online-learning.harvard.edu/course/fda-and-prescription-drugs-current-controversiescontext%20delta=0</a></li> <li>2. <a href="https://www.oreilly.com/library/view/ipr-biosafetand/9788131774700/xhtml/chapter017.xhtml">https://www.oreilly.com/library/view/ipr-biosafetand/9788131774700/xhtml/chapter017.xhtml</a></li> <li>3. <a href="http://www.biotech.iastate.edu/bioethics-case-studies/">http://www.biotech.iastate.edu/bioethics-case-studies/</a></li> </ol>

Evaluation Scheme	Total Marks	
<b>Theory: Midsemester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Article Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	20 marks

		Viva	10 marks
		Journal	10 marks
		Discipline	05 marks
		<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	1	1	1	1	0	1
CO2	2	2	1	2	1	2
CO3	2	1	2	1	2	1
CO4	1	1	2	2	2	2
CO5	1	2	1	1	1	2

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	2	2	2
CO2	1	2	2	2	0	3
CO3	1	0	0	1	2	1
CO4	2	1	2	3	2	2
CO5	2	2	1	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None

<b>COURSE CODE</b> <b>BSBO606</b>	<b>COURSE NAME</b> <b>MEDICAL</b> <b>BIOTECHNOLOGY</b>	<b>SEMESTER</b> <b>VI</b>
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Teaching Scheme (Hours)				Teaching Credit			
Lecture	Practical	Tutorial	Total Hours	Lecture	Practical	Tutorial	Total Credit
60	60	0	120	4	2	0	6

<b>Course Pre-requisite</b>	Prior knowledge in biology, genetics, and basic molecular biology techniques.
<b>Course Category</b>	Elective Courses
<b>Course Focus</b>	Employability
<b>Rationale</b>	Medical biotechnology is vital for modern healthcare. It revolutionizes patient care through personalized treatments, reduces adverse effects, and advances disease understanding. It provides precise diagnostics, fuels innovation, and improves healthcare, addressing pressing medical challenges and benefiting global well-being.
<b>Course Revision/ Approval date</b>	
<b>Course Objectives (As per Blooms' Taxonomy)</b>	<b>To enable the student to:</b> <ol style="list-style-type: none"> <li>1. Gain the basic knowledge and understanding of basic concept of medical biotechnology.</li> <li>2. Understand and remember about the genetic and metabolic disorders.</li> <li>3. Understand and analyze the revolution in treatment.</li> <li>4. Learn and understand about cancer and stem cells.</li> <li>5. Understand about gene therapy &amp; Nanobiotechnology.</li> </ol>

Course Content (Theory)	Weightage	Contact hours
<b>Unit 1: Basic concept of Medical Biotechnology</b> Introduction – Origin, significance & worldwide market of Medical Biotechnology. Revolution in clinical diagnosis, Antibody and Nucleic Acid Hybridization techniques, Imaging techniques (Nanodiagnosis).	20%	12
<b>Unit 2: Genetic &amp; Metabolic Disorders</b> Introduction, Classification, Impact of genetic diseases on human health - Chromosome errors - Down syndrome, Klinefelter's and Turner's syndrome. Metabolic disorders – Phenylketonuria, Homocystinuria, Lactic acidosis, Gaucher's disease, Diabetes, Hemophilia and sickle cell anemia. Treatment of Genetic diseases - prenatal diagnosis, Genetic Counseling -	20%	12

Ethical, Legal and Social Issues.		
<b>Unit 3: Revolution in treatment</b> Recombinant DNA technology for human insulin, Hepatitis B vaccine, Therapeutic proteins and peptides – Erythropoietin, Tissue plasminogen activator, clotting factor VIII. Antibody Engineering and Therapeutic Antibodies. Phage therapy.	20%	12
<b>Unit 4: Cancer</b> Molecular, cellular and genetic basis of cancer, tumor virus and oncogenes, tumor suppressor genes and mechanism of action of p53 proteins. Stem Cells - Sources and types of stem cells, Stem cell transplant and its types, Potential targets for stem cell treatment, Therapeutic applications of stem cells, Regenerative medicine and Stem cell ethics.	20%	12
<b>Unit 5: Gene therapy &amp; Nanobiotechnology</b> Basic approaches and types of gene therapy, vectors used in gene therapy, application of gene therapy in medicine. Nanobiotechnology - Introduction, types and structures of nanoparticles, biosynthesis of nanoparticles, application of nanoparticles in treatment.	20%	12

List Of Practicals	Weightage	Contact hours
1. Biochemical test for identification of bacteria		4
2. Extraction and separation of Antigen proteins from Bacteria & protozoa		4
3. Estimation of blood glucose.		4
4. Estimation of cholesterol in blood.		4
5. Estimation of iron in blood.		4
6. Biological synthesis of nanoparticles		4
7. Detection of plasmodium pathogen using peripheral smear		4
8. Widal test.		4
9. Revision		4
10. Revision		4
11. Revision		4

### Instructional Method and Pedagogy:

Audio-Visual Lectures, Quizzes, Debates, Project works, Case studies, and Assignments Practical exercises are designed to understand the theory as taught in classroom. Hands on in practical session.

Course Outcomes:	Blooms' Taxonomy Domain	Blooms' Taxonomy Sub Domain
<b>After successful completion of the above course, students will be able to:</b> CO1: Understand the basic concepts and applications of medical biotechnology.	Remember, Understanding	Describe
CO2: To describe the genetic and metabolic disorders.	Remember, Understanding, apply	Explain
CO3: Understand and analyze the recent developments in treatment of diseases.	Understanding, Analyze	Explain
CO4: Understand the principal of cancer and stem cells	Understanding	Describe
CO5: Remember and understand the techniques of gene therapy.	Remember, Understanding	Describe

Learning Resources	
1.	<b>Reference books:</b> 1. Glick B.R. and Pasurank..Molecular biotechnology – Principle and Applications of Recombinant DNA- J.I.(4th edition), ASM Press. 2010. 5. Anthony D. Ho, Hoffman. R, and Esmail D. Zanjani, Stem Cell Transplantation (4 <sup>th</sup> edition), Wiley – liss publishers, 2006. 6. Hornyak. G.L , Moore. J.J. Tibbals H.F., Dutta. J. Fundamentals of Nanotechnology (1st edition), CRC press, 2008. 7. Jogdand. S. N. Medical Biotechnology –, (4th edition), Himalayan publishing house, 2004.
2.	<b>Journal &amp; Periodicals:</b> 5. Journal of Cell Biology 6. Trends in Cell Biology 7. Cell Biology International 8. Science
3.	<b>Other Electronic resources : NPTEL</b>

Evaluation Scheme	Total Marks = 150	
<b>Theory: Mid semester Marks</b>	20 marks	
<b>Theory: End Semester Marks</b>	40 marks	
<b>Theory: Continuous Evaluation Component Marks</b>	Attendance	05 marks
	MCQs	10 marks
	Open Book Assignment	15 marks
	Research Paper Review	10 marks
	<b>Total</b>	<b>40 Marks</b>
<b>Practical Marks</b>	Attendance	05 marks
	Practical Exam	35 marks
	Viva	10 marks
	Journal	05 marks
	<b>Total</b>	<b>50 Marks</b>

### Mapping of PSOs & COs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	2	1	2	1
CO2	2	2	2	1	0	1
CO3	2	1	1	1	2	1
CO4	2	1	2	1	2	1
CO5	2	2	1	1	1	1

### Mapping of POs & COs

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	1	2	1
CO2	2	2	2	1	0	1
CO3	2	1	1	1	2	1
CO4	2	1	2	1	2	1
CO5	2	2	1	1	1	1

1: Slight (low); 2: Moderate (Medium); 3: Substantial (High); 0 None